Co-funded by the European Union

Ref. Ares(2025)711539 - 30/01/2025

ERASMUS-EDU-2023-CBHE

Erasmus+ Programme (ERASMUS) Project: 101128611 — reZEB

Fostering Renewable energy technologies and energy Efficiency knowledge towards near Zero Energy Buildings of engineers and professionals in Western Balkan Countries

DELIVERABLE 3.3: Labs setup for the new and modernised modules

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Project information

Project Number	101128611	**Acronym**	reZEB
Full Title	Fostering Renewable energy technologies and energy Efficiency knowledge towards near Zero Energy Buildings of engineers and professionals in Western Balkan Countries		
Call	ERASMUS-EDU-2023-CBHE		
Topic	ERASMUS-EDU-2023-CBHE-STRAND-2		
Type of action	ERASMUS Lump Sum Grants		
Coordinator institution	University of Castilla-La Mancha (UCLM), Spain		
Project URL	https://rezebproject-eu.com/		
Project starting & ending date	01 November 2023 – 31 October 2026 (36 months)		

Document control sheet

Deliverable title	D 3.3: Labs setup for the new and modernised modules			
Work package (WP) name & WP leader (WPL)	WP3: Development / WPL: University eCampus (UEC) (leader) & International Business College Mitrovica (IBC-M) (co-leader)			
Deliverable lead institution	UEC			
Author(s) (Names and affiliations)	Amparo Pazo (UCLM), Magín Lapuerta (UCLM), Luca Cioccolanti (UEC)			
Nature & Dissemination level	**Deliverable nature**	R – Report	**Dissemination level**	PU-Public
Date of delivery	**Contractual**	31/01/2025	**Actual**	30/01/2025

Versioning and contribution history

Rev. No.	Issue date	Author/Reviewer (Name and affiliation)	Action description
v0.1	06/01/2025	Amparo Pazo (UCLM), Magín Lapuerta (UCLM), Luca Cioccolanti (UEC),	First draft
v0.2	17/01/2025	Juan José Hernández (UCLM)	Minor modifications and corrections on the document layout and content
V0.3	30/01/2024	Project Executive Committee (PEC)	Approval of the draft and submission to EU

2. Deliverable description

This document presents a complete description of the new lab equipment purchased by Western Balkan (WB) Higher Education Institutions (HEIs) with the reZEB budget, as well as information on the proposed teaching activities to be done with them in the corresponding modules modernised withing the reZEB context. Evidence of the purchase, training and use of the equipment is also included.

3. Purpose of the labs, impact and sustainability

3.1 Purpose of the labs

The new labs were established to enhance the hands-on learning and research capabilities of students in the field of renewable energy technologies and energy efficiency. It aims to provide practical experience with the latest equipment used in the industry, enabling students and faculty to work on projects that support the objectives of the reZEB initiative.

3.2 Impact on educational outcomes

The lab has significantly enhanced the practical learning environment, equipping students with industry-standard skills and knowledge. It aligns closely with reZEB's objectives to develop a skilled workforce ready to implement renewable energy solutions and energy-efficient practices in the Western Balkans.

This setup supports the modernization of at least 25 course modules under the reZEB initiative, covering critical areas like energy audits, renewable technology applications, and life cycle analysis.

3.3 Future plans and sustainability

To ensure the lab's ongoing contribution to educational objectives, plans are in place for regular maintenance and software updates. Partnerships with local and regional industries will further enhance the lab's impact, allowing students to gain experience through internships and joint projects.

The equipment is expected to be used in upcoming collaborations with businesses and governmental bodies interested in renewable energy and sustainability, increasing the lab's role as a training and innovation center.

4. Tendering and purchasing procedure

Every WB HEI has followed their own tendering and purchasing procedures. Evidence of the tendering process has been requested for the release of the equipment budget. Details of the tender and purchase process are considered sensitive so, they are only available to registered users in the reserved area of the project website.

Table 1 shows the budget allocated to each institution.

Table 1. Equipment budget for every institution

Institution	Budget (€)
European University of Tirana (UET)	35000
Polis University (U_POLIS)	24000
Professional College of Tirana (KPT)	26000
Universum International College (UC)	22000
International Business College Mitrovica (IBC-M)	29600

5. Equipment purchased

The equipment purchased is listed in the following tables for each HEI (Table 2 to Table 6), including details and description, as well as the list of the modules in which they will be used. The unit price shown in the table does not include taxes. The equipment purchased have completed the already existing labs in most of the cases, which will allow to enhance practical performance.

Table 2. UET: Description of the equipment and list of modules involved

Equipment				Modernised/new modules involved
No. of units, name, brand & model	Technical description	Purpose	Unit cost (€)	
11 Desktop computers. DELL Vostro 3710	DELL Vostro 3710 i7-12700 SFF/ 16GB DDR4-SDRAM / 2 x 512 GB SSD / Windows 11 Pro PC	These items are going to be used by the teacher to explain lessons and seminars and by the students to write the course assignment.	1208	All, modernised & new ones
1 Dron. Mavic 3 Pro Fly	The Mavic 3 Pro features an advanced triple-camera setup, which includes: • Main Camera: A 4/3 CMOS Hasselblad camera with a 20MP resolution and a 24mm equivalent lens. It supports 12-bit RAW images and provides up to 5.1K video at 50 fps or 4K at 120 fps, delivering highly detailed images and smooth, cinematic video. • Medium Tele Camera: A 1/1.3-inch CMOS sensor with a 48MP resolution and a 70mm equivalent lens, ideal for capturing mid-range subjects with a focal length that enhances the subject's prominence in the frame.	This item is going to be used by the teacher to practically explain some of the concepts taught in these subjects and by the students in the framework of the course assignment.	5333	• Electrical systems • Electrical and Energy Measurements
2 Multimeters. UNI-T	LCD digital Multimeter, automatic current and voltage tester.		25	All, modernised & new ones
2 Workstation. LENOVO Legion T7 34IRZ8	LENOVO Legion T7 34IRZ8 PC 90V7000WGE i7-13700F 64 GB DDR5-SDRAM 1 TB SSD +4 TB HDD Red NVIDIA GeForce RTX 4070 Windows 11 pro	These items are going to be used by the teacher to explain lessons and seminars and by the students to write the course assignment	3679	• Electrical plants and safety • Electrical systems • Electrical and energy measurements • Energy management
1 Projector. ACER	Resolution 1920 x 1200, 4800 Lumens, Full HD, Input VGA, USB, Wifi.		767	All, modernised & new ones

Table 2 (continued). UET: Description of the equipment and list of modules involved

Equipment				Modernised/new modules involved
No. of units, name, brand & model	Technical description	Purpose	Unit cost (€)	
3 Thermal imaging cameras: • 1 UTi120B Thermal imaging camera 120 x 90 IR resolution • 1 UTi80P Thermal imaging camera pocket-size portable • 1 UTi30E Thermal imaging camera 320 x 240	<u>UTi120B Thermal Imaging Camera</u> • IR Resolution: 120 x 90 pixels • Temperature Range:-10°C- 400°C • Sensitivity and Accuracy: ±2°C or ±2% sensitivity, with a thermal sensitivity of ≤ 150mK • Display: 2.8-inch TFT LCD screen, providing real-time temperature visualization • Image Modes: Supports thermal, visual, and picture-in-picture (PIP) modes • Connectivity: USB for data transfer; includes storage options for recording and transferring images • Usage: Compact and versatile, suitable for HVAC, electrical, and mechanical inspections where medium resolution is adequate <u>UTi80P Pocket-Size Thermal Imaging Camera</u> • Design: Pocket-sized, portable, and handheld, designed for on-the-go inspections • IR Resolution: Low-resolution sensor (typically lower than the UTi120B), optimized for quick diagnostics and spot-checks • Temperature Range: Suitable for basic thermal inspections, often measuring up to around 300°C (exact specs vary by model) • Display and Features: Small display, generally with basic image analysis options • Connectivity and Storage: Likely equipped with USB for image transfer, with limited storage and basic reporting functions • Usage: Ideal for technicians and inspectors needing a portable, easy-to-use device for quick, general-purpose thermal checks <u>UTi30E High-Resolution Thermal Imaging Camera</u> • IR Resolution: 320 x 240 pixels, offering high detail for precision inspections • Temperature Range: typically from -20°C up to 400°C or higher • Sensitivity and Accuracy: High thermal sensitivity (typically ≤ 50mK), providing detailed thermal contrasts and precision • Display and Image Modes: Larger display with multi-mode imaging options like thermal, visual, and PIP • Connectivity and Storage: USB and possibly Wi-Fi support for data transfer; includes robust storage and software options for professional reporting • Usage: High-end choice for professional diagnostics, detailed inspections in electrical, industrial, and building applications requiring high resolution and precision.	This item is going to be used by the teacher to practically explain some of the concepts taught in these subjects and by the students in the framework of the course assignment.	250 333 1187	All, modernised & new ones

Table 2 (continued). UET: Description of the equipment and list of modules involved

Equipment				Modernised/new modules involved
No. of units, name, brand & model	Technical description	Purpose	Unit cost (€)	
2 Small solar panel educational set. IDUINO	100W 12V Solar Panel Kit and 30A Dual USB Multi-use Solar Controller.	Equipment to be used to practically explain the fundamentals of solar energy and photovoltaic systems in the framework of the course assignment	149	Electrical plants and safety
2 Educational set solar panel large. Schneider	Solar Panel 110W ETFE flexible monocrystalline 1000w Battery 12V. A	Equipment to be used to practically provide a deeper understanding of solar energy, photovoltaic technology, and energy storage systems in the framework of the course assignment	142	Energy management

Table 3. U_POLIS: Description of the equipment and list of modules involved

Equipment				Modernised/new modules involved
No. of units, name, brand & model	Technical description	Purpose	Unit cost (€)	
1 Blower door. Minneapolis Blower Door Model 3	Minneapolis Blower Door Model 3 with DG-1000 Pressure and Flow Gauge- BD3-KIT-001 Fan Flow (accuracy+/- 3%, using DG-1000, DG-700 or APT system. Rings D and E +/- 4% or I CFM, whichever is greater.) Maximum Flow in Free Air: CFM: 6,300 Liters.ls: 2,973 m3/h: 10,705 Maximum Flow at 50 Pascal test pressure: CFM: 5,400 Minimum Flow: CFM: 300 CFM (Ring 8), 85 CFM (Ring C), 30 CFM (Ring D), 11 CFM (Ring E). Dimensions: Fan Inlet diameter: 20 inches inlet diameter, 10.25 inches length. Fan Weight: 33 lbs. Power: 110V or 220V. Frame Height: 52 to 96 inches Panel Width: 28 to 40 inches.	Tool to measure the tightness level of a closed space in order to detect air infiltration and improve energy efficiency of buildings	6300	• Environmental Design Studio • Technical Physics and Plant Engineering

Table 3 (continued). U_POLIS: Description of the equipment and list of modules involved

Equipment				Modernised/new modules involved
No. of units, name, brand & model	Technical description	Purpose	Unit cost (€)	
1 Wind turbine 2kW. S6-24V-6B	2000w 2kw Horizontal Wind Turbine Generator 12V 24 V Free Energy Magnetic Dynamo Strong Power 220v Inverter Output	Equipment to be connected to other systems already available in Energy Efficiency (EE) Laboratory	1250	• Environmental Design Studio • Technical Physics and Plant Engineering
1 Solar PV panels test bench, 4kWp. JA SOLAR JAM72D40	4KW Solar Panel System with 7x photovoltaic Panel JA SOLAR JAM72D40 555-580 /GB series 575Wp, with two compartments (Halfcut) universal assembly, 2278 x 1134 x 35, 144 cell	Equipment to be connected to other systems already available in EE Laboratory	2950	• Environmental Design Studio • Technical Physics and Plant Engineering
2 Solar PV system. Christiani Gmbh	1 KW Solar Panel System with 1x photovoltaic Panel JA SOLAR JAM72D40 555-580 /GB series 575Wp, with two compartments (Halfcut) universal assembly, 2278 x 1134 x 35, 144 cell	Demonstrative kit for didactive purposes	500	• Environmental Design Studio • Technical Physics and Plant Engineering
1 Hygrometer.	General Tools MMD4E Digital Moisture Meter, Water Leak Detector, Moisture Tester, Pin Type, Backlit LCD Display with Audible and Visual High-Medium-Low Moisture Content Alerts, Grays	Tool to measure the moisture level of the materials and water infiltration in building envelope layers	500	• Building materials and constructive techniques • Architectural Technology • Environmental Design Studio
2 Design Builder Software licenses	Design Builder 1 Year License Module Software	Advanced building performance simulation tool	1500	• Building Retrofit Strategies for Sustainable Urban Regeneration • Environmental Design Studio • Technical Physics and Plant Engineering
2 Desktop computers. HP Z2 G9 Desktop Workstation	HP Z2 G9 Desktop Workstation, Intel Core i7-13700 up to 5.20 GHz, 16 GB DDR5-4800 nECC, 512 GB SSD PCIe NVMe M.2, Intel UHD Graphics, DVD+/-RW, Keyboard+ Mouse, Free DOS, 700W, IY	Desktop computers able to run software for simulation	2000	• Building Retrofit Strategies for Sustainable Urban Regeneration • Environmental Design Studio • Technical Physics and Plant Engineering
1 Geo-Thermal System. GRUNDFOS	Geo-Thermal System Main System Pump Bypass Valve Piping System	Equipment to be connected to other systems already available in the EE Laboratory	5000	• Building Retrofit Strategies for Sustainable Urban Regeneration • Environmental Design Studio • Technical Physics and Plant Engineering

Table 4. KPT: Description of the equipment and list of modules involved

Equipment				Modernised/new modules involved
No. of units, name, brand & model	Technical description	Purpose	Unit cost (€)	
5 Computers. LENOVO Neo 50t i5-13400 16GB SSD512GB	PC LENOVO Neo 50t i5-13400 16GB SSD512GB Graphic card 2GB GeForce GT710	Configured to run complex simulation software for energy systems and modeling	814	All, modernised & new ones
5 Monitors. Lenovo C24	24-inch FHD Monitor, 1920x1080 resolution, 75Hz refresh rate	Visual interface for desktops, suitable for engineering simulations and audits	153	All, modernised & new ones
1 Engineering Fundamentals. CYPE HVAC License	License for advanced HVAC design and simulation	Evaluate building envelopes from an energy-efficiency perspective, providing critical insights for NZEB projects	2500	• Energy Allocation and use • HVAC and cooling control systems • Energy Auditing
1 Renewable energy simulation. License-Retscreen	License for simulating various renewable energy systems	Analyse renewable energy systems for performance optimization and design	5000	• Energy Allocation and use • Energy Auditing
1 Triplite inverter charger. Tripplite Inverter-charger, APSX1250	1250 watts output, 230V input, 12VDC	Provides power backup and stable voltage conversion	917	• Energy Auditing • Energy allocation and use • HVAC and cooling control systems
1 Hermetic lead acid battery. Fuli 12V/55AH, FL1255	12 V / 55 Ah, sealed and maintenance-free	Energy storage and backup for renewable energy systems		
1 Full set of laboratory equipment to perform energy audit: • Thermocouple. RS PRO, 3971236 • Anemometer. RS PRO, RS-90 NTC 15558899 • Thermal Imaging Camera. RS PRO, 2740350(RS-979E) • Pressure Sensor. RS PRO, 2726975 • Thermo Hygrometer. Extech, RH490 288-0405 • Light Detectors. Tellemecanique Sensor, XUKIARCNL2 512-4640	• Thermocouple. Type K • Anemometer. Air velocity up to 25 m/s (sensor NTC-type), air Tª measurement. • Thermal Imaging Camera. Tª measurement range: 20 – 400 ºC, accuracy ± 2 ºC • Pressure Sensor. • Thermo Hygrometer. Humidity 0 to 100 % RH, basic accuracy ± 2 % RH • Light Detectors. Wiring technique 5-wire, sensing distance: nominal 7 m, max. 10 m reflex	Perform detailed energy audits, measure energy consumption, and identify inefficiencies	8013	• Energy Auditing • Engineering materials/Metrology

Table 5. UC: Description of the equipment and list of modules involved

Equipment				Modernised/new modules involved
No. of units, name, brand & model	Technical description	Purpose	Unit cost (€)	
4 Interactive whiteboards. IQ Touch TE1200 PRO	Model: LEO075MD, Diagonal size: 75'' Brightness: 350cd/m^2 Contrast Ratio: 1200:1 Panel Type: TFT Backlight: Direct LED (DED) Resolution: 4K UHD (3840-2160) Display Ratio: 16:9 Backlight Lifetime: 50,000 hrs Display Colors: 10bit (1.07B) Glass: 4mm Tempered Glass with Anti-Glare coating (8H) Dynamic Contrast Ratio: 5000:1	These interactive whiteboards will be used for dynamic teaching and training sessions, enabling the integration of multimedia and interactive content for modules focused on Renewable Energy Technologies (RETs) and Energy Efficiency (EE).	2043	All, modernised & new ones
5 Computers. AIO I Intel (24")-Luna Grey Leonovo	Intel® U300 Processor (E-cores up to 3.30 GHz P-cores up to 4.40 GHz) Windows 11 Home 64 Integrated Intel® UHD Graphics for 13th Gen Intel® Processors 8 GB DDR5-5200MHz (SODIMM) 256 GB SSD M.2 2280 PCIe Gen4 TLC 23.8" FHD (1920 x 1080), IPS, Anti-Glare, Non-Touch, 99%sRGB, 250 nits, 100Hz, 14ms 90W	These all-in-one computers will provide students and faculty with the necessary tools to run simulations, access e-learning platforms, and perform energy system modeling using specialized software.	784	All, modernised & new ones
10 computer. IdeaCentre AIO I Intel (27")	13th Generation Intel® Core™ i5-13420H Processor (E-cores up to 3.40 GHz P-cores up to 4.60 GHz) Windows 11 Home 64 Integrated Intel® UHD Graphics for 13th Gen Intel® Processors 16 GB DDR5-5200MHz (SODIMM) 512 GB SSD M.2 2280 PCIe Gen4 TLC 27" QHD (2560 x 1440), IPS, Anti-Glare, Touch, 99%sRGB, 350 nits, 100Hz, 14ms		784	All, modernised & new ones
1 License of HVAC software. Cool Automation Cloud Solutions	Key HVAC software feature. Core HVAC features: Dispatch management Mobile access Scheduling Work order management Common HVAC features: Billing and invoicing Customer database Inventory management Quotes/estimates	License for HVAC and RETs simulation. It will support specialized applications such as energy modeling, building simulation, and renewable energy analysis tools. The software facilitates practical, hands-on training for students.	2051	Energy Management

Table 6. IBC-M: Description of the equipment and list of modules involved

Equipment				Modernised/new modules involved
No. of units, name, brand & model	Technical description	Purpose	Unit cost (€)	
1 Thermal imaging camera. FLIR E5 Pro	Infrared Camera, Thermal Imager,-20:400 °C, 3.5", <0.06 °C, 33x25 °, IP54	Analyse heat distribution in buildings, contributing to energy efficiency assessments	1850	• Project Management • Renewable Energy • Advanced Natural Resources Management • Energy Management
1 Thermal imaging moisture meter. FLIR MR 277	Thermal Imaging Moisture Meter with integrated infrared guided measurement (IGM) technology and an external pin probe for contact moisture measurement,	Analyse heat and moisture distribution in buildings, contributing to energy efficiency assessments	1850	• Project Management • Renewable Energy • Advanced Natural Resources Management • Energy Management
1 Bench power supply. RND-320-KD	Programmable Bench power supply with 2 LED displays for voltage and current measurements, 2x 30 VDC, 5 A, 2 LED displays for voltage and current measurement, Output Current 3 Max.: 3A	A bench power supply will allow IBCM college students to calibrate measurement equipment, test instrumentation accuracy, or provide a baseline for comparing the outputs of actual renewable energy devices.	600	• Project Management • Renewable Energy • Advanced Natural Resources Management • Energy Management
1 Bench multimeter. Owon XDM3051	Laboratory use, up to 150 rdgs/s measurement speed, Mass storage configuration files and data files, Built-in cold terminal compensation for thermocouple temperature measurements, PC software included.	A bench multimeter can be used to test the Insulation Resistance of wiring and components used in buildings, Verify Electrical Continuity and Safety in circuits that run through insulated sections of a building, or Assess Material Conductivity and Quality.	640	• Project Management • Renewable Energy • Advanced Natural Resources Management • Energy Management
1 Drone. DJI Mavic 3 Pro (DJ RC)	3840 x 2160 (4K/60FPS), separate remote controller for drone navigation, 10km HD Video Transmission, Omnidirectional obstacle sensing, 40+ min flight time, a shoulder bag, spare propeller blades, and spare batteries.	The drone will be used by students and staff members of the reZEB project, Visual Inspection of Inaccessible Areas in Buildings, to capture high-resolution videos or photos of rooftops, eaves, gutters, and other structural elements. It will also be used to visualize and understand the complex layers of buildings by getting a real-time perspective of how roofs, walls, window openings, and thermal barriers interconnect.	2130	• Project Management • Renewable Energy • Advanced Natural Resources Management • Energy Management

Table 6 (continued). IBC-M: Description of the equipment and list of modules involved

Equipment				Modernised/new modules involved
No. of units, name, brand & model	Technical description	Purpose	Unit cost (€)	
5 All-in-One desktop computers. Lenovo	Intel Core i7, 27" display, 16GB, 512GB SSD, Win 11 Pro licensed	The computers will serve as portals to online courses, interactive tutorials, webinars, and multimedia-rich lectures, where the IBCM teaching staff will supplement hands-on lab exercises with virtual labs or simulations that replicate field testing of insulation materials under different environmental conditions.	855	All, modernised & new ones
2 Laptops. HP Elite book	14" display, Intel Core i7, 16GB RAM, 512GB SSD, Win 11 Pro licensed	IBCM teaching staff will use word processors, spreadsheets, and presentation software to compile lab reports and insulation analysis summaries and present case studies in building insulation. This includes formatting professional-grade documents, charts, tables, and diagrams that clearly convey research findings and design recommendations.	1050	All, modernised & new ones
SimaPro software (multiple license) and PhD license	SimaPro 8 is the latest generation of the world's most widely used Life Cycle Assessment (LCA) software. SimaPro is a professional tool that helps you to analyze the environmental aspects of products or services	Identification of improvement opportunities through identifying environmental hot spots in the life cycle of a product. Analysis of the contribution of the life cycle stages to the overall environmental load, usually with the objective of prioritizing improvements on products or processes.	6430	• Project Management • Renewable Energy • Life Cycle Assessment • Advanced Natural Resources Management
G-ISBEM software interface license	G-ISBEM Ltd is a software which specialises in survey applications requiring data capture of building geometry, floor plans and associated data	G-ISBEM software for modelling and monitoring energy efficiency in real-time, optimizing building systems	Repeating the call for bids	• Project Management • Renewable Energy • Life Cycle Assessment • Advanced Natural Resources Management • Energy Management

6. Teaching activities

The list and short description of the proposed teaching activities involving the use of the purchased equipment are detailed in Table 7 to Table 11.

Table 7. UET: Teaching activities description

Name of the teaching activity/Lab	Description	Modules involved	Equipment used and purchased with the reZEB budget
Teaching lessons and seminars.	Practical explanation of some of the concepts of taught in these subjects.	All, modernised & new ones.	• Desktop computers • Dron • Workstation • Projector Thermal imaging cameras: • UTi120B Thermal imaging camera 120 x 90 IR resolution • UTi80P Thermal imaging camera pocket-size portable • UTi30E Thermal imaging camera 320 x 240 • Small solar panel educational set • Educational set solar panel large • Multimeters
Course assignment	Writing and evaluation of the course assignment.	All, modernised & new ones.	• Desktop computer • Dron • Workstation • Projector Thermal imaging cameras: • UTi120B Thermal imaging camera 120 x 90 IR resolution • UTi80P Thermal imaging camera pocket-size portable • UTi30E Thermal imaging camera 320 x 240 • Small solar panel educational set • Educational set solar panel large • Multimeters

Table 8. U_POLIS: Teaching activities description

Name of the teaching activity/Lab	Description	Modules involved	Equipment used and purchased with the reZEB budget
Renewable Energy Systems	Activity to learn the fundamentals of solar power generation and storage	• Technical Physics and Plant Engineering • Environmental Design Studio	• Wind Turbine 2KW • Solar PV panels • Solar PV system • Geo-Thermal System
Energy Efficiency of the Building	Performance of a real-world assessments of building efficiency.	• Building materials and constructive techniques • Building Retrofit Strategies for Sustainable Urban Regeneration • Architectural Technology	• Blower door • Hygrometer • Design Builder Software • Computers

Table 9. KPT: Teaching activities description

Name of the teaching activity/Lab	Description	Modules involved	Equipment used and purchased with the reZEB budget
Lab Works No.: 1 to 7	To run renewable energy SW for simulation, video. Practical explanation of some of the concepts of taught in the course. Teaching lessons and labs. • Lab Work No. 1 Health and safety in energy allocation and use. Construction of an electric cabin. • Lab Work No. 2 Production of electricity from hydro turbines, transmission and distribution. How to maximize the efficient use. • Lab Work No. 3 Substations 220/110/35/10 kV as an important part of the energy system. Calculation of energy efficiency. • Lab Work No. 4 Construction of a 6-35 kV medium voltage line. Calculation of energy efficiency. • Lab Work No. 5 Construction of a cogeneration system in an apartment to increase energy efficiency. • Lab Work No. 6 Construction of a distribution panel for electricity connected with photovoltaic and wind powered panels. • Lab Work No. 7 Construction of a panel with capacitor batteries for the improvement of cos fi.	Energy allocation and use	Desktop computers
Lab 2.: Macro structures and micro structures. Metallographic microscopy Magnetic properties of metallic alloys	Practical explanation of some of the concepts of taught in the course. The new purchased desktops under the project will be used to be connected with the microscope (already in KPT) for the structural analysis • Lab 2.: Macro structures and micro structures. Metallographic microscopy Magnetic properties of metallic alloys	Engineering materials/ Metrology	Desktop computers
Teaching lessons and labs	To run renewable energy SW for simulation, video. To make course assignment	Energy Auditing	Desktop computers
Teaching lessons and labs	To run SW for simulation, video. Practical explanation of some of the concepts of taught in the course	HVAC and cooling control systems	Desktop computers

Table 9 (continued). KPT: Teaching activities description

Name of the teaching activity/Lab	Description	Modules involved	Equipment used and purchased with the reZEB budget
Teaching lessons	Practical explanation of some of the concepts of taught in the course. Teaching lessons	Applied thermo-technics	Desktop computers
Practical activities	Use of the inverter and batteries. Will be used as energy storage system, electrical systems, backup Systems. The topics covered are: • Topic 10. Buildings' energy management. Buildings' management from energy efficiency point of view. • Topic 13. Energy performances of buildings. Energy performances of buildings (energy use intensity (EUI) and energy performance certificates (EPCs). New trends (smart buildings, integration of renewable energy, and advanced materials and technologies) that aim to enhance energy efficiency and sustainability in the built environment.	Energy Auditing	• 1 inverter • 400WA batteries
Teaching lessons and labs	Electrical systems, Backup Systems	Energy Allocation and use	• 1 inverter • 400WA batteries
Teaching lessons and labs	The equipment will be used for their use as energy storage system	HVAC and cooling control systems	• 1 inverter • 400WA batteries
Practical activities	Practical activities about Energy Audit Techniques and Advanced Thermal Analysis; to help students to make a final report. The topics covered are: • Topic 5. Technical economic analysis. Technical economic analysis (cost-effectiveness of energy-saving measures). Its importance in prioritizing projects based on their economic viability and potential return on investment. • Topic 9. Applicable energy efficient technologies. Energy technologies for buildings that improve energy efficiency (advanced HVAC systems, energy-efficient lighting, building automation systems, and renewable energy installations) • Topic 10 – Buildings' energy management. Buildings' management from energy efficiency point of view.	Energy Auditing	Full set of laboratory equipment purchased under the project to perform energy audit
Lab Works No.: 1 & 6	Practical explanation of some of the concepts taught in the course. Work with thermocouples and hygrometer. • Lab 1 Health and Safety at work. Temperatures, their measurements and respective equipment (thermometer with three units of measurement. Laser beam pyrometers such as medical ones etc) • Lab 6 Ceramics in application (refractory coatings)	Engineering materials/ Metrology	Thermocouples and hygrometer from the full set of laboratory equipment
Lab Works No.: 5 to 7	Labs focus on energy-efficient climate control systems, Eelectrical systems, Renewable Energy Design • Lab Work No. 5 Construction of a cogeneration system in an apartment to increase energy efficiency. • Lab Work No. 6 Construction of a distribution panel for electricity connected with photovoltaic and wind powered panels. • Lab Work No. 7 Construction of a panel with capacitor batteries for the improvement of cos fi.	Energy Allocation and Use	Licences purchased

Table 9 (continued). KPT: Teaching activities description

Name of the teaching activity/Lab	Description	Modules involved	Equipment used and purchased with the reZEB budget
Practical lessons	Practical explanation of some of the concepts taught in the course related to topics: • Topic 10. Buildings' energy management. Buildings' management from energy efficiency point of view. • Topic 13. Energy performances of buildings	Energy Auditing	Licences purchased
Lab 2. Elements of a Control System for Energy Efficiency in Cooling and HVAC Systems: System Design	Practical explanation of some of the concepts taught in the course. • Lab 2. Elements of a Control System for Energy Efficiency in Cooling and HVAC Systems: System Design	HVAC and cooling control systems	Licences purchased

Table 10. UC: Teaching activities description

Name of the teaching activity/Lab	Description	Modules involved	Equipment used and purchased with the reZEB budget
Renewable Energy Systems	Students use interactive whiteboards for collaborative discussions on global energy resources, while computers and specialized software are employed to model and compare energy consumption patterns. Practical sessions where students simulate household or industrial energy consumption using software tools, visualized on interactive whiteboards.	Understanding Energy Resources and Consumption	• Interactive whiteboards • Computers
Life Cycle Management	Students perform LCA for products or processes using software tools on computers to identify environmental impacts. Using interactive whiteboards, students collaboratively design lifecycle strategies to minimize energy consumption and waste.	Life Cycle Management	Computers
Sustainable Economic Development	Interactive whiteboards facilitate group analyses of case studies focused on sustainable practices in energy management. Students use computers to conduct simulations on the economic impact of renewable energy adoption.	Sustainable Economic Development	• Interactive whiteboards • Computers
Energy Management	Students use software to conduct virtual energy audits of buildings, analyzing data and presenting findings on interactive whiteboards. Computers are used to model and optimize energy systems in real-time scenarios, supported by software for energy management.	Energy Management	• Interactive whiteboards • Computers • Software license
Financial Management	Students use specialized software on computers to calculate the economic viability of renewable energy projects, including cost-benefit analysis and risk assessment. Practical sessions where students model and analyze different investment scenarios in energy projects.	Financial Management	Computers

Table 11. IBC-M: Teaching activities description

Name of the teaching activity/Lab	Description	Modules involved	Equipment used and purchased with the reZEB budget
Energy Sources analysis Environmental Management Laboratory	Monitoring energy consumption in real-time	• Renewable energy • Energy Management	• Bench multimeter to measure battery voltage, current, and resistance, essential for understanding battery performance and energy storage in chemical sources • Desktop Computers to run software for designing and optimizing solar panels calculations (https://base.k2-systems.com/#/dashboard), wind turbine design, simulation and certification • Thermal imaging camera and Thermal imaging camera Moisture Meter to analyse energy efficiency through the detection of heat and moisture, their patterns, and loss in the buildings.
Techniques for optimizing energy efficiency in buildings	Solar Radiation and Shadows: Impact on Building Energy Efficiency. Understanding solar radiation The effect of shadows on energy efficiency	Renewable energy	• Drone will to capture aerial footage of buildings, and analyse the effects of shadows on energy efficiency from the aerial footage • G-ISBEM software for modelling and monitoring energy efficiency in real-time, optimizing building systems
Energy Saving Methods in Buildings	What are potentials in energy savings in buildings sector Energy-efficient materials Usage of new and old energy efficient materials and potentials in energy savings in building sector Plastic and Aluminum framing vs wooden frames, comparison	• Energy Management • Life Cycle Analysis	• Thermal imaging cameras • Sima PRO software
Monitoring and Optimization of Energy Efficiency in Buildings	Monitoring energy consumption in real-time Optimization techniques for existing building systems Application of digital tools in energy management	• Project Management • Energy Management	G-ISBEM software for modelling and monitoring energy efficiency in real-time, optimizing building systems
Field Trip	The evaluation of the power resources in the region of Mitrovica	Advanced Natural Resources Management	Drone is to be used to conduct aerial surveys of buildings to assess external environmental factors affecting energy efficiency

7. Evidences

Pictures of the labs set-up, details of the equipment and registration evidence, photographs of the equipment used by students and staff are shown in this section.

7.1 Equipment and installation

Each piece of equipment has been installed according to manufacturer guidelines and configured for use in specific training and research applications. When applicable, desktop computers and the workstation were set up with necessary simulation software to facilitate renewable energy and energy efficiency modeling tasks.

Instructors and lab technicians have received training on the operation of all equipment, ensuring safe and effective use by students.

The images in Table 12 to Table 16 illustrate the labs set-up and the equipment purchased and the evidence of the EU support.

Table 12. UET: Labs set up and equipment evidences

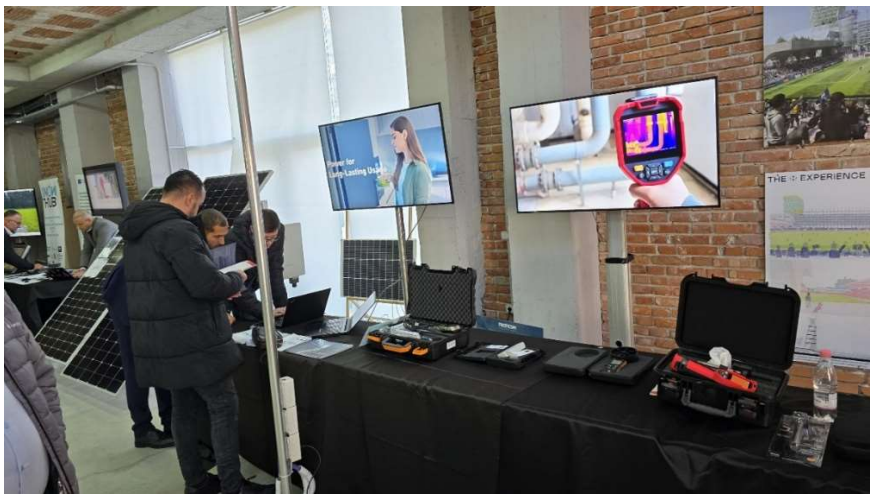
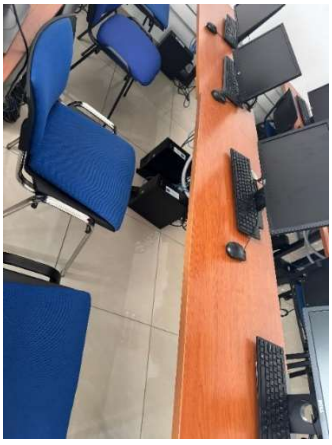
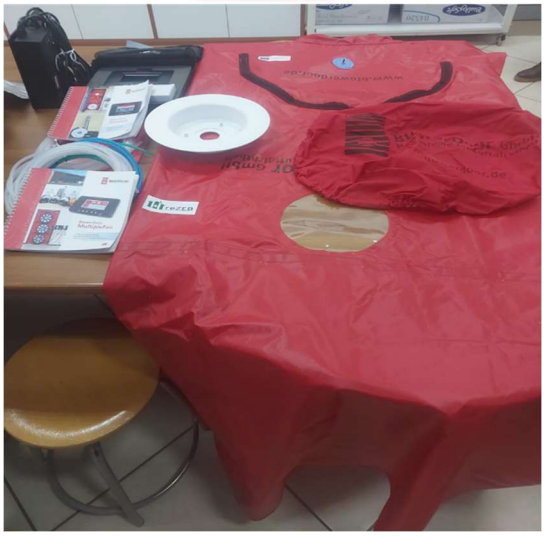
<table>
<tr><td colspan="2"> 
Lab set-up</td></tr>
<tr><td> 
11 Desktop computers</td><td> 
1 Dron</td></tr>
</table>

Table 12 (continued). UET: Labs set up and equipment evidences

 2 Multimeters	 2 Workstations
 1 Projector	  3 Thermal imaging cameras
 2 Small solar panel educational set	 2 Educational set solar panel large

Table 13. U_POLIS: Labs set up and equipment evidences



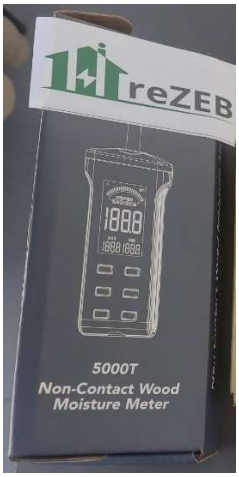
1 Blower door

1 Wind turbine 2kW

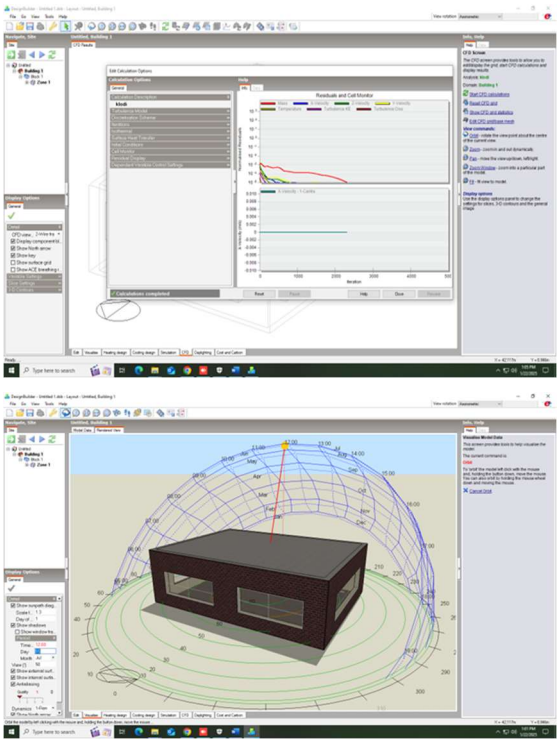
1 Solar PV panels test bench, 4kWp

2 Solar PV system (demonstrational kit for didactic purposes)

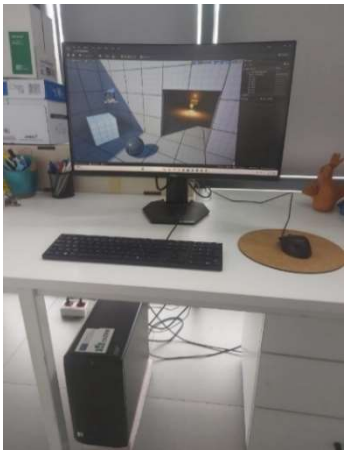
Table 13 (continued). U_POLIS: Labs set up and equipment evidences



1 Hygrometer



2 Design Builder Software licenses

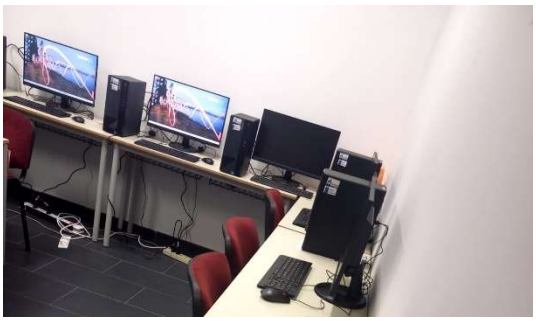


2 Desktop computers

1 Geo-thermal system

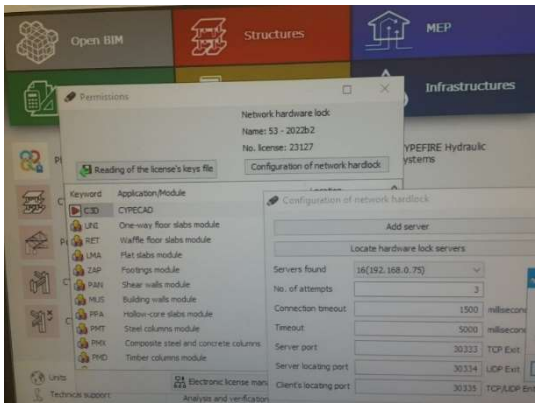
Table 14. KPT: Labs set up and equipment evidences

Labs



5 Computers with monitors

1 Engineering Fundamentals CYPE HVAC license



1 Renewable energy simulation license

1 Triplite inverter charger

Table 14 (continued). KPT: Labs set up and equipment evidences

 1 Hermetic lead acid battery	  1 Full set of laboratory equipment to perform energy audit (thermocouple, anemometer, thermal imaging camera, pressure sensor, thermo hygrometer, light detectors)

Table 15. UC: Labs set up and equipment evidences

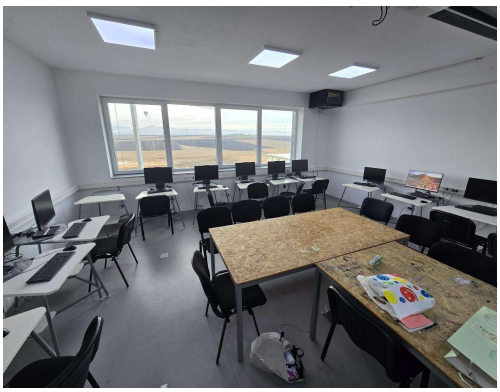
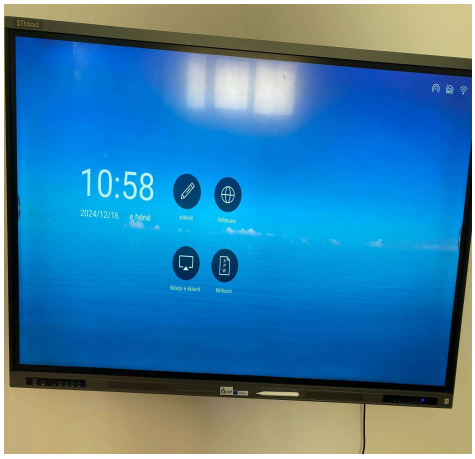
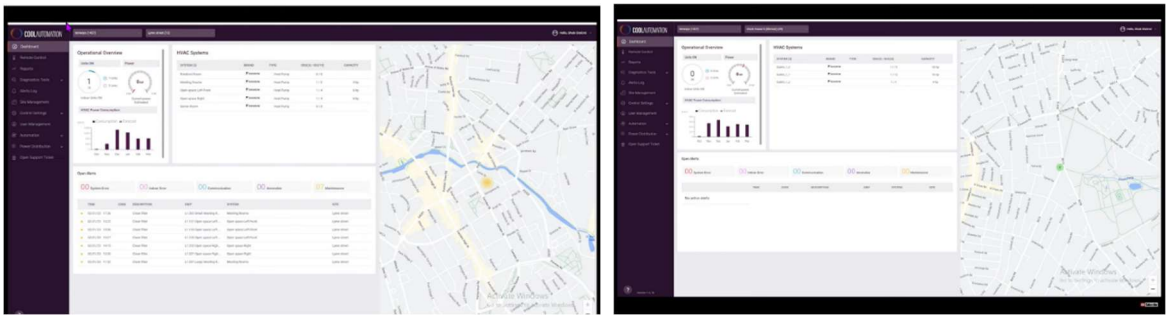
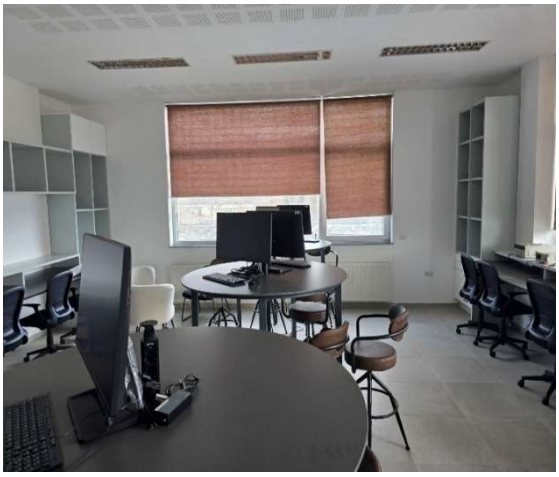
  Labs	
 4 Interactive whiteboards	 15 Computers

Table 15 (continued). UC: Labs set up and equipment evidences



1 License of HVAC software

Table 16. IBC-M: Labs set up and equipment evidences



Labs

Table 16 (continued). IBC-M: Labs set up and equipment evidences

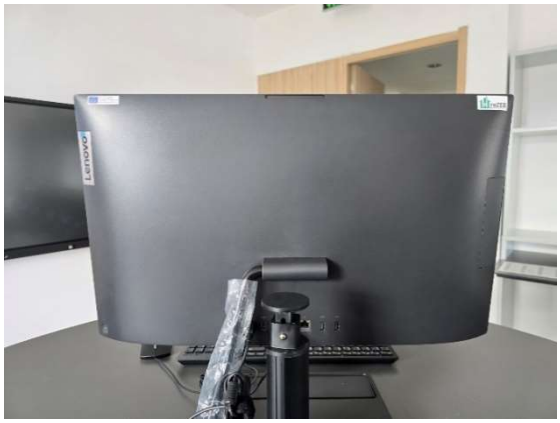
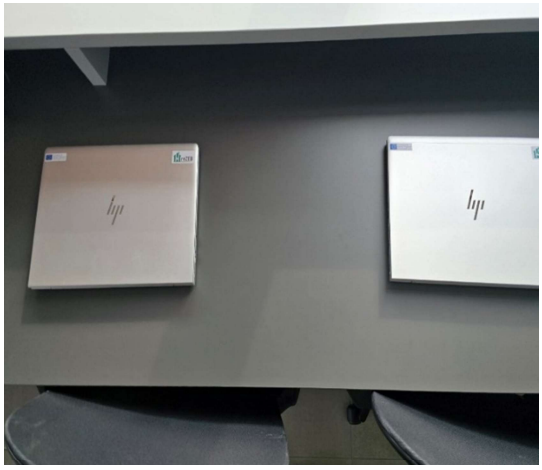
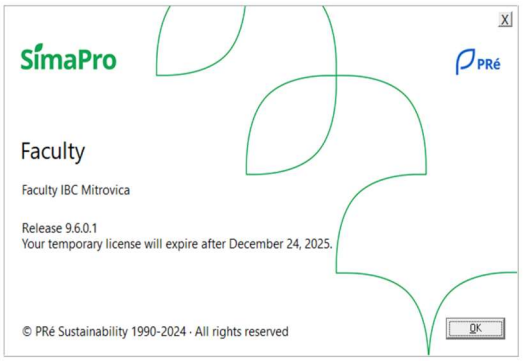
	
1 Thermal imaging camera	1 Thermal imaging moisture meter
	
1 Bench power supply	1 Bench multimeter
	
1 Drone	5 All-in-One desktop computers

Table 16 (continued). IBC-M: Labs set up and equipment evidences

 2 Laptops	 SimaPro software (multiple license) and PhD license

7.2 Equipment being used by the students and staff

Students and staff using the equipment are shown in the following pictures (Table 17 to Table 21).

Table 17. UET: Evidences of students and staff using the equipment

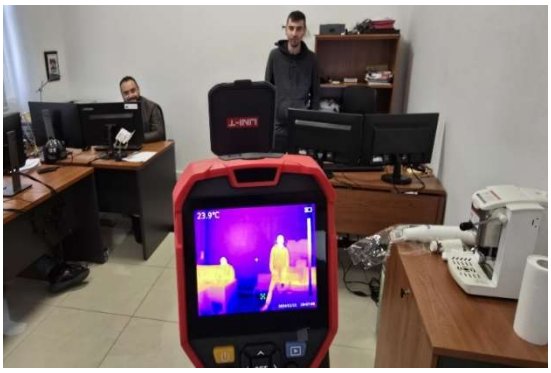
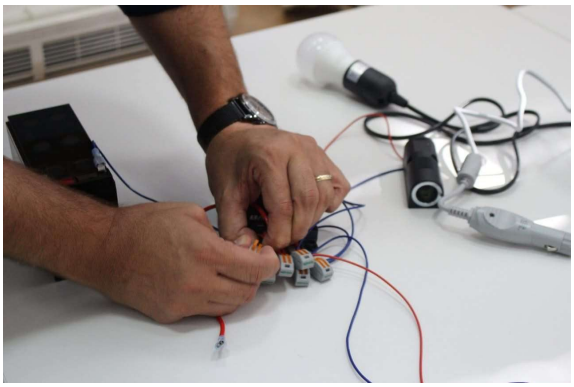
 Staff training	
 Students using the equipment	 Students working at the lab

Table 17 (continued). UET: Evidences of students and staff using the equipment

Presenting reZEB Lab to stakeholders and UET staff

Table 18. U_POLIS: Evidences of students and staff using the equipment

Staff training



Students working at the labs

Table 19. KPT: Evidences of students and staff using the equipment

Students in the laboratories using the equipment with the support of the staff

Table 20. UC: Evidences of students and staff using the equipment

Students using the interactive whiteboard during their exercises

Table 21. IBC-M: Evidences of students and staff using the equipment

Dron being used during practical lessons

Students and staff using the computers during the theory to practice approach activities

Abbreviations

Abbreviation	
HEIs	Higher Education Institutions
IBC-M	International Business College Mitrovica
KPT	Professional College of Tirana
PEC	Project Executive Committee
Rev.	Revision
reZEB	Fostering Renewable energy technologies and energy Efficiency knowledge towards near Zero Energy Buildings of engineers and professionals in Western Balkan Countries
UC	Universum International College
UCLM	University of Castilla-La Mancha
UEC	University eCampus
UET	European University of Tirana
U_POLIS	Polis University
WB	Western Balkan
WP	Work package
WPL	Work package leader