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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 STUDENTS PROFESSIONAL PRACTICE

DELIVERABLE D3.5

~ draft ~

Project Number: 101129321

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Executive Summary

This deliverable consolidates the laboratory manuals developed within the NEST4WB project and presents a coordinated set of practice-oriented laboratory courses implemented across partner higher education institutions in the Western Balkans. The laboratories constitute a core output of the project activities related to curriculum modernization and institutional capacity building in the field of digitalized energy systems. They provide structured, hands-on learning environments designed for integration into Bachelor and Master study programs, as well as short-cycle lifelong learning (LLL) courses targeting professionals and non-traditional learners.

The laboratory manuals address skills gaps identified during the project needs analysis and respond to current and emerging requirements of the energy sector. The documented laboratories cover key thematic areas such as SCADA systems and supervisory control, remote monitoring and control of medium-voltage switchgear, digital communication technologies, energy data collection and analytics, basic forecasting and anomaly detection, cybersecurity fundamentals for energy infrastructures, artificial intelligence and machine learning applications, additive manufacturing and rapid prototyping, virtual reality–based training environments, renewable energy technologies, and energy harvesting solutions. Each laboratory manual provides detailed descriptions of laboratory infrastructure and equipment, step-by-step experimental procedures, clearly defined learning outcomes, safety rules, and assessment methods, ensuring consistency and quality of implementation across institutions.

Using modern equipment, realistic simulations, and problem-oriented laboratory exercises, the laboratories enhance the practical relevance of academic curricula and support the development of competences that are directly applicable in professional contexts. The laboratories strengthen institutional teaching and training capacities by enabling academic staff to deliver up-to-date, digitally oriented laboratory courses and by supporting the introduction of innovative pedagogical approaches, including experiential learning and project-based work. At the same time, the inclusion of LLL-oriented laboratory courses extends the impact of the project beyond traditional degree programs and contributes to workforce upskilling and reskilling in the energy sector.

From a sustainability and impact perspective, the laboratory manuals are designed to be embedded into regular institutional curricula and training offers beyond the project duration. Their modular structure and reliance on widely used technologies facilitate regular updating, internal reuse, and adaptation to evolving technological and labor market developments. In addition, the standardized documentation format supports replicability and transferability, enabling other higher education institutions and training providers to adopt or adapt the laboratory models developed within NEST4WB. In this way, the deliverable contributes to the long-term objectives of the Erasmus+ CBHE action by promoting systemic improvement of higher education, strengthening links between education and industry, and supporting the digital transformation and resilience of energy systems in the Western Balkans.

In addition to laboratory-based learning, this deliverable is complemented by **Appendix A**, which provides a dedicated **Professional Practice Manual for Students**. The appendix defines the objectives, organization, supervision, and assessment of students' professional practice and ensures pedagogical continuity between laboratory manuals and applied, practice-oriented learning. Together, the laboratory manuals and the Professional Practice Manual form an integrated framework that strengthens employability, supports competence-based education, and enhances the long-term sustainability and impact of the NEST4WB project.

Introduction

In line with the objectives of the Erasmus+ Capacity Building in Higher Education (CBHE) action, the NEST4WB project is designed to support systemic improvements in higher education by modernizing energy-related curricula and strengthening the practical training capacities of higher education institutions in the Western Balkans. The energy sector is undergoing a profound transformation driven by digitalization, decarbonization, and decentralization, with smart grids, advanced monitoring and control systems, and data-intensive applications becoming integral components of modern power systems. These developments have led to a growing demand for graduates and professionals who possess not only solid foundations in power engineering, but also interdisciplinary competences encompassing digital communication technologies, data analytics, automation, and cybersecurity.

In many higher education institutions, existing curricula and laboratory infrastructures have not fully kept pace with these technological and sectoral changes, resulting in gaps between academic training and labor market expectations. Within this context, the development of laboratory manuals represents a key project outcome aimed at bridging this gap by translating modernized theoretical content into structured, hands-on learning activities. The laboratories provide realistic and application-oriented environments in which students and lifelong learners can engage with contemporary energy technologies, experiment with digital tools, and develop practical problem-solving skills under guided conditions.

This section presents the laboratory courses documented in this delivery and explains their contribution to the achievement of the objectives and indicators of the relevant Work Packages. It highlights how the laboratories support curriculum modernization, enhance institutional capacity for delivering practice-oriented education, improve learning outcomes, and strengthen alignment with labor market and sector needs, thereby contributing to the overall impact and sustainability of the NEST4WB project.

To further strengthen this link between education and professional requirements, the NEST4WB project complements laboratory-based learning with a structured framework for students' professional practice. Professional practice enables students to apply laboratory and theoretical knowledge in realistic, practice-oriented contexts under academic supervision, thereby enhancing employability and reinforcing alignment with labor market needs.

Description of the Laboratory Courses

Within the framework of the NEST4WB project, the development of laboratory manuals constitutes a central capacity-building output under the Work Packages dedicated to curriculum modernization, enhancement of practical competences, and alignment of higher education with labor market needs. The laboratories documented in this deliverable play a key role in strengthening institutional capacities by formalizing the use of upgraded laboratory infrastructure, introducing contemporary hardware and software solutions, and supporting the systematic adoption of modern pedagogical approaches such as experiential learning, problem-based learning, and guided experimentation. Through these laboratories, higher education institutions are enabled to move beyond theory-oriented instruction and

to offer structured, practice-based learning experiences that reflect operational conditions in modern energy systems.

The laboratory courses have been deliberately designed to support their sustainable and flexible integration into existing Bachelor and Master curricula as well as into lifelong learning (LLL) programs aimed at professionals and other non-traditional learners. Each laboratory manual includes clearly articulated learning outcomes aligned with course objectives, detailed descriptions of laboratory equipment and configurations, step-by-step procedures for experimental work, safety rules, and assessment methods. This level of documentation ensures consistency in delivery across different cohorts and instructors, facilitates quality assurance processes, and allows institutions to maintain and further develop the laboratories beyond the project lifetime using internal academic and technical staff. Furthermore, the modular structure of the laboratory exercises enables selective use and recombination of experiments, supporting curriculum updates, elective course development, and adaptation to evolving educational needs.

In terms of technological sustainability, the laboratories are based on widely used and industry-relevant platforms and tools, including SCADA systems, digital communication technologies, data analytics environments, artificial intelligence, and machine learning frameworks. This choice reduces dependency on project-specific or proprietary solutions, supports continuous staff capacity development, and enhances the long-term relevance of the laboratories in a rapidly evolving technological landscape. By familiarizing students and LLL participants with tools and concepts commonly used in professional practice, the laboratories also strengthen employability and facilitate smoother transitions from education to the workplace.

From the perspective of replicability and transferability, the laboratory manuals follow a standardized and transparent structure that enables straightforward reuse and adaptation. The clear specification of objectives, required equipment, experimental procedures, and expected learning outcomes supports internal replication within institutions, including across different departments or study programs. At the same time, comprehensive documentation facilitates transfer to other partner institutions and external stakeholders interested in establishing similar laboratory setups. This approach supports the scaling of project results beyond the immediate consortium and contributes to the broader Erasmus+ CBHE objectives of fostering regional cooperation, enhancing the quality and relevance of higher education, and achieving sustainable, long-term impact in the Western Balkans.

Laboratory Courses Prepared by Partner Institutions

Institution	Documented Laboratory Course / Manual	Contribution to WP Indicators
Academy of Applied Studies Kosovo and Metohija (AASKM)	*Laboratories for Simulation of Remote Monitoring Systems and Control of Switchgear (D3.5)*	Capacity building in SCADA and smart grid operation; direct labor-market relevance; replicable remote monitoring and control laboratory model
Faculty of Applied Sciences Podgorica (FPRN), University of Donja Gorica	*AI/ML, 3D Printing, and Virtual Reality Laboratory Manual*	Strengthening digital and interdisciplinary skills; sustainability through integration into LLL; high replicability using modular AI/VR lab structure
Luarasi University (LRS)	*Digital Energy Laboratory – Digitalization of Smart Energy Systems*	Capacity building in energy data analytics and cybersecurity; alignment with EU digitalization priorities; transferable intensive-course model
University of Mostar (SUM)	*Renewable Energy Sources Laboratory Manual*	Support to green transition competencies; sustainable use within study programs and LLL; replicable RES laboratory framework

Institution	Documented Laboratory Course / Manual	Contribution to WP Indicators
University of East Sarajevo (UES)	*Laboratory Manuals Supporting Power System Modernization*	Modernization of master-level laboratories; capacity building in protection, monitoring, and storage technologies; sustainability through upgraded equipment
University of Mitrovica (UPKM)	*UPKM Laboratory Manuals (Energy Harvesting and Related Experiments)*	Expansion of experimental learning in emerging energy technologies; scalable and transferable lab experiments
University of Sinergija Bijeljina (USB)	*Remote Monitoring and Control System Simulation Laboratory Manual*	Strengthening applied SCADA and smart grid skills; direct employability impact; replicable simulation-based laboratory approach

As part of the NEST4WB project's comprehensive strategy for dissemination, exploitation, and sustainability of results, the **laboratory manuals developed by each partner institution have been made publicly available through the official project website**. The manuals are published under a **dedicated tab for project results and educational resources**, which serves as a central repository for all laboratory-based learning materials produced within the project. This structured approach ensures long-term accessibility of the laboratory manuals beyond the project duration and supports their use by a broad range of stakeholders, including students, academic staff, lifelong learning participants, external higher education institutions, and training providers.

The online availability of the laboratory manuals supports several core objectives of the Erasmus+ Capacity Building in Higher Education action. By providing free access to complete and institution-specific laboratory manuals, the project facilitates **transferability and replicability of educational practices**, encourages the uptake of modern laboratory-based teaching approaches, and promotes regional and international cooperation in the field of digitalized energy systems. The manuals include detailed descriptions of laboratory objectives, required equipment, experimental procedures, learning outcomes, and safety considerations, thereby enabling external users to assess feasibility and adapt the laboratory courses to their own institutional contexts.

In addition, publishing the laboratory manuals on the project website enhances **transparency and quality assurance**, as it allows stakeholders to review the scope and depth of the developed laboratory courses and demonstrates the tangible outcomes achieved under the project. This approach also contributes to institutional capacity building by encouraging partner institutions to maintain, update, and further develop the laboratory manuals as part of their regular educational provision. The table below provides an overview of the partner institutions and the corresponding web links to their laboratory manuals hosted on the project website, ensuring direct and user-friendly access to the materials.

Online Availability of Laboratory Manuals by Partner Institution

Partner Institution	Laboratory Manual(s) – Web Link	Main Laboratory Theme(s) / Target Group(s)
Academy of Applied Studies Kosovo and Metohija (AASKM)	[URL to laboratory manual]	Remote monitoring & control of switchgear, SCADA / BSc, MSc, LLL
Faculty of Applied Sciences Podgorica (FPRN), University of Donja Gorica	[URL to laboratory manual]	AI/ML, 3D printing, virtual reality / MSc, LLL

Partner Institution	Laboratory Manual(s) – Web Link	Main Laboratory Theme(s) / Target Group(s)
Luarasi University (LRS)	[URL to laboratory manual]	Digitalization of smart energy systems, data analytics, cybersecurity / MSc, LLL
University of Mostar (SUM)	[URL to laboratory manual]	Renewable energy sources, power systems / BSc, MSc, LLL
University of East Sarajevo (UES)	[URL to laboratory manual]	Power systems, protection, monitoring / BSc, MSc
University of Mitrovica (UPKM)	[URL to laboratory manual]	Smart energy, energy harvesting, experimental labs / BSc, MSc
University of Sinergija Bijeljina (USB)	[URL to laboratory manual]	Remote monitoring & control, SCADA simulation / BSc, MSc, LLL

To access this content log in to the project's web site, https://nest4wb.akademijakm.edu.rs/, using:

Username: PO

Password: PO+2024

Students' Professional Practice Framework

While the laboratory manuals documented in this deliverable provide structured environments for guided experimentation and skill development, effective preparation for professional engineering roles also requires exposure to applied, practice-oriented activities. To address this need, the NEST4WB project introduces a structured framework for students' professional practice, detailed in **Appendix A**. The Professional Practice Manual complements the laboratory manuals by defining how laboratory-based learning outcomes are extended into supervised professional practice activities, ensuring coherence between experimental education, applied learning, and labor-market requirements.

Professional practice is understood as a supervised, practice-oriented learning activity that enables students to apply knowledge and skills acquired through coursework and laboratory exercises in realistic, semi-professional environments.

The professional practice framework is designed to be compatible with **Bachelor and Master study programs**, as well as **lifelong learning (LLL)** formats. It builds directly on the laboratory manuals presented in this deliverable, using laboratory environments, simulation platforms, pilot infrastructures, and where applicable external organizations, as structured settings for professional practice.

Objectives of Students' Professional Practice

The main objectives of students' professional practice within the NEST4WB framework are to:

- Bridge the gap between academic learning and professional engineering practice
- Strengthen application of laboratory and theoretical knowledge in realistic contexts
- Develop job-relevant technical and transversal competences
- Increase student preparedness for employment in the energy sector

- Familiarize students with professional, safety, and organizational procedures
-

Structure and Organization

Students' professional practice may be organized in different formats depending on institutional regulations and study program requirements, including:

- Short-term professional practice modules linked to specific laboratory courses
- Semester-based practice components integrated into Bachelor or Master programs
- Hybrid laboratory–practice formats combining guided experiments and applied tasks

The workload and duration of professional practice are aligned with **ECTS principles**, ensuring transparent academic recognition and integration into curricula.

Roles and Responsibilities

- **Students** actively participate in assigned practice tasks, comply with safety regulations, document activities, and prepare a final report.
- **Academic mentors** define learning outcomes, supervise the practice, and evaluate student performance.
- **Host laboratories or partner organizations** provide technical guidance, access to equipment or systems, and an appropriate professional context.

Learning Outcomes and Assessment

Upon completion of professional practice, students are expected to demonstrate:

- Practical ability to work with modern energy-related laboratory and digital systems
- Application of SCADA, monitoring, data analytics, or renewable energy tools in applied tasks
- Problem-solving skills and system-level understanding
- Teamwork, communication, and documentation competences
- Awareness of safety, reliability, and professional responsibility

Assessment is based on practical task performance, documentation (practice diary or logbook), final technical report, and mentor evaluation.

Contribution to Employability and Sustainability

Students' professional practice strengthens the employability impact of the laboratory manuals by extending hands-on learning beyond guided experiments toward applied, work-oriented activities. By integrating professional practice into regular curricula and lifelong learning offers, partner institutions ensure long-term sustainability of project results and reinforce their role as providers of practice-oriented, labor-market-relevant education.

Contribution to Erasmus+ CBHE Impact

Institutional Capacity Building

The laboratory manuals documented in this deliverable make a substantial contribution to institutional capacity building, which is a core objective of the Erasmus+ Capacity Building in Higher Education

(CBHE) action. Through the systematic development and documentation of laboratory-based learning environments, the NEST4WB project strengthens the ability of partner higher education institutions to design, deliver, and sustain modern, practice-oriented education in the field of digitalized energy systems. The laboratories provide a structured framework that enables institutions to move from theory-driven teaching to integrated learning models that combine conceptual understanding with hands-on experimentation and applied problem solving.

At an organizational level, the laboratories support the formalization and professionalization of laboratory teaching practices. The use of detailed laboratory manuals introduces a common reference point for academic and technical staff, contributing to more consistent implementation across courses, instructors, and cohorts. This strengthens internal quality assurance processes by clarifying expected learning outcomes, assessment criteria, safety requirements, and procedural standards. As a result, institutions are better positioned to ensure comparability of learning experiences and outcomes, which is particularly important in multidisciplinary and rapidly evolving fields such as smart grids and digital energy systems.

At a human capacity level, the laboratories contribute to the continuous development of academic and technical staff competences. Teaching staff gain experience in integrating digital tools, modern equipment, and interdisciplinary content into their courses, while technical staff enhance their ability to support advanced laboratory infrastructures and software environments. Over time, this accumulation of expertise increases institutional resilience and reduces dependency on external support. The laboratories therefore function not only as teaching environments for students, but also as learning platforms for staff, fostering a culture of continuous improvement and innovation within partner institutions.

Sustainability of Project Results

The design and implementation of the laboratory manuals strongly support the sustainability of project results, ensuring that the benefits of the NEST4WB project extend well beyond the formal project lifetime. Sustainability is addressed both structurally and operationally, through deliberate integration of the laboratories into institutional curricula, training offers, and organizational processes. Rather than being treated as stand-alone pilot activities, the laboratories are embedded into regular Bachelor and Master programs and into lifelong learning (LLL) courses, making them part of the standard educational provision of partner institutions.

The modular structure of the laboratory manuals plays a critical role in supporting long-term sustainability. Each laboratory is composed of clearly defined and self-contained exercises that can be updated, replaced, or expanded independently. This allows institutions to respond flexibly to technological developments, evolving learning outcomes, and feedback from students and external stakeholders without the need for comprehensive curriculum redesign. Such flexibility is particularly important in the context of digitalized energy systems, where technological cycles are short and continuous updating is required to maintain relevance.

From a resource perspective, the laboratories are designed to be maintained using institutional human and technical capacities. The reliance on widely adopted technologies and platforms reduces the risk

of obsolescence and facilitates access to training materials, updates, and user communities. Moreover, by integrating LLL-oriented laboratory courses, institutions strengthen their engagement with external stakeholders, including industry professionals and public-sector organizations. This ongoing interaction supports sustainable demand for laboratory-based training and reinforces the role of higher education institutions as long-term providers of continuing education and professional development.

The integration of professional practice into regular curricula and lifelong learning reinforces sustainability by ensuring continued use of laboratory infrastructures and educational resources beyond the project lifetime.

Replicability and Transferability

Replicability and transferability are key impact dimensions of the Erasmus+ CBHE action, and the laboratory manuals developed within the NEST4WB project are explicitly designed to support both. The use of a standardized and transparent documentation format ensures that the laboratories can be readily understood, reproduced, and adapted by different users and institutions. Each laboratory manual includes clear descriptions of objectives, required equipment, laboratory configurations, step-by-step procedures, safety measures, and expected learning outcomes, providing all essential information needed for implementation.

At the institutional level, this standardization supports internal replication across departments, study programs, and levels of study. Laboratories initially developed for a specific course or target group can be reused in related programs or adapted for different learner profiles, including undergraduate students, graduate students, and lifelong learners. This internal scalability enhances the cost-effectiveness of laboratory investments and maximizes the return on project resources.

At the consortium and regional level, the laboratory manuals facilitate transfer between partner institutions, supporting convergence of educational quality and practices across the Western Balkans. Institutions with more advanced laboratory infrastructures can serve as reference points, while others can adapt the laboratory models to their local contexts and available resources. Beyond the project partnership, the availability of comprehensive documentation enables external higher education institutions and training providers to adopt or adapt the laboratory concepts. In this way, the project contributes to the wider dissemination of good practices and supports the scaling of impact beyond the immediate consortium.

Employability and Labor-Market Relevance

The laboratories documented in this deliverable make a direct and measurable contribution to employability and labor-market relevance, which is a central objective of both the Erasmus+ CBHE action and the NEST4WB project. The laboratory exercises are explicitly aligned with current and emerging competence requirements in the energy sector, particularly those related to digitalization, smart grids, and the energy transition. By engaging learners in realistic, practice-oriented activities, the laboratories bridge the gap between academic knowledge and professional practice.

Students and lifelong learners participating in the laboratories develop a range of technical and transversal competences that are highly valued by employers. These include practical skills in operating SCADA systems, analyzing energy data, understanding digital communication and cybersecurity principles, and working with renewable energy and energy harvesting technologies. In addition, the laboratories foster problem-solving abilities, system-level thinking, teamwork, documentation skills, and safety-conscious behavior, all of which are essential for effective performance in professional environments.

The inclusion of lifelong learning laboratories further enhances labor-market relevance by addressing the needs of professionals already active in the energy sector. These participants can update or expand their competences in response to technological change, supporting workforce upskilling and reskilling. As a result, the laboratories contribute not only to graduate employability, but also to the adaptability and competitiveness of the existing workforce, thereby supporting innovation and resilience in the energy sector.

Students' professional practice further strengthens labor-market relevance by enabling learners to engage with applied engineering tasks that resemble professional workflows and responsibilities. Through supervised practice linked to laboratory environments and, where applicable, external stakeholders, students develop competences directly transferable to employment in the energy sector.

Regional and Systemic Impact

At a broader level, the combined effects of institutional capacity building, sustainability, replicability, and employability contribute to the regional and systemic impact of the NEST4WB project in the Western Balkans. By strengthening the capacity of higher education institutions to deliver modern, digitally oriented energy education, the laboratories support structural improvements in higher education systems and promote greater coherence and comparability across institutions and countries.

The laboratories also foster regional cooperation and knowledge exchange among partner institutions, contributing to the development of shared approaches, standards, and educational practices. Over time, this supports the creation of a more integrated higher education space in the field of digitalized energy systems. In the longer term, the availability of well-trained graduates and upskilled professionals contributes to the resilience and modernization of regional energy systems, supporting broader policy objectives related to digital transformation, energy security, and sustainable development.

Taken together, these impacts ensure that the laboratory manuals function not merely as educational resources, but as strategic drivers of institutional change, workforce development, and regional capacity building, fully aligned with the objectives and expected impacts of the Erasmus+ CBHE action.

Contribution to Work Package Objectives

The laboratory manuals developed under the NEST4WB project constitute a central contribution to the achievement of the objectives defined in the relevant Work Packages dedicated to curriculum modernization, enhancement of practical competences, and institutional capacity building. These

laboratories address one of the core challenges identified at the outset of the project, namely the limited availability of modern, practice-oriented laboratory environments capable of supporting education and training in digitalized energy systems. By systematically developing and documenting laboratory courses, the project strengthens the structural capacity of partner institutions to deliver education that is aligned with contemporary technological developments and labor market requirements.

At the level of **institutional capacity building**, the laboratories contribute to upgrading and formalizing laboratory infrastructure and teaching practices. The introduction of modern equipment, software tools, and digital platforms—such as SCADA systems, data analytics environments, and simulation tools—enhances the technical capabilities of partner institutions and enables the delivery of laboratory exercises that reflect real operational conditions in modern power systems. Equally important is the formalization of laboratory procedures through detailed manuals, which establish common standards for laboratory preparation, execution, safety, and assessment. This standardization strengthens internal quality assurance mechanisms and supports consistent implementation across different courses, instructors, and student cohorts.

In addition to physical and technical infrastructure, the laboratories contribute to **human capacity development** within partner institutions. Academic staff involved in the design and delivery of laboratory courses acquire experience in integrating digital technologies, interdisciplinary content, and student-centered pedagogical approaches into their teaching. Technical staff benefit from increased involvement in the operation and maintenance of advanced laboratory setups. Over time, this contributes to a more skilled and confident institutional workforce capable of sustaining and further developing laboratory-based education beyond the project period.

The laboratory manuals also play a significant role in **curriculum modernization**, another key Work Package objective. By embedding hands-on laboratory activities directly into Bachelor and Master programs, the project supports a shift from theory-based curricula towards learning models that integrate conceptual understanding with practical application. The laboratories address thematic areas that are linked to current industry practices and technological trends, including SCADA-based monitoring and control, data-driven system analysis, digital communication technologies, and cybersecurity awareness in energy infrastructures. This ensures that curricula remain relevant and responsive to sectoral developments, while also supporting the development of transversal competences such as problem-solving, analytical thinking, teamwork, and technical documentation.

A further contribution to WP objectives is achieved through the integration of **lifelong learning (LLL)-oriented laboratory courses**. These laboratories extend the reach of project results beyond traditional degree programs and enable professionals, early-career engineers, and other non-traditional learners to access modern training opportunities. By addressing the needs of the existing workforce, the project supports upskilling and reskilling in response to digitalization and energy transition challenges. This widened access and outreach contributes to the societal relevance of higher education institutions and strengthens their role as providers of continuous education.

In terms of **replicability and scalability**, the use of standardized laboratory manual structures directly supports the achievement of WP objectives related to dissemination and sustainability of results. The clear documentation of objectives, required equipment, procedures, and learning outcomes enables laboratories to be reused across different programs and departments within the same institution. At the

consortium level, this standardization facilitates transfer of laboratory models between partner institutions, promoting convergence of educational practices and quality. The reliance on widely available technologies and modular learning designs further reduces barriers to adoption by institutions beyond the project partnership, thereby supporting the potential for broader regional and international impact.

Conclusions and Sustainability Considerations

The laboratory manuals documented in this deliverable represent a **tangible, high-value, and sustainable output** of the NEST4WB project, directly supporting its long-term objectives and the broader goals of the Erasmus+ CBHE action. By providing well-structured, practice-oriented laboratory courses aligned with modern energy system requirements, the project delivers results that are not limited to the project duration but are embedded within the core educational missions of partner institutions.

A key element underpinning sustainability is the **integration of the laboratories into regular study programs and lifelong learning offers**. Rather than being treated as pilot activities or optional add-ons, the laboratories are incorporated into Bachelor and Master curricula and into institutional LLL portfolios. This ensures continued use of the laboratories beyond the project lifetime and enables successive generations of students and professionals to benefit from the developed resources. Institutional ownership of the laboratories is reinforced through the involvement of academic and technical staff in their design, implementation, and continuous improvement.

From an operational perspective, the sustainability of the laboratories is supported by their **modular design and comprehensive documentation**. The ability to update individual laboratory exercises, replace specific technologies, or adapt learning outcomes allows institutions to respond flexibly to technological evolution and changing labor market needs. This adaptability is particularly important in the context of digitalized energy systems, where rapid innovation requires continuous curriculum updating. The use of widely adopted technologies and platforms further supports sustainability by reducing dependency on project-specific or short-lived solutions and facilitating access to training resources, user communities, and technical support.

The structured laboratory manuals also provide a solid foundation for **replication and scaling**, which are essential components of sustainable impact. Within partner institutions, laboratories can be extended to additional programs, interdisciplinary courses, or new LLL offerings. At regional level, the availability of detailed documentation enables other higher education institutions and training providers to adopt or adapt the laboratory models developed within NEST4WB. This contributes to the diffusion of good practices and supports systemic improvement of higher education across the Western Balkans.

In broader terms, the sustainability of the laboratory output is intricately linked to their contribution to **educational quality, employability, and institutional development**. By equipping students and professionals with practical, transferable competences aligned with the digital transformation and energy transition, the laboratories enhance graduate employability and workforce adaptability. At the

same time, they strengthen the strategic positioning of higher education institutions as key actors in regional development and innovation.

In combination with the **Professional Practice Manual presented in Appendix A**, the laboratory manuals developed within the NEST4WB project constitute a coherent and sustainable model for practice-oriented energy education. Laboratory courses provide the technical foundation and structured experimental environments, while professional practice extends learning into applied and semi-professional contexts under academic supervision. This integrated approach enhances employability, reinforces institutional capacity, and supports the long-term sustainability, replicability, and transferability of project results, fully aligned with the objectives of the Erasmus+ Capacity Building in Higher Education action.

Appendix A: Professional Practice Manual for Students

A.1 Purpose and Scope

This **Professional Practice Manual** defines the framework, organization, and implementation principles for **students' professional practice** within the NEST4WB project. It complements the laboratory manuals presented in Deliverable D3.5 by extending laboratory-based learning into **applied, practice-oriented contexts** under academic supervision.

Professional practice is conceived as an integral component of modernized energy-related curricula, supporting the application of knowledge and skills acquired through lectures and laboratory exercises. The manual is applicable to **Bachelor and Master study programs** as well as **lifelong learning (LLL)** formats and is designed for sustainable use beyond the project duration.

The manual does not replace laboratory manuals but builds directly upon them, ensuring pedagogical continuity between guided experimentation and applied professional activities.

A.2 Target Groups

The professional practice framework is intended for:

- **Bachelor students** in energy, electrical engineering, and related study programs
- **Master students** specializing in smart grids, digitalized energy systems, renewable energy, and related fields
- **Lifelong learning participants**, including early-career engineers and professionals seeking upskilling or reskilling

The scope and complexity of professional practice tasks are adapted to the educational level and learning outcomes of each target group.

A.3 Positioning within the Curriculum

Students' professional practice is positioned as a **practice-oriented educational activity** that:

- Follows or accompanies laboratory-based courses
- Reinforces learning outcomes defined in laboratory manuals
- Supports competence-based curriculum design

Professional practice may be implemented as:

- A stand-alone curricular component
- An integrated part of laboratory-based courses
- A capstone or consolidation activity

The workload and duration are aligned with **ECTS principles** and institutional regulations to ensure transparent academic recognition.

A.4 Objectives of Professional Practice

The objectives of students' professional practice are to:

- Enable application of laboratory and theoretical knowledge in realistic contexts
- Strengthen job-relevant technical competences in the energy domain

- Develop transversal competences such as teamwork, communication, and documentation
- Increase familiarity with professional standards, safety procedures, and organizational workflows
- Enhance employability and readiness for professional engineering roles

A.5 Structure and Organization

Professional practice is organized around **applied tasks** derived from the laboratory environments and thematic areas addressed in the NEST4WB project. These may include:

- Advanced or extended laboratory experiments
- System-level integration tasks
- Simulation-based professional scenarios
- Data analysis and interpretation assignments
- Design, testing, or validation activities

Practice activities are conducted under the supervision of academic staff and, where applicable, in cooperation with external stakeholders.

A.6 Roles and Responsibilities

Students

Students are responsible for:

- Actively participating in assigned professional practice activities
- Complying with laboratory and institutional safety rules
- Maintaining a practice diary or logbook
- Preparing a final professional practice report

Academic Mentors

Academic mentors are responsible for:

- Defining learning outcomes and practice tasks
- Supervising student activities
- Ensuring alignment with laboratory manuals and curricula
- Evaluating student performance

Host Laboratories / Organizations

Host laboratories or partner organizations provide:

- Access to equipment, systems, or simulation environments
- Technical guidance and contextual support
- Input on professional standards and expectations

A.7 Learning Outcomes

Upon completion of professional practice, students are expected to demonstrate:

- Practical ability to operate and analyze modern energy-related systems
- Application of tools and methods introduced in laboratory courses (e.g. SCADA, monitoring, data analytics, renewable energy technologies)
- Problem-solving and system-level thinking
- Ability to document technical work clearly and professionally
- Awareness of safety, reliability, and ethical considerations

Learning outcomes are aligned with the level of study and the objectives of the corresponding laboratory courses.

A.8 Assessment and Evaluation

Assessment of professional practice is based on:

- Completion and quality of assigned practice tasks
- Practice diary or logbook
- Final professional practice report
- Mentor evaluation of student engagement and performance

Assessment criteria are transparent and consistent with institutional quality assurance procedures.

A.9 Health, Safety, and Ethical Considerations

All professional practice activities must comply with:

- Institutional health and safety regulations
- Laboratory safety rules defined in the corresponding laboratory manuals
- Ethical standards related to data handling, equipment use, and professional conduct

Students must receive appropriate safety instructions prior to commencing professional practice.

A.10 Contribution to Employability and Sustainability

Professional practice strengthens the employability impact of laboratory-based education by enabling students to engage with applied tasks resembling professional engineering workflows. By integrating professional practice into regular curricula and lifelong learning offers, partner institutions ensure:

- Continued use of laboratory infrastructures
- Long-term relevance of educational content
- Sustainable impact of the NEST4WB project

The standardized structure of this manual supports replication and transferability across institutions and programs.

A.11 Alignment with Laboratory Manuals

This Professional Practice Manual is explicitly aligned with the laboratory manuals documented in Deliverable D3.5. Laboratory manuals provide the technical foundation and structured experimental environments, while professional practice:

- Extends laboratory learning toward applied contexts
- Reinforces learning outcomes through professional-oriented tasks
- Enhances coherence between education and labor market needs

Together, laboratory manuals and professional practice form an integrated framework for practice-oriented energy education within the NEST4WB project.

A.12 Professional Practice Logbook Template

The **Professional Practice Logbook** is a mandatory document maintained by the student throughout the professional practice period. It ensures traceability of activities, supports supervision, and provides evidence for assessment.

Professional Practice Logbook

Student Name:
Student ID:
Study Program / Level: (BSc / MSc / LLL)
Institution:
Academic Year:

Course / Module Title:
Related Laboratory Course(s):

Professional Practice Period:
From: _____ To: _____

Academic Mentor:
Host Laboratory / Organization:

Logbook Entries

Students should complete **one entry per practice day or session**.

Date	Duration (hours)	Activity Description	Related Lab / Topic	Tools / Equipment Used	Learning Outcomes Addressed	Mentor Comments

(Add rows as needed)

Weekly Summary

Week Number:
Summary of Activities Performed:
Skills and Competences Developed:
Problems Encountered and Solutions:

Student Declaration

I confirm that the above entries accurately reflect the professional practice activities carried out.

Student Signature: _____
Date: _____

Mentor Validation

The professional practice activities documented above have been reviewed and validated.

Mentor Name and Signature: _____
Date: _____

A.13 Final Professional Practice Report Template

The **Final Professional Practice Report** summarizes and reflects on the professional practice experience. It is a key assessment document and must demonstrate alignment with laboratory learning outcomes and professional competences.

Final Professional Practice Report

Cover Page

Title: Final Professional Practice Report

Student Name:
Student ID:
Study Program / Level:
Institution:

Professional Practice Period:
Academic Mentor:
Host Laboratory / Organization:

Date of Submission:

1. Introduction

- Purpose of the professional practice
- Position of the practice within the study program
- Link to relevant laboratory courses and learning outcomes

2. Description of the Practice Environment

- Description of the laboratory, system, or organization
- Overview of equipment, software, or platforms used
- Relevance to modern energy systems

3. Professional Practice Activities

- Description of tasks performed
- Relation to laboratory manuals and experiments
- Applied methods, tools, and procedures

(May be structured by task, topic, or week)

4. Technical Outcomes and Results

- Measurements, simulations, analyses, or system observations
- Key findings and results
- Screenshots, diagrams, or tables (if applicable)

5. Learning Outcomes and Competence Development

- Technical competences acquired
- Transversal skills developed (teamwork, communication, documentation)
- Alignment with defined learning outcomes

6. Health, Safety, and Professional Conduct

- Safety procedures followed
- Risk awareness and mitigation
- Ethical and professional considerations

7. Discussion and Reflection

- Challenges encountered and solutions applied
- Comparison between laboratory learning and applied practice
- Relevance of professional practice to future employment

8. Conclusions

- Summary of achieved objectives
- Overall evaluation of the professional practice experience
- Recommendations for improvement

9. References (if applicable)

10. Appendices (optional)

- Extended data, figures, or additional documentation

Student Declaration

I confirm that this report represents my own work and accurately reflects the professional practice activities undertaken.

Student **Signature:** _____
Date: _____

Mentor Evaluation (to be completed by Academic Mentor)

Overall Performance: ☐ Excellent ☐ Very Good ☐ Good ☐ Satisfactory ☐ Unsatisfactory

Comments:

REPORT DONE BY:

БОЈАН ПРЛИНЧЕВИЋ 015309463 Sign

Digitally signed by БОЈАН ПРЛИНЧЕВИЋ 015309463 Sign
DN: c=RS, serialNumber=CA:RS-015309463, serialNumber=PNORS-1407976960005, sn=ПРЛИНЧЕВИЋ, givenName=БОЈАН, cn=БОЈАН ПРЛИНЧЕВИЋ 015309463 Sign
Date: 2026.01.23 19:00:58 +01'00'

Christos Manasis

[Phd Bojan Prlinčević]

WITH THE CONTRIBUTIONS OF

Ljiljana Pecić, Bojan Prlinčević, Danijela Zubac, Milan Mišić, Uroš Jakšić, Zorica Bogićević, Rene Prenc, Christos Manasis, Yannis Koutsoubis, Miroslav Voznak, Joaquin Ordieres-Mere, Slobodan Bojanić, Marija Boranijašević, Nebojša Arsić, Aleksandra Petrović, Sasa Statkic, Bojan Perovic, Milos Milovanovic, Jovan Vukasinovic, Andrijana Jovanovic, Slobodan Lubura, Marko Ikić, Miodrag Forcan, Srđan Jokić, Davorka Šaravrnja, Mirela Jurić, Drago Bago, Ivan Bevanda, Žaklina Spalević, Petar Spalević, Dael Dervishi, Maaruf Ali, Emir Džanić, Nela Milošević, Dael Dervishi, Erinda Ahmeti, Resina Pllaha, Anni Dasho, Enxhi Mete.

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 D3.5

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.

Digitálně podepsal prof. Ing. Miroslav Vozňák, Ph.D.
Datum: 2026.01.23 08:48:07 +01'00'

REPORT DONE BY:

_____

[Name and Surname]

_____

[Name and Surname]