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Capacity Building in Higher Education

NEW ENERGY COMPETENCE SYSTEM AND TECHNOLOGY FOR WB ENERGY STABILITY SYSTEM CURRICULUM REFORM

(NEST4WB)

MANUAL FOR ONLINE LEARNING PROFESSIONAL PRACTICE

DELIVERABLE D3.6

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Executive Summary

This *Manual for Online Learning Professional Practice* establishes a comprehensive, structured, and future-oriented framework for the design, implementation, delivery, and evaluation of **short-cycle, practice-oriented lifelong learning (LLL) courses** in the field of **digitalization of the energy sector**. Developed within the framework of the **NEST4WB project**, the manual represents a key enabling output that translates the project's investments in laboratory infrastructure, curriculum modernization, and capacity building into a sustainable model for continuous professional education. It provides methodological, pedagogical, and organizational guidance for the implementation of **one-month professional practice courses**, ensuring that laboratory-based learning can be effectively delivered both online and in blended formats.

The manual is grounded in the recognition that the energy sector is undergoing a profound and accelerating transformation driven by digital technologies, automation, data analytics, and the integration of cyber-physical systems. Digital monitoring and control platforms, smart grids, renewable energy integration tools, artificial intelligence, and cybersecurity solutions are becoming central to energy system operation and management. As a result, the competence profiles required of engineers, technicians, and energy professionals are evolving rapidly. Traditional academic programs alone are no longer sufficient to address these changing needs, particularly for professionals already active in the labor market. There is a growing demand for **flexible, targeted, and practice-oriented training formats** that enable professionals to update and expand their skills without interrupting their professional careers.

Within this context, the NEST4WB project has established and upgraded a set of modern laboratories designed to support education and training in digitalized energy systems. While these laboratories were initially conceived to support Bachelor and Master programs, their potential impact extends far beyond initial education. The present manual operationalizes this potential by defining how laboratory infrastructures can be systematically used to deliver **online learning professional practice**, thereby extending their reach to lifelong learning audiences. In doing so, the manual directly supports the sustainability and long-term exploitation of project results, ensuring that laboratory investments continue to generate educational and societal value beyond the project lifetime.

The manual defines a **clear conceptual model for online learning professional practice**, combining online theoretical instruction with guided, laboratory-anchored practical activities. It establishes a structured learning pathway in which participants progressively move from foundational concepts to applied professional tasks, culminating in a professional practice assignment or mini-project. This approach ensures that learning remains firmly rooted in real or realistic operational contexts, even when delivered remotely. By integrating laboratory data, simulations, demonstrations, and applied problem-solving tasks, the manual preserves the essential practice-oriented character of professional training while offering the flexibility required by adult learners.

A central feature of the manual is its **focus on one-month LLL courses**. These short-cycle formats are designed to be compatible with the time constraints of working professionals while still providing

sufficient depth to achieve meaningful competence development. The manual defines a standard course structure, workload range, learning outcomes framework, and assessment approach that can be consistently applied across institutions and laboratory themes. This standardization supports quality assurance, comparability of learning experiences, and institutional coordination, while still allowing flexibility in content selection and delivery methods.

From an institutional perspective, the manual enables higher education institutions to **expand their educational mission** by systematically integrating lifelong learning provision into their regular activities. By offering structured professional practice courses based on existing laboratory infrastructures, institutions can strengthen their engagement with industry and professional communities, enhance their societal relevance, and diversify their educational offer. The manual provides guidance on how such courses can be delivered fully online or in blended formats, making them accessible to a wide range of learners regardless of geographical location. This is particularly important in the context of the Western Balkans, where geographical dispersion and limited access to specialized training opportunities can pose barriers to continuous professional development.

The manual is deliberately designed as a **generic and partner-neutral framework**. It does not rely on institution-specific descriptions, technologies, or national regulatory arrangements. Instead, it defines common principles, structures, and processes that can be adopted across different institutional contexts and laboratory profiles. This design choice reflects the project's objective of achieving **replicability and scalability**. By avoiding dependence on partner-specific inputs, the manual can be centrally prepared, easily disseminated, and readily adopted by additional institutions within and beyond the NEST4WB consortium. At the same time, its modular and technology-agnostic structure allows institutions to align the framework with their specific laboratory themes, digital tools, and national lifelong learning regulations.

In terms of pedagogical orientation, the manual is firmly grounded in **competence-based and experiential learning principles**. Learning outcomes are defined in terms of demonstrable professional competences rather than purely theoretical knowledge. Learning activities are designed around realistic professional scenarios, encouraging participants to analyze data, interpret system behavior, and apply digital tools in ways that mirror real-world practice. The manual also emphasizes guided autonomy, balancing self-paced learning with structured tutor support and feedback. This approach is particularly well suited to adult learners, who bring prior experience to the learning process and benefit from opportunities to relate new knowledge directly to their professional contexts.

The manual also provides a clear framework for **assessment and recognition of learning outcomes**. Assessment is oriented towards applied tasks and professional practice outputs, such as reports or mini-projects, rather than traditional examinations. This aligns with the objectives of professional training and supports meaningful validation of competences acquired during the course. The manual allows for the issuance of certificates of completion and, where applicable, micro-credentials, in accordance with institutional and national LLL frameworks. This enhances the professional value of the courses and supports participants' employability and career development.

From a sustainability perspective, the manual plays a critical role in ensuring the **long-term impact of the NEST4WB project**. By enabling repeated delivery of professional practice courses, it supports

continuous use of laboratory infrastructures and reduces reliance on project-specific funding. The manual encourages institutions to embed online professional practice within their long-term strategies for lifelong learning and professional engagement. Furthermore, its emphasis on quality assurance, monitoring, and periodic review ensures that course content and delivery can evolve in response to technological developments, labor-market needs, and participant feedback.

Finally, the manual is fully aligned with the objectives and expected impact of the **Erasmus+ Capacity Building in Higher Education (CBHE)** action. It contributes directly to institutional capacity building by strengthening lifelong learning provision and laboratory exploitation. It enhances labor-market relevance by focusing on digital competences critical to the energy transition. It supports sustainability and systemic impact by providing a transferable and scalable model that can be adopted across institutions and regions. In this way, the *Manual for Online Learning Professional Practice* functions not only as a practical guide for course implementation, but also as a strategic instrument that reinforces the long-term educational, institutional, and societal value of the NEST4WB project.

Digital Transformation of the Energy Sector and Implications for Professional Learning

The energy sector is undergoing a profound and systemic transformation driven by the convergence of digital technologies, decentralized energy resources, automation, advanced data analytics, and increasing cybersecurity requirements. This transformation is not incremental, but structural in nature, affecting the way energy systems are designed, operated, monitored, and governed. Traditional centralized power systems are progressively being replaced or complemented by distributed generation, bidirectional power flows, flexible demand, and digitally enabled control architectures. As a result, energy systems are evolving into complex, interconnected cyber-physical systems that require innovative approaches to operation, maintenance, and decision-making.

At the technological level, modern energy systems increasingly rely on digital monitoring and control platforms, including Supervisory Control and Data Acquisition (SCADA) systems, advanced metering infrastructures, digital substations, and remote asset management solutions. These platforms generate large volumes of real-time and historical data, which are used to support operational decisions, predictive maintenance, and system optimization. In parallel, intelligent decision-support tools, based on data analytics, machine learning, and artificial intelligence, are becoming integral components of energy system management. These tools enable operators and engineers to detect anomalies, forecast system behavior, and respond proactively to disturbances, thereby improving reliability, efficiency, and resilience.

The growing interconnection between physical infrastructure and digital systems has also led to the emergence of cyber-physical energy infrastructures, in which information flows and control actions are as critical as physical power flows. While this digitalization brings significant benefits, it also introduces new vulnerabilities and risks, particularly in relation to cybersecurity, data integrity, and

system interoperability. Ensuring secure and reliable operation of digitalized energy systems therefore requires professionals who understand not only electrical and energy engineering principles, but also digital communication technologies, software tools, data management, and cybersecurity concepts.

These technological developments are fundamentally altering professional competence requirements in the energy sector. Traditional competence profiles, centered primarily on electrical engineering fundamentals and equipment-level operation, are no longer sufficient. Instead, there is growing demand for interdisciplinary skill sets that combine energy engineering expertise with digital and ICT-oriented competences. Energy professionals are increasingly expected to interpret digital data, interact with complex software platforms, understand system-level interactions, and collaborate across disciplinary boundaries. This shift affects a wide range of roles, including system operators, protection engineers, maintenance staff, planners, and technical managers.

From an educational perspective, this transformation presents significant challenges to conventional higher education delivery models. Degree programs at Bachelor and Master levels remain essential for providing foundational knowledge and initial professional qualifications. However, they are typically designed for full-time students and follow fixed curricula that cannot be rapidly updated to reflect fast-moving technological developments. Moreover, degree programs are not well suited to addressing the continuous upskilling and reskilling needs of the existing workforce, particularly for professionals who are already employed and cannot commit to long-term study.

Professionals working in the energy sector require learning formats that are flexible, targeted, and directly applicable to their professional contexts. Such formats must be short in duration, allowing participation alongside full-time employment, and must focus on applied competences rather than broad theoretical coverage. Accessibility is another critical factor: learning opportunities must be available remotely or in blended formats to overcome geographical, organizational, and time-related constraints. These requirements point to the growing importance of lifelong learning (LLL) and short-cycle professional training as integral components of modern higher education systems.

Despite widespread recognition of the importance of lifelong learning, many higher education institutions face structural and organizational challenges in delivering effective LLL provision. While universities may possess advanced laboratory infrastructures, these resources are often underutilized outside traditional degree programs. Laboratories are typically scheduled around undergraduate and postgraduate teaching, leaving limited capacity for professional training. Furthermore, laboratory-based education has traditionally been associated with physical presence, which can be difficult to reconcile with the needs of working professionals.

Within this context, the laboratory infrastructures developed under the NEST4WB project represent a strategic asset with significant untapped potential. These laboratories have been established or upgraded to support education and training in digitalized energy systems, encompassing areas such as remote monitoring and control, renewable energy integration, data analytics, automation, and related digital technologies. They provide realistic environments, system models, and data sources that closely reflect real-world energy systems and operational scenarios. As such, they offer an ideal foundation for practice-oriented learning that goes beyond purely theoretical instruction.

The strategic value of these laboratories lies not only in their technical capabilities, but also in their potential to support new modes of educational delivery. Through appropriate pedagogical design and use of digital platforms, laboratory resources can be integrated into online and blended learning formats. This may include virtual demonstrations, analysis of laboratory-generated datasets, remote access to simulations, and guided professional practice tasks based on realistic scenarios. Such approaches make it possible to preserve the applied and experiential character of laboratory-based learning while increasing accessibility and flexibility.

This manual builds on that potential by operationalizing the use of NEST4WB laboratory infrastructures for online lifelong learning provision. Rather than treating laboratories as isolated physical spaces, the manual conceptualizes them as integrated learning resources that can support structured professional practice in digital environments. By defining a common framework for one-month professional practice courses, the manual provides higher education institutions with a practical tool for extending the use of laboratory infrastructures beyond initial education and embedding them into sustainable LLL strategies.

A key objective of this approach is to ensure that digitalization-related competences can be developed through structured, high-quality professional practice, rather than through ad hoc or purely theoretical training. The manual emphasizes the importance of clearly defined learning outcomes, guided learning activities, and competence-oriented assessment. This ensures that professional learners not only acquire new knowledge but are able to apply digital tools and concepts in ways that are directly relevant to their professional roles.

Furthermore, by providing a generic and transferable framework, the manual supports harmonization and scalability across institutions. It allows different laboratories and technological themes to be integrated into a common professional practice model, facilitating cooperation, mutual learning, and quality assurance. At the same time, the framework is sufficiently flexible to accommodate institutional specificities, national lifelong learning regulations, and evolving labor-market needs.

In summary, the digital transformation of the energy sector is creating both pressing challenges and new opportunities for higher education. While traditional degree programs remain essential, they must be complemented by flexible, practice-oriented lifelong learning formats that support continuous professional development. The laboratory infrastructures established under the NEST4WB project provides a solid foundation for such provision. By defining a structured framework for online learning professional practice, this manual enables higher education institutions to respond effectively to the evolving competence needs of the energy sector, while ensuring sustainability, relevance, and long-term impact of project investments in line with Erasmus+ Capacity Building in Higher Education objectives.

Scope and Intended Use of the Manual

This manual has been developed as a strategic and operational reference document to support the design, implementation, and long-term exploitation of online learning professional practice in the field of digitalized energy systems. Its scope extends beyond the description of individual courses or

laboratory exercises and instead focuses on defining a coherent framework that can guide higher education institutions in developing, delivering, and sustaining short-cycle, practice-oriented lifelong learning (LLL) provision. In doing so, the manual addresses the needs of institutions, academic and training staff, professional learners, and quality assurance bodies involved in continuous professional education.

Primarily, the manual functions as a conceptual framework for online professional practice in the energy sector. It provides a shared understanding of what constitutes professional practice in an online or blended learning context, particularly in relation to digitalized energy systems. By clearly defining key concepts, principles, and expected outcomes, the manual establishes a common reference point that supports consistency across different course implementations and institutional contexts. This conceptual clarity is essential for ensuring that online professional practice maintains its applied and competence-oriented character, rather than being reduced to purely theoretical or content-driven instruction.

In addition to its conceptual role, the manual serves as a methodological guide for the design and delivery of one-month LLL courses. It outlines recommended course structures, learning phases, workload ranges, learning outcomes frameworks, and assessment approaches that are compatible with the needs of working professionals. The manual provides guidance on how to balance flexibility and structure, how to sequence learning activities, and how to ensure alignment between learning objectives, activities, and assessment. This methodological guidance supports academic and training staff in developing coherent and effective courses without prescribing rigid content or limiting pedagogical innovation.

The manual also acts as an operational reference for integrating laboratory resources into online learning environments. Recognizing that laboratories are traditionally associated with physical presence, the manual redefines their role as multifaceted learning resources that can support professional practice through virtual demonstrations, simulation-based exercises, analysis of laboratory-generated data, and guided problem-solving tasks. It provides guidance on how laboratory infrastructures can be leveraged in online or blended formats, ensuring that practical and experiential learning remains central even when access to physical facilities is limited. This operational perspective is particularly important for institutions seeking to maximize the use of existing laboratory investments and to extend their educational offer to professional learners.

Another key function of the manual is its role as a quality assurance instrument. By defining common principles, minimum requirements, and recommended practices for online professional practice, the manual supports consistent and comparable delivery across courses and institutions. It provides a reference framework that can be used to support internal quality assurance processes, including course approval, monitoring, evaluation, and periodic review. The emphasis on clearly defined learning outcomes, competence-oriented assessment, and structured feedback mechanisms contributes to transparency and accountability, which are essential for maintaining trust among learners, employers, and accreditation bodies.

Beyond its immediate application within the NEST4WB project, the manual is intended to serve as a replicable and transferable model for future professional training initiatives. Its generic structure and

technology-neutral design allow it to be applied across different laboratory themes, technological domains, and institutional settings. By avoiding dependence on project-specific technologies or partner-specific arrangements, the manual facilitates adoption by additional institutions and supports scaling of professional practice models at regional and international levels. This replicability is a key element of the Erasmus+ Capacity Building in Higher Education (CBHE) framework, which emphasizes systemic impact and dissemination of good practices.

A defining characteristic of the manual is its institution-agnostic approach. The document does not describe specific laboratories, digital platforms, software tools, or national regulatory frameworks. Instead, it focuses on general principles, processes, and structures that can be adapted to diverse institutional and legal contexts. This approach recognizes the diversity of higher education systems, laboratory infrastructures, and lifelong learning regulations across countries and institutions. By allowing for contextual adaptation, the manual supports institutional ownership and practical applicability while maintaining alignment with shared quality and pedagogical standards.

At the same time, the institution-agnostic design of the manual does not imply a lack of rigor or coherence. On the contrary, by clearly articulating roles, processes, and expected outcomes, the manual provides a robust framework that institutions can operationalize within their own governance structures and quality assurance systems. It encourages institutions to integrate online professional practice into their long-term strategies for lifelong learning and professional engagement, rather than treating such courses as ad hoc or project-driven activities.

In summary, the scope of this manual encompasses conceptual, methodological, operational, quality assurance, and strategic dimensions of online learning professional practice in the energy sector. Its intended use is to support higher education institutions in delivering flexible, practice-oriented, and high-quality LLL provision that responds to the evolving competence needs of the digitalized energy sector. By combining a generic, institution-agnostic design with clear guidance on principles and processes, the manual provides a durable and transferable foundation for sustainable professional training, fully aligned with the objectives, and expected impact of the Erasmus+ CBHE action.

Definition of Online Learning Professional Practice

Within the framework of the NEST4WB project, **online learning professional practice** is defined as a **structured, competence-oriented learning process** that enables learners to acquire, apply, and demonstrate professional skills relevant to the digitalized energy sector through online or blended educational formats. This definition reflects a deliberate shift away from traditional, content-centered online instruction towards a model that places **applied professional competences, realistic tasks, and authentic learning contexts** at the core of the learning experience.

At its foundation, online learning professional practice is **grounded in realistic professional tasks from the energy sector**. These tasks are derived from actual or representative operational scenarios, such as system monitoring, data interpretation, fault diagnosis, performance analysis, or optimization of digitally controlled energy systems. By anchoring learning activities in such scenarios, the professional practice model ensures that participants engage with problems and decision-making

processes that closely resemble those encountered in professional environments. This grounding in practice is essential for maintaining relevance to labor-market needs and for supporting meaningful competence development among adult and professional learners.

A defining characteristic of online learning professional practice within NEST4WB is the **significant role of laboratory infrastructures as core learning resources**. Laboratories established or upgraded under the project are not treated merely as physical spaces for experimentation, but as comprehensive learning environments that generate data, simulations, system models, and demonstrative workflows. These laboratory resources form the backbone of professional practice activities, enabling learners to work with authentic system representations and outputs even when direct physical access to equipment is limited. In this way, laboratories serve as the anchor point that connects theoretical concepts to applied professional tasks.

The delivery of online learning professional practice is intentionally designed to be **fully online or delivered in a blended mode**, depending on institutional arrangements and learner needs. Online delivery allows for asynchronous participation, flexible scheduling, and broader accessibility, which are critical factors for professionals balancing learning with full-time employment. Blended delivery may combine online instruction with limited, scheduled physical access to laboratories where feasible. Importantly, the definition of professional practice does not depend on continuous physical presence in laboratory facilities, but rather on the **quality and authenticity of the applied learning activities**.

Another essential element of the definition is that online learning professional practice **leads to demonstrable and assessable professional outputs**. Learning is not considered complete until participants produce tangible evidence of competence acquisition, such as professional practice reports, analytical outputs, case study solutions, or mini-project results. These outputs provide a basis for competence-oriented assessment and validation, ensuring transparency and accountability in the learning process. This outcome-focused approach aligns with lifelong learning principles and supports recognition of learning outcomes within institutional and professional frameworks.

Within this broad definition, **professional practice is understood in an inclusive and flexible manner**. It encompasses not only physical interaction with laboratory equipment, but also a wide range of activities that reflect contemporary professional practice in digitalized energy systems. These include, but are not limited to, the **analysis of laboratory-generated datasets**, such as monitoring logs, sensor data, performance indicators, and event records. Through such analysis, learners develop skills in data interpretation, pattern recognition, and evidence-based decision-making, which are increasingly critical in digitally operated energy systems.

Professional practice also includes the **interpretation of simulation and monitoring outputs**, which allows learners to explore system behavior under different operating conditions without the constraints or risks associated with live system operation. Simulations and monitoring platforms provide safe and controlled environments for experimenting with system parameters, testing hypotheses, and understanding cause–effect relationships. These activities mirror professional workflows in system planning, operation, and optimization, reinforcing the authenticity of the learning experience.

In addition, **remote demonstrations of laboratory systems** form a vital component of online professional practice. Through live or recorded demonstrations, instructors can highlight system

operation, configuration procedures, and diagnostic processes using actual laboratory equipment or software platforms. Learners can observe expert practice, ask questions, and relate demonstrated procedures to their own professional contexts. Such demonstrations help bridge the gap between theoretical instruction and applied practice, particularly when direct hands-on access is constrained.

A further key element of online learning professional practice is the inclusion of **guided troubleshooting and decision-making exercises**. These exercises challenge learners to identify problems, analyze system behavior, and propose appropriate interventions based on available data and system information. By engaging in structured problem-solving tasks, learners develop critical thinking, analytical reasoning, and professional judgement. Guidance from instructors ensures that learners receive timely feedback and support, reinforcing correct practices and addressing misconceptions.

The broad and inclusive definition of professional practice adopted within NEST4WB reflects the realities of **contemporary professional work in the energy sector**, where digital tools, remote access, and data-driven analysis play an increasingly prominent role. Many professional tasks no longer involve direct physical interaction with equipment, but instead rely on interpreting digital information, configuring software systems, and making decisions based on complex datasets. By aligning the definition of professional practice with these realities, the manual ensures that learning remains authentic and relevant.

This definition also has important implications for **pedagogical design and quality assurance**. By explicitly recognizing a wide range of practice-oriented activities as valid forms of professional practice, the framework supports flexibility and innovation in course design while maintaining clear expectations regarding learning outcomes and assessment. It allows institutions to design professional practice courses that are robust, scalable, and accessible, without compromising on educational quality or professional relevance.

Finally, the definition ensures that **professional practice remains meaningful and authentic even when physical access to laboratories is limited**. This is particularly important in contexts where geographical distance, time constraints, or external factors restrict on-site participation. By focusing on competence development through realistic tasks, laboratory-based resources, and demonstrable outputs, the online learning professional practice model provides a resilient and future-proof approach to professional education. It enables higher education institutions to respond effectively to evolving sectoral needs and to deliver high-quality lifelong learning provision aligned with the objectives of the NEST4WB project and the Erasmus+ Capacity Building in Higher Education framework.

Pedagogical Principles

The design and implementation of online learning professional practice within the NEST4WB framework are underpinned by a coherent set of **pedagogical principles specifically tailored to adult and professional learners**. These principles reflect contemporary approaches to lifelong learning, professional education, and competence development, and are aligned with the evolving needs of the digitalized energy sector. They provide a common pedagogical foundation that guides course design,

learning activities, assessment strategies, and instructor–learner interaction, ensuring that online professional practice remains effective, relevant, and learner-centered.

Unlike traditional academic teaching models, which often prioritize content transmission and disciplinary completeness, the pedagogical approach adopted in this manual places **professional competence development and applied learning** at the center of the educational process. This shift is essential for addressing the expectations and learning characteristics of adult learners, who typically bring prior knowledge and professional experience, are motivated by immediate applicability, and require flexible learning pathways compatible with their professional responsibilities.

Competence-Based Learning

At the core of the pedagogical framework is a **competence-based learning approach**, in which learning is organized around clearly defined and assessable competences rather than around exhaustive content coverage. Competences are understood as integrated combinations of knowledge, skills, and professional attitudes that enable learners to perform tasks effectively in real-world contexts. In the context of digitalized energy systems, such competences may include the ability to interpret monitoring data, analyze system behavior, apply digital tools for decision support, or assess the impact of control actions.

Within this approach, each learning activity is explicitly linked to one or more targeted competences. Rather than progressing through a predefined body of theoretical material, learners engage in tasks that progressively build their ability to perform professional functions. This ensures that learning remains purposeful and outcome-oriented, which is particularly important for professional learners who seek tangible benefits from their participation. Competence-based learning also supports transparency, as learners are clearly informed about what they are expected to be able to do upon completion of the course.

From an instructional design perspective, competence-based learning requires careful alignment between learning outcomes, activities, and assessment. The manual therefore emphasizes the need to define learning outcomes in operational terms and to design assessment tasks that allow learners to demonstrate their competences through applied outputs. This approach supports meaningful validation of learning outcomes and facilitates recognition within lifelong learning and professional development frameworks.

Experiential and Applied Learning

A second fundamental principle is **experiential and applied learning**, which recognizes that adults learn most effectively when they can relate new knowledge to concrete experiences and professional contexts. Within the NEST4WB framework, experiential learning is operationalized through engagement with realistic scenarios, laboratory-generated datasets, simulations, and system models that mirror those encountered in professional practice within the energy sector.

Rather than treating laboratories solely as environments for controlled experiments, the pedagogical model positions them as sources of authentic learning experiences. Learners interact with real or

realistic system representations, analyze operational data, and observe or replicate professional workflows. This experiential engagement enables learners to evaluate assumptions, explore cause–effect relationships, and develop practical insights that go beyond theoretical understanding.

Applied learning also supports the integration of learners' prior professional experience into the learning process. Participants are encouraged to relate course activities to their own work contexts, compare laboratory scenarios with real-world systems, and reflect on similarities and differences. This reflective dimension enhances learning depth and reinforces the relevance of new competences. By grounding learning in authentic practice, the manual ensures that professional practice courses contribute directly to improved performance in the workplace.

Problem-Oriented Approach

Intricately linked to experiential learning is the **problem-oriented approach**, which structures learning activities around practical problems rather than abstract topics. In the context of digitalized energy systems, such problems may include system monitoring challenges, fault detection and diagnosis, performance optimization, data interpretation, or decision-making under uncertainty. These problems are representative of the tasks professionals routinely face in their work and therefore provide a natural and motivating entry point for learning.

Problem-oriented learning shifts the focus from passive reception of information to active engagement in analysis, reasoning, and decision-making. Learners are challenged to identify relevant information, apply appropriate tools and methods, and justify their conclusions. This process supports the development of higher-order cognitive skills, such as critical thinking, systems thinking, and professional judgement, which are essential in complex and dynamic energy systems.

The manual emphasizes the importance of structuring problems at an appropriate level of complexity. Problems should be sufficiently challenging to stimulate learning, but not so complex as to overwhelm learners or require excessive background knowledge. Guided problem-solving, supported by scaffolding and feedback from instructors, ensures that learners can progressively develop confidence and competence. This approach also facilitates formative assessment, as instructors can observe learners' reasoning processes and provide targeted feedback.

Flexibility and Accessibility

Flexibility and accessibility are central pedagogical principles when designing learning opportunities for adult and professional learners. Participants in lifelong learning programs often balance learning with full-time employment, family responsibilities, and other commitments. Consequently, rigid schedules, fixed attendance requirements, and lengthy course durations can constitute significant barriers to participation.

To address these constraints, the manual promotes **flexible course design**, including asynchronous learning opportunities, modular learning activities, and adaptable scheduling. Online delivery allows learners to access learning materials at times that suit their personal and professional circumstances, while modular structures enable learners to manage their workload more effectively. Where

synchronous activities are required, they should be planned judiciously and supported by recordings or alternative participation options.

Accessibility also encompasses considerations related to digital literacy, technological infrastructure, and inclusiveness. Learning activities should be designed to minimize unnecessary technical barriers and to ensure that learners can participate using commonly available digital tools. Clear instructions, user-friendly platforms, and technical support are essential for maintaining engagement and preventing frustration. By prioritizing flexibility and accessibility, the pedagogical framework supports wider participation and contributes to the inclusiveness objectives of lifelong learning provision.

Guided Autonomy

The final pedagogical principle underpinning the manual is **guided autonomy**, which reflects a balanced approach between independent learning and structured instructional support. Adult learners value autonomy and self-direction, particularly when learning is intricately linked to their professional roles. At the same time, effective learning requires guidance, feedback, and opportunities for interaction with instructors and peers.

Within the NEST4WB framework, guided autonomy is achieved by encouraging learners to take responsibility for their learning while providing clear expectations, structured tasks, and timely feedback. Learners are given the freedom to explore problems, analyze data, and develop solutions independently, but within a framework that defines objectives, milestones, and assessment criteria. Instructors function as facilitators and mentors, supporting learners' progress, clarifying concepts, and addressing difficulties as they arise.

This approach supports motivation and engagement, as learners feel empowered to direct their own learning while benefiting from expert support. Guided autonomy is particularly important in professional practice contexts, where learners must develop confidence in applying new competences independently. By combining autonomy with guidance, the pedagogical model fosters both competence development and professional self-efficacy.

In summary, the pedagogical principles underpinning the *Manual for Online Learning Professional Practice* provide a coherent and robust foundation for delivering high-quality, practice-oriented lifelong learning in the digitalized energy sector. By integrating competence-based learning, experiential and applied approaches, problem-oriented instruction, flexibility and accessibility, and guided autonomy, the manual ensures that online professional practice is pedagogically sound, professionally relevant, and responsive to the needs of adult learners. These principles support not only effective learning outcomes, but also sustainability, scalability, and long-term impact of professional training initiatives developed within the NEST4WB project and aligned with Erasmus+ Capacity Building in Higher Education objectives.

Structure of the One-Month LLL Professional Practice Course

The one-month lifelong learning (LLL) professional practice course defined within the NEST4WB framework has been carefully structured to balance pedagogical effectiveness, professional relevance,

and practical feasibility for adult learners. The course structure reflects the specific needs of professionals operating in the digitalized energy sector, who require short, focused learning interventions that can be completed alongside full-time employment while still delivering meaningful competence development. The structure is intentionally modular and progressive, enabling learners to move from orientation and skill acquisition towards applied professional practice and reflective integration.

The defined structure also supports consistency and comparability across different implementations of professional practice courses, regardless of the specific laboratory theme or institutional context. By establishing a common temporal framework and a shared set of learning phases, the manual provides a reference model that supports quality assurance, scalability, and replicability of LLL provision.

Duration and Workload

The professional practice course is designed for a total duration of four consecutive weeks, corresponding to one calendar month. This duration has been selected to align with common lifelong learning formats and to ensure compatibility with the schedules and commitments of working professionals. A one-month period allows sufficient time for learners to engage meaningfully with learning activities, while remaining short enough to maintain motivation and minimize disruption to professional responsibilities.

The total workload of the course ranges from 20 to 30 hours, depending on the specific laboratory theme, learning outcomes, and depth of applied activities. This workload range reflects a balance between breadth and depth, ensuring that learners have adequate time to acquire and apply new competences without being overburdened. Within this range, institutions may adapt the precise workload to reflect the complexity of the professional practice tasks or the prior experience of the target group.

The weekly workload is estimated at 5 to 8 hours, distributed flexibly across asynchronous and synchronous activities. This workload is explicitly designed to be compatible with part-time participation alongside professional employment, recognizing that most LLL participants will be engaged in full-time or near full-time work. The manual encourages institutions to distribute activities evenly across the four weeks and to avoid clustering deadlines or intensive sessions that could create unnecessary pressure on learners.

Flexibility in scheduling is a key aspect of the workload design. Learners should be able to complete most activities asynchronously, supported by clear timelines and milestones. Where synchronous activities are included—such as live demonstrations, discussions, or feedback sessions—they should be scheduled with consideration for participants' availability and, where possible, supported by recordings or alternative participation options. This approach enhances accessibility and supports inclusiveness in lifelong learning provision.

Course Phases and Functions

The one-month professional practice course is organized into four sequential phases, each with a distinct pedagogical function and contribution to competence development. The phases are designed to build progressively towards independent professional practice, ensuring that learners are adequately prepared before engaging in applied tasks and reflective reporting.

Phase 1: Orientation

The Orientation phase introduces learners to the overall structure, objectives, and expectations of the professional practice course. During this phase, participants are familiarized with the learning environment, digital platforms, laboratory resources, and communication channels used throughout the course. Clear guidance is provided on course timelines, assessment criteria, and expected learning outcomes, ensuring transparency and alignment from the outset.

A vital component of the Orientation phase is the introduction to safety considerations and responsible use of laboratory resources, even when access is remote or virtual. Learners are informed about relevant safety principles, data protection considerations, and ethical aspects related to the use of laboratory data and system models. This phase also provides an opportunity to assess learners' prior knowledge and experience, enabling instructors to tailor subsequent activities or provide additional support where necessary.

The Orientation phase establishes a shared understanding of professional practice expectations and creates the foundation for effective engagement in subsequent phases.

Phase 2: Skill Development

The Skill Development phase focuses on the acquisition of digital methods, tools, and analytical approaches relevant to the specific professional practice theme. During this phase, learners engage with instructional materials, demonstrations, and guided exercises designed to build the competences required for applied professional tasks. These may include familiarization with monitoring and control concepts, data analysis techniques, simulation tools, or digital platforms used in energy system operation.

Learning activities in this phase are typically scaffolded, progressing from basic concepts to more advanced applications. The emphasis is on developing operational understanding rather than exhaustive theoretical coverage. Learners are encouraged to explore tools and methods actively, supported by examples and guided practice. Instructor feedback plays a key role in reinforcing correct approaches and addressing misconceptions at an early stage.

This phase ensures that learners acquire the foundational competences necessary to engage confidently and effectively in applied professional practice.

Phase 3: Applied Practice

The Applied Practice phase represents the core of the professional practice course. In this phase, learners engage directly in laboratory-based tasks and realistic professional scenarios derived from digitalized energy systems. Activities may include analysis of laboratory-generated datasets,

interpretation of monitoring and simulation outputs, remote demonstrations of system operation, or guided troubleshooting and decision-making exercises.

The applied tasks are designed to mirror professional workflows and challenges encountered in real energy sector contexts. Learners are expected to apply the competences developed during the Skill Development phase to analyze problems, interpret system behavior, and propose or justify solutions. This phase emphasizes active engagement, critical thinking, and professional judgement.

Instructor support remains available during the Applied Practice phase, but learners are encouraged to take increasing responsibility for their work. This gradual shift towards independence is essential for preparing learners for autonomous professional practice beyond the course.

Phase 4: Integration and Reflection

The final phase, Integration and Reflection, focuses on consolidating learning outcomes and supporting reflective practice. During this phase, learners complete a professional practice task or mini-project, which serves as the main summative assessment of the course. This task requires learners to integrate knowledge, skills, and professional reasoning developed throughout the course into a coherent output, such as a professional practice report or case study analysis.

Reflection is a key component of this phase. Learners are encouraged to reflect on their learning process, the competences acquired, and the relevance of these competences to their professional roles. This reflective dimension supports deeper learning and helps learners articulate the value of the course in relation to their ongoing professional development.

The Integration and Reflection phase also provides instructors with an opportunity to assess competence acquisition in a holistic manner and to provide constructive feedback that supports learners' future development.

In summary, the structure of the one-month LLL professional practice course provides a coherent, progressive, and learner-centered framework for delivering applied professional training in the digitalized energy sector. By combining manageable duration and workload with clearly defined learning phases, the course structure supports effective competence development, accessibility for working professionals, and consistent quality across implementations. This structured approach ensures that professional practice courses developed within the NEST4WB framework are pedagogically sound, practically feasible, and aligned with the objectives of lifelong learning and Erasmus+ Capacity Building in Higher Education.

Learning Outcomes Framework

The learning outcomes framework defined in this manual provides a structured and transparent basis for the design, delivery, and assessment of online learning professional practice courses in the field of digitalized energy systems. Learning outcomes articulate what participants are expected to know, understand, and be able to do upon successful completion of the course, and serve as a key reference point for aligning learning activities, assessment methods, and quality assurance processes. Within the context of lifelong learning and professional education, clearly defined learning outcomes are essential

for ensuring relevance to labor-market needs, supporting competence-oriented assessment, and facilitating recognition of learning achievements.

In line with contemporary approaches to professional and lifelong learning, the learning outcomes framework is structured at two complementary levels: *technical learning outcomes* and *transversal learning outcomes*. This dual-level structure reflects the interdisciplinary nature of digitalized energy systems and recognizes that effective professional practice requires not only technical expertise, but also a range of transversal competences related to analysis, communication, and reflective learning. Together, these two levels provide a holistic representation of the competences developed through the professional practice course.

Technical Learning Outcomes

Technical learning outcomes describe the domain-specific competences that participants are expected to acquire in relation to digitalized energy systems and laboratory-based professional practice. These outcomes are linked to the use of laboratory infrastructures and digital tools and reflect the operational and analytical tasks commonly encountered in professional energy sector contexts.

Upon successful completion of the professional practice course, participants will be able to interpret data from digital monitoring and control systems. This includes the ability to understand the structure and meaning of monitoring data, recognize normal and abnormal system behavior, and identify relevant indicators for system performance and reliability. Participants learn to contextualize data within broader system configurations and operational conditions, which is essential for informed decision-making in digitalized energy environments.

Participants will also be able to apply digital tools to analyze energy system behavior. This outcome encompasses the use of software platforms, analytical methods, and simulation tools to explore system dynamics, assess the impact of operating conditions, and evaluate potential interventions. Through applied learning activities, participants develop practical skills in navigating digital interfaces, configuring analytical tools, and interpreting computational outputs in relation to real-world energy systems.

Another key technical outcome is the ability to use laboratory outputs to support operational decisions. Participants learn how to translate laboratory-generated data, simulation results, and demonstrative workflows into actionable insights that inform operational choices. This may involve comparing alternative operating strategies, assessing risks and trade-offs, or justifying decisions based on evidence derived from laboratory resources. This outcome emphasizes the applied and decision-oriented nature of professional practice in digitalized energy systems.

Finally, participants will be able to identify and assess system-level issues in digitalized environments. This outcome reflects the growing complexity of modern energy systems, where issues often arise from interactions between physical components, digital control systems, and communication networks. Participants develop the ability to recognize system-level patterns, diagnose potential causes of disturbances or inefficiencies, and assess their implications for system performance and reliability. This competence is critical for professionals working in interconnected and dynamic energy infrastructures.

Together, these technical learning outcomes ensure that participants acquire practical, job-relevant competences that can be directly applied in professional contexts and that reflect current and emerging practices in the digitalized energy sector.

7.2 Transversal Learning Outcomes

In addition to technical competences, effective professional practice in digitalized energy systems requires a range of transversal learning outcomes that support analysis, communication, and continuous professional development. These outcomes are transferable across roles, organizations, and technological domains and are therefore essential for long-term employability and adaptability.

Upon completion of the course, participants will be able to apply analytical and problem-solving skills to complex systems. This outcome reflects the need to deal with multi-dimensional problems involving technical, operational, and contextual factors. Participants learn to structure problems, identify relevant information, evaluate alternative solutions, and justify their reasoning. These skills are developed through problem-oriented learning activities and are applicable across a wide range of professional situations.

Participants will also be able to document technical work in a professional manner. Professional practice in the energy sector requires clear and accurate documentation of analyses, procedures, and decisions. Through the preparation of professional practice reports and applied assignments, participants develop skills in organizing technical information, presenting results clearly, and adhering to professional standards of documentation. This outcome supports accountability, knowledge transfer, and effective collaboration in professional environments.

Another key transversal outcome is the ability to communicate findings clearly to both technical and non-technical audiences. Digitalized energy systems often involve interdisciplinary teams and stakeholders with varying levels of technical expertise. Participants therefore learn to adapt their communication style and level of detail to different audiences, using appropriate terminology, visualizations, and explanatory approaches. This competence enhances collaboration, stakeholder engagement, and the practical impact of technical work.

Finally, participants will be able to reflect on their own professional practice and learning progress. Reflective competence supports continuous improvement and lifelong learning by enabling individuals to assess their strengths, identify areas for development, and plan further learning activities. Within the professional practice course, reflection is encouraged through guided activities and reflective reporting, helping participants to integrate new competences into their professional identity and practice.

In summary, the learning outcomes framework defined in this manual provides a comprehensive and balanced representation of professional competence development in the context of online learning professional practice. By integrating technical and transversal learning outcomes, the framework ensures that participants not only acquire digital and laboratory-based skills, but also develop the analytical, communicative, and reflective competences required for effective and sustainable professional practice. This integrated approach supports labor-market relevance, quality assurance, and

recognition of learning outcomes, fully aligning with the objectives of lifelong learning and the Erasmus+ Capacity Building in Higher Education action.

Learning Activities

Learning activities constitute the core operational component of the online learning professional practice framework defined in this manual. They translate learning outcomes into concrete learner engagement and provide the primary mechanism through which professional competences are developed, applied, and demonstrated. Within the NEST4WB framework, learning activities are deliberately designed to be modular, reusable, and scalable, ensuring that they can be adapted to different laboratory themes, institutional contexts, and target groups while maintaining consistent quality and professional relevance.

The modular design of learning activities allows individual components to be combined, adapted, or reused across different professional practice courses. This approach supports sustainability by reducing the need to design entirely new activities for each course iteration and enables institutions to tailor course content to the specific needs of different learner groups. Reusability and scalability are also essential for enabling wider adoption of the professional practice model and for supporting repeated course delivery within lifelong learning frameworks.

A central principle guiding the selection and design of learning activities is alignment with defined learning outcomes. Each activity is explicitly linked to one or more technical or transversal learning outcomes, ensuring coherence between objectives, activities, and assessment. At the same time, activities are designed to reflect authentic professional practice in the digitalized energy sector, thereby enhancing labor-market relevance and learner motivation.

Guided Analysis of Laboratory Datasets

One of the primary learning activities employed within online learning professional practice is the guided analysis of laboratory-generated datasets. These datasets may include monitoring logs, sensor measurements, event records, simulation outputs, or performance indicators generated by laboratory systems. Through structured analysis tasks, learners develop the ability to interpret digital data, identify patterns or anomalies, and draw evidence-based conclusions regarding system behavior.

Guided analysis activities typically involve clearly defined tasks, such as identifying trends, comparing operating scenarios, or assessing system performance against predefined criteria. Instructors provide guidance on analytical methods and interpretation strategies, while allowing learners to explore the data independently. This balance between guidance and autonomy supports competence development and mirrors professional workflows in which engineers and operators routinely work with complex datasets to inform decisions.

Interpretation of System Behavior under Different Operating Conditions

Another key category of learning activities focuses on the interpretation of system behavior under varying operating conditions. Using laboratory models, simulations, or monitoring outputs, learners explore how changes in parameters, loads, control strategies, or external conditions affect system performance and stability. These activities promote system thinking and help learners understand the dynamic and interconnected nature of digitalized energy systems.

By analyzing system responses to different scenarios, learners develop the ability to anticipate potential issues, assess operational risks, and evaluate the effectiveness of alternative strategies. Such activities are particularly relevant for professional roles involving system operation, planning, and optimization, and they support the development of professional judgement and decision-making skills.

Virtual Demonstrations of Laboratory Equipment and Software

Virtual demonstrations play a key role in enabling access to laboratory-based learning within online and blended formats. Through live or recorded demonstrations, instructors highlight the operation of laboratory equipment, software platforms, and digital tools used in energy system monitoring and control. Learners can observe professional workflows, system configurations, and analytical procedures, gaining insights into practical aspects of system operation that may not be easily conveyed through textual descriptions alone.

Virtual demonstrations also provide opportunities for interactive engagement, such as question-and-answer sessions or guided walkthroughs. By observing expert practice and discussing underlying principles, learners can contextualize theoretical knowledge and better understand how digital tools are applied in real-world settings. These activities are particularly valuable when physical access to laboratories is limited or when learners are geographically dispersed.

Case Studies Based on Real or Simulated Energy Systems

Case study-based learning activities are used to situate learning within realistic professional contexts and to encourage holistic analysis of complex situations. Case studies may be based on real energy systems, anonymized operational data, or realistic simulations designed to reflect familiar challenges in digitalized energy environments. Learners are tasked with analyzing the case, identifying key issues, and proposing or evaluating solutions based on available information.

Case studies support the integration of technical and transversal competences by requiring learners to apply analytical skills, interpret data, communicate findings, and justify decisions. They also promote reflection on broader system-level considerations, such as reliability, efficiency, sustainability, and risk management. By engaging with case studies, learners develop a deeper understanding of how digital tools and laboratory outputs are used in professional decision-making processes.

Individual or Group Mini-Projects

The most comprehensive learning activity within the professional practice framework is the individual or group mini-project, which typically serves as a capstone task towards the end of the course. Mini-projects require learners to address a defined professional problem by integrating knowledge, skills,

and tools developed throughout the course. Tasks may involve analyzing a complex dataset, evaluating system performance, or developing a reasoned recommendation based on laboratory outputs.

Mini-projects may be completed individually or collaboratively, depending on course design and learning objectives. Group projects can support the development of teamwork and communication skills, while individual projects allow for focused assessment of personal competence acquisition. In both cases, mini-projects culminate in a tangible professional output, such as a report or presentation, which can be assessed against defined criteria.

Alignment with Learning Outcomes and Professional Relevance

Across all activity types, careful attention is given to ensuring alignment with learning outcomes and professional relevance. Activities are selected and designed to support the acquisition of competences that are directly applicable to professional practice in the digitalized energy sector. This alignment enhances learner motivation and ensures that the time invested in learning yields practical benefits.

In summary, the learning activities defined within this manual provide a diverse, flexible, and professionally relevant toolkit for delivering online learning professional practice. By combining data analysis, scenario interpretation, demonstrations, case studies, and applied projects, the framework supports deep and meaningful learning that reflects the realities of contemporary professional practice. The modular, reusable, and scalable design of these activities contributes to sustainability, quality assurance, and long-term impact of lifelong learning provision within the NEST4WB project and beyond.

Role of Laboratories and Digital Infrastructure

Laboratories play a central and strategic role in the online learning professional practice framework defined within the NEST4WB project. They constitute the primary link between theoretical knowledge and applied professional competence, ensuring that learning activities remain firmly grounded in realistic energy system contexts. Within this framework, laboratories are not viewed solely as physical facilities for experimentation, but rather as integrated learning environments that combine physical infrastructure, digital tools, data sources, and expert workflows to support professional practice-oriented learning.

Laboratories as Anchors of Professional Practice

At the core of the professional practice model, laboratories serve as the anchor for authenticity and relevance. They provide realistic system representations that reflect the configuration, behavior, and operational constraints of modern energy systems. These representations may include physical equipment, digital twins, simulation models, or hybrid configurations that integrate physical and virtual components. By engaging in such representations, learners gain exposure to system structures and interactions that closely resemble those encountered in professional settings.

Laboratories also provide access to authentic data and operational scenarios, which are essential for competence development in digitalized energy systems. Monitoring data, sensor measurements, event logs, and simulation outputs generated within laboratory environments enable learners to work with information that mirrors real-world operational datasets. Through analysis and interpretation of these data, learners develop practical skills in evidence-based decision-making, anomaly detection, and performance assessment. This exposure to authentic data enhances learners' ability to transfer competences acquired during the course to their professional roles.

In addition, laboratories function as demonstration platforms for digital tools and methods used in contemporary energy system operation and analysis. Software platforms for monitoring, control, data analytics, and system simulation can be demonstrated using laboratory setups, allowing learners to observe professional workflows and tool usage in context. Demonstrations support understanding complex systems and provide insights into best practices, operational constraints, and typical challenges faced by practitioners.

Reframing Laboratories for Online and Blended Learning

A key contribution of the manual is its reframing of laboratories to support online and blended professional practice. Traditionally, laboratory-based learning has been associated with physical presence and hands-on manipulation of equipment. While physical interaction remains valuable, the manual recognizes that many professional tasks in digitalized energy systems are increasingly performed through digital interfaces, remote access, and data-driven analysis.

Within this framework, laboratories are leveraged through a variety of access modes, including:

- Remote access, allowing learners to interact with laboratory systems or simulations via digital platforms;
- Scheduled access, where limited on-site participation is combined with online preparation and follow-up;
- Demonstration-based use, where instructors operate laboratory systems while learners observe, analyze, and interpret outputs.

This flexible approach ensures that professional practice remains feasible and meaningful even when continuous physical access to laboratories is not possible. It also supports scalability and inclusiveness by enabling participation of geographically dispersed learners.

Role of Digital Infrastructure

Digital infrastructure plays a critical enabling role in supporting access, interaction, communication, and collaboration within online learning professional practice. It provides the technical backbone that connects learners, instructors, and laboratory resources into a coherent learning environment.

A principal component of the digital infrastructure is the learning management system (LMS), which serves as the primary platform for course organization and communication. The LMS typically hosts learning materials, activity instructions, schedules, and assessment submissions, and provides tools for tracking learner progress. By centralizing course management, the LMS supports transparency, consistency, and quality assurance.

Remote desktop and simulation environments are another key element of the digital infrastructure. These tools allow learners to access software platforms, analytical tools, or simulated laboratory systems without the need for local installation. Such environments support hands-on engagement with digital tools while ensuring consistency of software versions and configurations. They are particularly valuable for professional learners who may have limited access to specialized software or hardware.

Video conferencing tools enable synchronous interaction between instructors and learners, supporting live demonstrations, discussions, and feedback sessions. These tools facilitate real-time engagement and allow learners to ask questions, clarify concepts, and interact with peers. Recordings of live sessions further enhance accessibility by allowing learners to review content at their own pace.

Cloud-based repositories for data and documentation provide shared access to datasets, reports, templates, and learning resources. These repositories support collaboration, version control, and knowledge sharing, and enable learners to work with common datasets in a controlled and secure manner. Cloud-based solutions also facilitate reuse of learning materials across course iterations, contributing to sustainability.

Integration of Laboratories and Digital Infrastructure

The effective delivery of online learning professional practice depends on the integrated use of laboratory resources and digital infrastructure. Laboratories generate data, scenarios, and system representations that form the basis of professional practice, while digital infrastructure enables access, interaction, and pedagogical coordination. The manual emphasizes the importance of designing learning activities that explicitly integrate these elements, ensuring a seamless learning experience for participants.

For example, a professional practice activity may involve accessing laboratory-generated data via a cloud repository, analyzing the data using tools provided through a remote desktop environment, discussing findings in a video conferencing session, and submitting a report through the LMS. Such integration mirrors contemporary professional workflows, where digital platforms are used to coordinate analysis, communication, and documentation.

Flexibility and Sustainability Considerations

The manual explicitly allows for flexibility in how laboratories are accessed and used, recognizing that institutional resources, technical capabilities, and learner needs may vary. This flexibility supports adaptation to different contexts while maintaining core principles of professional practice. It also enhances resilience, enabling institutions to continue delivering professional practice courses under varying conditions, including constraints on physical access.

From a sustainability perspective, the combined use of laboratories and digital infrastructure maximizes the return on investment in project-funded resources. By enabling repeated and scalable use of laboratory infrastructures for lifelong learning, institutions can embed professional practice provision into their long-term educational strategies. The digital infrastructure further supports

sustainability by facilitating reuse of learning materials, efficient course management, and continuous improvement based on learner feedback.

In summary, laboratories and digital infrastructure together form the foundation of online learning professional practice within the NEST4WB framework. Laboratories provide authenticity, realism, and professional relevance, while digital infrastructure ensures accessibility, flexibility, and scalability. By integrating these elements into a coherent learning environment, the manual enables higher education institutions to deliver high-quality, practice-oriented lifelong learning that responds effectively to the evolving demands of the digitalized energy sector and aligns with the objectives of the Erasmus+ Capacity Building in Higher Education action.

Assessment Strategy

Assessment within the online learning professional practice framework is designed as a competence-oriented and evidence-based process that verifies the extent to which participants have achieved the intended learning outcomes. In contrast to traditional assessment approaches that prioritize recall of theoretical knowledge, the assessment strategy defined in this manual focuses on learners' ability to apply knowledge, skills, and professional judgement in realistic and professionally relevant contexts. This approach is particularly appropriate for lifelong learning (LLL) and professional education, where the primary objective is to enhance practical competence and workplace performance.

The assessment strategy reflects the nature of professional practice in the digitalized energy sector, where success is determined by the ability to analyze complex information, use digital tools effectively, and communicate findings clearly. Accordingly, assessment activities are designed to mirror authentic professional tasks and to generate tangible evidence of competence acquisition. This ensures that assessment outcomes are meaningful for learners, institutions, and external stakeholders, including employers and professional bodies.

Principles Underpinning the Assessment Strategy

The assessment strategy is underpinned by several key principles that guide the design and implementation of assessment activities across all professional practice courses developed within the NEST4WB framework.

First, assessment is competence-based, meaning that it evaluates what learners can do in applied contexts rather than what they can recall from memory. Competences are assessed through tasks that require analysis, interpretation, problem-solving, and decision-making, reflecting the realities of professional work in digitalized energy systems.

Second, assessment is integrated into the learning process. Rather than being confined to a single final examination, assessment activities are distributed throughout the course and aligned with learning activities in each phase. This integrated approach supports formative feedback, allowing learners to identify strengths and areas for improvement as they progress.

Third, assessment is transparent and criterion referenced. Clear assessment criteria are defined in advance and communicated to learners, ensuring that expectations are explicit and that evaluation is fair and consistent. Criterion-referenced assessment supports comparability across course implementations and contributes to quality assurance.

Finally, assessment is authentic and professionally relevant. Tasks are designed to resemble professional outputs, such as analytical reports, technical documentation, or project deliverables. This enhances learner motivation and ensures that assessment outcomes have practical value beyond the course itself.

Assessment Components

Assessment within the professional practice course may comprise a combination of complementary components, each contributing to the overall evaluation of competence acquisition. The specific weighting of components may be adapted by institutions, but the overall structure remains consistent with the framework defined in this manual.

Completion of Applied Exercises

Applied exercises form a vital component of formative and summative assessment. These exercises are typically linked to specific learning activities, such as data analysis tasks, interpretation of system behavior, or guided problem-solving scenarios. Through applied exercises, learners demonstrate their ability to use digital tools, analyze laboratory-generated data, and apply relevant methods to defined tasks.

Applied exercises provide early and ongoing evidence of competence development and allow instructors to provide targeted feedback. They also help learners build confidence and prepare for more comprehensive assessment tasks later in the course. From a quality assurance perspective, applied exercises support continuous monitoring of learner progress and engagement.

Submission of a Professional Practice Report

The professional practice report is a central summative assessment component within the online learning professional practice framework. The report requires learners to document and reflect on an applied task or set of activities undertaken during the course. It typically includes a description of the problem context, methodology, analysis, results, and conclusions, as well as reflective commentary on learning outcomes and professional relevance.

The preparation of a professional practice report serves multiple purposes. It allows learners to demonstrate technical competence, analytical reasoning, and professional documentation skills. It also encourages reflection on learning processes and outcomes, supporting deeper learning and continuous professional development. For instructors and institutions, the report provides a comprehensive and assessable record of learner performance.

Evaluation of a Mini-Project

The mini-project represents the most integrative and comprehensive assessment activity within the course. It requires learners to address a defined professional problem by applying knowledge and skills

acquired throughout the course. Mini-projects may be completed individually or in small groups, depending on course design and learning objectives.

Mini-projects typically involve analyzing a complex dataset, evaluating system performance, or proposing solutions to operational challenges based on laboratory outputs. The evaluation of mini-projects focuses on the learner's ability to integrate technical and transversal competences, demonstrate professional judgement, and produce coherent and well-justified outputs. As such, mini-projects provide convincing evidence of readiness for independent professional practice.

Assessment Criteria

Assessment criteria are defined to ensure that evaluation is consistent, transparent, and aligned with learning outcomes. The manual identifies three core dimensions that should be considered across all assessment components.

The first dimension is the correctness and depth of analysis. This criterion evaluates the accuracy of interpretations, the appropriateness of methods applied, and the depth of understanding demonstrated by the learner. It considers whether learners have correctly identified relevant information, applied suitable analytical approaches, and drawn well-founded conclusions.

The second dimension is the appropriate use of digital tools. Given the focus on digitalized energy systems, assessment places particular emphasis on learners' ability to select, configure, and use digital tools effectively. This includes correct operation of software platforms, appropriate handling of data, and meaningful interpretation of tool outputs. This criterion reflects the practical digital competences required in professional energy sector contexts.

The third dimension is the quality of documentation and reflection. Professional practice requires clear, structured, and accurate documentation of analyses and decisions. Assessment therefore considers the clarity, organization, and professionalism of written or presented outputs, as well as the learner's ability to reflect on their own learning and professional development. Reflection is assessed not as a subjective narrative, but as evidence of critical self-evaluation and awareness of competence development.

Formative and Summative Assessment

The assessment strategy combines formative and summative elements to support learning and competence development. Formative assessment occurs throughout the course through applied exercises, feedback on intermediate outputs, and instructor–learner interaction. Its primary purpose is to support learning by identifying areas for improvement and reinforcing effective practices.

Summative assessment focuses on evaluating overall competence acquisition at the end of the course, primarily through the professional practice report and mini-project. Summative assessment provides a basis for certification and recognition of learning outcomes within lifelong learning frameworks.

Alignment with Lifelong Learning and Quality Assurance

The assessment strategy defined in this manual is fully aligned with lifelong learning principles and Erasmus+ CBHE quality assurance expectations. By focusing on competence acquisition, authentic tasks, and transparent criteria, the strategy supports meaningful recognition of learning outcomes and enhances the credibility of professional practice courses.

Furthermore, the structured and criterion-referenced nature of assessment facilitates comparability across course implementations and institutions, supporting scalability and replicability of the professional practice model. Assessment outputs also provide valuable input for course evaluation and continuous improvement, contributing to the long-term sustainability of professional training provision.

In summary, the assessment strategy outlined in this manual provides a robust, competence-oriented, and professionally relevant framework for evaluating learning outcomes in online learning professional practice. By emphasizing applied tasks, integrative projects, and reflective documentation, the strategy ensures that assessment serves not only as a means of evaluation, but also as a powerful driver of learning, professional development, and quality assurance within the NEST4WB framework and the Erasmus+ Capacity Building in Higher Education action.

Certification and Recognition

Certification and recognition constitute an essential component of the online learning professional practice framework, as they provide formal acknowledgement of learning outcomes achieved by participants and enhance the value of lifelong learning (LLL) provision. Within the context of professional education in the digitalized energy sector, certification serves not only as proof of participation, but also as evidence of competence acquisition that can be used for professional development, career progression, and employability.

Upon successful completion of the professional practice course, participants may receive a certificate of completion issued by the delivering institution. This certificate typically confirms the title of the course, its duration, the total workload expressed in training hours, and the learning outcomes achieved. The certificate provides a formal and tangible record of professional training, which participants can present to employers, professional bodies, or other educational institutions as evidence of their continued professional development.

In addition to certificates of completion, participants may benefit from the recognition of training hours within institutional lifelong learning frameworks. Many higher education institutions maintain internal systems for recording and recognizing non-formal and informal learning activities undertaken by learners. By aligning professional practice courses with these frameworks, institutions can ensure that training hours are formally acknowledged and can contribute to broader learning portfolios or

professional development requirements. This form of recognition enhances the institutional legitimacy of professional practice courses and supports their integration into long-term LLL strategies.

Where supported by national regulations and institutional policies, professional practice courses may also be recognized through the issuance of micro-credentials. Micro-credentials provide a structured and standardized way of certifying short cycle learning experiences and are increasingly promoted at European level as a tool for supporting lifelong learning and workforce upskills. When implemented, micro-credentials clearly describe the learning outcomes, assessment methods, and workload of the course, thereby enhancing transparency and portability of learning achievements across institutions and borders.

Certification and recognition mechanisms play a crucial role in supporting professional recognition and employability. By providing formal evidence of competence acquisition in areas such as digital monitoring, data analysis, and system operation, certification enhances the visibility and credibility of learners' skills in the labor market. This is particularly important in the context of the digital transformation of the energy sector, where employers increasingly seek verifiable evidence of up-to-date digital competences.

From an institutional perspective, clear and transparent certification arrangements also contribute to quality assurance and stakeholder trust. They signal that professional practice courses are delivered according to defined standards, assessed rigorously, and aligned with recognized learning frameworks. In this way, certification and recognition support the long-term sustainability, impact, and credibility of online learning professional practice provision developed within the NEST4WB project and aligned with the objectives of the Erasmus+ Capacity Building in Higher Education action.

Quality Assurance and Continuous Improvement

Quality assurance and continuous improvement are integral components of the online learning professional practice framework defined within the NEST4WB project. Given the professional, practice-oriented, and lifelong learning (LLL) nature of the courses addressed by this manual, quality assurance mechanisms are essential for ensuring educational effectiveness, professional relevance, and institutional credibility. This section outlines the key quality assurance mechanisms embedded in the framework and explains how they collectively support consistency, transparency, and continuous enhancement of professional practice provision.

The quality assurance approach adopted in this manual is aligned with established higher education quality standards and Erasmus+ Capacity Building in Higher Education (CBHE) principles. It emphasizes both ex ante quality design, through clear definition of objectives and structures, and ex post quality monitoring, through evaluation, feedback, and review processes. By integrating quality assurance into all stages of the course lifecycle, the framework supports sustainable and high-quality delivery of online professional practice courses.

Clearly Defined Learning Outcomes

Clearly defined learning outcomes form the foundation of quality assurance in online learning professional practice. Learning outcomes specify the competences that participants are expected to acquire and provide a reference point for course design, learning activities, and assessment. By articulating learning outcomes in clear, operational terms, institutions ensure transparency for learners and alignment with labor-market needs.

From a quality assurance perspective, learning outcomes supports consistency across course iterations and implementations. They enable instructors to design learning activities and assessment tasks that are purposefully aligned with intended competences and provide a benchmark against which learning achievements can be evaluated. Clearly defined learning outcomes also facilitate communication with external stakeholders, such as employers and accreditation bodies, enhancing the credibility and recognition of professional practice courses.

Standardized Course Structure

A standardized course structure is another key quality assurance mechanism embedded in the framework. By defining common elements such as course duration, workload ranges, learning phases, and assessment components, the manual ensures a baseline level of consistency across different professional practice courses. This standardization supports comparability of learning experiences and outcomes, which is particularly important in multi-institutional contexts and for scalable lifelong learning provision.

Standardization does not imply rigidity. Rather, it provides a stable framework within which instructors can adapt content and activities to specific laboratory themes and learner needs. From a quality assurance perspective, a standardized structure facilitates course approval, monitoring, and review processes, as deviations from the framework can be identified and justified in a transparent manner.

Instructor Supervision and Feedback

Instructor supervision and feedback play a significant role in maintaining and enhancing the quality of online professional practice. Instructors act not only as content experts, but also as facilitators and mentors who guide learners through applied tasks and professional practice activities. Regular supervision ensures that learners remain engaged, that misunderstandings are addressed promptly, and that learning activities are implemented as intended.

Feedback is a particularly important quality assurance tool in professional practice contexts. Constructive and timely feedback helps learners understand their performance in relation to defined learning outcomes and assessment criteria. It also provides instructors with insights into the effectiveness of learning activities and assessment tasks. By systematically integrating feedback into the learning process, the framework supports continuous improvement at both individual and course levels.

Participant Evaluation Surveys

Participant evaluation surveys provide a structured mechanism for gathering learner feedback on course content, delivery methods, workload, and perceived relevance. Such surveys are typically administered at the end of the course and may also include interim feedback points. They offer valuable insights into learners' experiences and perceptions, complementing instructor observations and assessment results.

From a quality assurance perspective, participant evaluations support evidence-based decision-making. They help identify strengths, areas for improvement, and potential mismatches between learner expectations and course design. Importantly, evaluation surveys also give learners a voice in the quality assurance process, reinforcing a learner-centered approach and enhancing transparency and trust.

Periodic Review of Course Content and Delivery

The framework emphasizes the importance of periodic review of course content and delivery as a key mechanism for continuous improvement. Digital technologies, energy systems, and professional practices evolve rapidly, and professional practice courses must be updated regularly to remain relevant. Periodic reviews allow institutions to assess whether learning outcomes, activities, and assessment methods remain aligned with current technological developments and labor-market needs.

Reviews may draw on multiple sources of evidence, including assessment results, participant evaluations, instructor reflections, and external feedback from industry stakeholders. By systematically incorporating these inputs, institutions can make informed adjustments to course content, teaching methods, and assessment strategies. This cyclical review process ensures that professional practice courses remain dynamic, up to date, and responsive to change.

In summary, the quality assurance and continuous improvement framework defined in this manual provides a robust and integrated approach to ensuring high-quality delivery of online learning professional practice. Through clearly defined learning outcomes, a standardized course structure, active instructor supervision, systematic participant feedback, and regular course review, the framework supports consistency, transparency, and ongoing enhancement of professional training provision. These mechanisms collectively contribute to the sustainability, credibility, and long-term impact of professional practice courses developed within the NEST4WB project and aligned with the objectives of the Erasmus+ Capacity Building in Higher Education action.

Sustainability and Long-Term Exploitation of Results

Sustainability is a core objective of the Erasmus+ Capacity Building in Higher Education (CBHE) action and a central design principle of the *Manual for Online Learning Professional Practice*. The manual has been developed to ensure that the outcomes of the NEST4WB project remain **operational,**

relevant, and impactful beyond the project lifetime, supporting long-term institutional capacity building and continuous professional education in the field of digitalized energy systems.

First, the manual supports sustainability by **enabling repeated and systematic course delivery**. By defining a standardized yet flexible framework for one-month lifelong learning (LLL) professional practice courses, the manual allows institutions to offer the same or adapted courses on a recurring basis without the need for substantial redesign. Course structures, learning outcomes, assessment strategies, and learning activities can be reused and updated incrementally, ensuring continuity and efficiency in course provision. This repeatability is essential for embedding professional practice courses into regular institutional offerings rather than treating them as one-off project outputs.

Second, the manual contributes to sustainability by **maximizing the utilization of laboratory infrastructures** established or upgraded within the NEST4WB project. Laboratory facilities represent significant investments in terms of equipment, software, and human resources. By extending their use beyond Bachelor and Master programs to include online and blended LLL provision, the manual increases the return on investment in these infrastructures. The framework enables laboratories to function as long-term learning resources supporting professional training, thereby strengthening their role within institutional teaching and outreach strategies.

The manual also supports sustainability by **aligning professional practice courses with institutional lifelong learning strategies**. Many higher education institutions are increasingly prioritizing LLL as a strategic area of development, in response to labor-market needs and policy objectives. By providing a clear and transferable model for online professional practice, the manual facilitates the integration of NEST4WB outcomes into institutional LLL portfolios. This strategic alignment promotes institutional ownership of the courses and supports their continuation using internal governance, quality assurance, and administrative mechanisms.

Finally, the manual contributes to long-term sustainability by **reducing reliance on project-specific funding**. By designing professional practice courses that can be delivered using existing laboratory infrastructures, digital platforms, and academic expertise, the framework minimizes the need for additional external funding. Once established, courses can be maintained and updated through institutional resources, tuition fees, or continuing education budgets. This financial sustainability is critical for ensuring that project results are not dependent on temporary funding streams and can continue to deliver value over time.

In summary, the manual provides a **robust foundation for sustainable exploitation of project results**, supporting repeated course delivery, efficient use of laboratory infrastructures, integration into institutional LLL strategies, and financial viability beyond the project duration. Through these mechanisms, the manual contributes to the long-term impact of the NEST4WB project and fully aligns with the sustainability objectives of the Erasmus+ CBHE framework.

Replicability and Future Development

Replicability and future development are central design objectives of the *Manual for Online Learning Professional Practice* and reflect the Erasmus+ Capacity Building in Higher Education (CBHE)

emphasis on systemic impact, transferability, and scaling of project results. From its inception, the framework has been conceived not as a project-specific solution, but as a generic, modular, and future-oriented model that can be adopted, adapted, and further developed by a wide range of higher education institutions and training providers.

A key feature supporting replicability is the framework's adaptability to different laboratory themes. The manual does not prescribe specific technologies, equipment, or disciplinary content. Instead, it defines common pedagogical principles, course structures, learning outcomes, and assessment strategies that can be applied across diverse laboratory domains. This allows institutions to implement the framework in laboratories focusing on various aspects of the digitalized energy sector, such as smart grids, renewable energy systems, digital substations, data analytics, artificial intelligence, cybersecurity, or automation. By decoupling the pedagogical model from specific laboratory setups, the manual ensures broad applicability while maintaining coherence and quality.

In addition to adaptability within the energy domain, the framework is extendable to other digital and technology-driven domains beyond energy systems. The core principles of competence-based learning, experiential and problem-oriented instruction, laboratory anchoring, and online professional practice are equally relevant in fields such as industrial automation, smart manufacturing, digital infrastructure management, or environmental monitoring. This extensibility enhances the long-term value of the manual, allowing institutions to build on the framework when developing professional practice courses in emerging digital domains and responding to evolving labor-market demands.

The framework is also explicitly designed to be transferable to institutions beyond the project consortium. Its institution-agnostic and technology-neutral design allows other higher education institutions, training centers, or professional academies to adopt the model without requiring access to identical laboratory infrastructures or project-specific resources. Institutions with various levels of technological maturity can implement the framework by mapping its principles and structures onto their own facilities and digital platforms. This transferability supports dissemination of good practices and contributes to regional and international capacity building, particularly in contexts where access to advanced professional training opportunities is limited.

From a future development perspective, the manual provides a flexible foundation for continuous evolution and enhancement. As digital technologies, energy systems, and professional competence requirements continue to evolve, the framework can be updated incrementally by revising learning outcomes, activities, and assessment approaches while preserving the overall structure. The modular design of the framework facilitates the introduction of new laboratory themes, emerging technologies, or alternative delivery formats, such as hybrid micro-credentials or stackable learning pathways.

Furthermore, the framework supports future integration with European and national policy initiatives related to lifelong learning, digital skills, and micro-credentials. By aligning professional practice courses with competence-oriented learning outcomes and transparent assessment criteria, the manual creates favorable conditions for future recognition, accreditation, or integration into broader qualification frameworks. This forward-looking orientation enhances the strategic relevance of the manual and strengthens its contribution to long-term educational reform.

In summary, the *Manual for Online Learning Professional Practice* provides a replicable, transferable, and future-proof framework for professional education in digitalized systems. Its adaptability to different laboratory themes, extensibility to other digital domains, and transferability beyond the project consortium ensure that it can continue to generate impact well beyond the NEST4WB project. Through these features, the manual supports the Erasmus+ CBHE objective of achieving sustainable, scalable, and systemic improvements in higher education and lifelong learning.

Alignment with Erasmus+ CBHE Objectives

The *Manual for Online Learning Professional Practice* is closely aligned with the objectives and expected impact of the Erasmus+ Capacity Building in Higher Education (CBHE) action. It has been conceived as a strategic instrument that translates project activities and investments into sustainable educational practices, contributing to institutional development, labor-market relevance, lifelong learning, and systemic impact. Through its design and intended use, the manual supports both the immediate and long-term goals of CBHE projects.

First, the manual makes a direct contribution to institutional capacity building. By providing a structured framework for the delivery of online and blended professional practice courses, it strengthens the ability of higher education institutions to design, manage, and deliver practice-oriented lifelong learning programs. The manual supports the development of academic and organizational capacities, including curriculum design for professional learners, competence-based assessment, and effective use of laboratory and digital infrastructures. In doing so, it enhances institutional readiness to respond to evolving educational and technological demands and reinforces the role of universities as key actors in continuous professional education.

Second, the manual significantly enhances labor-market relevance of higher education provision. The professional practice model defined in the manual is explicitly oriented towards applied competences required in the digitalized energy sector. By grounding learning activities in realistic professional tasks, laboratory-based scenarios, and authentic datasets, the manual ensures that learning outcomes are linked to workplace needs. This alignment supports employability, upskilling, and reskilling of professionals and contributes to narrowing the skills gap between higher education outputs and labor-market requirements, which is a central concern of the CBHE action.

Third, the manual strongly supports the development of lifelong learning (LLL) within higher education institutions. It provides a practical and transferable model for short-cycle, flexible, and practice-oriented courses that are accessible to adult learners and working professionals. By enabling institutions to extend the use of their laboratory infrastructures beyond traditional degree programs, the manual facilitates the integration of LLL into institutional strategies and educational portfolios. This contributes to widening access to higher education, promoting inclusion of non-traditional learners, and supporting continuous professional development, all of which are core priorities of Erasmus+.

Finally, the manual contributes to sustainability and systemic impact, which are key expectations of CBHE projects. Its generic, institution-agnostic, and technology-neutral design ensures that it can be reused, adapted, and scaled beyond the project consortium. By enabling repeated course delivery, maximizing the use of laboratory infrastructures, and reducing reliance on project-specific funding, the manual supports long-term exploitation of project results. Furthermore, its transferability to other institutions and digital domains contributes to broader systemic change by promoting good practices in professional education and lifelong learning at regional and international levels.

In summary, the *Manual for Online Learning Professional Practice* is fully aligned with the Erasmus+ CBHE objectives of strengthening institutional capacity, enhancing labor-market relevance, expanding lifelong learning provision, and achieving sustainable and systemic impact. Through this alignment, the manual functions not only as a practical guide for course implementation, but also as a strategic contribution to higher education reform and capacity building in the context of digital transformation.

Conclusions

This *Manual for Online Learning Professional Practice* provides a **comprehensive, flexible, and future-oriented framework** for the delivery of professional training in the field of digitalized energy systems. Developed within the NEST4WB project, the manual consolidates pedagogical, methodological, and organizational approaches into a coherent model that enables higher education institutions to respond effectively to the evolving competence needs of the energy sector. By focusing on short-cycle, practice-oriented lifelong learning (LLL) provision, the manual complements traditional degree programs and strengthens the role of universities as key providers of continuous professional education.

A defining strength of the manual lies in its **systematic integration of laboratory infrastructures into online and blended learning formats**. Laboratories established or upgraded under the project are leveraged not only as physical facilities, but as integrated learning environments that provide realistic system representations, authentic data, and professional workflows. Through the structured use of laboratory resources in online professional practice, the manual ensures that applied learning remains central, even when physical access is limited. This approach preserves the authenticity and professional relevance of training while significantly increasing accessibility for working professionals and geographically dispersed learners.

The manual's **generic, institution-agnostic, and technology-neutral design** ensures that it can be implemented across diverse institutional contexts and adapted to a wide range of laboratory themes and digital domains. This design choice supports scalability, replicability, and transferability of project results, enabling adoption beyond the NEST4WB consortium and contributing to broader regional and international impact. By avoiding reliance on partner-specific configurations or project-exclusive resources, the manual promotes institutional ownership and long-term usability.

From an institutional perspective, the manual contributes to **capacity building and sustainability** by enabling repeated delivery of professional practice courses, maximizing utilization of laboratory infrastructures, and supporting the development of structured lifelong learning strategies. The

framework reduces dependence on project-specific funding and facilitates integration of professional practice provision into regular institutional governance, quality assurance, and educational portfolios. In this way, the manual transforms project outputs into enduring institutional assets.

At a broader level, the manual supports **societal and labor-market impact** by enhancing employability, upskilling, and reskilling of professionals in a sector undergoing rapid digital transformation. By aligning learning outcomes with professional tasks and digital competences required in modern energy systems, the framework contributes to narrowing skills gaps and supporting the energy transition. This alignment reinforces the relevance of higher education to economic development and technological innovation.

In conclusion, the *Manual for Online Learning Professional Practice* functions not only as a practical guide for course implementation, but as a **strategic instrument for long-term educational reform and capacity building**. By embedding laboratory-based professional practice into sustainable online LLL provision, it ensures that the NEST4WB project achieves lasting educational, institutional, and societal impact, fully aligned with the objectives, and expected outcomes of the **Erasmus+ Capacity Building in Higher Education** action.

To support implementation and demonstrate the operationalization of the framework defined in this manual, Deliverable D3.6 is complemented by Appendix A – Online Learning Professional Practice Course Scenarios. Appendix A presents a set of fully developed, partner-specific online professional practice course scenarios based exclusively on laboratories established or upgraded within the NEST4WB project and documented in Deliverables D3.5 and D3.6.

The scenarios illustrate how the Manual for Online Learning Professional Practice can be translated into concrete one-month lifelong learning (LLL) courses, including detailed implementation procedures, competence-oriented assessment and evaluation criteria, and explicit alignment with relevant Work Package tasks, indicators, and Erasmus+ CBHE impact categories. Appendix A therefore provides practical evidence of implementation readiness, sustainability, and replicability of project results, reinforcing the contribution of D3.6 to institutional capacity building and long-term exploitation.

Appendix A – Online Learning Professional Practice Course Scenarios

A.1 Purpose of the Appendix

This appendix complements the Manual for Online Learning Professional Practice by providing examples of possible implementation scenarios that operationalize the framework defined in Deliverable D3.6. The scenarios are based exclusively on laboratories documented in Deliverable D3.5 and demonstrate how these laboratory infrastructures can be used to deliver one-month online or blended lifelong learning (LLL) professional practice courses.

Each scenario illustrates the translation of laboratory-based capacity building into structured online professional practice, including implementation procedures and competence-oriented assessment.

A.2 Structure of the Course Scenarios

All partner scenarios follow a harmonized structure to ensure comparability, quality assurance, and replicability:

1. Laboratory context and professional focus
2. Target group and prerequisites
3. Implementation procedure (four-week structure)
4. Learning outcomes addressed
5. Learning activities and laboratory use
6. Assessment and evaluation criteria
7. Alignment with WP tasks, WP indicators, and CBHE impact categories

A.3 Partner-Specific Course Scenarios

A.3.1 University of Mitrovica (UPKM), Kosovo

Selected Laboratory:
Laboratory for simulation of remote monitoring systems and control of switchgear
Professional Focus:
Digital monitoring, remote control of switchgear, and interpretation of operational data
Target Group:
Engineers, technicians, utility staff, and professionals involved in operation and maintenance of power systems.
Implementation Procedure

- **Week 1 – Orientation:** Introduction to SCADA concepts, laboratory system architecture, safety principles, and course tools
- **Week 2 – Skill Development:** Familiarization with monitoring interfaces, communication protocols, and switchgear control logic
- **Week 3 – Applied Practice:** Analysis of monitoring datasets, remote operation scenarios, fault detection exercises

- **Week 4 – Integration and Reflection:** Completion of a professional practice report analyzing a remote control scenario

Assessment and Evaluation Criteria

- Accuracy and depth of data interpretation
- Correct use of monitoring and control tools
- Quality of professional documentation and reflection

A.3.2 University of East Sarajevo (UES), Bosnia and Herzegovina

Selected Laboratory:
Laboratory for simulation of remote monitoring systems and control of switchgear
Professional Focus:
Digital substations, monitoring architecture, and operational decision support
Target Group:
Power engineers and system operators
Implementation Procedure
Four-week online delivery following the common NEST4WB course structure, with emphasis on simulation-based operational analysis and remote diagnostics.
Assessment and Evaluation Criteria

- Correct interpretation of simulated operational scenarios
- Application of digital tools for decision support
- Professional clarity of final report

A.3.3 University of Mostar (SUM), Bosnia and Herzegovina

Selected Laboratory:
Laboratory for simulation of remote monitoring systems and control of switchgear
Professional Focus:
Monitoring of power system components and system behavior analysis
Target Group:
Engineers and technical staff in energy utilities
Implementation Procedure
Structured online courses combining dataset analysis, remote demonstrations, and applied troubleshooting exercises.
Assessment and Evaluation Criteria

- Analytical correctness
- Appropriate use of laboratory outputs
- Quality of professional reasoning

A.3.4 University Sinergija Bijeljina (USB), Bosnia and Herzegovina

Selected Laboratory:
Laboratory for simulation of remote monitoring systems and control of switchgear
Professional Focus:
Digital monitoring workflows and fault analysis
Target Group:
Energy professionals and technical managers
Implementation Procedure
Online delivery emphasizing problem-oriented tasks and applied system diagnostics.
Assessment and Evaluation Criteria

- Depth of fault analysis

- Professional documentation
- Reflective learning outcomes

A.3.5 Luarasi University (LRS), Albania

Selected Laboratory:
Laboratory for simulation of remote monitoring systems and control of switchgear
Professional Focus:
Digitalization of power system operation
Target Group:
Young professionals and continuing education participants
Implementation Procedure
Four-week blended/online delivery with guided analysis and virtual demonstrations.
Assessment and Evaluation Criteria

- Effective use of digital tools
- Clarity of professional outputs
- Reflection on professional practice

A.3.6 Metropolitan University Tirana (UMT), Albania

Selected Laboratory:
Laboratory for simulation of remote monitoring systems and control of switchgear
Professional Focus:
Remote system monitoring and operational analytics
Target Group:
Engineers and professionals in energy and automation sectors
Implementation Procedure
Online professional practice using laboratory datasets and scenario-based learning.
Assessment and Evaluation Criteria

- Analytical competence
- Professional reporting quality

A.3.7 Faculty of Applied Sciences Podgorica (FPRN), Montenegro

Selected Laboratory:
Laboratory for simulation of remote monitoring systems and control of switchgear
Professional Focus:
Digital monitoring and decision-making in power systems
Target Group:
Energy sector professionals
Implementation Procedure
Four-week online course integrating monitoring data analysis and applied decision tasks.
Assessment and Evaluation Criteria

- Correctness of system interpretation
- Application of professional judgement

A.3.8 Academy of Applied Studies Kosovo and Metohija (AASKM), Serbia

Selected Laboratory:
Laboratory for digital monitoring, data acquisition, and analysis in energy systems
Professional Focus:
Digital data acquisition, monitoring, and applied analysis for energy systems operation

Target Group:
Energy sector professionals, technical staff, and lifelong learning participants involved in monitoring, diagnostics, and data-based decision-making

Implementation Procedure
The online learning professional practice course is delivered over four consecutive weeks in accordance with the framework defined in Section 6 of Deliverable D3.6:

- **Week 1 – Orientation:** Introduction to laboratory context, digital monitoring concepts, data sources, course tools, safety principles, and assessment requirements.
- **Week 2 – Skill Development:** Guided familiarization with laboratory-generated datasets, data acquisition principles, and basic analytical methods relevant to energy systems.
- **Week 3 – Applied Practice:** Analysis of monitoring data from laboratory systems, identification of system behavior patterns, and interpretation of operational indicators under different scenarios.
- **Week 4 – Integration and Reflection:** Completion of a professional practice report focusing on data-driven analysis of an energy system scenario and reflection on professional applicability.

Delivery is fully online, using LMS, shared data repositories, and instructor-guided analysis sessions.

Assessment and Evaluation Criteria
Assessment is competence-oriented and based on:

- correctness and depth of data analysis;
- appropriate handling and interpretation of monitoring datasets;
- clarity and professionalism of analytical reporting;
- reflection on professional relevance and learning outcomes.

Assessment components include applied data-analysis exercises and a final professional practice report, aligned with Section 10 of this manual.

A.4 Mapping of Scenarios to WP Indicators and CBHE Impact

Partner Institution	Laboratory Focus	WP Indicators Addressed	CBHE Impact Categories
UPKM	Remote monitoring & control	LLL courses; professionals trained	Capacity building; sustainability
UES	Digital substations	Learning outcomes; LLL provision	Employability; relevance
SUM	System behaviour analysis	Skills development	Labour-market relevance
USB	Fault diagnostics	Professional upskilling	Institutional capacity
LRS	Digital operation	LLL deployment	Accessibility; sustainability
UMT	Monitoring analytics	Competence acquisition	Replicability
FPRN	Decision-support systems	LLL participation	Systemic impact
AASKM	Digital monitoring & data analysis	LLL courses; professionals trained	Capacity building; LLL; sustainability

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REPORT DONE BY:

Christos Manasis

[Phd Bojan Prlinčević]

WITH THE CONTRIBUTIONS OF

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CHECKLIST FOR REVIEW OF DELIVERABLE[1]

Project acronym:	**NEST4WB**
Project full title:	**NEW ENERGY COMPETENCE SYSTEM AND TECHNOLOGY FOR WB ENERGY STABILITY SYSTEM CURRICULUM REFORM**
Project No:	**101129321 (Call: ERASMUS-EDU-2023-CBHE)**
Coordinator institution:	**ACADEMY OF APPLIED STUDIES KOSOVO AND METOHIJA**
Coordinator:	**Phd Bojan Prlincevic,prof.a.s.**
Beneficiaries:	**SVEUCILISTE U RIJECI-TEHNICKI FAKULTET (UNIRI RITEH), Croatia** **ETHNIKO KAI KAPODISTRIAKO PANEPISTIMIO ATHINON (NKUA), Greece** **VSB - TECHNICAL UNIVERSITY OF OSTRAVA (VSB - TUO), Czech** **UNIVERSIDAD POLITECNICA DE MADRID (UPM), Spain,** **AKADEMIJA TEHNICKO-VASPITACKIH STRUKOVNIH STUDIJA (AATPS), Serbia,** **AKADEMIJA TEHNICKO-UMETNICKIH STRUKOVNIH STUDIJA (ATUSS), Serbia,** **UNIVERSITY OF MITROVICA (UPKM), Kosovo *,** **UNIVERZITET U ISTOCNOM SARAJEVU (UES), Bosnia and Herzegovina,** **University of Mostar (SUM), Bosnia and Herzegovina,** **UNIVERZITET SINERGIJA BIJELJINA (USB), Bosnia and Herzegovina,** **LUARASI UNIVERSITY (LRS), Albania,** **UNIVERSITETI METROPOLITAN TIRANA (UMT), Albania,** **FAKULTET PRIMIJENJENE NAUKE PODGORICA (FPRN), Montenegro.**

[1] *This form has to be filled and to be returned to author of deliverable and WP leader, and to the coordinator, on e-mail address:* nest4wb@akademijakm.edu.rs..

WP3

Deliverable D3.6

ASSURANCE POINT	ISSUES TO BE ADDRESSED	ASSESSMENT	COMMENTS	RECCOMENDATIONS
Compiliance with NEST4WB objectives	*Does the deliverable comply with the overall objectives of the project?*	▶ yes		
Compiliance with the specfic objectives of the WP	*Does the deliverable comply with the WP Objectives as specified in the WP description?*	▶ yes		
Correspondence with the description of work of the relevant activity	*Does the deliverable correspond with the activity description as specified in the Application Form?*	▶ yes		
Compliance with the deliverables format	*Is the deliverable presented using the Project's deliverable format – Annex K*	▶ yes		
Adequacy of complementary information	*Examples of complementary info:* *- Sources used,* *- Bibliography,* *- List of contacts,* *- Methodology used.*	▶ yes		
Adequacy of written language	*Level of written English*	▶ adeguate		
Overall assessment and suggestions for improvement	**I consider the report to be appropriate.**			
Date of Quality Assurance performed by CQA ~~or EC~~ reviewer				
Deadline for submission of amended version of the Deliverable				

Reviewer signement:_____

prof. Ing. Miroslav Vozňák, Ph.D.

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