With the support of the Erasmus+ Programme of the European Union

Education for Digitalization of Energy

Deliverable 6.6

Report describing the mutual impact of suggested policies on deployed activities

Author(s): **Konstantinos Michos, Alexandros Chronis, Amila Kaharevic, Berna Balci, Jakob Junkermann, Philipp Artur Kienscherf, Alessandra Tomasini, Geno Ponce, Álvaro López, Alessandra Tomasini, Daniela Casiraghi, Bianca Santolini, Katerina Tasidou, Michela Cremona**

Status -Version: **V0.3**

Delivery Date (DOW): **30 June 2023**

Actual Delivery Date: **30 June 2023**

Distribution - Confidentiality: **Public**

Abstract:

This report will analyze how the work envisioned in the BSDE has effectively conditioned the work in the real deployment. For this purpose, the mutual impact of the project work packages WP2, WP3, WP4 and WP5 on the deployed piloting activities in WP6 is explained.

Keywords:

piloting activities, WP2, WP3, WP4, WP5, WP6, impact

DISCLAIMER

	Participant organisation name	Short	Country
01	UNIVERSIDAD PONTIFICIA COMILLAS	COMILLAS	Spain
02	NATIONAL TECHNICAL UNIVERSITY OF ATHENS	NTUA	Greece
03	RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE	RWTH	Germany
04	FOSS Research Centre for Sustainable Energy – U. of Cyprus	FOSS	Cyprus
05	Politecnico di Milano – METID	POLIMI	Italy
06	Kungliga Tekniska Högskolan	KTH	Sweden
07	Fundación Obra Social y Monte de Piedad de Madrid – Escuelas Profesionales Padre Piquer	PIQUER	Spain
08	Centrul Roman al Energiei	CRE	Romania
09	REPSOL SA	REPSOL	Spain
10	IBERDROLA	IBERDROLA	Spain
11	GE Energy Products France SNC	GE	France
12	DNV-GL	DNVGL	Spain
13	EDSO for Smart Grids	E.DSO	Belgium
14	NTT Data Italia SPA	NTT	Italy
15	NOVEL Group	NOVEL	Luxembourg
16	University of Cologne Business School	UCBS	Germany
17	Institute of Energy Economics at the University of Cologne	EWI	Germany

ACKNOWLEDGEMENT

This document is a deliverable of EDDIE project. This project has received funding from the European Union's Erasmus+ under grant agreement Nº 612398.
The opinions expressed in this document reflect only the author's view and in no way reflect the European Commission's opinions. The European Commission is not responsible for any use that may be made of the information it contains.

Document History

Version	Date	Contributor(s)	Description
V0.1	**29.03.2023**	**Berna Balci**	**Table of Contents**
V0.2	**07.06.2023**	**Konstantinos Michos, Alexandros Chronis, Álvaro López, Alessandra Tomasini, Daniela Casiraghi, Bianca Santolini, Katerina Tasidou, Michela Cremona, Amila Kaharevic, Berna Balci**	**First Draft of Contents**
V0.3	**21.06.2023**	**Konstantinos Michos, Alexandros Chronis, Amila Kaharevic, Berna Balci, Jakob Junkermann, Philipp Artur Kienscherf, Alessandra Tomasini, Geno Ponce**	**Implementation of piloting activities**
V1.0	**29.06.2023**	**Berna Balci**	**Final Document after review**

Document Reviewers

Date	Reviewer's name	Affiliation
28.06.2023	**Juan Carlos del Real Romero**	**COMILLAS**
29.06.2023	**Laia Guitart**	**EDSO**

Table of Contents

Definitions, Acronyms and Abbreviations

ACS – Institute for Automation of complex Power Systems

BSDE – Blueprint Strategy for the Digitalisation of Energy

EQF – European Qualifications Framework

EWI – Institute of Energy Economics at the University of Cologne

LEGOS – Lite Emulator of Grid Operations

LEM – Local Energy Markets

List of Figures

Executive Summary

The digitalization process of the Energy Sector creates not only several crucial challenges, but also great opportunities towards energy efficiency and sustainability. Personnel with the adequate skills will be required to take advantage of these opportunities. EDDIE's purpose is to develop an industry-driven Blueprint Strategy that will identify and try to cover the skills demand in the European Energy Sector digitalization.

The project aims to create new profiles of engineers, researchers and technicians, trained in -and familiar with- the new technologies, tools and methods to support and improve the digitalization of the Energy Sector. Additionally, the educational and research sectors should fit in the new era and be in the spotlight of synergies with industry, policy makers and other relevant actors.

The roll-out of the Blueprint Strategy for the Digitalization of Energy will take place in a main pilot site in Aachen (Germany) and four smaller-scale pilot sites in Cologne (Germany), Athens (Greece), Milan (Italy) and Madrid (Spain). This deliverable focuses on the mutual impact of the conducted work in the work packages 2, 3, 4 and 5 on the design, implementation, and assessment of the pilots.

The mutual impact between each of the above mentioned work packages and the deployed activities is considered in this document separately. The general impact of the pilots and the individual piloting activities are explored below. The main elements are: The identification of skill needs and gaps in the energy sector. We see this in WP2, which supports the content development of pilot activities, which aims to mitigate these gaps. The interconnection between WP3 and the individual piloting activities focuses on the mapping of relevant stakeholders to align education programs with industry needs. The development of recommendations for VET, university and LLL on the basis of best practices and examples, enhances the design and implementation of the pilots. The piloting activities in WP5 test different components of the BSDE strategy, providing a platform for refining and validating the effectiveness of this said strategy. The analysis and pilots create a continuous feedback loop, strengthening the overall strategy for digitalizing the energy industry. The insights gained from the pilots also inform the training program marketplace, improving its design and sharing valuable lessons learned. Furthermore, the pilots contribute to filling job vacancies in the energy industry and identifying newly acquired skills for the marketplace's database.

1. Introduction

The digitalisation of the energy sector has a central role in the transition towards a sustainable future. The European Green Deal, along with other initiatives, positions the European Union as a global leader in this challenge. Europe has a unique opportunity to establish global leadership in the energy transition and to shape the future energy systems. Driven by technology innovations, as well as by the decarbonisation ambition set by the Paris Agreement and the EU 2050 target, this new architecture enables and supports increasing shares of renewables, energy storage and demand response management, all of which can increase grid flexibility.

The purpose of the EDDIE project is the foundation and establishment of a Sector Skills Alliance to develop an industry-driven Blueprint Strategy for the education and training in the energy sector, which is continuously being affected by digitalisation. This Blueprint is an industry-driven strategy that aims to meet and anticipate the skills' demands for the sustainable growth and digitalisation for the European Energy sector. The ongoing digitalisation procedure of the energy sector causes major technological, economic, and social challenges, creating new skills demands that need to be met in order to ensure the sustainable future of the energy sector. Providing adequate training and fostering cooperation among all stakeholders throughout Europe is vital for this goal to be reached. Thus, the Blueprint strategy will establish a sustainable framework that allows the definition and update of educational programs responding to industry changes and to increase the attractiveness of the energy sector as a career choice. It will also take into consideration, soft skills, social sciences humanities, economics and gender dimension.

Part of the project work is the deployment of piloting activities in WP6 as a roll-out of and response to the EDDIE Blueprint Strategy for the Digitalization of Energy (BSDE). These pilot activities are a collection of different types of educational programmes addressing various European Qualifications Framework (EQF) levels, target audiences and stakeholders. The bases for the design, implementation and assessment of the activities can be seen in the work done in WP2, WP3, WP4 and WP5. At the same time the piloting activities will provide different kinds of feedback to these work packages. Figure 1 demonstrates the interconnection between the different work packages and the deployed activities. In this deliverable the interconnection and the mutual impact points of the piloting activities in general as well as individually with the work packages 2, 3, 4 and 5 will be explored and presented.

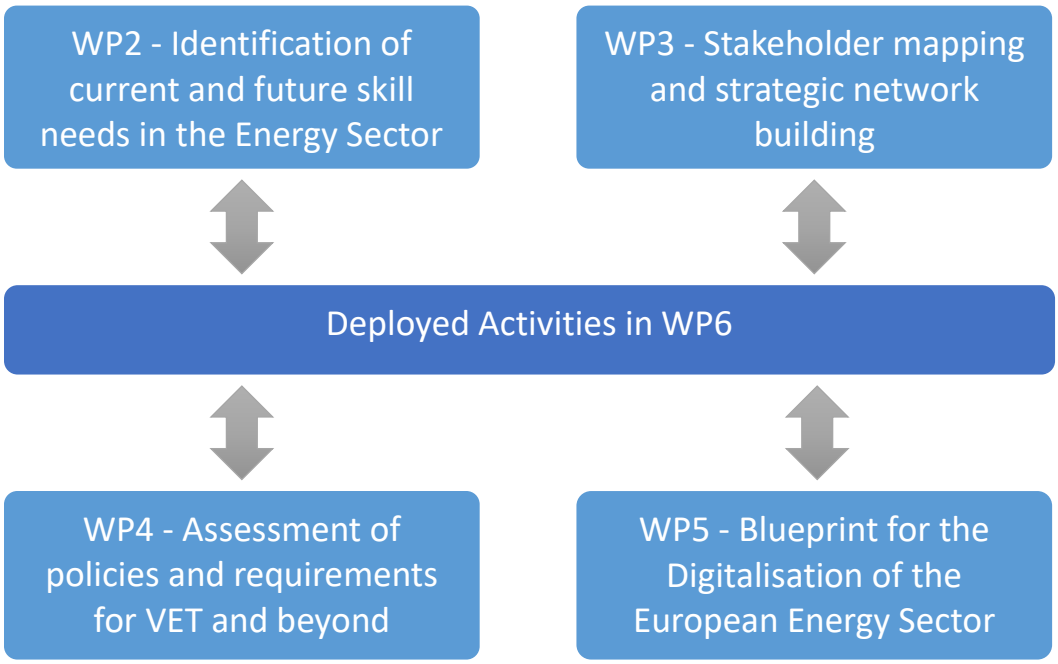

Figure 1 Interaction of the EDDIE work packages with the deployed activities

1.1. Overview of piloting activities

In total there are 17 individual piloting activities distributed over the field test sites in Aachen, Athens, Milan, Cologne and Madrid. Deliverables 6.1 and 6.2 provide a detailed description of the development plan and content of all activities. However, to better understand this deliverable an overview with a brief description of the different piloting activities is given in Table 1.

Table 1: Overview of all piloting activities

Pilot site	Pilot activity	Description
Aachen	Archimedischer Sandkasten with city of Aachen	3-week summer vacation program about the energy generation through wind power for school children from 10-16 years old organized by the city of Aachen and supervised by the local educational institution. Children have the opportunity of a flexible participation in the program.
	Gymnasium Workshop	Interactive workshop for students of the lower secondary level in a STEM group of a local gymnasium (high school) in Aachen. The aim is for students to understand the challenge of the energy transition and interact with the LEGOS demonstrator of a energy grid.
	Workshop on Data Platforms for the Energy Infrastructure	A workshop on open-source data platform - the energy infrastructure showcasing applications with FIWARE and Message Queue Telemetry Transport (MQTT). Organized together with ACS, HS Bochum and IDEASFORUM e.V in Herne.
	Future energy systems lecture on energy digitalisation	Lecture on the digitalization of the energy system for electrical engineering students. Lecture is part of a lecture series offered jointly from different institutes.
	Leonardo lecture on energy transition	Two interdisciplinary lectures on the digitalization of the energy system and urban electrical energy system. Lectures are part of a teaching series of lectures open to all students in collaboration of different institutes and industry.
	ACS lecture on automation of complex systems	Elective master course at RWTH University about technologies that are used to achieve monitoring, control, and communication of complex power systems.
	Science Night at RWTH	Open scientific event organised by RWTH Aachen University to explain science in a way that is understandable and tangible for all generations. The Institute ACS offers an introduction to the topic of electricity grids by means of a presentation and energy grid demonstrator.
	Girl's Day at ACS	Career orientation day for girls from the fifth grade with a plug-and-play demo demonstrating the interaction

		between electricity production and power consumption in the modern energy grid.
Athens	Lectures on Local energy markets, energy communities and blockchain applications	Two lectures on energy markets, energy communities, local energy markets (LEM) formulation, and blockchain basic principles and applications in decentralized systems and energy communities. Lectures titles: “Local energy markets in the context of smart grids” & “Securing the Decentralized Coordination of Active Distribution Grids with Blockchain”.
	Lectures on AI applications on energy systems: Dynamic security and forecasting	Two lectures focusing on machine learning, dynamic safety in power systems, power prediction, mathematical formulation of forecasting. Lectures titles: “Application of supervised machine learning for dynamic safety assessment in electrical power systems” & “Introduction to RES production forecasting”.
	MOOC (cooperation with ERIGrid 2.0 project)	Lecture raising awareness in the educational challenges that occur due to the digitalization of the energy systems, in the MOOC for advanced validation methods for smart grids, developed by ERIGrid 2.0 project
	Summer school (cooperation with ERIGrid 2.0 project)	A presentation targeting to disseminate the projects’ goals and outcomes, during the Summer School on smart grid applications organized by ERIGrid 2.0 project
Milan	MOOC on Energy management for real estates	MOOC design, development, launch and monitoring, open to anyone on Polimi Open Knowledge platform (www.pok.polimi.it). The MOOC has been replicated also in Coursera (https://www.coursera.org/learn/energy-management-for-real-estate)
Cologne	Certificate in Future Energy Business	Two-semester lecture series, including a project designed for university students. Students can select from a wide range of courses, which will be taught by lectures from EWI and/or practitioners from the energy field.
	EWI Academy	A training program designed for companies and consisting of several modules on different contents of interest related to the digitization-driven transition of the energy sector.
	Smart Energy Certificate Programme	Modular lecture series for employees with various topics in the energy sector.

Madrid	Home Energy Efficiency and Electrical Installations VET level Course (EQF 4 and 5)	The aim of this training is to establish a complementary training module to the educational offer in Vocational Education Training (VET) which includes the possible restructuring of the electrical installation of a home, and the use of automation to improve energy efficiency and manage the energy consumption. This course aims to build new skills for electrical installers and emphasizes the digitalization of the systems and the skills of both installers and consumers to improve energy efficiency.

1.2. Structure of the Document

The subsequent five chapters of this document, are structured as follows: Chapter 2 presents the impact of the results from WP2 regarding the current challenges as well as the current and future needs for energy sector skills in the piloting activities. Chapter 3 describes the mutual impact of the work in WP3 on stakeholder mapping along with strategic network building and activities deployed.. Similarly, chapter 4 presents the mutual impact of the recommendations drafted in WP4 for VET, university and LLL and the piloting activities. Following the same approach, chapter 5 shows the mutual impact of the work in WP5 and the deployed activities in WP6. Finally, in a conclusion the main points of the document are summarized.

2. Mutual Impact between deployed activities and WP2

The work conducted in WP2 was divided in two parts, each corresponding to one of the deliverables that have been submitted: “D2.1 Current challenges in the energy sector and state of the art in education and training” and D2.2 Current and future skill needs in the energy sector”.

D.2.1 primarily focused on the identification of the key challenges that the industry faces in relation to the digitalization of the energy system. These challenges encompassed the adoption of new technologies and tools, the value generated by them, and the necessary skills required in the new digital era. To facilitate the identification process, a dedicated survey was developed, targeting relevant stakeholders. The survey analysis was complemented by a comprehensive review and analysis of the state of the art in education and training in Europe, also considering projects and initiatives related to the energy system.

On the other hand, “D2.2 focused on the required and emerging skills in the Energy Sector. To obtain accurate results, a methodology was employed which involved analyzing the existing occupations pertinent to the sector. Additionally, a dedicated survey and interviews were conducted with industry professionals to gather insights on the specific skills and knowledge needed. Furthermore, an analysis was carried out to assess the skills and knowledge offered by education and training providers, incorporating a dedicated survey and interviews as well. This comprehensive analysis served as the basis to identify skill gaps in the energy sector. The outcomes of the two deliverables served as tools for the design and development of the pilot activities.

2.1. Current challenges in the energy sector and state of the art in education and training

One of the outcomes of D2.1 that impacted the design and development of the pilot activities is the use of digital tools and technologies by the industry and the main challenges industrial stakeholders face while integrating them into their business models and operational activities. The usage of digital technologies and tools, an example of which is presented in Figure 2, provided insights to the pilot content developers to select the areas that should be targeted. Amongst others, some significant technologies to be considered are the following:

- Cybersecurity services
- Digital Platforms,
- Cloud services
- Communication technologies
- Energy Management systems

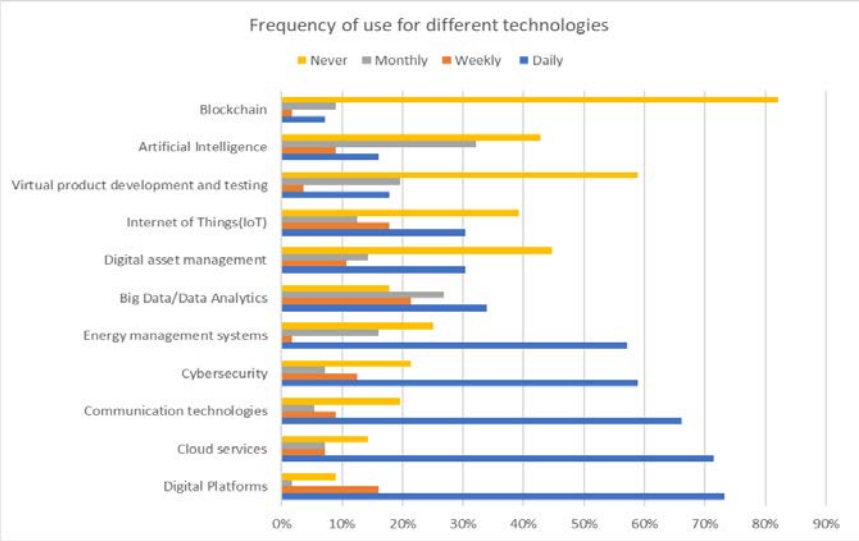

Figure 2 Most frequent digital technologies (source: "D2.1 Current challenges in the energy sector and state of the art in education and training", chapter 2.7.3, p. 42/153)

Considering what was mentioned above, the first part of the report assessed the key challenges the energy industry faces related to the digitalization of the sector. Technical, regulatory, economic, social and environmental challenges were considered in the process. Each challenge, as well as the relevant digital technologies, were considered in the design of the pilot activities. From a technical perspective the lack of adequate skills signified the importance of the pilots while challenges like technology integration, IT security and data management added elements to the different activities.

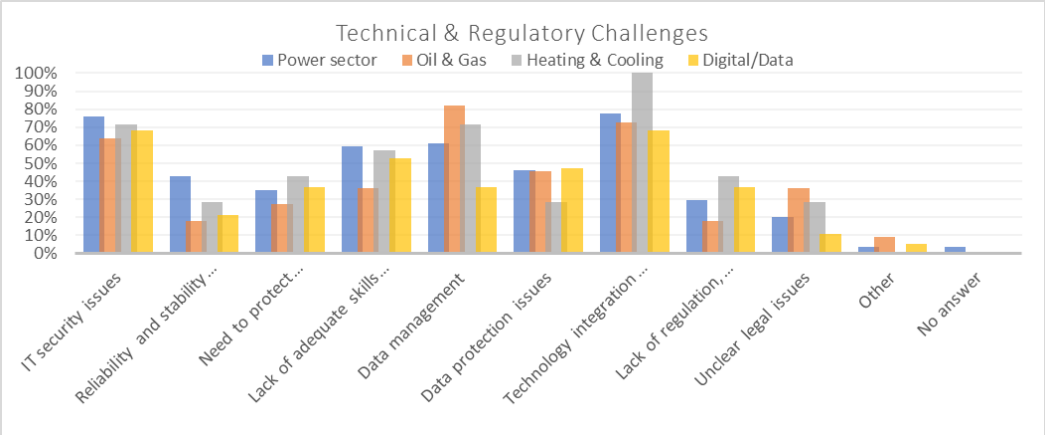

Figure 3 Technical & Regulatory challenges in the different sectors (source: "D2.1 Current challenges in the energy sector and state of the art in education and training", chapter 2.7.3, p. 47/153)

The second part of D2.1 dealt with the state of the art in education and training related to the digitalization of the energy sector. It is evident that identifying best practices, reference initiatives and having an overview of the status impacted the selection of educational activities by EDDIE partners. The analysis of other Blueprint projects provided valuable insights from other sectors on how they approach their respective area of operation in terms of the targeted educational levels, skills and technologies as well as educational tools used to achieve the defined objectives. The analysis of other Erasmus+ Sector Skills Alliance projects and Energy education/training related projects, led to cumulative learnings and lessons learned, separated according to the WP for which they were relevant within EDDIE. The straight recommendations to the roll out and action plan (WP6) included the multiple factors that an education project is dependent on, such as the context of each participant, institute, company or country. This should be kept in mind when implementing the project activities, since there is a difference in the actions plans developed for each educational level addressed. An added insight from the analysis pointed out the criteria that other projects utilize to assess the relation of actions/activities to the current/future skill gaps.

2.2. Current and future skill needs in the energy sector

The first part of the work conducted in D2.2 focused on ESCO and CEDEFOP analysis. This analysis aimed to identify occupations that are expected to have a demand rise in the future, and the skills related to them. A significant finding through that analysis, is that cybersecurity knowledge appears as a mandatory skill related to data in the power sector, as well as machine learning algorithms and artificial intelligence techniques related to data management in power sector. Accordingly, more occupations targeting these skills are expected on the future labour market. The second part of the deliverable deals with the feedback from industry, education and training providers. In this context, a comparative analysis was conducted to identify skill gaps. Computing tools and platforms identified as a major skill area needed for engineers and researchers, while programming and development related skills presented a high expertise demand among engineers/researchers and technicians/specialists. Overall, the analyses consistently indicate that skill gaps related to digitalization primarily lie in the areas of data management and analysis, big data, cybersecurity, and programming and development competences.

The identified skill gaps have played a pivotal role in shaping the design of pilot educational activities as part of EDDIE. These skill gaps have underscored the urgent need to address the evolving demands of the digitalization of the energy sector and ensure that educational programs align with industry requirements. With a clear

understanding of the emerging skill gaps in areas such as data management and analysis, big data, cybersecurity, and programming and development, the pilot educational activities have been strategically tailored to bridge these gaps. The aim is to equip students, professionals, and individuals seeking to enter the energy sector with the necessary knowledge and competencies to thrive in the digital era. Drawing on the information learned through the comprehensive analysis of skill gaps, the pilot educational activities have been designed to focus on cutting-edge technologies, industry-relevant practices, and innovative approaches. These activities provide a platform for hands-on learning, practical training, and exposure to real-world challenges encountered in the digitalization of the energy sector.

The activities can be separated in two categories, the ones that were created from scratch, utilizing the feedback from the various WPs of EDDIE and the ones that modified their structure and content, based on the outcomes of the work conducted during the project. The outcomes of WP2, regarding demand in skill needs and the skill gaps facilitate both procedures.

An indicative example is the MOOC "Energy management for real estates. Fundamentals, Methods and Digital Tools" designed and delivered by Politecnico di Milano (Polimi) at the pilot test in Milan. This course targets the occupation of Energy Manager, as one of the most relevant occupations identified from the ESCO analysis. Green and sustainability skills are major part of the occupation description and therefore addressed through the content of the MOOC. The design process, presented in D6.2 "Intermediate report on the field tests", shows the impact that WP2 outcomes had at the design process. Figure 4 shows part of the fact sheet for the MOOC. The skill gaps targeted by this program are listed.

12. **Skill gap area:** Data management and analysis; Big Data; Cybersecurity; Programming and development competences
13. **ISCED code of program content:** 07 Engineering, manufacturing and construction
14. **Starting point of program design:** Energy program with an ICT add-on
15. **Funding 1. - Available for free:** yes
16. **Funding 2. - Types of funding**
17. **Target groups:** Professionals
18. **EQF level:**7

Figure 4 MOOC "Energy management for real estates" fact sheet

The development and implementation stages of the course were also connected with the outcomes of WP2, utilizing a digital platform and designed as a MOOC, following the trend of online courses identified during the survey to industry.

An example of the other category, consisting of existing activities that were updated, is the set of lectures provided by NTUA in the field test of Athens. The two lectures, "Local energy markets, energy communities and blockchain applications" and "AI applications on energy systems: Dynamic security and forecasting" are part of the MSc program "Energy Production and Management" and the course "Digitalization of energy systems". The topic of the course refers to a dynamic and constantly changing environment, and therefore its content requires continuous adaptation to current developments. In that direction the work of EDDIE project and especially of WP2 is considered as highly relevant. These two lectures complement the content of the course, utilizing the findings from WP2. The lectures' content was driven by the skill gaps, and specifically Blockchain, energy markets, Machine learning and Artificial Intelligence.

The central pilot site of Aachen, provides various activities covering multiple EQF levels, including both new and modified activities. Part of the new activities is the Workshop on Data Platforms for the Energy infrastructure. This workshop is designed and developed to mitigate the skill gap related to data management and arrange the skill demand of the use of digital platforms and tools. An additional activity, modified according to the outcomes of EDDIE project, is the Leonardo lecture series, which includes the lecture "Digital Energy Revolution" and "Urban Electrical Energy Systems" focusing on smart and optimized grids. The ESCO and CEDEFOP analysis indicates as a major direction that the future workforce should master both digital and green skills. The combination of both skills leads to the development and deployment of these two lectures, that include open standards and digitalization means in the area of grid operation, urban energy systems and smart grids performance and types – objectives – characteristics – relations of energy communities, among others.

On the other hand, the design of the pilot educational activities incorporates collaboration with industry partners, leveraging their expertise and insights. This ensures that the content is aligned with current industry practices and

anticipates future needs, enabling participants to acquire practical skills and knowledge that directly align with the demands of the job market. The activities at pilot site of Cologne, are mainly targeting companies and employees, aiming to bridge the skill needed from companies and the ones offered from employees and candidates, and in that direction standing in the core of the findings from survey to industry, where lack of adequate skills by employees stands as a major key point. In this direction, the content of “Smart Energy Certificate Program” for example, was modified utilizing the identified data management and analysis skill gap and focused on Smart home and smart cities infrastructure applications in an attempt to mitigate these gaps.

The Madrid pilot activity serves as an illustrative example that further emphasizes the practical application of the work conducted in WP2, particularly in relation to the analysis of VET education and technicians/specialists. The pilot activity, titled "Home Energy Efficiency and Electrical Installations Course," specifically targets electrical technicians. As a result, the intended learning outcomes of the course should align with the specific needs and requirements of technicians/specialists within the sector. To achieve this alignment, a complementary module has been designed as part of the EDDIE project. This module focuses on the Administration of hardware infrastructure, which emerged as a skill requirement specifically identified within the technicians/specialist’s category. By incorporating this module into the course, the content directly addresses the skill gap identified and aligns with the existing topic of the course. By tailoring the course to the unique needs of technicians/specialists identified in WP 2, the Madrid pilot activity ensures that the learning outcomes are relevant, practical, and directly applicable to the target audience. This approach enhances the effectiveness of the course and maximizes its impact in closing the skill gap within the electrical technician sector.

Overall, the impact of the identified skill gaps on the design of pilot educational activities is instrumental in fostering a generation of professionals who are well-equipped to drive the digitalization of the energy sector forward. By mitigating some of these skill gaps, the initiative aims to create a talent pool that can confidently navigate the complexities of the digital era and contribute to the sustainable and efficient energy systems of the future.

In the following table is an overview of the linkage between each of the piloting activity and the identified skill gaps in WP2 presented.

Table 2 Addressed skill gaps by the individual piloting activities

Pilot site	Pilot activity	Addressed skill gap
Aachen	Archimedischer Sandkasten with city of Aachen	Energy management systems
	Gymnasium Workshop	Energy management systems
	Workshop on Data Platforms for the Energy Infrastructure	Digital Platforms
	Future energy systems lecture on energy digitalisation	Digital Platforms, Cybersecurity, Energy management systems, Cloud services, Internet of things
	Leonardo lecture on energy transition	Digital Platforms, Cybersecurity, Energy management systems, Cloud services, Internet of things
	ACS lecture on automation of complex systems	Energy management systems, Standardisation of Communication technologies
	Science Night at RWTH	Energy management systems

	Girl's Day at ACS	Energy management systems
Athens	Lectures on Local energy markets, energy communities and blockchain applications	Blockchain, mathematical optimization, computing tools & platforms, data analysis
	Lectures on AI applications on energy systems: Dynamic security and forecasting	Artificial intelligence, mathematical optimization, forecasting, data analysis, machine learning
	MOOC (cooperation with ERIGrid 2.0 project)	Big Data/Data Analytics, Cybersecurity
	Summer school (cooperation with ERIGrid 2.0 project)	Big Data/Data Analytics, Cybersecurity
Milan	MOOC on Energy management for real estates	Energy management systems, analysing and evaluating information and data
Cologne	Certificate in Future Energy Business	Big data, Programming and development competencies, Data management and analysis
	EWI Academy	Programming and development competences, Data management and analysis.
	Smart Energy Certificate Programme	Big data, Programming and development competences, Data management and analysis.
Madrid	Home Energy Efficiency and Electrical Installations VET level Course	Data management and analysis, Programming and development competences

3. Mutual Impact between deployed activities and WP3

The main task of WP 3, titled *Stakeholder Mapping and Strategic Network Building* was to create a Stakeholders database of sector occupations and jobs. It was done through various consultations that included various sectors, occupations and job profiles. This then set the framework needed for a strategic sectoral cooperation in order to design and build a strategic network as explained below.

Three deliverables were produced through this work package. The first deliverable identified institutions, companies, organizations, and all other interest groups that were deemed relevant to the energy transformation system in Europe evaluating their influence and interest for the EDDIE project in the process. The result of the Stakeholder identification was presented in a first version of the online database currently available on the EDDIE website. The stakeholders were divided into 5 different main categories which were then be subdivided into subcategories for further analysis. The categorization was as follows:

1. Industry
2. Education
3. Administration
4. Associations and Communities
5. Individuals.

Research was conducted to develop both an automated and elegant database, making it visual, efficient and attractive for users.

At the moment of writing this deliverable, the Consortium is working on ways to increase database subscriptions in order to ensure that it is used to its full potential once the project comes to an end. The deployed activities in the project (the pilot sites) will play a big role in ensuring that the latter aim is reached as they are the perfect opportunity to disseminate the database. Through the piloting activities, different potential EDDIE stakeholders are introduced to the project thus potentially peaking their interest in it. Following the various events in the pilot sites, stakeholders in attendance will be asked to join the database.

Collaboration amongst the identified stakeholders in WP 3 within the pilot sites is an important part of the EDDIE project. Industry professionals, education, administration stakeholders, associations, and communities are critical stakeholders when it comes to bridging the skills gap between the education and the energy sector. The activities organised in the pilot sites are good examples of this collaboration. These programs provide students with practical experience and exposure to real-world challenges in the energy sector, aligning them with industry needs, and help them drive innovation and development. The involvement of administration stakeholders, associations, and communities provides a platform for collaboration and networking, while industry professionals and educators offer training, knowledge, and mentorship opportunities. Overall, collaboration among stakeholders is essential in enhancing the skills and knowledge of the students and driving innovation and development in the energy sector.

When looking at the activities organised in the pilot sites from an outside perspective, one can see tangibly and in practice that the stakeholders identified in WP 3 are in fact the force that will bring the EDDIE project into a reality. Through the piloting sites the EDDIE project is working towards closing the skills gap and when it comes to the organisation of these activities and also the people in attendance. This is clear by the fact that the identified stakeholders are the ones that are making this situation a reality. The education sector together with the administrative stakeholders are the ones organising and in some cases even deploying their knowledge making them imperative both logistically and as a knowledge sharing hub Importantly, the stakeholders in attendance to these events would be coming from both the industry stakeholder group and the education stakeholder group.

Table 3 Summary of pilot activities and corresponding stakeholders

	Industry	Education	Administration	Associations and Communities	Individuals
Pilot activities in Aachen	Workshop on Data Platforms for the Energy Infrastructure, Leonardo lecture on energy transition	Archimedischer Sandkasten with city of Aachen, Gymnasium Workshop, Workshop on Data Platforms for the Energy Infrastructure, Leonardo lecture on energy transition, ACS lecture on automation of complex systems, Science Night at RWTH, Girl's Day at ACS		Archimedischer Sandkasten with city of Aachen, Workshop on Data Platforms for the Energy Infrastructure	Archimedischer Sandkasten with city of Aachen, Science Night at RWTH
Pilot activities in Athens	Presentation on the emerging needs in the educational sector (MOOC)	Lectures on Local energy markets, energy communities and blockchain applications, Lectures on AI applications on energy systems:			Presentation on the emerging needs in the educational sector (MOOC), presentation to disseminate EDDIE project's goals and outcomes (summer school)

		Dynamic security and forecasting, Presentation on the emerging needs in the educational sector (MOOC), Presentation to disseminate EDDIE project's goals and outcomes (summer school)			
Pilot activity in Milan	MOOC on Energy management for real estates	MOOC on Energy management for real estates	MOOC on Energy management for real estates	MOOC on Energy management for real estates	MOOC on Energy management for real estates
Pilot activities in Cologne	"EWI Academy": A training program designed for companies and consisting of several modules on different contents of interest related to the digitization-driven transition of the energy sector.	"Future Energy Business" Lecture series held by EWI and/or practitioners from the energy field in close cooperation with the industry. Attendees are young professionals and students.			Lecture series held by EWI and/or practitioners from the energy field in close cooperation with the industry. Attendees are young professionals and students from various universities and study programmes.

Pilot activity in Madrid	Complementary module/course for technicians/specialists in energy efficiency installations.	Practical training for technicians about home energy efficiency and electrical installations.	This course can be replicated in any of the educational centres that provide training for electrical and telecommunication installation technicians.	This course complements the diploma obtained by the technicians by providing them with an official certificate showing the practical skills acquired.	Students will be able to carry out an efficient electrical installation considering all the parameters learned in a theoretical and practical way in the course.

Above, table 3 provides a list of the different stakeholder categories and the different pilot activities are assigned to a corresponding stakeholder category. This categorisation helped in designing the pilot activities and targeting the right stakeholders. In this way, activities reached the right target group and enhanced the collaboration and established the networking inside the recognized and corresponding stakeholder group(s). In addition, this improved and facilitated the dissemination of pilot activities. The piloting activity **Home Energy Efficiency and Electrical Installations VET level Course** in Madrid addresses all the stakeholder in a different way as shown exemplary in the table.

Besides that, the EDDIE database is the perfect opportunity and tool to keep track of those stakeholders in attendance at the activities organized by the pilot sites. Once the stakeholders in attendance form part of the database, it will also eventually be an ideal tool to use in order to invite these same stakeholders to other events the pilot sites might organize in the future. This is an essential part of the strategic network building envisaged in WP 3 of the EDDIE project.

Another task of this WP, was the definition of a network of strategic partners and stakeholders. This was considered pivotal for the implementation and success of the Blueprint for the Digitalisation of the European Energy Sector (BSDE). The “University Hub”: a local coordination structure set between key University partners and other stakeholders, for the synergic local action on the different educational levels targeted by the project was also defined. The University Hub will support a quick transfer of knowledge from the university to the other educational entities, including high school level, thus representing the pillar on which to build a strong cooperation at European level. The relationships with stakeholders are of paramount importance in relation to the success of the Blueprint. EDDIE needs to develop relationships with potential stakeholders and also to demonstrate a strong network and dialogue with beneficiaries and other key stakeholders in order to build credibility. The “University Hub” will help in dissemination of pilot activities and networking of stakeholders through pilot activities.

4. Mutual Impact between deployed activities and WP4

The work in WP4 is focused on exploring the teaching and learning procedures in the categories of VET, University education and LLL to align them to the requirements of the new digital world and energy sector. In this sense the deliverables D4.2 – D4.4 are giving an overview of current guidelines, emerging strategies, and existing examples of good practices presented in the categories of Best Practices (BP) and Good Examples (GE). These BP and GE for the education in VET, universities and LLL are existing educational programs addressing the identified skill needs in EDDIE and are offering practical examples. In the framework of the EDDIE project the BP are the groundwork to understand the work that has already been carried out and can be considered as a good practice, to measure the extent to which these practices could be transferred in other countries and to learn from these.

In the following subchapters are the main recommendations driven from the BP and GE for the education in VET, universities and LLL presented. These recommendations consider also the lessons learned and problems identified during the research of the good practices. To display the impact of the recommendations in the design and development of the individual piloting activities, the piloting activities applying individual connection of these activities is described below each of the recommendations.

4.1. Recommendations for VET programs

1. **Strong emphasis on practical training and hands-on experience**

Professionals in the sector of energy digitalization, are required to show practical knowledge and approach of digital skills in order to be competitive in the field. Thus, it is important for these training programs to offer the opportunity to students and professionals to gain hands-on experience and practical skills through on-the-job trainings and apprenticeships. This not only helps to ensure that students are well-prepared for careers in the industry, but also helps to keep the VET sector relevant and responsive to changing industry needs.

Practical recommendations:

- Develop training programs that provide hands-on experience in areas such as automated production systems and energy and environmental technologies.
- Provide trainees with access to modern equipment and technology to simulate real-world scenarios.
- Develop partnerships with local companies to provide trainees with opportunities for work-based learning.
- Offer apprenticeships and internships to provide trainees with hands-on experience in the industry.

Piloting Activities:
Home Energy Efficiency and Electrical Installations VET level Course

The pilot activity developed by the Escuelas Profesionales Padre Piquer (Madrid) has as its strong point the emphasis on the practical training of the proposed course. The course consists of 30 theoretical-practical hours in which students will simulate the electrical installation of a house in the most efficient way using the necessary technologies. This learning based on real simulation will use modern applications and materials (such as solar panels, Specific systems for reducing the standby consumption, etc.) that will bring the student closer to a real scenario. This course focuses its content on the development of skills of analysis and practical implementation of technologies related to home automation to reduce energy consumption and making the dwelling more efficient.

2. **Customized learning and strong industry partnerships**

In order to ensure that the VET program is aligned with the industry needs and trends, the establishment of strong links with industry partners is really important. This can help bridge the gap between theoretical and practical knowledge and align the program with the technological advancements and changes in the energy sector. VET providers need to work closely with industry partners to understand their needs and develop tailored programs to meet those needs.

Practical recommendations:

- Develop partnerships with local companies to gain insights into their needs and requirements.
- Offer customized training programs that are tailored to the needs of individual companies or sectors.
- Provide trainees with access to industry experts and mentors to gain real-world insights and experience.
- Collaborate with industry and research stakeholders to stay up-to-date with the latest trends and practices in the energy transition and digitalization sectors.

Piloting Activities:

Home Energy Efficiency and Electrical Installations VET level Course

This pilot activity is part of a training program for students of electrical and telecommunications installation qualifications (EQF level 4 and 5) as a complement to their official training. It has been decided to do it after the end of the second year and just before the students leave the school to start their internships in companies in the sector (which last 3 months). For the time being, the pilot activity has been presented to the competent authorities in this educational aspect regulated by the Community of Madrid, for its possible official implementation, either as the school's own project or as a project exportable to other institutions.

There is a close relationship between this training and industry. As we know, the industry is very interested in recruiting employees who can handle the latest trends and practices in energy transition and the digital sector. In this sense, this training is an opportunity to develop specific energy saving competences through the use of digitalization at a training level (EQF 4 and 5) which in Spain is not usually focused on. The improvement of the skills of both technicians and users will be of particular interest to the industry. Hence, the students have been able to evaluate the impact of the knowledge acquired in the course in their professional internships. They have been given a diploma accrediting this training so that they can demonstrate the acquisition of skills related to digitalization and energy, making these students more competent for industry.

3. Utilize digital tools and virtual scenarios

In the context of energy digitalization, the use of digital tools has become increasingly important for the VET sector to keep up with the rapidly evolving industry. Digital tools can be used to simulate real-world scenarios, provide interactive learning experiences, and enable students to gain practical skills and experience in a safe and controlled environment. This is especially important in the field of energy digitalization, where students need to understand complex systems and technologies, and be able to troubleshoot and solve problems quickly and efficiently. Even when real-world opportunities are limited, digital tools and virtual scenarios can provide trainees with practical skills and experience. Overall, they can help trainees gain a deeper understanding of complex systems and technologies.

Practical recommendations:

- Develop digital simulators and virtual scenarios that replicate real-world scenarios in areas such as electrical distribution systems or renewable energy sources.
- Use online learning modules to provide trainees with access to learning materials anytime and anywhere.
- Use digital platforms for communication and collaboration among trainees and between trainees and industry experts.
- Provide training and support to VET trainers and instructors on how to effectively use digital tools in teaching.
- Provide courses and tailored training for using digital tools relevant to energy digitalization, such as:
    - Virtual and augmented reality simulators
    - Digital twins
    - Energy management software
    - IoT devices and sensors
    - Computer-aided design and manufacturing tools
    - Data analytics and visualization software
    - Cybersecurity tools and protocols
    - Cloud computing platforms
    - Machine learning and artificial intelligence tools
    - Robotics and automation systems.

Piloting Activities:

Home Energy Efficiency and Electrical Installations VET level Course

The TEAMS digital platform has been used as the basis of the course. The materials and the problems to be solved for the students have been uploaded on this platform. The students have used specific applications of the equipment used. A registration to the manufacturers' platforms was simulated in order to obtain a real-time reading of the energy consumption and thus be able to make adjustments to the electrical installation and the work of the electricity meters. The students had to create their own Wi-Fi network for the use of all the devices used in the course. The students worked with equipment such as solar panels, intelligent devices and specific applications.

4. Interactive and multi-disciplinary training methods

Traditional classroom lectures and theoretical lessons may not be enough to equip students with the practical skills and knowledge they need to succeed in such a specialized industry. As such, VET providers should incorporate interactive and multi-disciplinary training methods into their curriculums to provide students with a comprehensive understanding of the sector. These methods can also help trainees develop critical thinking, problem-solving, and collaboration skills. Skills that are critical for success in the rapidly evolving energy transition and digitalization sectors, where new challenges and opportunities are constantly emerging.

Practical recommendations:

- Use group discussions and project work to encourage collaboration and critical thinking among trainees.
- Offer training in multiple disciplines such as engineering, data analytics, and business management to provide a comprehensive understanding of the energy transition and digitalization sectors.
- Develop training programs that address not only technical skills but also soft skills such as communication, leadership, and teamwork.
- Use case studies and real-world examples to illustrate the practical application of theoretical concepts.

Piloting Activities:

Home Energy Efficiency and Electrical Installations VET level Course

The pilot course developed by Escuelas Profesionales Padre Piquer has used a methodology based on problem solving, interactive lectures and based learning. At our school, we place special emphasis on the importance of acquiring technical skills in a practical way "learning by doing". We consider that the learning of the course contents has been acquired by the students from experiencing electrical installations and real home automation equipment in the classroom. We know that the motivation of our students is based above all on the practical value of the training they have chosen. In addition, companies want to recruit students who are highly competent on a practical level. Therefore, all the contents of the course have been put into practice by each one of the students simulating the real electrical installation of a house (including solar panels, air conditioning systems, etc.) in the workshop classroom.

Apart from the above, to improve the effectiveness of vocational education and training (VET) programs, it may be beneficial to offer short-term training cycles that combine theoretical learning with on-the-job practice. This approach would help students develop practical skills and competencies while also gaining valuable work experience. It is also important to incorporate certification schemes into VET courses to ensure that professionals are well-prepared for the workforce. In addition, it is essential to investigate necessary skills for specific jobs and develop holistic programs that address both labor market needs and relevant EU directives. To facilitate this, mobilizing a network of stakeholders to provide apprenticeships and training opportunities for both students and trainers can be helpful. Offering professional development opportunities for VET trainers and mentors can also equip them with appropriate methodologies and digital tools to upgrade VET provision. Finally, including professionals with experience and expertise in curriculum development can directly address mismatches of workforce supply to labor market demands.

4.2. Recommendations for University programs

1. **University programs targeting the necessary skills for digital energy**

Through analysis of best practices and good examples, it was concluded that the following skills for digital energy that were identified in WP 2 are still not covered in depth in many bachelor or master studies: Artificial Intelligence and Machine Learning, Cybersecurity, IoT, Robotics, Big Data, Blockchain, Augmented reality, Energy modelling, Simulation and optimization and Cloud services. To give more broaden perspective of job opportunities to future students and to fill the gaps in job markets, it is necessary to integrate upper mentioned topic in regular curriculums.

Piloting Activities:

ACS Lecture on complex power systems

The course in Aachen is targeting the skill gaps in Energy modelling and simulation with its content by integrating a new teaching tools:

- Jupyter notebook:
  A new notebook was written with a goal to help students understand better energy modelling and simulation. This was done under the lecture Converter control where students were able to see different control techniques for a converter written in Octave and simulated.
- Demo:
  A lecture Voltage control was improved by showing students a voltage control demo developed by a research assistant for his PhD.

Lectures on Local energy markets, energy communities and blockchain applications and **Lectures on AI applications on energy systems: Dynamic security and forecasting**

The piloting activities **Lectures on Local energy markets, energy communities and blockchain applications** and **Lectures on AI applications on energy systems: Dynamic security and forecasting**, in pilot site Athens, aim to mitigate a wide range of the abovementioned missing skills:

- Energy modelling, simulation and optimization: a major part of the lecture on local energy market focuses on the modelling of energy markets, and the market clearing mechanisms, providing also a presentation of the modelling of an actual local energy market and the basic results of the simulation.
- Blockchain: an entire lecture is dedicated to blockchain, providing the basic principles of the Blockchain technology and smart contracts, also presenting a simulation of a practical decentralized application and an Ethereum based application, along with fruitful results.
- AI and Machine learning: One lecture focuses on machine learning, and especially decision trees, classifiers, training sets, also providing a practical example of classifiers application and comparison in the power system of a non-interconnected Greek island. Additionally, one lecture focuses on artificial neural networks utilized in power prediction, introducing training process, error functions, deep learning and evaluation metrics, and also presenting an actual example of artificial neural network facilitating a power forecasting and the evaluation of the various metrics in the example.

2. **University programs supporting international/pan-European exchange and collaboration with other universities**

In order to support and encourage a pan-European view on digital energy, it is necessary to enhance the exchange and collaboration between university programs. This will diversify the education and support international/pan-European with other universities. It could be done through designing a double degree program or by encouraging the exchanges through joint projects/seminars/workshops.

Piloting Activities:

Workshop on Data Platforms for the Energy Infrastructure

The workshop was done in collaboration with RWTH Aachen University, HS Bochum, city of Herne and Ideasforum e.V.. The participants of this workshop were students from both universities, Stadtwerke employees, university employers and professionals. This workshop covered the following topics:

1. Challenges of data management in the energy grid,
2. Presentation of MQTT and presentation of the LEGOS demonstrator,
3. Presentation of FIWARE and presentation of the Functional Miniature Model from the Herne climate district, and

4. Presentation of Smart City business models.

3. University programs with strong connections to the energy industry

In order to be enable faster recruiting process and keep education up to date in terms of technology development and the skill gaps identified by energy industry, it is recommended to establish a symbiotic relationship between industry and universities. By offering different internships and project work, industry would be able to attract a talented students who could be a potential worker later on. In this way, students would get a benefit of dealing with real application scenarios and job opportunity.

Piloting Activities:

Leonardo Lecture on energy transition

In the module “Energy transformation”, current discourses and challenges in the context of energy (policy) were examined and discussed. Different forms of energy as well as their production and supply mechanisms were considered. Political and economic interests were considered and compared with the technical feasibility. Different fields of action and approaches to solutions were discussed from an interdisciplinary perspective. These discussions were supported not only by professors but also by industry partners giving students an overall picture of challenges from academic and industry points of view in the energy transition.

Introductory lecture into MOOC on advanced validation methods for smart grids

The MOOC (developed by ERIGrid 2.0 project) will focus to advanced validation methods on smart grids, attracting both students and professionals. In the context of the MOOC, a presentation from NTUA will present the educational challenges that occur due to the digitalization of the energy systems, aiming to set up an open discussion professionals/industry to express their opinions/needs on that matter.

4. Extracurricular activities for students to increase interest/knowledge in digital energy

In order to increase interest/knowledge in digital energy through university, it is recommended to organize extracurricular activities. This could be done by organizing different workshops and case studies that would focus possibly on the topics and skills that are identified in WP2 and listed in the first recommendation point. Furthermore, it is recommended to organize thematic competitions, such as hackathons or ideathons, where students would have the possibility to actively contribute to the development or brainstorming of relevant topics in digital energy. It is recommended to encourage students to participate in digital energy thematically based conferences.

Piloting Activities:

Workshop on Data Platforms for the Energy Infrastructure

The workshop dealt with the important role of open source data platforms and business models for the necessary change in the energy grid as part of the energy transition. Students had the opportunity to learn more about the open-source technologies MQTT (Message Queuing Telemetry Transport) and FIWARE for use in smart energy networks. For this purpose, a physical demonstrator was presented in each case, which was used to illustrate the functions and fields of application. In addition, the development of business models in connection with Smart Cities were discussed.

Participation in the Summer School (organized by ERIGrid 2.0 project)

The presentation of EDDIE project during the summer school, aims to disseminate the project work and goals, raising the issue of the digitalization of the energy sector and giving examples of the identified skill gaps, best practices, and the education/training material that the participants can access through EDDIE website.

Certificate in Future Energy Business

The pilot activity **Certificate in Future Energy Business** in Cologne is a two-semester lecture series designed to bridge the gap between theoretical knowledge in energy economics and practical challenges from companies in the energy business. The program consists of several courses that EWI and participating companies offer. This approach ensures the practical relevance of the curriculum. Companies have the incentive to engage in teaching to position themselves as potential employers for the participants. By this approach, addressees of the program are students and companies from the energy sector. Topics include energy modelling, simulation and optimization, data management and data analysis and big data.

5. **Increase the interest in the topics of digital energy already on primary/secondary education level**

In order to foster a new generation in the digital energy sector, it is recommended to start familiarization with digital energy from an early age (on primary/secondary education level). It is recommended to organize workshop and events that would attract children and teenagers to be involved in digital energy topics.

Piloting Activities:

Archimedischer Sandkasten with city of Aachen, Gymnasium Workshop, Science Night, and Girls' day

The pilot activities in Aachen such as **Archimedischer Sandkasten with city of Aachen, Gymnasium Workshop, Science Night, and Girls' day** could serve as an example and a good basis to promote and organize more workshops and events in this direction. In each of these pilot activities, we used different demonstrators that showed part of electrical grids and different tasks were able to be demonstrated (e.g. control of production and consumption of electrical energy). Each of demonstrators was interactive and people of all ages were able to use them.

4.3. Recommendations for LLL programs

1. **LLL programs and courses focused on Upskilling and Reskilling for digital transformation**

The main keywords of the best practices and success stories identified are related to the need for constant upskilling and reskilling. Given the rapidly evolving nature of digital technologies, there is a continuous requirement to update knowledge and skills to stay relevant. The focus has to be on a range of skills, including: maintenance management, smart grid principles, energy digitalization, digital transformation, smart technologies, and intelligent systems. Furthermore, there's an increasing emphasis on reskilling in the field of renewable energy sources, Energy Consumption and Efficiency.

Practical recommendations:

- create strong partnerships with industry experts and global stakeholders provide specialized training and effective knowledge transfer;
- link to key companies in the field for a complete understanding of the main skills to address;
- link to key companies in the field for a complete understanding of the kind of professionals/workforce to involve in the training activities.

Piloting Activities:

MOOC on Energy management for real estates

All the initiatives carried out by Politecnico di Milano, even designed with a the specific target of professionals in mind, were designed to be open and accessible to everyone interested. In order to develop outputs that can attract and be effective for energy professionals, MOOC structure and materials, as well as the webinar topic, were thought in strong collaboration and with direct involvement, even in early design stage, of companies associations and experts who has fruitful collaborations with the industry sector.

Certificate in Future Energy Business

The pilot activity **Certificate in Future Energy Business** in Cologne is a two-semester lecture series designed to bridge the gap between theoretical knowledge in energy economics and practical challenges from companies in the energy business. The program consists of several courses that EWI and participating companies offer. This approach ensures the practical relevance of the curriculum. Companies have the incentive to engage in teaching to position themselves as potential employers for the participants. By this approach, addressees of the program are students and companies from the energy sector. The program focuses on preparing students for a position in the energy sector and support networking between students and companies.

2. **LLL programs and courses focused on Specialized training (with Quality Assurance processes) and certification mechanisms**

The practices stress the importance of capacity building in relation to digital skills also through Specialized Training. This ensures the sector has the capability to adopt, manage, and advance digital transformation. Specialized and

personalized training in digital technologies and their application in the energy sector is crucial. This is demonstrated by practices focusing on areas like smart grids, digital tools for energy behavioral change, and digital transformation in the energy sector. Furthermore, the practices emphasize the importance of developing certification mechanisms, demonstrating that validation and recognition of digital skills in the energy sector are vital. This is particularly true for professionals willing to demonstrate their expertise.

Practical recommendations:

- create relevant and cost-effective training solutions for professionals to grow and develop;
- develop industry-oriented initiatives with links to professionals, industries and global stakeholders;
- focus on practical training from real-world professionals and experts is crucial for success;
- create tailor-made courses, short and focused on specific topics, mixing diverse format: online and in-presence; theory and practice; synchronous and asynchronous;
- use tolls based on artificial intelligence to easily create small and updated modules of contents;
- follow quality assurance mechanism to ensure the quality of the courses provided;
- provide certification or credentials to support the visibility of the skills acquired by professionals.

Piloting Activities:

MOOC on Energy management for real estates

The choice to go for a MOOC perfectly fits with the need to offer an agile path that can be explored and enjoyed at own learners' pace. Users can watch "here and there" and deep just what they need/want to learn without any constrains of time or mandatory tasks to complete, apart the summative quizzes to obtain the Certificate of accomplishment. At these days, Politecnico di Milano is at an early stage in the process to evaluate the possibility to offer micro-credentials (See more at ECTS for microcredential) for some of its educational offer. Anyway, the MOOC design process take into account the necessity to provide transparent and coherent information about what learners will find in the course in order to be aligned with the European indication on micro-credential in the future but also with other European framework like ESCO. MOOC has been structured with a majority of asynchronous materials (video lessons, articles and case studies) that can facilitate contents fruition at different pace and from different parts of the world. A synchronous event has been added to discuss and interact with a professional who concretely work in industry sector about practical issues related to his job.

EWI Academy

The pilot activity **EWI Academy** in Cologne is a training program designed for companies that want to train their employees in the field of energy. The program consists of several modules on different contents of interest related to the digitization-driven transition of the energy sector. The addressees of the EWI Academy are companies, both on the supply- and demand-side, that are willing to offer training to their employees on different carrier stages. The programs' modules are offered online and in-person, combining input sessions with active parts, such as discussions. Besides lectures, the courses can be accompanied by interactive workshop sessions. The modularized structure allows adjusting each training program content- and process-wise to the needs of the companies. E.g., the training can be held on a single day or in multiple day sessions. The training's language is German or English. Participants receive a proof of certification.

3. LLL programs and courses created through Collaboration and Networking

Several practices are built on partnerships and networks, indicating that collaboration and the sharing of knowledge and best practices are key in the digitalization of the energy sector. This theme is crucial due to the rapidly evolving nature of digital technologies: a strong contact among academia and research centers, training provider, industries and professionals could guarantee the overcoming of market barriers and the alignment between training and sector needs, in order to support the adaptation of the workforce to market trends and requirements in digitalization. This could also be useful to disseminate the results of the initiatives: reaching a large audience is key to making a meaningful impact on the industry and society and to guarantee the sustainability of the Entity.

Practical recommendations:

- reach a large audience and raise awareness on the topic through dissemination activities (social networks, conferences, etc..);
- create courses involving actors from different sectors (e.g.: companies, professionals working in the field, etc);
- make the courses available on different international platforms (open or not) in order to guarantee the involvement of different target.

Piloting Activities:

MOOC on Energy management for real estates

The Polimi Open Knowledge platform, chosen for primarily hosting the MOOC of pilot test in Milan, represents an effective environment to favor the dissemination toward a large audience as it records more than 160.000 learners enrolled in it and attending an offer of almost 110 courses. A large part of them, more than 50, are specifically dedicated to professionals and to their upskilling. The platform, as part of the educational offer of a technical-scientific university, is continuously updated and enriched with new courses developed by international experts. At a second stage of the pilot, the MOOC has been also published on Coursera with the objective to reach a more international target.

5. Mutual Impact between deployed activities and WP5

The Blueprint Strategy for the Digitalisation of the European Energy (BSDE) is being developed in WP5

The challenges addressed by EDDIE include integrating digital skills into the training ecosystem, retraining the current and future energy sector workforce, and making the energy sector an appealing career choice for digitally skilled individuals. While EDDIE will generate various documents and recommendations, the primary outcome sought is the Blueprint Strategy for Digitalisation of Energy (BSDE). This strategy envisions the establishment of an institution, referred to as the Entity, to provide services to stakeholders involved in the digitalization of the energy sector.

In this section, we focus on the analysis of the mutual impact between the BSDE, formally developed in WP5, and the piloting activities which design and implementation has been developed in WP6.

5.1. Adaptive-learning process for digital skills

The adaptive-learning process for digital skills is presented in the deliverable document D5.1, as one of the key outcomes of WP5, especially considering that it is a key result used for structuring the main components of the BSDE strategy. This process is the target process to be improved within the EDDIE project: the digital skills acquisition through training and recruiting, which is already operational and evolving. The main stakeholders involved, including Energy Sector companies, digital systems developers, and Education & Training providers, strive to adapt to the dynamic needs with the support of administrations, research groups, and professional associations.

The process can be broken down into blocks and skill-flows, allowing for an initial assessment of stakeholders and tasks. The blocks and associated tasks include regular training and certification, recruiting of employees, job development, performance evaluation, digital-skills tailored training, evaluation and certification, and recruiting of students for tailored training. Figure 4, already presented in D5.1, shows the dynamics of the process.

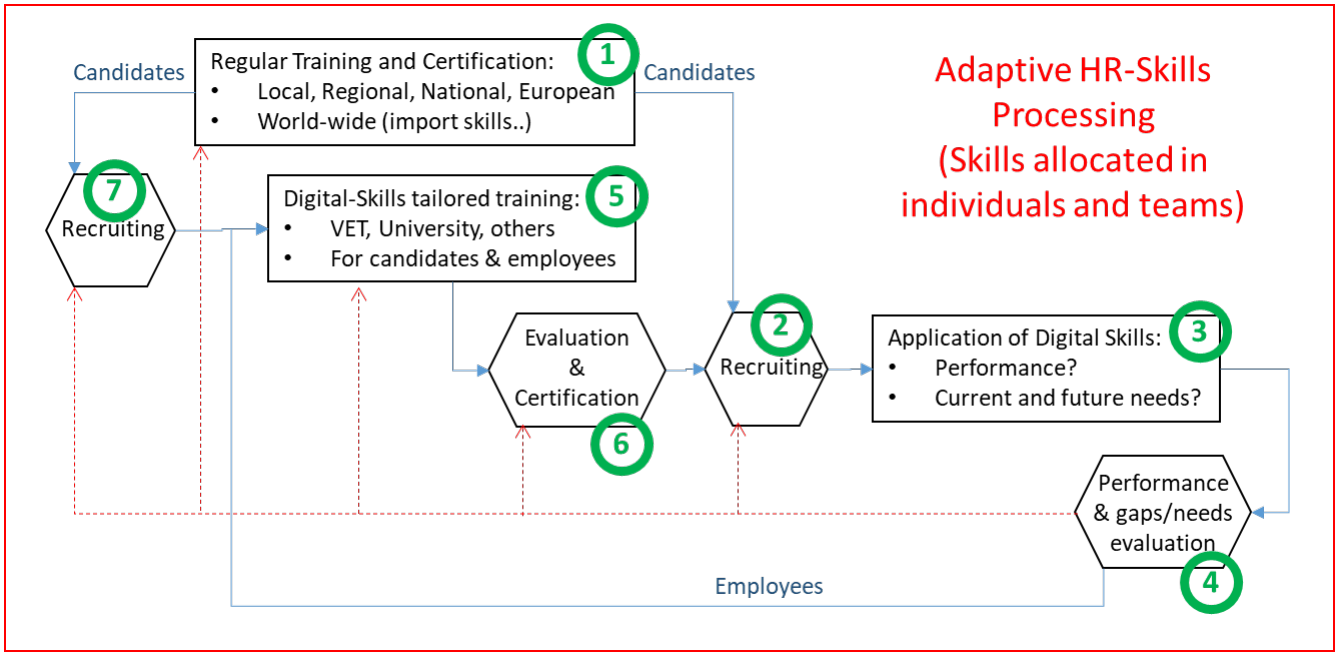

Figure 5 The adaptive-learning process for digital skills

The primary challenge of EDDIE is to design and implement a strategy that enhances the efficiency, flexibility, adaptability, agility, and overall quality of this process. By addressing these aspects, the project aims to drive significant improvements in the acquisition of digital skills within the Energy Sector, ultimately fostering its digitalization and growth.

The strategy seeks to create new profiles of professionals trained in new technologies, tools, and methods to support and enhance the digitalization process. The strategy is being piloted with various activities, such as lectures,

workshops, demonstrations, and courses, targeting different stakeholders and EQF levels. The assessment procedure will measure the impact of these activities, informing the continuous update and sustainability of the Strategy. The pilots will test and refine components of the Strategy, addressing skill gaps and utilizing training program templates and best-practice analyses. The outcomes of the pilots will be disseminated through the proposed training-programmes marketplace and dissemination portal.

The mutual impact between the strategy and the set of piloting activities is evident and integral to the overall objective of the EDDIE project. The piloting activities serve as a fundamental tool for analysing and evaluating key elements and information flows within the process of acquiring digital skills.

The strategy aims to improve the efficiency, flexibility, adaptability, agility, and quality of the digital skills acquisition process in the Energy Sector. The piloting activities, through their diverse range of interventions, directly contribute to this objective by implementing lectures, workshops, demonstrations, and courses, the pilots actively engage stakeholders at different levels, providing them with new technologies, tools, and methods to support and enhance the digitalization process. The results obtained from the piloting activities hold great significance as they provide valuable insights and outcomes that can validate and refine the understanding of stakeholder behaviour and the effectiveness of the strategy itself. The pilots serve as a testing ground to assess the impact of the strategy's components, address skill gaps, and utilize best-practice analyses and training program templates. Through the first iteration of an iterative process, the piloting activities set the ground for the continuous improvement and sustainability of the strategy. Moreover, the outcomes and lessons learned from the pilots will be disseminated through the proposed training-programmes marketplace and dissemination portal. This knowledge sharing will further enhance the strategy and contribute to its wider implementation and adoption within the Energy Sector.

In conclusion, the interrelation between the strategy and the piloting activities is crucial. The pilots provide a platform to analyse, refine, and validate the strategy's effectiveness, while the strategy guides and informs the design and implementation of the pilots. Together, they form a symbiotic relationship that advances the acquisition of digital skills in the Energy Sector and drives its digitalization and growth.

5.2. Analysis of the elements/components of a training program

The analysis of the components of a training programme, as presented in D5.1, emphasizes the importance of combining daily work with specialized training for skills acquisition, especially digital skills. The analysis adopts a project-based approach, employing a waterfall model consisting of phases such as specification, design, implementation, and test-validation. The primary objective is to thoroughly identify relevant topics and concepts within the BSDE model's tasks.

This analysis focuses on three groups of concepts for each development phase: targets and products, tasks and resources, and related topics, tasks, and products. The identification of targets, tasks, and related topics aids in systematic development and classification of best practices. Additionally, it helps in defining a general template for training programmes, allowing for recommendations, and finding suitable programmes to meet specific needs.

The subsequent step further categorizes the tasks into two groups: the business model and the academic model. The business model encompasses management and organizational topics shared by similar programmes, while the academic model focuses on the skills-acquisition process, including contents and teaching/learning methods. This categorization serves as a foundation for developing a general template for training programmes.

Now setting the scope on the impact of the analysis of the components of a training programme on the pilot activities, we see a clear effect of the former on the latter. The thorough identification of components, stakeholders, and tasks within the training programme has greatly assisted in the design and implementation of the piloting campaign. The insights gained from the analysis have provided valuable guidance in structuring the pilots, ensuring their alignment with the identified targets, tasks, and related topics. Furthermore, the categorization of tasks into the business and academic models has facilitated the development of a general template for training programmes, which in turn has influenced the design and execution of the pilot activities. Conversely, the pilot activities can also reinforce confidence in the analysis of the components of a training programme or offer valuable insights for potential refinements. The piloting process serves as a means of testing and validating the identified components and concepts. Through activities such as lectures, workshops, demonstrations, and courses, stakeholders at various EQF levels are engaged, and their feedback and assessment contribute to the continuous improvement and sustainability of the strategy. The outcomes of these pilots, including the identification of skill gaps and the utilization of training program templates, will be disseminated through the proposed training-programmes marketplace and dissemination portal, further enhancing the effectiveness and impact of the analysis.

In conclusion, the interplay between the analysis of the components of a training programme and the piloting activities in the EDDIE project is symbiotic. The analysis informs and shapes the design and execution of the pilots, while the pilots, in turn, validate and enhance the analysis, creating a continuous feedback loop that strengthens the overall strategy for the digitalization of the energy sector.

5.3. General templates for training programs

Some tasks within WP5 have been oriented to defining a template for gathering and presenting data for educational programs. This template has been first proposed and then refined and improved in D5.2 and D5.3, respectively. It emphasizes the importance of designing programs based on available information and making the information easily accessible to prospective students. The development of the template involved extensive work and collaboration among project partners. The template provides a structure for various types of training and integrates with educational taxonomies to facilitate program design and searching.

The mutual impact between the template designed to structure training programmes and the set of piloting activities implemented may be stated to be asymmetric:

- The influence of the template on the piloting activities is limited since the activities are not always conceived as full education or training programmes. The piloting activities, such as lectures, workshops, demonstrations, and courses, may not align perfectly with the whole structured format of the template. These activities may be more focused on specific skills or knowledge areas rather than comprehensive training programmes, which could restrict the direct application of the template.
- However, the pilot activities can be useful to analyse the flexibility of the different sections of the template to efficiently gather and structure the information of a set of heterogeneous education and training initiatives. By implementing the piloting activities and utilizing the training program templates (even though sometimes only a fraction of the template will be tested), it becomes possible to assess the adaptability and effectiveness of the template in capturing diverse educational programs. The pilots can serve as a testing ground for the template's ability to gather and organize information from various stakeholders and EQF levels, allowing for refinement and improvement based on the outcomes.

In summary, while the template may have limited influence on the piloting activities due to their diverse nature, the activities themselves can provide valuable insights into the flexibility and efficiency of the template in gathering and structuring information from heterogeneous education and training initiatives. The analysis of the pilot outcomes can inform the continuous update and enhancement of the template, contributing to the overall success and sustainability of the strategy.

5.4. Training programs marketplace

D5.1 provides an initial draft analysis of the business model for a training programme marketplace, focusing on the development of an e-marketplace for e-learning materials. The marketplace aims to address issues related to marketing, re-use, and targeting of learning materials, offering benefits to buyers, sellers/providers, and trusted partners, with emphasis on the advantages and disadvantages of an online marketplace business model, including network effects, high user engagement, data creation, dependence on other platforms, high setup costs, competition, and varying seller quality. It also outlines the main types of marketplaces and key indicators for tracking growth.

The design of the training programme marketplace in WP5 propose a progressive deployment approach, moving from a barebone portal to a user-generated content portal, with a focus on consolidating a content-edited portal. Various issues and contingency plans have been identified, including the need for national portal linkage, common competences libraries, a federation of repositories, integration with existing networks, and critical mass of available learning objects.

The stakeholders' analysis highlighted the need for a web-based platform as a virtual meeting, exchange, and networking portal for e-learning content and e-skills. The marketplace aims to facilitate the development of the e-skills market, enhance the supply of e-skills e-learning courses, serve as a reference point, and foster collaboration among providers, consumers, and research/training centres.

Regarding the mutual impact between the training programme marketplace and the piloting activities, it is clear that the analysis of the characteristics of this type of marketplace, along with the design activities carried out in WP5, have proven highly valuable in guiding the selection and design of the piloting activities. The marketplace's business model, functionalities, and stakeholder analysis have provided essential insights into the needs and requirements

of the energy sector stakeholders. This alignment has ensured that the piloting activities are tailored to address their specific concerns and expectations.

The results of the piloting activities, particularly the analysis of the responses gathered through surveys, can have a significant impact on understanding the perception of key stakeholders in the energy sector regarding different aspects of the training programme marketplace. This feedback will be instrumental in refining the analysis and outcomes of the whole WP5, also in the part related with the training programme marketplace. The surveys will shed light on stakeholders' views on marketing, re-use, and targeting of learning materials, as well as their experiences with the marketplace's benefits and limitations. These insights can inform adjustments and improvements in the marketplace design to better meet the sector's needs.

Moreover, the outcomes of the piloting activities will be disseminated through the proposed training programme marketplace and dissemination portal. This dissemination will ensure that the lessons learned, best practices, and refined components of the piloting activities are shared with a wider audience, including stakeholders in the energy sector. Their feedback and engagement will further enrich the marketplace's development, ensuring that it continues to evolve and better serve the e-skills market.

5.5. Jobs marketplace

The mission of Jobs Marketplace platform is the creation of a specific and pioneer online platform for the search of jobs in the energy sector, with a special focus on offers that appeal to and highlight the digitalization of the sector. To achieve this, the platform will be fed by the stakeholders' database and will offer professionals who are actively looking for work, the opportunity to find quality and specific job offers in their field of professional development.

To attract users to the platform and make it work, the following can be applied:

- Act as producer: “Selling our own products first” (like posted jobs vacancies from members of the Entity) other stakeholders can then join a platform with a proven and active customer base.
- Have an appealing mission.
- Make it simple.
- User programs: create dedicated user programs to show the possibilities of the platform.

This platform can be very useful to analyze what the real needs of the industry are so that the educational programs of the institutions can be adjusted to them and be able to cover them correctly.

In order to be able to fill the jobs in the energy sector of the future, it is necessary that today's students at all levels are adequately prepared for the demands of the industry and that today's employees learn new skills to be able to evolve in their careers. For this reason, several of the pilots that have been developed within the framework of the EDDIE project are linked to the Jobs Marketplace to feed it with prepared professionals.

Thanks to these pilots, it will be possible to fill current and future job vacancies that companies in the energy industry are already demanding in a simpler and more agile way, as well as to identify the new skills that the participants of these activities have acquired so that they can be used in the portal's database.

In Aachen the “Workshop on Data Platforms for the Energy Infrastructure” can help employees who want to broaden their programming and development competences, data management and analysis and big data, which will enable them to access new positions and job offers.

Another pilot at Aachen, the Leonardo lecture series "Energy Transition - Potential Tension between Economy, Politics and Science" will help students to start acquiring skills needed in jobs related to green hydrogen, Smart grids, energy efficiency, circular economy, digitalization and the energy transition, which will be present on the jobs marketplace platform. The same will happen with the “ACS lecture on automation of complex systems” students will gain a basic understanding of the technologies used to monitor, control and communicate complex power systems.

The pilot projects developed in the city of Cologne will have the greatest impact in the jobs marketplace, as it is mainly industry-driven, they are aimed at professionals who want, or need due to the requirements of their work, to broaden their knowledge.

Companies need qualified applicants to fill relevant open positions to cope with the transformation of the energy systems. The pilots developed in this city seeks to reduce the mismatch between the required qualifications in the Energy Sector and the ones of the applicants after graduating from university and offer companies the opportunity to train their employees on new trends in the Energy Sector, also by offering companies the opportunity to train their employees in new trends in the sector.

The activities carried out in the Athens pilot will not have as much impact on the jobs marketplace. Due to the nature of the readings, they aim more to broaden knowledge on digitization technologies in the sector on a more informative level, so not as much as providing specific skills required for a specific job.

The Milan pilot is thinking about an energy manager profile, and it is targeted at all those professionals who revolve around energy management in the real estate field. This will enable the employee to access a job that requires new skills in the sector.

A VET course is being developed in Madrid that will allow students to acquire new knowledge and skills that will open the door to job offers related to automation for improving home efficiency and energy consumption management.

All these activities will contribute to the proper development of the jobs marketplace as the students/professionals who carry them out will be able to find more easily and be suitable for the jobs that will be published in the portal.

6. Conclusion

The digitization of the energy sector plays a key role in the transition towards a sustainable and efficient future. However, to address the challenges and opportunities a targeted skill set is needed. EDDIE's purpose is to develop an industry-driven Blueprint Strategy for the Digitalization of Energy that will identify and try to cover these new skill needs in the European Energy Sector.

The roll-out of the BSDE will take place in 17 different piloting activities distributed over the pilot sites in in Aachen (Germany), Athens (Greece), Cologne (Germany), Milano (Italy) and Madrid (Spain). The pilot activities consist of a variety of educational programs that target different EQF levels, audiences, and stakeholders, forming a comprehensive assortment. However, the correlation of the piloting activities with the BSDE is not unidirectional and exclusive. There is a mutual impact between the piloting activities in general as well as individually with the work in WP2, WP3, WP4 and WP5. In this deliverable the mutual impact points have been explored and described.

The base of the design, implementation and assessment of the pilot activities is built by the framework of the Blueprint Strategy, directly linking the deployment activities to WP2, WP3, WP4 and WP5. On the other side the deployed piloting activities will provide different forms of input and information as general and specific feedback to the work packages. In Figure 6 is an overview of the described mutual impact and interaction points of this deliverable.

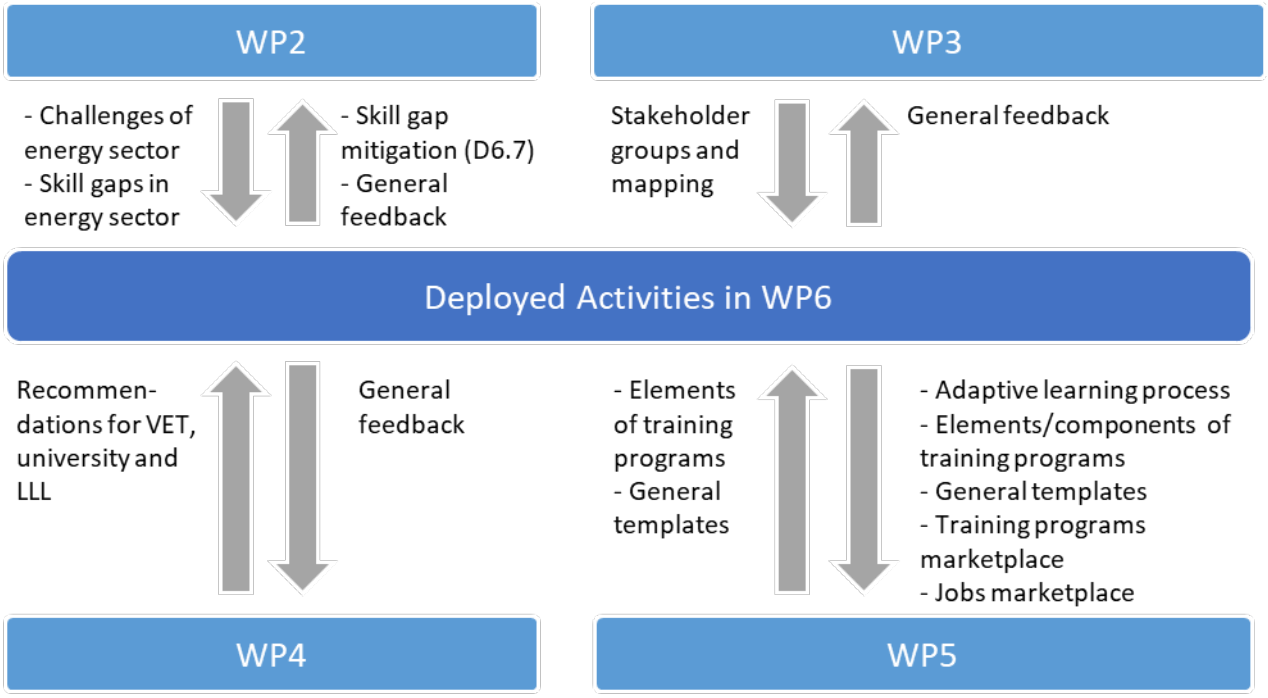

Figure 6 Detailed interaction of the EDDIE work packages with the deployed activities

The skill needs identified to address digitalization challenges, outlined in WP2, along with the skill gaps identified through analysis in the same work package, act as inputs for developing the content of the activities. The individual pilot activities incorporate measures to address the skill gaps identified in WP2. A detailed analysis of the skill gap mitigation with the piloting activities will be part of deliverable D6.7 "Analysis of skill gap mitigation" and serve as feedback from the deployed activities to WP2.

In WP3, the analysis focuses on establishing the link between the education programs and the industry, with the goal of mapping relevant stakeholders from different sectors such as industry, education, administration, associations, and communities. This process is closely connected to the pilot activities, as it enables the designers to define the educational content based on stakeholders' needs and facilitates effective engagement with the relevant stakeholders for each pilot activity.

The main recommendations driven from the identification of best practices and good examples for VET, university and LLL in WP4 provide valuable insights for the design and implementation of the developed piloting activities. This includes the content development, methodology, addressing of target groups and implementation of learning techniques.

Overall, the piloting activities are testing different parts of the BSDE in WP5 and returning insights and content to the BSDE. Hence, there are multiple impact points: The **adaptive-learning process for digital skills** as one of the main components of the BSDE strategy is the target process to be improved within the EDDIE project. Here, the pilots provide a platform for analyzing, refining, and validating the strategy's effectiveness, while the strategy, in turn, guides and informs the design and implementation of the pilots. The relation between the **analysis of the components of a training program** and the piloting activities interacts bilaterally. A continuous feedback loop is created, strengthening the entire strategy for the digitalization of the energy industry. The analysis informs and influences the design and deployment of the pilots, and the pilots in turn validate and improve the analysis. The piloting activities provide valuable insights into the flexibility and efficiency of the **general templates for training programs** in gathering and structuring information from heterogeneous education and training initiatives. The piloting activities and **training program marketplace** have a symbiotic relationship, as the marketplace analysis and design guide the selection and design of pilots, while the results and stakeholder feedback from pilots inform marketplace improvements. Dissemination through the marketplace and portal shares lessons learned, enriching marketplace development to better serve the skill market. Lastly, the pilots are directly linked to the **jobs marketplace**, providing skilled professionals. The piloting activities support the process of filling existing and future job vacancies in the energy industry and enable the identification of newly acquired skills for the marketplace's database.