



GreenTech **HORIZONS**

Fostering Dual Green and Digital Transitions through
Education and Innovation in the Neighbourhood East,
Central Asia, and Asia



Co-funded by
the European Union

Deliverable 2.3

Competency-oriented curriculum model

WP 2 - Design a Competency-Oriented Learning Ecosystem



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- **Table with Acronyms**

Acronym	Full Form
CDP	Course Development Plan
LDP	Laboratory Development Plan

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- **EXECUTIVE SUMMARY**

Deliverable D2.3 presents a competency-oriented curriculum model developed within Work Package 2 of the GreenTech Horizons project, aimed at modernizing higher education programs to better respond to green and digital transition needs. The deliverable brings together two complementary instruments: the Course Development Plan (CDP) and the Laboratory Development Plan (LDP), which jointly define how updated curricula and practical learning environments will be implemented across partner higher education institutions.

The curriculum model was developed through a structured, multi-phase process that combined evidence-based analysis, stakeholder consultations, and cross-institutional collaboration. This approach ensured alignment between educational offerings, labor market needs, and broader policy priorities, while promoting consistency, quality, and institutional ownership across diverse regional contexts.

The anticipated impact of this deliverable is the establishment of a solid foundation for future-oriented, competency-based education that enhances graduate employability, strengthens institutional capacity, and supports sustainable economic and societal development. By linking academic content with practical infrastructure and real-world relevance, the model contributes to long-term education reform and supports partner institutions in leading green and digital transformation processes in their regions.

1. INTRODUCTION

The **GreenTech Horizons** project establishes a diverse and multi-country cross-regional partnership that includes:

- **Azerbaijan:** 3 higher education institutions (HEIs) and 1 industry partner,
- **Kazakhstan:** 3 HEIs and 1 industry partner,
- **Mongolia:** 2 HEIs and 1 industry partner,
- **European Union and Associated Countries:** 5 HEIs from 4 EU Member States (Latvia, Lithuania, Poland, Croatia), 1 HEI from Serbia (a third country associated with the Programme), and 1 VET provider from Latvia.

The primary objective of **GreenTech Horizons** is to support a successful **dual green and digital transition** in the Neighbourhood East, Central Asia, and Asia regions. The project places particular emphasis on addressing the specific contexts of Azerbaijan, Kazakhstan, and Mongolia by equipping stakeholders with the skills and competencies required to meet the demands of the modern workforce. This includes a focus on **green, digital, and business skills** that contribute to **sustainable economic growth** and **job creation**.

Core Components of the Project

1. **Competency-Oriented Learning Ecosystem:** At the heart of the project is an **innovative competency-oriented curriculum model** designed to modernize and enhance existing educational frameworks in eight HEIs across the target regions. This model will enable students and educators to address the challenges and opportunities posed by the green and digital transitions, fostering **sustainable societal impact**.
2. **Integration of eLearning and MOOCs:** The project will establish a robust **eLearning ecosystem**, incorporating competency-based courses designed using innovative instructional methodologies. The integration of **Massive Open Online Courses (MOOCs)** will ensure wide accessibility and scalability, enhancing learning outcomes for students and educators alike.
3. **Targeted Stakeholder Engagement:** The project engages stakeholders at multiple levels:
 - At the **individual level**, it targets students, educators, and professionals.
 - At the **institutional and systemic levels**, it involves higher education institutions, employers, policymakers, and governments to ensure a cohesive and sustainable approach to capacity building.
4. **Strategic Alignment with Regional and Global Priorities:** By addressing the twin green and digital transitions, the project supports regional development goals while aligning with broader EU priorities for sustainable growth, digital transformation, and global collaboration.

Deliverable D2.3 Competency-oriented curriculum model presents the formal output of one of the core academic modernization activities under Work Package 2 (WP2) of the GreenTech Horizons project. The deliverable comprises two interlinked outputs:

- The Course Development Plan (CDP)
- The Laboratory Development Plan (LDP)

Both plans define the academic architecture and infrastructural foundations that will enable the full implementation of competency-based, industry-relevant, and future-oriented curricula across partner higher education institutions (HEIs) involved in the project. The ultimate aim is to ensure that graduates are equipped with the knowledge, skills, and competencies necessary to actively contribute to - and lead - the green and digital transitions in their respective countries and regions. This deliverable is not the isolated product of a standalone activity, but the result of a carefully designed, multi-phased, data-driven and consultative process implemented since the outset of the GreenTech Horizons project. The methodology applied reflects good international practices for curriculum modernization, capacity building, and policy-informed program design in higher education systems undergoing systemic transformation.

2. METHODOLOGICAL PATHWAY TO COMPETENCY-ORIENTED CURRICULUM MODEL

The elaboration of **D2.3 Competency-oriented curriculum model** followed five major consecutive phases, ensuring both academic rigor and strong alignment with project objectives.

2.1 Phase 1: Foundational Analytical Stage – The State-of-the-Art Report on Green and Digital Transition

The project commenced with an in-depth analytical exercise documented in *Deliverable D2.1: State-of-the-Art Report on Green and Digital Transition*. This report established a robust empirical and contextual foundation for subsequent curriculum and capacity-building activities.

Key methodological elements included:

- Extensive desk research covering over 100 strategic policy documents, national development plans, academic literature, and global trend reports related to green and digital transitions.
- Curriculum mapping of more than 40 existing higher education programs across the eight participating HEIs in Azerbaijan, Kazakhstan, and Mongolia.
- Labor market needs assessment across more than 50 sectors to identify current and emerging skill shortages linked to green and digital economies.
- Large-scale online survey conducted with 895 industry professionals across the three target countries, generating quantitative evidence of workforce demands and capability gaps.
- Semi-structured interviews with 125 HEI representatives, providing qualitative insights into institutional capacities, governance frameworks, and reform barriers.

The analysis identified several systemic gaps and constraints, including:

- Substantial skill shortages in areas such as AI, IoT, smart manufacturing, renewable energy, circular economy, and sustainability governance;
- Institutional capacity limitations for embedding interdisciplinary and cross-cutting competencies into curricula;
- Misalignment between academic program offerings and industry workforce needs.

Distinct regional barriers were also noted: Azerbaijan's high fossil fuel dependency (85% of GDP), regulatory burdens impacting 55% of businesses in Kazakhstan, and limited renewable energy integration in Mongolia (only 20% of HEIs offering such programs).

2.2. Phase 2: Competency Framework Development — The Twin Green and Digital Transition Competency Framework

Building directly on the empirical foundation established through the State-of-the-Art Report, the consortium developed the *Competency Framework for Twin Green and Digital Transition*, which serves as both:

- A strategic reference model for institutional capacity-building across participating HEIs, and
- An operational design tool for curriculum modernization and alignment with workforce needs.

The framework defines:

- Three competency domains: Green, Digital, and Business competencies;
- Sixteen competency areas across these domains;
- Seventy-two specific competencies organized into functional, managerial, and systemic levels.

The Competency Framework ensures that the GreenTech Horizons curriculum modernization is directly linked to policy goals, labor market expectations, and institutional learning outcomes, while simultaneously embedding transdisciplinary and future-facing capabilities into the participating HEI systems.

2.3 Phase 3: Initial Mapping of Potential Courses

Based on the Competency Framework, the consortium collectively identified a long-list of 18 potential courses, structured along the three Talent Triangle domains:

- Green Area (6 courses): e.g., Sustainable Energy Systems, Environmental Science and Technology, Circular Economy, Smart Cities, Environmental Governance, and Sustainable Agriculture.
- Digital Area (6 courses): e.g., Digital Tools for Sustainability, Smart Systems and IoT, AI and Big Data, Cybersecurity and Data Ethics, Green Digital Infrastructure, and Digital Literacy.
- Business Area (6 courses): e.g., Green Business Operations, Ethical Leadership, Green Entrepreneurship, Strategic Management for Twin Transition, Stakeholder Engagement, and Sustainable Project Management.

The table below presents the full initial list of 18 courses identified during the consortium-wide mapping phase. Each course is categorized by domain (Green, Digital, Business), with its corresponding set of targeted competencies derived from the GreenTech Horizons Competency Framework.

Table 1. Initial mapping of 18 potential courses aligned with Twin Green & Digital framework

Area	Course title	Associated competencies
Green	Sustainable Energy Systems	<ul style="list-style-type: none"> ● Expertise in solar, wind, hydro technologies ● Integration into systems ● Application in operations ● Strategies for energy/resource efficiency
	Environmental Science and Technology	<ul style="list-style-type: none"> ● Environmental science principles ● Climate change mitigation/adaptation ● Risk assessment ● Biodiversity and ecosystem protection ● Environmental impact assessments
	Circular Economy and Zero-Waste Strategies	<ul style="list-style-type: none"> ● Waste reduction models ● Recycling strategies ● Eco-design ● Sustainable supply chains
	Smart Cities and Urban Green Innovation	<ul style="list-style-type: none"> ● Green infrastructure ● Urban sustainability strategies ● Mobility and transport planning ● Resilient urban ecosystems
	Green Policy and Environmental Governance	<ul style="list-style-type: none"> ● Environmental regulations and standards ● Policy development for sustainability ● Compliance and advocacy ● Stakeholder policy influence
	Sustainable Agriculture	<ul style="list-style-type: none"> ● Regenerative farming practices ● Sustainable food systems ● Land and soil conservation ● Agri-environmental technologies
Digital	Digital Tools for Sustainability	<ul style="list-style-type: none"> ● Use of digital platforms in sustainability ● Data visualization ● Sustainability-focused digital applications ● Software for energy/resource management
	Smart Systems and IoT for Green Innovation	<ul style="list-style-type: none"> ● IoT systems in sustainability ● Real-time environmental monitoring ● Automation in green processes ● Interoperability and integration
	AI and Big Data for Sustainability	<ul style="list-style-type: none"> ● AI for environmental forecasting ● Big data analysis ● Predictive modeling

		<ul style="list-style-type: none"> ● Algorithmic decision support 	
	Cybersecurity and Data Ethics in Green Innovation	<ul style="list-style-type: none"> ● Secure data management ● Ethical AI use ● Cyber risk in green systems ● Data governance in sustainability 	
	Green Digital Infrastructure and Cloud Computing	<ul style="list-style-type: none"> ● Energy-efficient computing ● Sustainable data centers ● Cloud optimization for green goals ● Green software engineering 	
	Digital Literacy and Transformation for Sustainability	<ul style="list-style-type: none"> ● Digital upskilling for sustainability ● Leading digital transformation ● Cultural change in organizations ● Global digital strategy for green goals 	
Business	Sustainable Business Operations	<ul style="list-style-type: none"> ● Daily sustainability practices ● Supply chain greening ● Operational optimization ● Strategic sustainability integration 	
	Ethical Leadership and Corporate Governance	<ul style="list-style-type: none"> ● Sustainability governance ● Ethical decision-making ● ESG reporting ● Global standards influence 	
	Green Entrepreneurship and Innovation	<ul style="list-style-type: none"> ● Sustainability-linked ventures ● Innovation ecosystems ● Start-up strategies ● Global entrepreneurship frameworks 	
	Green Marketing and Communication	<ul style="list-style-type: none"> ● Environmentally responsible marketing strategies ● Sustainable consumer behavior and market trends ● Communicating sustainability values across different media and stakeholder groups ● Critical evaluation of greenwashing practices and ethical marketing standards 	
	Engaging Stakeholders for Sustainable Change	<ul style="list-style-type: none"> ● Managing stakeholder relations ● Cross-sector collaboration ● Public-private partnerships ● Global engagement practices 	
	Managing Green and Sustainable Projects	<ul style="list-style-type: none"> ● Project planning and delivery ● Risk identification and mitigation ● Program-level management ● Budgeting for sustainability outcomes 	

Universal (cross-cutting)	Sustainable Business Strategies	<ul style="list-style-type: none"> ● Integrating sustainability into core business strategy and competitive positioning ● Aligning value creation with ESG goals and macroeconomic trends ● Applying strategic tools for sustainable growth, innovation, and global expansion ● Evaluating and measuring business impact using sustainability and financial metrics
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Each course candidate was mapped directly to the Competency Framework to ensure consistency and operational alignment.

2.4 Phase 4: Prioritization and Final Course Selection Process

To ensure focused development while maximizing institutional relevance and regional applicability, a structured internal ranking and validation process was carried out across the consortium. This process utilized both:

- Partner institutional input (ranking and feasibility assessment);
- Cross-institutional consultations and expert group reviews.

Based on internal ranking, feasibility assessments, and cross-institutional expert validation, the following 10 courses were prioritized for full development under the GreenTech Horizons project. This final list reflects both regional relevance and balanced coverage of green, digital, and business competency areas.

Table 2. Final selection of 10 priority courses for curriculum development

Domain	Course Title
Green Area	Environmental Science and Technology
	Smart Cities and Urban Green Innovation
	Sustainable Energy Systems
Digital Area	Digital Literacy and Transformation for Sustainability
	Digital Tools for Sustainability
	Cyber-security and Data Ethics in Green Innovation
Business Area	Green and Sustainable Project Management
	Green Entrepreneurship and Innovation
	Green Marketing and Communication
Universal (cross-cutting)	Sustainable Business Strategy

These 10 courses form the foundation of the current Course Development Plan (CDP), providing a balanced academic architecture across green, digital, and business dimensions of the Twin Transition.

2.5 Phase 5: Structured Preparation of CDP and LDP

The competency-oriented curriculum model developed within GreenTech Horizons is composed of two mutually integrated components:

- The Course Development Plan (CDP) — defining the full academic architecture, course structure, and competency alignment of the updated curricula.
- The Laboratory Development Plan (LDP) — detailing how updated laboratory infrastructure will directly support delivery of practical, hands-on, and applied learning aligned with the updated courses.

Both components are fully aligned with the GreenTech Horizons Competency Framework for Twin Green and Digital Transition and together form the operational foundation for subsequent development of teaching materials (D3.1) and laboratory reinforcement (D3.3).

The Course Development Plan (CDP)

The CDP establishes the full academic blueprint for each of the 10 courses, including:

- Course descriptions and learning objectives;
- Measurable learning outcomes directly linked to the Competency Framework;
- ECTS credit allocation and standardized workload structures;
- 10-module content breakdown for each course;
- Applied pedagogical methodologies (competency-based assessment, active learning, blended delivery, integration of AI-supported learning content, microlearning components, and MOOCs);
- Institutional division of labor for course development.

The CDPs will serve as the operational foundation for Deliverable D3.1 — full development of teaching and learning materials, including e-textbooks, lecture notes, practical exercises, and AI-generated video content.

The Laboratory Development Plan (LDP)

In parallel, the LDP provides the laboratory modernization roadmap that complements course delivery through hands-on, practice-oriented learning environments.

For each laboratory, the LDP details:

- Linkages to the newly developed courses;
- Equipment specification and functional roles in learning delivery;
- Staffing and operational management plans for both the project implementation phase and post-project sustainability;
- Revised mission statements clearly referencing the EU-funded reinforcement and long-term utilization commitments.

The LDP developed under this deliverable will directly serve as the operational foundation for Deliverable D3.3: Equipping and Operationalizing 8 Laboratories. Each partner's LDP provides detailed guidance on equipment specification, integration into updated curricula, institutional staffing, and long-term sustainability mechanisms necessary for effective laboratory reinforcement under the EU grant.

3. PART A: COURSE DEVELOPMENT PLAN (CDP)

3.1 COURSE PORTFOLIO - GREEN AREA

1. Course Title
<i>Environmental Science & Technology</i>
2. Course Description
This course provides comprehensive knowledge and applied skills in environmental science and the use of technological innovations to support sustainable development. It explores the dynamic interaction between natural systems and industrial processes, with particular emphasis on environmental monitoring, pollution prevention, and compliance with regulatory frameworks. Students will develop competencies in applying emerging technologies, interpreting EU environmental legislation, and using ESG metrics and key performance indicators (KPIs) to assess and improve environmental and sustainability performance. The course prepares students to critically evaluate environmental risks, design mitigation strategies, and contribute to data-driven, policy-relevant solutions in the context of green and digital transition.
3. Learning Objectives
By the end of this course, students will be able to: <ul style="list-style-type: none"> • LO-1: Collect, analyze, and interpret environmental data using field and laboratory methods to assess air, water, soil, and waste quality in line with EU monitoring requirements. • LO-2: Apply EU environmental regulations and directives (e.g., Water Framework Directive, Industrial Emissions Directive) to real-world industrial and community-based environmental management scenarios. • LO-3: Use ESG frameworks and calculate environmental Key Performance Indicators (KPIs) to evaluate sustainability performance in industrial and organizational contexts. • LO-4: Identify sources and pathways of environmental pollution and design appropriate mitigation technologies or management strategies to reduce ecological and health risks. • LO-5: Develop and communicate evidence-based environmental reports and action plans, integrating technical data, regulatory compliance, and sustainability targets.
4. Learning Outcomes (Competency-Based Outcomes)
<ul style="list-style-type: none"> • Outcome 1: Analyze environmental systems and industrial processes to identify sustainability challenges and opportunities across sectors. • Outcome 2: Design and implement environmental monitoring strategies using field methods, laboratory protocols, and digital tools in compliance with EU directives. • Outcome 3: Apply ESG frameworks and calculate environmental KPIs to evaluate and communicate organizational sustainability performance. • Outcome 4: Develop evidence-based mitigation and control strategies for pollution and resource inefficiency using appropriate environmental technologies. • Outcome 5: Integrate regulatory, technical, and policy knowledge to prepare compliance documentation and sustainability action plans for public or private

stakeholders.			
5. Relevant Competencies (Link to Competency Framework for Twin Green & Digital Transition)			
Competency Area	Competency	Competency Description	
Green	G2.1	Principles of environmental science and sustainability	
Green	G2.5	Environmental impact assessment and management	
Green	G3.1	Circular economy models for waste reduction and resource efficiency	
Green	G5.1	Understanding and application of environmental policies and regulations	
Green	G5.2	Integration of environmental ethics into corporate strategies and decision-making	
Digital	D10.2	Cultivating digital culture to support sustainable business practices	
Business	B11.1	Integrating sustainability principles into daily business operations	
Business	B11.2	Leading ethical governance and corporate leadership for sustainability	
Business	B11.4	Measuring and reporting sustainability performance with actionable insights	
Business	B12.3	Identifying and creating sustainable value propositions for businesses	
6. ECTS Credits			
<i>Total number of ECTS credits allocated to the course:</i>			
<ul style="list-style-type: none"> • Standard for all courses is 6 ECTS • 6 ECTS = approx. 180 hours total workload. 			
7. Total Workload Breakdown			
<ul style="list-style-type: none"> • for 6 ECTS → ~ 180 hours 			
Component	Contact Hours	Student Workload	Description / Notes
Lectures	45h	—	Theoretical foundations on...
Practical Workshops	25h	—	Hands-on sessions where students work with environmental monitoring tools, regulatory templates, KPI lists, and environmental management system components.
Supervised Group Work	10h	—	Students collaborate in small groups to solve applied problems, develop monitoring strategies, prepare compliance documents, or design sustainability

			interventions with guidance from instructors.
Self-study	—	70h	Background reading, case analysis, theory reflection
Assessments/ Group project & presentation	—	20h	Monitoring plan within Final project / Oral presentation.
Other (field/site visit/evaluation and reflection)	—	10h	Field visit to an industrial or environmental management site (e.g., wastewater plant) / Structured reflection activity linking field observations
Total	80h	100h	~180 hours total workload

8. Course Structure (10 Modules)

Module No.	Module Title	Short Description
M1	Foundations of Environmental Science	Explore the structure and function of natural systems (air, water, soil), environmental processes, and human impact on the environment.
M2	Environmental pollution and health impact	Examine major pollutants (chemical, biological, physical), sources and pathways, and their effects on ecosystems and human health.
M3	Environmental monitoring and data collection	Introduction to environmental sampling, field methods, lab protocols, quality assurance, and the interpretation of monitoring data.
M4	Environmental regulations and EU Directives	Detailed overview of EU environmental legislation, compliance frameworks, and their national-level implementation.
M5	Environmental technologies and control measures	Survey of clean technologies for air, water, and soil protection focus on industrial applications, waste treatment, and emission reduction.
M6	Environmental Management Systems (EMS)	Explore the structure and application of ISO 14001, including compliance audits, and continuous improvement.
M7	ESG frameworks and environmental KPIs	Understand the role of environmental data in ESG reporting, calculate key indicators (GHG emissions, water use, waste intensity), and link to CSRD/EU Taxonomy.
M8	Circular economy	Learn about resource flows, life-cycle thinking, waste hierarchy, and strategies for reducing, reusing, and recycling in line with EU circular economy goals.
M9	Environmental risk	Methods for identifying and assessing environmental

	assessment and resilience	risks (quantitative and qualitative), including climate vulnerability, disaster prevention, and system resilience.
M10	Environmental action planning	Capstone simulation: learners develop an environmental action plan for a selected sector or site, integrating monitoring, compliance, KPIs, and communication tools.

9. Pedagogical Approaches

Instructional Approach	Application	Relation to D3.1 Materials
Active learning (PBL, simulation cases)	All modules	Simulation-based learning experience that mirrors real-world professional tasks in environmental science and sustainability management. Realistic environmental scenarios such as pollution events, industrial audits, or sustainability reporting.
Competency-based assessment	All modules	Each module includes targeted tasks mapped to Twin Transition Competency Framework.
eLearning platforms integration	All modules	All learning materials will be fully available in eLearning platform: authorized lectures, reading materials, templates, cases, assignments, quizzes, self-assessment tools.
Microlearning formats	All modules	Modular skill-building units that are designed to focus on a specific environmental science or sustainability topic and provide practical tools for immediate application. Formats include checklists (e.g., key elements of an environmental monitoring plan), templates (e.g., ESG compliance matrix or KPI dashboard), flowcharts (e.g., steps for selecting pollution control technologies).
AI-assisted video tutorials	All modules	For each module, short AI-generated video introductions (2–3 minutes) summarizing key module concepts and learning goals.
Blended learning	Entire course	Flipped classroom structure: students prepare basic concepts via eLearning materials, while in-class activities focus on applied exercises, simulations, and mentoring sessions.

10. Preparation for D3.1 Teaching & Learning Materials

D3.1 Component	Input from CDP and Pedagogy	Notes on Content Development
E-Textbook (approx.	Content structure based on 10-	Authors assigned per module;

50-80 pages)	module outline; key concepts from Learning Outcomes and Competency Areas.	ensure competency mapping is visible in chapters.
Authorized lectures	Module-based lectures following active learning principles.	Each module includes theoretical inputs and applies case discussions.
Practical training materials	Derived from active learning approaches, problem-based tasks, real-life business scenarios.	Industry and public sector examples will be embedded per module.
AI-supported video clips (~20 -30 minutes, 2 per module)	Short AI-supported lectures focusing on complex concepts, core models, and applied frameworks.	Scripts to be developed collaboratively based on module content.
Course module structure	Directly derived from Section 8 (Module Structure Table).	Ensures logical learning progression and integration across materials.

10. Consortium Institutions Involved in Preparation

List institutions that will co-develop this course:

- Institution 1: University of Novi Sad (UNS), Serbia - Lead Institution

1. Course Title

Smart cities and urban green innovation

2. Course Description

The course introduces students to the practical and strategic use of digital technologies in support of urban development and green innovation. The course introduces the practical and strategic use of digital technologies for sustainable urban development. Students learn how IoT sensing, GIS & remote sensing, AI analytics, digital twins, service-oriented infrastructure and reliability engineering enable data-driven planning, critical infrastructure protection, and inclusive governance. Through case-based and project-based learning, participants design and evaluate solutions aligned with EU policy (e.g., CER, Noise Directive) and SDGs, gaining skills in visualization, simulation, and ethical technology deployment. The course equips students with knowledge of smart city frameworks. The course is intended for undergraduate and graduate students in engineering, business, IT, sustainability, and related fields seeking applied digital competencies for sustainability-oriented careers.

3. Learning Objectives

Upon successful completion of this course, students will be able to:

- LO-1: Urban technologies in smart cities.
- LO-2: Identify and evaluate urban planning concepts and applications that support sustainable development.
- LO-3: Use data visualization tools to apply development strategy in particular city effectively.
- LO-4: Apply software solutions for energy/resource efficiency and monitoring.

- *LO-5: Design sustainability-focused smart cities in business or public sector settings.*

4. Learning Outcomes (Competency-Based Outcomes)

Upon completion, students will be able to:

- *Outcome 1: Plan and design of green infrastructure*
- *Outcome 2: Design of urban sustainability strategies*
- *Outcome 3: Development of city mobility and transport planning*
- *Outcome 4: Develop and simulate sustainability scenarios in resilient urban ecosystems*
- *Outcome 5: Evaluate digital sustainability solutions through stakeholder engagement, impact assessment, and ethical review frameworks.*

5. Relevant Competencies (Link to Competency Framework for Twin Green & Digital Transition)

Competency Area	Competency	Competency Description
Green	G1.2	Integration of renewable energy technologies into existing systems
Green	G2.1	Principles of environmental science and sustainability
Green	G1.4	Strategies for energy conservation and resource efficiency
Green	G5.1	Understanding and application of environmental policies and regulations
Green	G1.3	Application of green technologies in business and operations
Green	G4.2	Smart cities and sustainable urban development strategies
Digital	D6.5	Integration of AI, IoT, and big data to drive green solutions
Business	B14.4	Communicating effectively with stakeholders on sustainability-related matters

6. ECTS Credits

Total number of ECTS credits allocated to the course:

- Standard for all courses is 6 ECTS
- 6 ECTS = approx. 180 hours total workload.

7. Total Workload Breakdown

Component	Contact Hours	Student Workload	Description / Notes
Lectures	45h	—	Theoretical foundations on digital tools and sustainability frameworks
Practical Workshops	25h	—	Tool walkthroughs, data visualization labs

Supervised Group Work	10h	—	Guidance on group sustainability tech project
Self-study	—	70h	Background reading, case analysis, tool practice and reflection
Assessments/ Group project & presentation	—	20h	Tool application project, oral presentation
Other (field/site visit/evaluation and reflection)	—	10h	Knowledge sharing from experts from digital/sustainability sectors
Total	80h	100h	~180 hours total workload

8. Course Structure (6 Modules)

Module No.	Module Title	Short Description
M1	Global trends in urban development	The introduction in Smart cities and urban green innovation, explanation of main trends and state of the art in urban development.
M2	Factors influencing urbanization processes	The economical and technological factors analysis for planning of city infrastructure, the prognosis and factors of city development, long term planning, modelling and definition of critical infrastructure.
M3	Modern paradigms of urban planning	City development concept, including macro modelling and semantic data models, standards.
M4	Basic principles of sustainable urban development	Sustainability vs efficiency of city infrastructure, energy balance, energy consumption in buildings.
M5	The legal framework system regulating urban planning	Legal framework system regulating urban planning, in particular OMA2050, and EU trends in Smart city concept development.
M6	Public participation in urban planning	The concept of sustainable living: livinglab for individuals, business and public authorities.
M7	IoT based automation for Smart city	IoT, intelligent transport and resilience of infrastructure for city planning
M8	Critical infrastructure	EU concept for critical infrastructure protection in cities
M9	Service oriented infrastructure	Characteristics, factors and indicators that define SmartCity the Interdependencies of city life, structure, people, and services, and be able to control and coordinate at every level of activity for the benefit of the community.
M10	Reliability of CI	This mapping, measurement, and management of each layer of the city's infrastructure, engineering structures,

		streets, lighting, buildings, green spaces, and environment, best practice examples.
9. Pedagogical Approaches		
Instructional Approach	Application	Relation to D3.1 Materials
Active learning (PBL, simulation cases)	M2-9	Students collaboratively develop a digital solution for a real sustainability case using tools from each module.
Competency-based assessment	All modules	Each module includes targeted tasks mapped to Twin Transition Competency Framework.
eLearning platforms integration	All modules	All learning materials will be fully available in eLearning platform: authorized lectures, reading materials, templates, cases, assignments, quizzes, self-assessment tools.
Microlearning formats	All modules	Checklists for IoT deployment, cheat-sheets for cloud commands, flowcharts for AI model selection.
AI-assisted video tutorials	All modules	For each module, short AI-generated video introductions (2–3 minutes) summarizing key module concepts and learning goals.
Blended learning	Entire course	Flipped classroom structure: students prepare basic concepts via eLearning materials, while in-class activities focus on applied exercises, simulations, and mentoring sessions.
10. Preparation for D3.1 Teaching & Learning Materials		
D3.1 Component	Input from CDP and Pedagogy	Notes on Content Development
E-Textbook (approx. 50-80 pages)	Content structure based on 10-module outline; key concepts from Learning Outcomes and Competency Areas.	Authors assigned per module; ensure competency mapping is visible in chapters.
Authorized lectures	Module-based lectures following active learning principles.	Each module includes theoretical inputs and applies case discussions.
Practical training materials	Derived from active learning approaches, problem-based tasks, real-life business scenarios.	Industry and public sector examples will be embedded per module.
AI-supported video clips (~20 -30 minutes, 2 per module)	Short AI-supported lectures focusing on complex concepts, core models, and applied frameworks.	Scripts to be developed collaboratively based on module content.

Course module structure	Directly derived from Section 8 (Module Structure Table).	Ensures logical learning progression and integration across materials.
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10. Consortium Institutions Involved in Preparation

List institutions that will co-develop this course:

- Institution 1: Riga Technical University (RTU) — Lead Institution
- Institution 2: UNIST — Partner

1. Course Title

Sustainable Energy Systems

2. Course Description

This course introduces students to the basic concepts of energy generation and energy utilization principles, historical patterns of energy consumption and the development of energy systems. Strong emphasis will be given to the evolution of fuel sources (transitions in energy carriers), focusing on new and emerging fuels. In particular, students will get a chance to explore the sustainability of fuels, concepts of renewable energy sources and the inherent synergy between different contemporary energy systems and technologies. Students will gain insight into fuel supply chains, infrastructural requirements and lifecycle impacts of various energy carriers. It will explain a strong bond between contemporary technologies and energy security, energy resilience and energy equity, energy demand and society development. The course will explain the main principle of operation for key sustainable energy resources, while noting the fundamental importance of the balanced energy mix in a sustainable system. Through lectures, discussions, and applied projects, students will be equipped to recognize the principles of operation for different sustainable energy systems and critically evaluate future pathways for fuel diversification and sustainable energy systems.

3. Learning Objectives

Upon successful completion of this course, students will be able to:

- LO-1: Understand the basic concept of energy system and recognize the historical pattern of development
- LO-2: Have a functional understanding of basic operational principles of different energy systems both classical and contemporary
- LO-3: Analyze the role of renewable energy sources in sustainable development
- LO-4: Understand the concept and the importance of energy security, resilience and equity, and the role of sustainable solutions
- LO-5: Recognize the importance and critically evaluate future pathways for fuel diversification.

4. Learning Outcomes (Competency-Based Outcomes)

Upon completion, students will be able to:

- Outcome 1: Utilize software tools (such as HOMER, SAM, PVSyst, MATLAB etc.) to model, simulate, and analyze the operational principles of sustainable energy systems, enabling data-driven decision-making for energy management and optimization

- Outcome 2: Collaborate in multidisciplinary teams to develop innovative solutions addressing energy security, resilience, and equity challenges
- Outcome 3: Integrate knowledge of contemporary energy technologies to design conceptual models of balanced energy mixes for sustainable urban and rural settings
- Outcome 4: Evaluate lifecycle environmental impacts of various energy carriers and propose mitigation strategies for reducing carbon footprint
- Outcome 5: Compare and evaluate the operational principles of conventional and sustainable energy systems, including their environmental and technological impacts

5. Relevant Competencies (Link to Competency Framework for Twin Green & Digital Transition)

Competency Area	Code	Competency Description
Green	G1.1	Expertise in solar, wind, hydro, and other renewable energy technologies
Green	G1.2	Integration of renewable energy technologies into existing systems
Green	G1.3	Application of green technologies in business and operations
Green	G1.4	Strategies for energy conservation and resource efficiency
Green	G2.2	Strategies for climate change mitigation and adaptation
Green	G3.2	Strategies for recycling and sustainable resource utilization
Green	G4.1	Design and implementation of green infrastructure in urban settings
Green	G4.2	Smart cities and sustainable urban development strategies
Digital	D6.4	Data-driven decision-making for sustainability outcomes
Digital	D6.6	Use of simulation tools for energy system modeling and optimization
Business	B11.3	Developing and implementing long-term sustainability strategies for businesses
Business	B11.5	Designing sustainable finance and investment strategies for green projects
Business	B15.5	Monitoring, evaluating, and reporting on sustainability-related projects

6. ECTS Credits

Total number of ECTS credits allocated to the course:

- Standard for all courses is 6 ECTS
- 6 ECTS = approx. 180 hours total workload.

7. Total Workload Breakdown

- for 6 ECTS → ~ 180 hours

Component	Contact Hours	Student Workload	Description / Notes
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Lectures	45h	—	Theoretical foundations on energy system operation
Practical Workshops	25h	—	Energy system development, modeling and analysis of operation
Supervised Group Work	10h	—	Project guidance and feedback
Self-study	—	70h	Background reading, case study analysis, theory reflection
Assessments/ Group project & presentation	—	20h	Project plan, oral defense, written exam
Other (field/site visit/evaluation and reflection)	—	10h	Visit to companies/guest speakers/Individual essay and peer assessment
Total	80h	100h	~180 hours total workload

8. Course Structure (10 Modules)

Module No.	Module Title	Short Description
M1	Development of energy system	Introduction to the basic concepts of energy systems, historical development
M2	Fuel types and energy mix	The introduction to energy source concept, concept of energy mix, influence of the energy mix on sustainability and energy security
M3	Renewable energy systems 1	Introduction to the renewable energy systems – solar and basic principles of operation.
M4	Renewable energy systems 2	Introduction to the renewable energy systems - wind and basic principles of operation.
M5	Renewable energy systems 3	Introduction to the renewable energy systems - hydro and basic principles of operation.
M6	Integration of distributed energy resources	Basic parameters of energy networks, energy generation and energy distribution, basic requirements for integration of sustainable energy systems
M7	Future energy fuels	The comparative analysis of new and emerging fuel technologies for the future.
M8	Sustainability of energy systems	Basic principles of energy sustainability, levelized cost of energy, energy economics, Lifecycle assessment, carbon footprint analysis, emissions factors and environmental trade-offs.
M9	Software Tools for Energy System Modeling	Introduction to basic software tools used in the modeling, simulation, and optimization of sustainable energy systems (e.g., HOMER, SAM PVsyst, MATLAB/Simulink).

M10	Energy Equity, Security, and Policy Frameworks	Exploration of how energy systems intersect with social, economic, and geopolitical factors.
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9. Pedagogical Approaches

Instructional Approach	Application	Relation to D3.1 Materials
Active learning (PBL, simulation cases)	Modules 3-6, 8-9	Students work on practical examples of sustainable energy systems, their integration the existing grids. They will analyze the economic and operational parameters of actual sustainable energy systems and learn to model them and predict their behavior.
Competency-based assessment	All modules	Each module includes targeted tasks mapped to Twin Transition Competency Framework.
eLearning platforms integration	All modules	All learning materials will be fully available in eLearning platform: authorized lectures, reading materials, templates, cases, assignments, quizzes, self-assessment tools.
Microlearning formats	All modules	Checklists (e.g., energy mix evaluation checklist, lifecycle impact screening tool), flowcharts (e.g., renewable source selection logic, smart grid integration decision tree), and short guides (e.g., LCOE calculation template, Sustainable energy investment guide)
AI-assisted video tutorials	All modules	For each module, short AI-generated video introductions (2–3 minutes) summarizing key module concepts and learning goals.
Blended learning	Entire course	Flipped classroom structure: students prepare basic concepts via eLearning materials, while in-class activities focus on applied exercises, simulations, and mentoring sessions.

10. Preparation for D3.1 Teaching & Learning Materials

D3.1 Component	Input from CDP and Pedagogy	Notes on Content Development
E-Textbook (approx. 50-80 pages)	Content structure based on 10-module outline; key concepts from Learning Outcomes and Competency Areas.	Authors assigned per module; ensure competency mapping is visible in chapters.
Authorized lectures	Module-based lectures following active learning principles.	Each module includes theoretical inputs and applies case discussions.

Practical training materials	Derived from active learning approaches, problem-based tasks, real-life business scenarios.	Industry and public sector examples will be embedded per module.
AI-supported video clips (~20 -30 minutes, 2 per module)	Short AI-supported lectures focusing on complex concepts, core models, and applied frameworks.	Scripts to be developed collaboratively based on module content.
Course module structure	Directly derived from Section 8 (Module Structure Table).	Ensures logical learning progression and integration across materials.
10. Consortium Institutions Involved in Preparation		
<i>List institutions that will co-develop this course:</i>		
<ul style="list-style-type: none"> Institution 1: University of Novi Sad (UNS), Serbia - Lead Institution 		

3.2 COURSE PORTFOLIO - DIGITAL AREA

1. Course Title
Digital Literacy & Transformation for Sustainability
2. Course Description
This course explores how digital literacy can serve as enabler of sustainability in business, society, and governance. Students will gain foundational knowledge of emerging digital technologies, data-driven tools, and strategic frameworks that drive environmental and social change. Through a competency-based and project-oriented approach, the course equips learners with the ability to assess digital solutions from ethical, ecological, and societal perspectives, design digital strategies aligned with the UN Sustainable Development Goals (SDGs), and lead transformation initiatives within various organizational and sectoral contexts.
3. Learning Objectives
<i>Upon successful completion of this course, students will be able to:</i>
LO-1: Understand the principles, challenges, and opportunities of the twin (green and digital) transition in the context of sustainable development.
LO-2: Apply digital tools, platforms, and data analytics techniques to assess and enhance environmental and social performance in organizations.
LO-3: Design and lead responsible digital transformation initiatives that align with ESG standards, ethical values, and long-term sustainability strategies.
LO-4: Critically reflect on the societal and cultural implications of digital transformation, including equity, inclusion, and digital ethics.
LO-5: Collaborate in interdisciplinary teams to co-create innovative digital solutions for real-world sustainability challenges using agile and design-based methodologies.
4. Learning Outcomes (Competency-Based Outcomes)
<i>Upon completion, students will be able to:</i>
Outcome 1: Critically assess the role of emerging technologies (e.g., IoT, blockchain, AI) in advancing environmental, social, and governance (ESG) objectives.

Outcome 2: Demonstrate the ability to use and interpret outputs of digital tools and analytical approaches to identify, track, and evaluate sustainability metrics.

Outcome 3: Develop and present a digital transformation roadmap that integrates sustainable practices into a business process or organizational strategy.

Outcome 4: Collaborate in cross-functional teams to co-create a digital innovation project aimed at achieving specific sustainability targets within a selected industry or region.

Outcome 5: Analyze and assess the cultural barriers and enablers that impact digital and sustainability initiatives within diverse organizational contexts.

Outcome 6: Apply change management frameworks to foster a digital culture that embraces innovation and sustainability in a real or simulated organizational case.

Outcome 7: Design and evaluate elements of a digital strategy aligned with international sustainability standards and the UN SDGs.

5. Relevant Competencies (Link to Competency Framework for Twin Green & Digital Transition)

Competency Area	Competency	Competency Description
Green	G1.3	Application of green technologies in business and operations
Green	G2.1	Principles of environmental science and sustainability
Green	G5.1	Understanding and application of environmental policies and regulations
Green	G5.2	Integration of environmental ethics into corporate strategies and decision-making
Digital	D10.1	Enhancing digital literacy for sustainability professionals
Digital	D10.2	Cultivating digital culture to support sustainable business practices
Digital	D10.3	Leading digital transformation efforts in business to align with sustainability objectives
Business	B11.2	Leading ethical governance and corporate leadership for sustainability
Business	B11.3	Developing and implementing long-term sustainability strategies for businesses
Business	B12.2	Driving strategic entrepreneurship to support green and digital transitions
Business	B13.1	Leading sustainability-driven transformations across organizations
Business	B13.2	Making strategic decisions to align business goals with green and digital transitions
Business	B13.3	Managing risks in environmental and digital shifts for sustainable growth

Business	B13.4	Solving complex sustainability and digital challenges with advanced problem-solving skills	
Business	B14.3	Engaging key stakeholders to support green and digital transition initiatives	
Business	B15.3	Managing stakeholders for green and digital transitions	
6. ECTS Credits			
<i>Total number of ECTS credits allocated to the course:</i>			
<ul style="list-style-type: none"> • Standard for all courses is 6 ECTS • 6 ECTS = approx. 180 hours total workload. 			
7. Total Workload Breakdown			
<ul style="list-style-type: none"> • for 6 ECTS → ~ 180 hours 			
Component	Contact Hours	Student Workload	Description / Notes
Lectures	45h	—	Theoretical foundations on...
Practical Workshops	25h	—	Applied sessions focused on conceptual use of digital tools for ESG tracking, data visualization, and innovation prototyping (e.g. illustrative dashboards, mock-ups, low-code concepts). Hands-on, team-based exercises.
Supervised Group Work	10h	—	Instructor-supported development of digital sustainability projects, stakeholder engagement maps, and transformation roadmaps.
Self-study	—	70h	Reading core texts and case studies, preparing module assignments, reflective writing, self-assessment tasks, watching video tutorials and engaging with e-learning modules.
Assessments/ Group project & presentation	—	20h	Preparation of project outputs (e.g., pitch deck, ESG dashboard mock-up, co-created solution prototype), oral presentation, peer evaluation, and final individual report.
Other (field/site visit/evaluation and reflection)	—	10h	Guest speakers from sustainable tech companies or public sector; virtual company visits or analysis of real-world digital sustainability practices; individual reflection task.
Total	80h	100h	~180 hours total workload
8. Course Structure (10 Modules)			

Module No.	Module Title	Short Description
M1	Understanding the Twin Transition – Green & Digital	Explores the intertwined nature of green and digital transformation. Topics include: twin transition logic, digital sustainability, key policy frameworks (e.g. EU Green Deal, Digital Compass), and SDG alignment.
M2	Foundations of Digital Literacy for Sustainability	Covers core digital literacy in the sustainability context. Topics include: digital fluency, cybersecurity awareness, responsible use of digital tools, and open data for sustainability.
M3	Emerging Technologies for Sustainable Impact	Focuses on enabling technologies. Topics include: IoT for smart resource use, blockchain in supply chains, AI for ESG metrics, and cloud solutions for low-carbon operations.
M4	Measuring Sustainability Through Digital Tools	Introduces data-driven sustainability. Topics include: ESG indicators, sustainability dashboards, lifecycle analysis (LCA), and data visualization best practices.
M5	Business Models for Digital Sustainability	Explores digitally enabled business models. Topics include: platform economy, product-as-a-service, circular business design, low-carbon value chains, and SDG-oriented entrepreneurship.
M6	Data Analytics and Visualization for Sustainable Decision-Making	Focuses on data analytics and visualization as cognitive and strategic support for sustainability-oriented decision-making. Topics include analytical reasoning, interpretation of sustainability data, decision support through visualization, and responsible use of data under uncertainty.
M7	Leading Digital Transformation for Sustainability	Develop leadership competencies. Topics include digital transformation roadmaps, change management, stakeholder engagement, and digital maturity frameworks.
M8	Digital Ethics, Inclusion, and Societal Impact of Transformation	Addresses ethical and societal dimensions. Topics include digital equity, algorithmic bias, environmental costs of IT, ethics-by-design, and regulations like GDPR & AI Act.
M9	Innovation Labs – Designing Sustainable Digital Solutions	Students co-create and test digital solutions. Topics include design thinking, innovation lifecycle, prototyping, co-creation with stakeholders, and pitching sustainable solutions.
M10	Future Scenarios and Resilience in the	Focuses on foresight and systemic thinking. Topics include: scenario planning, digital risk, resilience in value chains, speculative design, and futures literacy.

	Digital Green Economy	
9. Pedagogical Approaches		
Instructional Approach	Application	Relation to D3.1 Materials
Active learning (PBL, simulation cases)	Modules 4–10	Students engage in real-world ESG and digital transformation cases (e.g. stakeholder mapping, prototype development, data dashboards). Problem-based activities reflect actual green/digital business dilemmas.
Competency-based assessment	All modules	Each module includes targeted tasks mapped to Twin Transition Competency Framework.
eLearning platforms integration	All modules	All learning materials will be fully available in eLearning platform: authorized lectures, reading materials, templates, cases, assignments, quizzes, self-assessment tools.
Microlearning formats	All modules	Modules contain concise digital assets: checklists (e.g., for ESG KPIs), flowcharts (e.g., VRIO logic), explainer guides (e.g., GDPR overview, data ethics canvas).
AI-assisted video tutorials	All modules	Short AI-generated video introductions (2–3 minutes) summarizing key module concepts and learning goals.
Blended learning	Entire course	Flipped classroom structure: students prepare basic concepts via eLearning materials, while in-class activities focus on applied exercises, simulations, and mentoring sessions.
10. Preparation for D3.1 Teaching & Learning Materials		
D3.1 Component	Input from CDP and Pedagogy	Notes on Content Development
E-Textbook (approx. 50-80 pages)	Content structure based on 10-module outline; key concepts from Learning Outcomes and Competency Areas.	Authors assigned per module; ensure competency mapping is visible in chapters.
Authorized lectures	Module-based lectures following active learning principles.	Each module includes theoretical inputs and applies case discussions.
Practical training materials	Derived from active learning approaches, problem-based tasks, real-life business scenarios.	Industry and public sector examples will be embedded per module.

AI-supported video clips (~20 -30 minutes, 2 per module)	Short AI-supported lectures focusing on complex concepts, core models, and applied frameworks.	Scripts to be developed collaboratively based on module content.
Course module structure	Directly derived from Section 8 (Module Structure Table).	Ensures logical learning progression and integration across materials.

10. Consortium Institutions Involved in Preparation

List institutions that will co-develop this course:

- University of Information Technology and Management (UITM) Poland - Lead Institution
- University of Split (UNIST), Croatia - Participant
- University of Novi Sad (UNS), Serbia - Participant
- Kaunas University of Technology (KTU), Lithuania - Participant

1. Course Title

Digital Tools for Sustainability

2. Course Description

The course introduces students to the practical and strategic use of digital technologies in support of sustainable development and the twin green and digital transition. It focuses on how data-driven tools—such as IoT systems, AI and analytics, geospatial technologies, digital twins, dashboards, and collaborative platforms—can be applied to monitor, analyze, and improve environmental, social, and economic performance across business and public-sector contexts. The course equips students with knowledge of sustainability frameworks, lifecycle and circular economy principles, and ethical technology use, while developing hands-on skills in data visualization, simulation, digital prototyping, and sustainability impact assessment. Through project-based learning and real-world case studies, students gain competencies in designing, evaluating, and communicating sustainability solutions. The course is intended for undergraduate and graduate students in engineering, business, IT, sustainability, and related fields seeking applied digital competencies for sustainability-oriented careers.

3. Learning Objectives

Upon successful completion of this course, students will be able to:

- *LO-1: Understand the role of digital technologies in advancing sustainability agendas.*
- *LO-2: Identify and evaluate digital platforms and applications that support sustainable development.*
- *LO-3: Use data visualization tools to communicate sustainability-related insights effectively.*
- *LO-4: Apply software solutions for energy/resource efficiency and monitoring.*
- *LO-5: Design sustainability-focused digital interventions in business or public sector settings.*

4. Learning Outcomes (Competency-Based Outcomes)

Upon completion, students will be able to:

- *Outcome 1: Design and deploy digital sensing and IoT-based setups for environmental and resource data acquisition.*
- *Outcome 2: Use green digital infrastructure (e.g., cloud, edge computing, green software) to support sustainability strategies.*
- *Outcome 3: Create spatial and visual analytics using GIS, satellite data, and data visualization tools for sustainable development.*
- *Outcome 4: Develop and simulate sustainability scenarios using digital twins, AI models, blockchain-enabled systems.*
- *Outcome 5: Evaluate digital sustainability solutions through stakeholder engagement, impact assessment, and ethical review frameworks.*

5. Relevant Competencies (Link to Competency Framework for Twin Green & Digital Transition)

Competency Area	Competency	Competency Description
Digital	D6.4	Data-driven decision-making for sustainability outcomes
Digital	D6.5	Integration of AI, IoT, and big data to drive green solutions
Digital	D6.6	Use of simulation tools for energy system modeling and optimization
Digital	D10.2	Cultivating digital culture to support sustainable business practices
Green	G1.3	Application of green technologies in business and operations
Green	G4.2	Smart cities and sustainable urban development strategies
Business	B13.2	Making strategic decisions to align business goals with green and digital transitions
Business	B14.3	Engaging key stakeholders to support green and digital transition initiatives
Business	B14.4	Communicating effectively with stakeholders on sustainability-related matters
Business	B15.6	Using agile and traditional PM methodologies for sustainable outcomes

6. ECTS Credits

Total number of ECTS credits allocated to the course:

- Standard for all courses is 6 ECTS
- 6 ECTS = approx. 180 hours total workload.

7. Total Workload Breakdown

Component	Contact Hours	Student Workload	Description / Notes

Lectures	45h	—	Theoretical foundations on digital tools and sustainability frameworks
Practical Workshops	25h	—	Tool walkthroughs, data visualization labs
Supervised Group Work	10h	—	Guidance on group sustainability tech project
Self-study	—	70h	Background reading, case analysis, tool practice and reflection
Assessments/ Group project & presentation	—	20h	Tool application project, oral presentation
Other (field/site visit/evaluation and reflection)	—	10h	Knowledge sharing from experts from digital/sustainability sectors
Total	80h	100h	~180 hours total workload

8. Course Structure (10 Modules)

Module No.	Module Title	Short Description
M1	Digital Sustainability Fundamentals	This module introduces the foundational principles of sustainability and their integration with digital technologies.
M2	IoT Sensing and Data Acquisition	This module introduces IoT sensing technologies and data acquisition architectures (sensor types, edge computing, communication protocols, low-power design, and real-time environmental data collection and streaming) used for environmental and resource monitoring.
M3	Cloud & Green Digital Infrastructure	This module examines cloud architectures and green digital infrastructure that enable scalable, energy-efficient sustainability solutions. Students analyze carbon-aware computing, green coding practices, and infrastructure optimization strategies.
M4	GIS & Remote Sensing for Sustainability	This module focuses on the use of geospatial data and remote sensing technologies for environmental analysis and spatial decision-making. Students learn how GIS tools support land-use monitoring, climate-risk assessment, and sustainability planning.
M5	AI & Data Analytics for Sustainability Insights	This module explores how AI and data analytics are applied to sustainability metrics, prediction, and anomaly detection. Ethical, transparent, and responsible AI use is emphasized throughout applied examples.

M6	Digital Twins and Simulation for Resource Efficiency	This module introduces digital twins and simulation models for analyzing energy, resource, and circular systems. Students explore scenario modeling and decision support for sustainability optimization.
M7	Blockchain & Traceability in Sustainable Systems	This module examines blockchain basics, smart contracts, supply chain transparency, and circular economy applications using distributed ledger technologies that enhance transparency, accountability, and circular economy practices.
M8	Sustainability Dashboards & Collaborative Platforms	This module focuses on sustainability dashboards, data visualization, and collaborative digital platforms for decision support. Students learn how visual analytics and co-creation tools enhance stakeholder engagement.
M9	Evaluating Digital Impact on Sustainability: Technology Risk, Greenwashing & Digital Ethics	This module addresses technology risk, digital ethics, and greenwashing in sustainability-focused digital systems.
M10	Project Development and Presentation	This module integrates knowledge and skills from all previous modules through the group-based design and prototyping of a real-world sustainability solution using digital tools; final presentations with visual dashboards and tool demonstration.

9. Pedagogical Approaches

Instructional Approach	Application	Relation to D3.1 Materials
Active learning (PBL, simulation cases)	Modules 2 - 9	Students collaboratively develop a digital solution for a real sustainability case using tools from each module.
Competency-based assessment	All modules	Each module includes targeted tasks mapped to Twin Transition Competency Framework.
eLearning platforms integration	All modules	All learning materials will be fully available in eLearning platform: authorized lectures, reading materials, templates, cases, assignments, quizzes, self-assessment tools.
Microlearning formats	All modules	Checklists for IoT deployment, cheat-sheets for cloud commands, flowcharts for AI model selection.
AI-assisted video tutorials	All modules	For each module, short AI-generated video introductions (2–3 minutes) summarizing key module concepts and learning goals.

Blended learning	Entire course	Flipped classroom structure: students prepare basic concepts via eLearning materials, while in-class activities focus on applied exercises, simulations, and mentoring sessions.
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10. Preparation for D3.1 Teaching & Learning Materials

D3.1 Component	Input from CDP and Pedagogy	Notes on Content Development
E-Textbook (124 pages)	Content structure based on 10-module outline; key concepts from Learning Outcomes and Competency Areas.	Authors assigned per module; ensure competency mapping is visible in chapters.
Authorized lectures	Module-based lectures following active learning principles.	Each module includes theoretical inputs and applies case discussions.
Practical training materials	Derived from active learning approaches, problem-based tasks, real-life business scenarios.	Industry and public sector examples will be embedded per module.
AI-supported video clips (~20 -30 minutes, 2 per module)	Short AI-supported lectures focusing on complex concepts, core models, and applied frameworks.	Scripts to be developed collaboratively based on module content.
Course module structure	Directly derived from Section 8 (Module Structure Table).	Ensures logical learning progression and integration across materials.

10. Consortium Institutions Involved in Preparation

List institutions that will co-develop this course:

- Institution 1: Kaunas University of Technology (KTU) - Lead Institution
- Institution 2: University of Novi Sad (UNS) - Partner
- Institution 3: Riga Technical University (RTU) - Partner

1. Course Title

Cyber Security and Data Ethics in Green Innovation

2. Course Description

This course explores how cybersecurity, secure data management, and data ethics support the development of sustainable digital solutions in the context of the green and digital transition. It focuses on protecting data, systems, and critical infrastructures used in areas such as smart grids, renewable energy, IoT, AI, and digital platforms for sustainability. The course addresses current regulatory, ethical, and governance challenges, linking technical security measures with environmental responsibility and societal trust. Students gain practical knowledge of cyber-risk management, privacy and data protection, ethical AI, secure system design, and governance frameworks relevant to green innovation. Emphasis is placed on integrating

security and ethics into sustainable digital architectures rather than treating them as add-ons. The course is designed for students in information technology, cybersecurity, engineering, sustainability, and related fields who seek to understand how secure and ethical digital systems enable resilient, trustworthy, and environmentally responsible innovation.

3. Learning Objectives

General learning goals students are expected to achieve after completing this course:

- LO-1: Analyse secure data-management principles, cybersecurity foundations and data-ethical frameworks relevant to green innovation.
- LO-2: Evaluate cyber-risk, privacy impacts and regulatory compliance requirements in sustainable digital systems.
- LO-3: Apply secure-by-design, privacy-by-design and ethical AI methodologies across IoT, cloud, AI and blockchain applications.
- LO-4: Develop data-governance strategies and incident-response plans that foster resilience and stakeholder trust.
- LO-5: Propose application strategy of cyber-risk, data-governance and ethical considerations effectively to technical and non-technical audiences.

4. Learning Outcomes (Competency-Based Outcomes)

Upon completion, students will be able to:

- Outcome 1: Conduct a comprehensive cyber-risk and data-governance assessment for an IoT-enabled sustainability solution using established standards.
- Outcome 2: Configure and harden a small-scale sensor network applying secure communication protocols, encryption and key-management.
- Outcome 3: Map data flows and implement privacy-by-design and secure data-management controls aligned with GDPR and AI Act requirements.
- Outcome 4: Create an ethical AI impact assessment report that addresses bias, transparency and societal implications of data use.
- Outcome 5: Develop a cross-functional incident-response and governance playbook and present mitigation strategies to stakeholders.

5. Relevant Competencies (Link to Competency Framework for Twin Green & Digital Transition)

Competency Area	Competency	Competency Description
Digital	D9.4	Secure data management and stewardship for sustainability
Digital	D6.5	Ethical and responsible AI use in sustainability applications
Digital	D8.3	Managing cyber-risk in green digital infrastructures
Digital	D9.3	Data-governance frameworks supporting sustainability objectives
Green	G5.1	Understanding and application of environmental policies and regulations

Green	G5.2	Integration of environmental ethics into corporate strategies and decision-making	
6. ECTS Credits			
Total number of ECTS credits allocated to the course:			
<ul style="list-style-type: none"> • Standard for all courses is 6 ECTS • 6 ECTS = approx. 180 hours total workload 			
7. Total Workload Breakdown			
Component	Contact Hours	Student Workload	Description / Notes
Lectures	45 h	—	Conceptual foundations, secure data management, ethical AI use
Practical Workshops	25 h	—	Labs on secure IoT, threat modelling, data-governance implementation
Supervised Group Work	10 h	—	Capstone coaching and feedback
Self-study	—	70 h	Reading, regulation analysis, tool exploration
Assessments / Group project & presentation	—	20 h	Risk & governance assessment report, playbook, oral defense
Other (field/site visit/evaluation and reflection)	—	10 h	Visit to energy utility SOC or guest cyber-ethics speakers
Total	80 h	100 h	~180 hours total workload
8. Course Structure (10 Modules)			
Module No.	Module Title	Short Description	
M1	Foundations of Cybersecurity & Sustainability	Introduces core cybersecurity principles, secure data management, and their role in supporting the green–digital transformation.	
M2	Threat Landscape in Green Digital Infrastructures	Examines cyber threats and attack vectors affecting smart grids, renewable energy assets, EV charging, and smart city infrastructures.	
M3	Data Protection, Privacy & Regulatory Frameworks	Explores GDPR, NIS2, Cyber Resilience Act, and AI Act, focusing on privacy, compliance, and responsible data use in sustainable systems.	
M4	Secure IoT & Smart Grid Architectures	Focuses on securing IoT and smart grid systems through edge security, secure firmware, cryptographic protocols, and zero-trust networking.	

M5	Ethical AI & Responsible Data Governance	Addresses ethical AI use, data governance, bias, transparency, and responsible data stewardship in sustainability applications.
M6	Risk Assessment, Compliance & Audit	Covers cyber-risk assessment, threat modelling, compliance evaluation, and alignment of security controls with sustainability goals.
M7	Blockchain Security, Traceability & Circular Economy	Examines blockchain security, smart contracts, traceability, and their application in circular economy and sustainable supply chains.
M8	Incident Response, Resilience & Cyber-Physical Safety	Focuses on incident response, digital forensics, business continuity, and resilience of cyber-physical systems in green infrastructures.
M9	Socio-ethical Impacts & Stakeholder Engagement	Explores socio-ethical impacts of digitalization, data justice, stakeholder engagement, and ethical decision-making in green innovation.
M10	Capstone Project & Secure Solution Pitch	Integrates cybersecurity, data ethics, and sustainability in a team-based project addressing a real-world green innovation challenge.

9. Pedagogical Approaches

Instructional Approach	Application	Relation to D3.1 Materials
Active learning (PBL, simulation cases)	Modules 2-10	Students conduct iterative threat and data-governance modelling for a renewable-energy IoT scenario.
Competency-based assessment	All modules	Each artefact (risk matrix, governance checklist, incident-response plan) maps directly to targeted competencies.
eLearning platforms integration	All modules	Moodle hosts labs, reading packs, code notebooks, quizzes, self-assessment tools and peer review forums.
Microlearning formats	All modules	Cheat-sheets for encryption setups, DPIA checklists, data-governance flowcharts.
AI-assisted video tutorials	All modules	Short 2-3-minute explainers demonstrating secure coding patterns and ethical dilemmas.
Blended learning	Entire course	Flipped classroom: pre-recorded lectures and readings before class; live sessions focus on labs and group coaching.

10. Preparation for D3.1 Teaching & Learning Materials

D3.1 Component	Input from CDP and Pedagogy	Notes on Content Development
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E-Textbook (210 pages)	Content structure based on 10-module outline; key concepts from Learning Outcomes and Competency Areas.	Authors assigned per module; ensure competency mapping is visible in chapters.
Authorized lectures	Module-based lectures following active learning principles.	Each module includes theoretical inputs and applies case discussions.
Practical training materials	Derived from active learning approaches, problem-based tasks, real-life business scenarios.	Industry and public sector examples will be embedded per module.
AI-supported video clips (~20 -30 minutes, 2 per module)	Short AI-supported lectures focusing on complex concepts, core models, and applied frameworks.	Scripts to be developed collaboratively based on module content.
Course module structure	Directly derived from Section 8 (Module Structure Table).	Ensures logical learning progression and integration across materials.

10. Consortium Institutions Involved in Preparation

List institutions that will co-develop this course:

- Kaunas University of Technology (KTU) - Lead Institution
- University of Split (UNIST) - Partner

Green Area	Environmental Science and Technology
	Smart Cities and Urban Green Innovation
	Sustainable Energy Systems
Digital Area	Digital Literacy and Transformation for Sustainability
	Digital Tools for Sustainability
	Cyber-security and Data Ethics in Green Innovation
Business Area	Green and Sustainable Project Management
	Green Entrepreneurship and Innovation
	Green Marketing and Communication
Universal (cross-cutting)	Sustainable Business Strategy

3.3 COURSE PORTFOLIO - BUSINESS AREA

1. Course Title
Green and Sustainable Project Management
2. Course Description
Green and Sustainable Project Management is a comprehensive course designed to equip students with the knowledge and practical skills required to manage projects within the context of the twin green and digital transition. The course covers the full project life cycle, from initiation to closure, while systematically integrating sustainability, digitalisation, and governance considerations into core project management decisions. The course examines how

environmental, social, governance, and digital requirements reshape project constraints, success criteria, risk profiles, and stakeholder expectations. Students gain an understanding of internationally recognised project management standards and frameworks and learn how to adapt them to sustainability-oriented and digitally enabled project environments. Through a combination of conceptual foundations, applied tools, case studies, and hands-on activities, the course develops analytical, managerial, and decision-making capabilities relevant to contemporary project-based organisations. The course is suitable for undergraduate and graduate students preparing for roles in project management, sustainability management, digital transformation, and related fields.

3. Learning Objectives

Upon successful completion of this course, students will be able to:

- LO-1: Understand the fundamental principles of project management and the structure of the project life cycle.
- LO-2: Analyze different project types, levels of complexity, and organizational contexts in which projects are executed.
- LO-3: Evaluate how sustainability and digitalisation influence project constraints, governance, and success criteria.
- LO-4: Interpret and apply international project management standards and frameworks in green and digital project contexts.
- LO-5: Analyze stakeholder roles, governance structures, and decision-making mechanisms in project-based organizations.
- LO-6: Apply integrated planning approaches that incorporate sustainability, risk, and performance considerations.
- LO-7: Evaluate risks, uncertainty, and change in sustainability-oriented projects using structured analytical tools.
- LO-8: Design project management solutions that support sustainable value creation and long-term project legacy.

4. Learning Outcomes (Competency-Based Outcomes)

Upon completion, students will be able to:

- Outcome-1: Explain key project management concepts, terminology, and life-cycle phases in a sustainability context.
- Outcome-2: Differentiate between projects, programs, and portfolios and assess their role in organizational strategy.
- Outcome-3: Develop core project artefacts (e.g., business case, stakeholder analysis, project plan) incorporating sustainability and digital requirements.
- Outcome-4: Assess project performance using multidimensional success criteria, including environmental and social impact.
- Outcome-5: Identify and evaluate sustainability-related risks, uncertainties, and ethical challenges in projects.
- Outcome-6: Apply digital tools to support planning, coordination, monitoring, and control of projects.
- Outcome-7: Design governance and stakeholder engagement approaches that

- enhance accountability and trust.
- Outcome-8: Communicate project outcomes, lessons learned, and sustainability legacy in a structured and professional manner.

5. Relevant Competencies (Link to Competency Framework for Twin Green & Digital Transition)

Competency Area	Code	Competency Description
Business	B11.2	Leading ethical governance and corporate leadership for sustainability
Business	B11.4	Measuring and reporting sustainability performance with actionable insights
Business	B11.1	Designing sustainable finance and investment strategies for green projects
Business	B13.1	Leading sustainability-driven transformations across organizations
Business	B13.2	Making strategic decisions to align business goals with green and digital transitions
Business	B13.3	Managing risks in environmental and digital shifts for sustainable growth
Business	B14.1	Facilitating cross-functional teamwork for collaborative sustainability efforts
Business	B14.2	Promoting interdisciplinary collaboration to advance sustainability goals
Business	B14.3	Engaging key stakeholders to support green and digital transition initiatives
Business	B14.4	Communicating effectively with stakeholders on sustainability-related matters
Business	B15.1	Applying project management principles to green/digital transformations
Business	B15.2	Strategically planning sustainability-focused projects
Business	B15.3	Managing stakeholders for green and digital transitions
Business	B15.4	Allocating resources for sustainable project outcomes
Business	B15.5	Monitoring and reporting sustainability-related projects
Business	B15.6	Using agile and traditional PM methodologies for sustainable outcomes
Business	B16.2	Effectively managing time within sustainability-driven and digital projects
Digital	D6.4	Data-driven decision-making for sustainability outcomes
Digital	10.1.	Enhancing digital literacy for sustainability professionals
Digital	D10.2	Cultivating digital culture to support sustainable business practices

Digital	D10.2	Leading digital transformation efforts in business to align with sustainability objectives
Business	B10.2	Managing complexity, uncertainty, and change in project environments
Green	G1.3	Application of green technologies in business and operations
Green	G5.1	Understanding and application of environmental policies and regulations

6. ECTS Credits

Total number of ECTS credits allocated to the course:

- Standard for all courses is 6 ECTS
- 6 ECTS = approx. 180 hours total workload.

7. Total Workload Breakdown

Component	Contact Hours	Student Workload	Description / Notes
Lectures	45h	—	Foundations of PM, lifecycle phases, sustainability integration
Practical Workshops	25h	—	Work breakdown structures, stakeholder analysis, risk exercises
Supervised Group Work	10h	—	Applied project work and coaching
Self-study	—	70h	Reading, case analysis, group assignments
Assessments/ Group project & presentation	—	20h	Project plan, oral defense, written exam
Other (field/site visit/evaluation and reflection)	—	10h	Visit to companies/guest speakers/Individual essay and peer assessment
Total	80h	100h	~180 hours total workload

8. Course Structure (10 Modules)

Module	Title	Short Description
M1	Project Management Fundamentals	Introduces projects as temporary, structured vehicles for change. Covers project characteristics, types, complexity, life cycle phases, and evolving concepts of project success.
M2	Sustainability and the Twin Transition	Explores how green and digital transitions reshape project constraints, governance, and success criteria. Sustainability is positioned as a stable design constraint, not an add-on.
M3	Project Governance and Organizational Structures	Examines project governance through organizational layers, decision rights, and authority structures.

		Analyses functional, matrix, and project-oriented organizations and their implications.
M4	Project Initiation and Business Case Design	Focuses on translating needs into authorised projects through initiation requests, business cases, and charters. Integrates sustainability, legitimacy, and justification logic.
M5	Stakeholder Mapping and Engagement Planning	Develops systematic stakeholder identification, prioritisation, and engagement strategies. Emphasises power-interest dynamics and conflict prevention in sustainability-oriented projects.
M6	Integrated Project for Planning Sustainability	Demonstrates how sustainability is embedded into core planning baselines-scope, WBS, schedule, budget, resources, KPIs, and procurement-rather than treated as reporting. Focuses on enforceability and traceability.
M7	Risk, Change, Complexity, and Uncertainty	Develops an integrated view of uncertainty management combining risk governance, adaptive learning, and structured change control. Addresses sustainability-related and systemic uncertainties.
M8	Project Execution and Coordination	Examines execution as a managed system integrating operational control, team management, procurement implementation, and communication. Emphasises baseline-driven delivery under real conditions.
M9	Monitoring, Reporting, and Project Control	Focuses on performance measurement, KPI tracking, deviation analysis, sustainability reporting, and evidence-based control. Links monitoring to decision-making and accountability.
M10	Project Closure, Knowledge Transfer and Sustainability Legacy	Reframes project closure as a strategic phase linking delivery to long-term value creation. Focuses on lessons learned, transition planning, sustainability impact assessment, and institutionalisation of outcomes.
M11	IT Tools Supporting Effective Project Management	Explains how digital tools support planning, coordination, monitoring and collaboration across the project life cycle. Emphasises tool selection logic and designing a minimal, coherent digital project ecosystem.

9. Pedagogical Approaches

Instructional Approach	Application	Relation to D3.1 Materials
Active learning (PBL, simulation cases)	Modules 4–11	Full project case simulation across entire lifecycle; real-world scenarios; practical exercises based on project artefacts (e.g. Business Case, WBS, Risk Register, Stakeholder Plan, Closure Report).

Competency-based assessment	All modules	Applied tasks, group assignments, role-play stakeholder sessions, individual project artefact preparation fully aligned with Twin Transition Competency Framework.
eLearning platforms integration	All modules	All learning materials will be fully available in eLearning platform: authorized lectures, reading materials, templates, cases, assignments, quizzes, self-assessment tools.
Microlearning formats	All modules	Short self-contained learning units per sub-topic: checklists, templates, flowcharts, quick-reference guides (rather than micro-videos).
AI-assisted video tutorials	All modules	For each module, short AI-generated video introductions (2–3 minutes) summarizing key module concepts and learning goals.
Blended learning	Entire course	Flipped classroom structure: students prepare basic concepts via eLearning materials, while in-class activities focus on applied exercises, simulations, and mentoring sessions.

10. Preparation for D3.1 Teaching & Learning Materials

D3.1 Component	Input from CDP and Pedagogy	Notes on Content Development
E-Textbook (approx. 50-80 pages)	Content structure based on 10-module outline; key concepts from Learning Outcomes and Competency Areas.	Authors assigned per module; ensure competency mapping is visible in chapters.
Authorized lectures	Module-based lectures following active learning principles.	Each module includes theoretical inputs and applied case discussions.
Practical training materials	Derived from active learning approaches, problem-based tasks, real-life business or policy scenarios.	Industry and public sector examples will be embedded per module.
AI-supported video clips (~20 -30 minutes, 2 per module)	Short AI-supported lectures focusing on complex concepts, core models, and applied frameworks.	Scripts to be developed collaboratively based on module content.
Course module structure	Directly derived from Section 8 (Module Structure Table).	Ensures logical learning progression and integration across materials.

10. Consortium Institutions Involved in Preparation

List institutions that will co-develop this course:

- Institution 1: University of Novi Sad (UNS), Serbia - Lead Institution

1. Course Title

Green Entrepreneurship and Innovation

2. Course Description

The course introduces participants to the principles and practices of green entrepreneurship and innovation, guiding them through the complete journey of developing sustainable business ideas and models from mindset to market-ready pitches. Through an experiential, project-based approach, the course covers idea generation, value proposition design, sustainable business modeling, prototyping, financial sustainability, and effective communication. Participants apply tools such as Design Thinking, business model frameworks, experimentation, and impact-oriented financial planning to develop responsible, resilient, and future-oriented enterprises.

3. Learning Objectives

Upon successful completion of this course, students will be able to:

LO-1: Understand the principles and ecosystem of green entrepreneurship in the context of sustainable development and digital innovation.

LO-2: Identify and assess business opportunities that respond to environmental and societal challenges using sustainability frameworks.

LO-3: Develop, test, and refine green business ideas using start-up-oriented and Design Thinking methodologies.

LO-4: Collaborate in interdisciplinary teams to design impactful green business innovation with measurable environmental and social benefits.

4. Learning Outcomes (Competency-Based Outcomes)

Upon completion, students will be able to:

Outcome 1: Formulate and evaluate sustainable business models and green value propositions using market data.

Outcome 2: Apply Design Thinking and entrepreneurship tools to identify user needs and prototype eco-innovative solutions.

Outcome 3: Integrate ESG principles into green venture design and communication.

Outcome 4: Present a viable green entrepreneurship project aligned with SDG goals, and digital-enablement.

5. Relevant Competencies (Link to Competency Framework for Twin Green & Digital Transition)

Competency Area	Competency	Competency Description
Business	B12.1	Creating innovative business models that foster economic growth
Business	B12.2	Driving strategic entrepreneurship to support green and digital transitions

Business	B12.3	Identifying and creating sustainable value propositions for businesses
Business	B12.4	Exploring new markets for green and digital products and services
Business	B13.2	Making strategic decisions to align business goals with green and digital transitions
Business	14.3.3	Engaging key stakeholders to support green and digital transition initiatives
Digital	D6.4	Data-driven decision-making for sustainability outcomes
Digital	D10.2	Cultivating digital culture to support sustainable business practices
Green	G3.3	Eco-friendly product design and development

6. ECTS Credits

Total number of ECTS credits allocated to the course:

- Standard for all courses is 6 ECTS
- 6 ECTS = approx. 180 hours total workload.

7. Total Workload Breakdown

- for 6 ECTS → ~ 180 hours

Component	Contact Hours	Student Workload	Description / Notes
Lectures	45h	—	Theoretical foundations of green innovation and entrepreneurship
Practical Workshops	25h	—	Design Thinking, canvases, business model preparation, stakeholder analysis, prototyping
Supervised Group Work	10h	—	Mentoring for green venture development
Self-study	—	70h	Literature review, reflection tasks
Assessments/ Group project & presentation	—	20h	Green business pitch, business model preparation
Other (field/site visit/evaluation and reflection)	—	10h	Feedback session
Total	80h	100h	~180 hours total workload

8. Course Structure (10 Modules)

Module No.	Module Title	Short Description
M1	The green entrepreneurial mindset, skills & character traits	Module introduces concept of green entrepreneurship within the broader context including digital transformation. It develops learners awareness of the traits, mindsets, and competencies needed to drive

		sustainable innovation and responsible business. The module prepares students by introducing the Critical Design Thinking framework as a human-centered approach to solving complex problems.
M2	Find your why in business - personal discovery	This module aims to help students understand that the success of a business idea is closely linked to the founder's personal attributes. Students will explore how individual passions, values, talents and personal assets can influence the development and viability of green entrepreneurial ventures.
M3	Business ideas generation - empathize with the planet & people	This module focuses on generating innovative and sustainable business ideas through empathy for both people and the planet. Students are introduced to creative ideation methods that integrate green principles, ensuring that business opportunities are aligned with environmental protection, social responsibility, and sound corporate practices.
M4	Design value for people and planet	Module focuses on translating sustainability-driven ideas into clear, compelling, and implementable value propositions that create simultaneous value for customers, society, and the environment. Participants learn how to intentionally design products and services that respond to real human needs while addressing environmental challenges.
M5	Building sustainable business models – the customer facing part	This module examines how green ventures design and validate the customer-facing components of sustainable business models. Participants learn how to clearly define value propositions, identify and prioritize customer segments, and design effective channels and customer relationships supporting both market adoption and sustainability goals.
M6	Building sustainable business models – the backstage	This module focuses on the internal architecture of sustainable business models—the operational “backstage” that enables consistent value delivery to customers while achieving environmental and social objectives. Participants learn how to design and align key activities, key resources, and strategic partnerships to support green value propositions in an efficient, resilient, and responsible manner.
M7	Prototyping and testing green solutions	This module introduces participants to experimentation-driven innovation as a core practice in green entrepreneurship. It focuses on transforming

		assumptions about products, services, and business models into testable hypotheses, and using low-fidelity prototyping to validate ideas quickly, affordably, and responsibly.
M8	Financial sustainability of green ventures	The module explores how environmentally responsible new ventures can achieve long-term financial sustainability while fostering green and digital transformation - the essence of the Twin Transition concept. Students will gain knowledge and practical tools to design sustainable financial strategies that align profitability with careful management of revenues and expenses in emerging green businesses.
M9	Communicating your green business vision	The module focuses on developing the communication capabilities required to clearly and persuasively convey the impact, value, and strategic intent of green business ideas to diverse stakeholders. Participants learn how to translate complex sustainability concepts, data, and business logic into compelling narratives that inspire trust, understanding, and action.
M10	Pitching green ventures to stakeholders – final presentations	The module focuses on enabling participants to design and deliver clear, compelling, and investor-ready pitch presentations for green ventures. It brings together insights from mindset development, problem discovery, value design, business modeling, prototyping, financial sustainability, and communication into a coherent narrative tailored to diverse stakeholder audiences.

9. Pedagogical Approaches

Describe pedagogical and instructional methods to be used:

Instructional Approach	Application	Relation to D3.1 Materials
Active learning (PBL, simulation cases, Canvases)	All modules	Students work in teams to develop a green entrepreneurship solution driven by stakeholder input using the Design Thinking framework and selected tools and techniques. Students are engaged also in case-based learning and game-based learning.
Competency-based assessment	All modules	Each module includes targeted tasks mapped to Twin Transition Competency Framework.
eLearning platforms integration	All modules	All learning materials will be fully available in eLearning platform: authorized lectures, reading materials, templates, cases, assignments, quizzes, self-assessment tools.

Microlearning formats	All modules	Bite-sized tools per concept (e.g., templates, checklists, cards)
AI-assisted video tutorials	All modules	Short AI-generated video clips (2–3 minutes) at the start of each module to introduce key ideas. Supplemented with transcripts, scenario prompts, and visual campaign examples from leading sustainable brands.
Blended learning/Flipped classroom	Entire course	Flipped classroom approach: core concepts are prepared individually, while in-class sessions focus on active application.

10. Preparation for D3.1 Teaching & Learning Materials

D3.1 Component	Input from CDP and Pedagogy	Notes on Content Development
E-Textbook (approx. 50-80 pages)	Content structure based on 10-module outline; key concepts from Learning Outcomes and Competency Areas.	Authors assigned per module; ensure competency mapping is visible in chapters.
Authorized lectures	Module-based lectures following active learning principles.	Each module includes theoretical inputs and applies case discussions.
Practical training materials	Derived from active learning approaches, problem-based tasks, real-life business scenarios (templates for persona creation, green KPIs, campaign storyboards)	Industry and public sector examples will be embedded per module.
AI-supported video clips (~20 -30 minutes, 2 per module)	Short AI-supported lectures focusing on complex concepts, core models, and applied frameworks.	Scripts to be developed collaboratively based on module content.
Course module structure	Directly derived from Section 8 (Module Structure Table).	Ensures logical learning progression and integration across materials.

10. Consortium Institutions Involved in Preparation

List institutions that will co-develop this course:

- University of information technology and management (UITM), Poland - Lead Institution
- University of Novi Sad (UNS), Serbia - Participant

1. Course Title

Green Marketing and Communication

2. Course Description

This course introduces students to the fundamental principles and advanced strategies of marketing, with a strong emphasis on sustainability and digital transformation. Designed for students without prior marketing knowledge, the course starts with foundational marketing concepts and gradually progresses to advanced topics in green marketing, ethical branding, sustainability-driven communication, and digital campaign strategies. Students will learn how marketing can drive the twin transition (green and digital) through value-based messaging, inclusive brand narratives, sustainable value proposition design, and stakeholder engagement. The course integrates project-based learning with hands-on development of marketing strategies aligned with environmental and social objectives, emerging digital tools (such as automation platforms, AI content assistants, and sustainability analytics), and circular economy principles. Real-world case studies from globally recognized brands (e.g., Patagonia, Unilever, IKEA, The Body Shop, Tesla) are embedded throughout the course to support applied learning and critical analysis of best practices and ethical dilemmas in green marketing.

3. Learning Objectives

Upon successful completion of this course, students will be able to:

- LO-1: Understand the foundational concepts of marketing, market segmentation, and consumer behavior.
- LO-2: Explain the principles of green marketing and their alignment with sustainability goals.
- LO-3: Analyze the role of communication strategies in shaping stakeholder perceptions and behavior.
- LO-4: Design sustainability-aligned marketing campaigns using both digital and traditional channels.
- LO-5: Evaluate greenwashing risks and develop credible, ethics-based communication strategies.
- LO-6: Apply digital tools and platforms to implement and monitor green marketing initiatives.
- LO-7: Develop inclusive and accessible marketing messages in support of SDG-oriented transformations.
- LO-8: Create persuasive sustainability narratives using strategic storytelling and brand authenticity.
- LO-9: Critically assess the role of AI and automation in sustainable marketing communication and ethical targeting.
- LO-10: Facilitate two-way engagement with diverse stakeholder groups using interactive and transparent communication approaches.

4. Learning Outcomes (Competency-Based Outcomes)

Upon completion, students will be able to:

- Outcome 1: Define the core elements of a marketing mix and apply them in green product/service design.

- Outcome 2: Develop stakeholder-specific sustainability messages and identify suitable communication channels.
- Outcome 3: Create marketing personas and tailor digital strategies to target responsible consumers.
- Outcome 4: Conduct critical assessment of sustainability claims using frameworks like ISO 14021.
- Outcome 5: Plan and execute an integrated green marketing campaign using digital storytelling.
- Outcome 6: Design metrics and dashboards to measure the impact of green communication activities.
- Outcome 7: Apply AI-supported tools (e.g. content generators, analytics platforms) to optimize sustainable marketing efforts and ensure ethical targeting.
- Outcome 8: Develop and present brand narratives that authentically communicate sustainability values across multiple platforms.
- Outcome 9: Facilitate stakeholder dialogues through participatory tools (e.g. surveys, social listening, co-creation platforms) to enhance transparency and trust.

5. Relevant Competencies (Link to Competency Framework for Twin Green & Digital Transition)

Competency Area	Code	Competency Description
Business	B11.6	Marketing and promoting sustainable products and services in competitive markets
Business	B12.3	Identifying and creating sustainable value propositions for businesses
Business	B12.4	Exploring new markets for green and digital products and services
Business	B14.3	Engaging key stakeholders to support green and digital transition initiatives
Business	B14.4	Communicating effectively with stakeholders on sustainability-related matters
Business	B11.4	Measuring and reporting sustainability performance with actionable insights
Digital	D6.4	Data-driven decision-making for sustainability outcomes
Digital	D10.1	Enhancing digital literacy for sustainability professionals
Green	G3.3	Eco-friendly product design and development

6. ECTS Credits

Total number of ECTS credits allocated to the course:

- Standard for all courses is 6 ECTS
- 6 ECTS = approx. 180 hours total workload.

7. Total Workload Breakdown

Component	Contact Hours	Student Workload	Description / Notes
Lectures	45h	—	Theoretical foundations of marketing and sustainability integration; includes concepts such as value proposition, 4Ps, segmentation, and fundamentals of green marketing.
Practical Workshops	25h	—	Hands-on campaign design, market research, use of AI-supported tools (e.g., ChatGPT, Canva, analytics platforms), persona building, and ethical messaging scenarios.
Supervised Group Work	10h	—	Collaborative development of stakeholder-specific green campaigns; application of frameworks like ISO 14021 and planning for impact-driven communication strategies.
Self-study	—	70h	Background reading, campaign planning, peer review; critical evaluation, individual preparation of storytelling components, digital communication tactics, and case study reflections.
Assessments/ Group project & presentation	—	20h	Final group presentation of a full green marketing strategy and oral pitch; short exam on key concepts (greenwashing detection, ethics, digital impact assessment).
Other (field/site visit/evaluation and reflection)	—	10h	Guest speakers from global sustainable brands; company visits (virtual or physical); individual reflection essay and peer assessment.
Total	80h	100h	~180 hours total workload

8. Course Structure (10 Modules)

Module	Title	Short Description
M1	Introduction to Marketing	Core marketing principles: needs, value creation, the 4Ps, segmentation, targeting, positioning. Introduces students to the role of marketing in

		supporting sustainable development goals (SDGs).
M2	Consumer Behavior and Sustainability Trends	Behavioral drivers of green consumerism, barriers to change, and sustainability consciousness. Includes introduction to nudging, framing, and behavioral design for promoting sustainable behaviors.
M3	Principles of Green Marketing	Evolution of green marketing: key frameworks (3Cs, green marketing mix), lifecycle thinking, eco-labels, and sustainable product development. Students analyze best-practice global examples.
M4	Digital Tools and Platforms for Green Campaigns	Overview of digital channels (SEO, social media, content automation), campaign analytics, and AI-supported tools (e.g., ChatGPT, Google Trends, EcoSend). Students use digital dashboards to track sustainability KPIs.
M5	Stakeholder Mapping and Message Tailoring	Persona creation, empathy mapping, and audience-specific message design. Application of stakeholder engagement techniques and co-creation platforms to develop inclusive green communication.
M6	Ethics, Transparency and Anti-Greenwashing	Ethical frameworks in marketing, transparency standards (ISO 14021), and techniques to avoid greenwashing. Focus on credibility, verification tools, and global regulatory cases.
M7	Circular Economy and Sustainable Branding	Principles of circular branding and storytelling. Students explore sustainable value propositions, design communication for circular models, and evaluate branding strategies used by companies.
M8	Integrated Campaign Planning	Students design full sustainability campaigns including objective setting, message framing, media planning, budgeting, and channel selection. Emphasis on balancing ethics, creativity, and strategy.
M9	Monitoring, KPIs and Impact Assessment	Introduction to sustainability metrics, behavioral impact indicators, and communication dashboards. Includes evaluation techniques for social media campaigns and real-time data use in campaign optimization.

M10	Final Project Pitch and Peer Review	Student teams present their campaigns to a simulated stakeholder panel. Peer feedback and critical reflection. Evaluation includes originality, impact, and alignment with ethical and sustainability standards.
9. Pedagogical Approaches		
Instructional Approach	Application	Relation to D3.1 Materials
Active learning (PBL, simulation cases)	Modules 4–10	Full-cycle campaign simulation including stakeholder engagement, storytelling, and ethical review. Students work on real-world challenges using project artefacts (e.g., stakeholder maps, campaign briefs, feedback matrices).
Competency-based assessment	All modules	Includes applied assignments, campaign planning tasks, stakeholder role-play, and ethical scenario responses. Outcomes are aligned with Twin Transition Competency Framework and mapped in each assessment rubric.
eLearning platforms integration	All modules	Learning materials hosted on digital platforms; includes annotated lectures, downloadable templates, case study libraries, quizzes, self-paced reflections, and interactive assignments (e.g., peer review checklists).
Microlearning formats	All modules	Bite-sized content per concept (e.g., “How to detect greenwashing,” “AI tools for campaign optimization”). Includes checklists, templates, storytelling frameworks, KPI dashboards, and ethics filters.
AI-assisted video tutorials	All modules	Short AI-generated video clips (2–3 minutes) at the start of each module to introduce key ideas. Supplemented with transcripts, scenario prompts, and visual campaign examples from leading sustainable brands.
Blended learning	Entire course	Flipped classroom approach: core concepts are prepared individually, while in-class sessions focus on active application—e.g., stakeholder simulation, storytelling critique, campaign pitch rehearsal, and group mentoring.
10. Preparation for D3.1 Teaching & Learning Materials		

D3.1 Component	Input from CDP and Pedagogy	Notes on Content Development
E-Textbook (approx. 50-80 pages)	Content structure based on 10-module outline; key concepts from Learning Outcomes and Competency Areas.	Authors assigned per module. Chapters will include embedded competency markers, storytelling case boxes, visuals for campaign flows, and critical thinking prompts ("Spot the Greenwashing").
Authorized lectures	Module-based lectures following active learning principles.	Each lecture will include conceptual theory and practical discussion based on real-world scenarios. Visual slide decks will incorporate campaign examples, message analysis tools, stakeholder matrices, and KPI rubrics.
Practical training materials	Derived from active learning approaches, problem-based tasks, real-life business scenarios (templates for persona creation, green KPIs, campaign storyboards)	Includes templates for: persona creation, sustainability messaging, empathy maps, storytelling arcs, stakeholder engagement tools, impact dashboards, and green campaign storyboards. All materials adaptable for in-person and online delivery.
AI-supported video clips (~20 - 30 minutes, 2 per module)	Short AI-supported lectures focusing on complex concepts, core models, and applied frameworks.	Video scripts to be developed collaboratively with academic and media teams. Includes key visuals (e.g., green marketing funnel, campaign ecosystem), AI voiceovers, and subtitles. Each video will highlight a core dilemma or strategic decision.
Course module structure	Directly derived from Section 8 (Module Structure Table).	Each module flows logically from foundational to advanced content. Microlearning inserts (e.g., 2-minute tips, downloadable flowcharts) will be integrated into each module to support flipped learning. Peer

	review and reflection checkpoints included.
10. Consortium Institutions Involved in Preparation	
<i>List institutions that will co-develop this course:</i>	
<ul style="list-style-type: none"> • University of Novi Sad (UNS), Serbia - Lead Institution • University of Split (UNIST), Croatia - Participant 	

3.4 COURSE PORTFOLIO – CROSS-CUTTING COURSE

1. Course Title
Sustainable Business Strategies
2. Course Description
<p>This course introduces students to the foundations of strategic thinking and decision-making in business, with a strong emphasis on business reasoning and sustainability. It is designed for students without prior knowledge of business strategy and provides a progressive learning path from basic strategic concepts to the formulation and evaluation of sustainability-oriented strategies in a globalized economy. Students will explore how global business trends, market structures, and firm-level capabilities shape competitive and sustainable strategies. Special attention is given to how companies integrate environmental, social and governmental dimensions into strategic choices, not as externalities but as core economic and value creation drivers. The course combines classical modern strategic tools, and applied case studies to foster critical thinking about business viability in the era of green and digital transformation.</p>
3. Learning Objectives
<p>Upon successful completion of this course, students will be able to:</p> <ul style="list-style-type: none"> • LO-1: Understand the economic rationale behind strategic business planning and market positioning. • LO-2: Apply macroeconomic and microeconomic analysis to identify sustainability challenges and opportunities. • LO-3: Analyze the role of firm resources, capabilities, and cost structures in developing competitive advantage. • LO-4: Recognize the influence of stakeholders, institutions, and regulatory frameworks on strategic decision-making. • LO-5: Evaluate and design strategies that promote long-term business performance and socio-environmental value.
4. Learning Outcomes (Competency-Based Outcomes)
<p>Upon completion, students will be able to:</p> <ul style="list-style-type: none"> • Outcome 1: Conduct basic macroeconomic and industry-level analysis using tools like PESTEL and market structures. • Outcome 2: Apply microeconomic concepts such as opportunity cost, economies of scale, and pricing strategies to real business cases. • Outcome 3: Evaluate internal strengths and constraints of a firm through RBV and SWOT frameworks.

- Outcome 4: Integrate stakeholder needs and ESG risks into strategic planning processes.
- Outcome 5: Design sustainable business models that balance economic viability with long-term impact.

5. Relevant Competencies (Link to Competency Framework for Twin Green & Digital Transition)

Competency Area	Competency	Competency Description
Business	B11.2	Leading ethical governance and corporate leadership for sustainability
Business	B11.3	Developing and implementing long-term sustainability strategies for businesses
Business	B11.4	Measuring and reporting sustainability performance with actionable insights
Business	B11.5	Designing sustainable finance and investment strategies for green projects
Business	B11.7	Managing corporate social responsibility (CSR) and engaging stakeholders in sustainability initiatives
Business	B12.3	Identifying and creating sustainable value propositions for businesses
Business	B13.1	Leading sustainability-driven transformations across organizations
Business	B13.2	Making strategic decisions to align business goals with green and digital transitions
Business	B13.4	Solving complex sustainability and digital challenges with advanced problem-solving skills
Business	B14.4	Communicating effectively with stakeholders on sustainability-related matters
Digital	D6.4	Data-driven decision-making for sustainability outcomes
Digital	D10.1	Enhancing digital literacy for sustainability professionals
Digital	D10.2	Cultivating digital culture to support sustainable business practices
Green	G5.1	Understanding and application of environmental policies and regulations
Green	G5.2	Integration of environmental ethics into corporate strategies and decision-making

6. ECTS Credits

Total number of ECTS credits allocated to the course:

- Standard for all courses is 6 ECTS
- 6 ECTS = approx. 180 hours total workload

7. Total Workload Breakdown

Component	Contact Hours	Student Workload	Description / Notes
Lectures	45h	—	Theoretical foundations and strategy models
Practical Workshops	25h	—	Industry analysis, simulations, stakeholder mapping
Supervised Group Work	10h	—	Project guidance and feedback
Self-study	—	70h	Background reading, case analysis, theory reflection
Assessments/ Group project & presentation	—	20h	Project plan, oral defense, written exam
Other (field/site visit/evaluation and reflection)	—	10h	Visit to companies/guest speakers/Individual essay and peer assessment
Total	80h	100h	~180 hours total workload

8. Course Structure (10 Modules)

Module No.	Module Title	Short Description
M1	Strategic Thinking and Economic Foundations	Introduction to strategy; economic logic of business decisions; value creation and competition.
M2	Macroeconomic Trends and Global Risks	PESTEL analysis, economic cycles, climate risk, inflation, interest rates, ESG policy trends.
M3	Microeconomic Analysis for Strategy/ Firm Capabilities and Competitive Advantage	Market structures, pricing, cost leadership vs. differentiation, opportunity cost, demand shifts, RBV/VRIO, dynamic capabilities, eco-innovation assets
M4	Stakeholders & Materiality	Stakeholder theory, legitimacy, regulations, power-interest mapping; double materiality; ethics & licence to operate
M5	Competitive Positioning Tools	Cost/differentiation, Blue-Ocean, Porter vs. shared-value frames
M6	Sustainable Business Models and Value Propositions	Circular economy, low-carbon value chains, inclusive business models and SDG alignment.
M7	Growth, Diversification, and Green Internationalization	Strategic options for scaling; risks of greenwashing in global expansion; carbon border adjustments.
M8	Innovation, Digital Transformation and Resource Efficiency	Linking digital and green strategies for cost efficiency, productivity, and sustainable innovation.

M9	Strategy Implementation and Governance	Organizational design, change leadership, internal alignment, etc.
M10	Impact Measurement and Scenario Planning	Balanced Scorecard, sustainability reporting, scenario analysis, future resilience testing.

9. Pedagogical Approaches

Instructional Approach	Application	Relation to D3.1 Materials
Active learning (PBL, simulation cases)	Modules 3–10	Students work on a strategic project simulation from industry analysis to scenario planning; use of real cases and artefacts like stakeholder maps and BSC.
Competency-based assessment	All modules	Each module includes targeted tasks (e.g., stakeholder role-play, market structure analysis, strategy pitch) mapped to Twin Transition Competency Framework.
eLearning platforms integration	All modules	All learning materials will be fully available in eLearning platform: authorized lectures, reading materials, templates, cases, assignments, quizzes, self-assessment tools.
Microlearning formats	All modules	Checklists (e.g., strategy canvas, double materiality map), flowcharts (e.g., VRIO logic), and short guides (e.g., PESTEL template, stakeholder scoring matrix).
AI-assisted video tutorials	All modules	For each module, short AI-generated video introductions (2–3 minutes) summarizing key module concepts and learning goals.
Blended learning	Entire course	Flipped classroom structure: students prepare basic concepts via eLearning materials, while in-class activities focus on applied exercises, simulations, and mentoring sessions.

10. Preparation for D3.1 Teaching & Learning Materials

D3.1 Component	Input from CDP and Pedagogy	Notes on Content Development
E-Textbook (approx. 50-80 pages)	Content structure based on 10-module outline; key concepts from Learning Outcomes and Competency Areas.	Authors assigned per module; ensure competency mapping is visible in chapters.
Authorized lectures	Module-based lectures following active learning principles.	Each module includes theoretical inputs and applies case discussions.
Practical training materials	Derived from active learning approaches, problem-based tasks, real-life business scenarios (templates	Industry and public sector examples will be embedded per module.

	for persona creation, green KPIs, campaign storyboards	
AI-supported video clips (~20 -30 minutes, 2 per module)	Short AI-supported lectures focusing on complex concepts, core models, and applied frameworks.	Scripts to be developed collaboratively based on module content.
Course module structure	Directly derived from Section 8 (Module Structure Table).	Ensures logical learning progression and integration across materials.
10. Consortium Institutions Involved in Preparation		
List institutions that will co-develop this course:		
<ul style="list-style-type: none"> University of Novi Sad (UNS), Serbia - Lead Institution 		

4. PART B: LABORATORY DEVELOPMENT PLAN (LDP)

4.1 Al-Farabi Kazakh National University, Kazakhstan (KazNu)

1. Institutional Information	
Institution Name	Al-Farabi Kazakh National University
Country	Kazakhstan
Faculty / Department	Artificial Intelligence and Big Data
2. Laboratory Name and Thematic Focus	
Laboratory Official Name	Digital Innovative Solutions Lab
Primary Thematic Focus	The laboratory focuses on the integration of Artificial Intelligence, Internet of Things (IoT), and green computing technologies to support the Twin Green and Digital Transition. The lab specializes in intelligent systems for energy efficiency, smart data analytics, and sensor-based monitoring of environmental and industrial systems.
3. Current Laboratory Status and Planned Reinforcement	
Current Laboratory Description	The Digital Innovative Solutions Lab is currently equipped with basic computing workstations, network infrastructure, and several AI-enabled microcontroller kits (e.g., Arduino, Raspberry Pi). It is used for teaching undergraduate and master's courses in AI, Big Data, and IoT. Existing activities include coursework, lab sessions, and small-scale research projects.

	<p>The laboratory supports foundational training in data processing, embedded systems, and prototyping. However, it lacks the advanced tools and simulation capabilities required for comprehensive practical training in digital manufacturing, real-time sensor data acquisition, robotics, and the development of AI-driven sustainable systems. There is also limited capacity for interdisciplinary project work, industrial collaboration, and immersive technologies (e.g., AR/VR), which hinders the development of full-scale digital twins and applied innovation aligned with green and digital transformation goals. Upgrading the lab is essential to bridge the gap between theoretical knowledge and industry-oriented skills, enabling students and researchers to work on complex, real-world challenges.</p>
<p>Reinforcement through GreenTech Horizons</p>	<p>With EU funding through the GreenTech Horizons project, the laboratory will be upgraded with advanced hardware and software, including:</p> <ul style="list-style-type: none"> • AI Edge Devices (e.g., NVIDIA Jetson Nano, Google Coral Dev Boards) to support real-time inference, low-power AI processing, and embedded intelligence for green IoT applications. • Environmental Sensors capable of monitoring temperature, humidity, gas composition (CO₂, NH₃, H₂S, etc.), particulate matter, and other parameters essential for air quality and climate tracking. • Industrial-grade IoT Kits and PLCs, enabling robust prototyping of smart infrastructure, including renewable energy systems, intelligent transportation, and smart building automation. • 3D Printer with Eco-Filament Support, to allow students and researchers to design and prototype sustainable components and device enclosures with minimal environmental impact. • High-performance Workstations (e.g., Alienware Aurora) to facilitate complex simulations, CAD/CAM design, data analysis, and modeling of digital twin environments in industry and urban systems. • Licensed software suites for CAD/CAM (e.g., SolidWorks), IoT analytics, digital twin development, and simulation tools such as AnyLogic, Prometheus, Grafana, and PostgreSQL. <p>These upgrades will enable students to engage in real-world project simulations in smart agriculture, green logistics, and sustainable urban systems.</p>
<p>Contribution to Learning Ecosystem</p>	<p>The enhanced lab will allow integration of Twin Transition topics across undergraduate and graduate curricula. It will support interdisciplinary learning, enabling students to design and implement</p>

	<p>intelligent, energy-efficient, and environmentally friendly systems. The lab will be used in capstone projects, joint research with industry, and as a base for faculty-led innovation in smart and green technologies.</p> <p>In addition, the laboratory will serve as a platform for real-time project-based learning in areas such as intelligent traffic systems, environmental monitoring, smart rehabilitation technologies, and digital twins for sustainable industries. Equipped with advanced technologies, including AR/VR, IoT, and state-of-the-art AI devices, the laboratory will foster the development of practical skills and innovative thinking in line with national and regional strategies for green digital transformation.</p>														
4. Revised Laboratory Mission Statement															
<p>This laboratory has been reinforced through EU funding under the GreenTech Horizons project, enabling a comprehensive modernization of its technical infrastructure, equipment, and digital learning environment. The funding has played a pivotal role in transforming the lab into a center of excellence in Artificial Intelligence, Internet of Things (IoT), and sustainable digital innovation, aligned with the objectives of the Twin Green and Digital Transition.</p> <p>The laboratory is now fully integrated into the revised undergraduate, graduate, and doctoral curricula. It supports practical and interdisciplinary education through hands-on lab sessions, project-based learning, and research activities focused on energy efficiency, intelligent monitoring, and environmentally sustainable system design. The enhanced laboratory infrastructure also empowers faculty to adopt new teaching methodologies and conduct applied research in collaboration with European and local partners.</p> <p>Post-project, the laboratory will operate as a permanent educational and research facility embedded within the university's strategic development plan. Its long-term sustainability is ensured through regular institutional funding, academic integration, and collaboration with external stakeholders. The lab will continue to support regional innovation ecosystems by fostering joint projects, publications, and technology transfer initiatives.</p> <p>In addition, the laboratory will function as a capacity-building hub dedicated to the continuous upskilling of students, academic staff, and external stakeholders, including representatives from industry, public sector organizations, and non-profits. Through specialized training programs, workshops, and professional certification courses, the lab will contribute to the development of a skilled workforce capable of addressing the challenges of the green and digital transformation in Kazakhstan and beyond.</p>															
5. Planned Equipment and Resources															
<table border="1"> <thead> <tr> <th data-bbox="199 1675 466 1759">Equipment</th> <th data-bbox="474 1675 873 1759">Technical Description / Specifications</th> <th data-bbox="873 1675 959 1759">QTY</th> <th data-bbox="959 1675 1406 1759">Purpose and Teaching Use</th> </tr> </thead> <tbody> <tr> <td data-bbox="199 1759 466 1791"></td> <td data-bbox="474 1759 873 1791"></td> <td data-bbox="873 1759 959 1791"></td> <td data-bbox="959 1759 1406 1791"></td> </tr> </tbody> </table>	Equipment	Technical Description / Specifications	QTY	Purpose and Teaching Use					<table border="1"> <thead> <tr> <th data-bbox="474 1675 873 1759">Technical Description / Specifications</th> <th data-bbox="873 1675 959 1759">QTY</th> <th data-bbox="959 1675 1406 1759">Purpose and Teaching Use</th> </tr> </thead> <tbody> <tr> <td data-bbox="474 1759 873 1791"></td> <td data-bbox="873 1759 959 1791"></td> <td data-bbox="959 1759 1406 1791"></td> </tr> </tbody> </table>	Technical Description / Specifications	QTY	Purpose and Teaching Use			
Equipment	Technical Description / Specifications	QTY	Purpose and Teaching Use												
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Interactive Panel XG 75TDS	75" 4K UHD Interactive Touch Display, 400 nits brightness, Android 11.0/13.0, 8GB/14GB RAM, 128GB Storage, built-in speakers, Wi-Fi, multiple HDMI/USB inputs, wall mount included.	1	Interactive visualization systems for collaborative learning and project demonstrations. These panels will be used to display real-time data from IoT systems, visualize complex engineering processes, and facilitate interactive workshops and remote collaboration.
Interactive Panel iiyama ProLite TE6512MIS-B1AG	65" 4K UHD (3840x2160) IPS panel, PureTouch-IR (40 touch points), Anti-glare coating, 24/7 Operation, Android 11 OS, iiWare 10, WiFi slot, USB-C connection, integrated speakers.	1	Interactive visualization systems for collaborative learning and project demonstrations. These panels will be used to display real-time data from IoT systems, visualize complex engineering processes, and facilitate interactive workshops and remote collaboration.
NVIDIA Jetson Nano Developer Kit 4GB	Quad-core ARM A57 @ 1.42 GHz, 128-core NVIDIA Maxwell GPU, 4 GB 64-bit LPDDR4 RAM, 4K video support, MIPI CSI-2 camera connectors, Gigabit Ethernet, HDMI/DisplayPort.	4	Used for teaching AI algorithms, computer vision, and edge computing. Students will develop autonomous robotic systems and AI-driven models for the "Digital Skills for the Future" pillar.
Raspberry Pi 5 Model B (8 GB) Starter Kit	Broadcom BCM2712 2.4GHz quad-core 64-bit Arm Cortex-A76 CPU, 8GB LPDDR4X-4267 SDRAM, Dual 4Kp60 HDMI output, Wi-Fi 5, Bluetooth 5.0, includes case, power supply, and cooling.	3	Serves as a versatile platform for IoT prototyping and embedded Linux systems. Used in "Sustainable Infrastructure and Automation" to collect and process sensor data.
Single-board computer Raspberry Pi 5 Model B	2.4GHz quad-core 64-bit Arm Cortex-A76 CPU, 8GB RAM, PCIe 2.0 interface, dual-band Wi-Fi, PoE+ support via HAT.	6	Core hardware for student projects involving network management, distributed computing, and IoT gateway development.
Levenhuk Wezzer PRO LP700 Weather Station	Remote sensors for wind speed, direction, rainfall, temperature, humidity, and UV radiation. Wi-Fi console, color LCD, data logging.	2	Practical tool for "Green Skills" development. Used to monitor environmental parameters and analyze climate data for

			sustainable agricultural and urban projects.
Vega BS-1.2 Base Station (LoRaWAN)	8-channel gateway, LoRaWAN 1.0.x/1.1 support, 870 MHz frequency band, Ethernet/3G/4G connectivity, IP67 protection class.	3	Infrastructure for building Low Power Wide Area Networks (LPWAN). Teaches students how to deploy city-scale IoT networks for smart city solutions.
LoRaWAN Antenna 868-01, 870MHz	Omni-directional outdoor antenna, frequency range 860-880 MHz, high gain (approx. 5-8 dBi), N-type connector, lightning protection.	3	Used to extend the range of the LoRaWAN base station for outdoor environmental monitoring and remote sensor data collection.
Virtual Reality System Meta Quest 3S, 128 GB	Mixed Reality (MR) headset, Snapdragon XR2 Gen 2 platform, 128GB storage, 4K+ Infinite Display, Touch Plus controllers.	2	Supports "Digital Transition" by allowing students to visualize engineering designs in 3D and simulate industrial environments through VR/AR training modules.
Digital Storage Oscilloscope UTD1062C	Bandwidth: 60MHz, Channels: 2, Sample Rate: 250MS/s, LCD color display, built-in multimeter functions, USB interface.	2	Fundamental tool for "Automatic Control and Robotics." Used for signal analysis, troubleshooting electronic circuits, and sensor calibration.
Digital Multimeter UT71D (Intelligent High Accuracy)	40,000 count display, True RMS, data logging, USB interface, measurement of voltage, current, resistance, capacitance, and frequency.	2	Used in laboratory work for precise measurements of electrical parameters in IoT and green energy system prototypes.
Function/Arbitrary Waveform Generator UTG962E	Max frequency: 60MHz, 2 channels, 200MS/s sampling rate, 14-bit vertical resolution, various modulation functions.	1	Used to simulate sensor signals and test control systems in "Sustainable Infrastructure and Automation" courses.
Power Supply UDP6731	Single channel, output up to 30V/5A, 150W, high resolution (1mV/1mA), programmable via PC, low ripple and noise.	1	Provides stable power for testing electronic modules and robotics components during laboratory exercises.

Ultrasonic Cleaning Tank VGT-1620QTD	2L capacity, 60W ultrasonic power, 100W heating power, digital timer, stainless steel construction.	1	Maintenance and cleaning of precision mechanical parts for robots and electronic components after assembly/soldering.
Soldering Station 992D-II mini	2-in-1 station (soldering iron + hot air gun), digital temperature control, ESD safe, PID high-speed temperature tracking.	1	Essential for the "Digital Skills" practical module where students assemble custom PCB boards and IoT sensor nodes.
Lenovo IdeaPad Slim 5 14IMH9 Laptop	14" OLED Display, Intel Core Ultra processor, 16GB RAM, 512GB SSD, Windows 11 Pro.	2	Primary workstation for software development, AI model training, and running simulation software for "Automatic Control and Robotics."
IOT Green House Kit for Technology Study	Includes sensors (soil moisture, light, temp/humidity), water pump, solar panel options, and Wi-Fi controller for automated plant care.	20	A direct application of "Green and Digital Skills." Students learn to build automated, energy-efficient agricultural systems (Smart Farming).
Radio Control System Radiolink AT9S	10/12 channels, 2.4GHz DSSS & FHSS spread spectrum, telemetry support, 900m-1500m range.	1	Used for manual control and testing of UAVs and autonomous mobile robots in the "Robotics" course.
Radio Control System FlySky FS-16	6 channels, 2.4GHz AFHDS 2A system, multi-channel frequency hopping, backlit LCD, lightweight design.	1	Entry-level radio equipment for student pilot training and testing of remote-controlled prototypes.

6. Linkage to Courses - IMPORTANT

Supported Course	Course Title (from CDP)	Specific Laboratory Role / Learning Activities
Course 1	Smart Cities and Urban Green Innovation	Students will design and simulate smart infrastructure using real-time traffic data, develop AI-based control algorithms for adaptive systems, and analyze urban environmental data using IoT platforms and dashboards. Lab sessions include configuring intelligent traffic lights, testing air quality sensors, and visualizing city-scale data flows using digital twins and GIS-integrated platforms.

Course 2	Digital Tools for Sustainability	Learners will build and deploy IoT-based environmental monitoring systems, develop dashboards using PostgreSQL + Grafana, and apply Prometheus for metrics collection and anomaly detection in sustainable system design. Students will use VR simulations, sensor kits, and containerized software (Docker) to analyze sustainable processes and evaluate technological solutions.
Course 3	Managing Green and Sustainable Projects	Students will prototype and manage interdisciplinary green-tech projects (e.g., smart orthosis, food lab automation, EcoKeep), using agile methodologies, AR interfaces, and performance monitoring tools. Lab will be used for feasibility studies, performance testing, and sustainability impact assessments of proposed projects using real data and digital modeling environments
Course 4	Sustainable Business Strategy	Students will analyze and design business models that integrate sustainability principles, evaluate environmental, social, and economic impacts, and develop strategic plans for green innovation adoption. Lab sessions include scenario simulations for sustainable decision-making, financial and environmental impact modeling using Excel and specialized sustainability software, and collaborative workshops to design eco-efficient business strategies.

7. Staffing Plan

Period	Type of Staff	Allocation (FTE / Hours)	Main Responsibilities
During Project	Academic Coordinator (Professor / PhD holder)	0.5 FTE	Overall supervision of laboratory activities, integration with CDP courses, coordination with project partners, quality assurance, and reporting.
	Technical Specialist (IoT/AI/Simulation expert)	0.5 FTE	Installation and configuration of new equipment (AI edge devices, sensors, EMS modules), software setup, support of student and faculty use.
	Research Assistant / Graduate Student	0.5 FTE	Assist in equipment testing, manage lab sessions, support data collection (e.g., EcoKeep, EMS), and participate in applied research tasks.
	Lab Administrator	0.5 FTE	Organize procurement, ensure compliance with usage schedules,

			handle inventory, and coordinate with facility services during upgrades.
Post-Project	Academic Lead / Course Instructor	0.5 FTE	Use of lab for teaching updated curricula in sustainability, IoT, and AI; mentoring of student capstone and thesis projects.
	Technical Support Staff	0.5 FTE	Ongoing maintenance of devices (e.g., sensors, VR, robotics), support for digital twin simulations and data visualization tools.
	Innovation Facilitator	0.5 FTE	Guide interdisciplinary student teams in developing green-tech solutions using lab resources; support for collaboration with industry and international partners.

4.2 International Engineering-Technological University, Kazakhstan (METU)

1. Institutional Information	
Institution Name	International Engineering Technological University
Country	Kazakhstan
Faculty / Department	Department of Biotechnology and Software Engineering
2. Laboratory Name and Thematic Focus	
Laboratory Official Name	Innovation Tech Lab
Primary Thematic Focus	Twin Green & Digital Transition through the integration of sustainability technologies, digital tools, and entrepreneurial innovation across biotechnology and software engineering education
3. Current Laboratory Status and Planned Reinforcement	
Current Laboratory Description	The Innovation Tech Lab is currently in its initial stage of development, with limited basic computing facilities and shared use of general-purpose classroom equipment. It lacks specialized hardware for simulation, prototyping, or digital collaboration, which restricts its functionality in advanced sustainability and bioengineering education.
Reinforcement through GreenTech Horizons	Through GreenTech Horizons funding, the lab will be equipped with advanced workstations, 3D scanning and printing tools, a large interactive display, and video conferencing systems. These resources

	will enable real-time collaboration, high-precision prototyping, and the delivery of modernized digital and green transition curricula in biotechnology and software engineering.
Contribution to Learning Ecosystem	The upgraded lab will support new and revised bachelor's and master's courses by providing a hands-on learning environment for sustainable design, digital modeling, and innovation project development. It will also enhance digital competencies, promote interdisciplinary learning, and support collaborative activities with industry and international partners

4. Revised Laboratory Mission Statement

Include structured elements (Example given bellow):

- This laboratory has been reinforced through EU funding under GreenTech Horizons project.
- It is fully integrated into updated curricula to support the delivery of Twin Green & Digital Transition competencies.
- Post-project, the laboratory will serve as a permanent teaching, training, and research facility aligned with national and regional workforce development strategies.
- The laboratory will also serve as a capacity-building center for continuous upskilling of students, academic staff, and external stakeholders (industry, public administration, etc.).

The Innovation Tech Lab has been reinforced through EU funding under the GreenTech Horizons project to support the transition toward a sustainable and digitally integrated educational ecosystem at the International Engineering Technological University (METU).

This laboratory is fully embedded within updated curricula across bachelor's and master's degree programs in Biotechnology and Software Engineering, directly supporting the implementation of courses such as Environmental Science and Technology for Biotechnology, Digital Tools for Sustainability, and Green Entrepreneurship and Innovation. Through this integration, the lab facilitates the acquisition of essential Twin Transition competencies, including digital fluency, sustainability-driven thinking, systems innovation, and entrepreneurial problem-solving.

Post-project, the Innovation Tech Lab will function as a permanent interdisciplinary hub for teaching, training, and applied research, contributing to Kazakhstan's national and regional workforce development strategies. It will provide students and academic staff with access to cutting-edge tools such as interactive displays, 3D modeling equipment, and high-performance computing systems, ensuring hands-on experience in digital and green technologies.

Furthermore, the laboratory will serve as a capacity-building center that fosters continuous upskilling and lifelong learning. It will support not only university stakeholders, but also external actors including industry partners, public administration bodies, NGOs, and international collaborators. Through joint projects, workshops, internships, and open innovation sessions, the lab will become a platform for the co-creation of sustainable technological solutions addressing real-world challenges.

The Innovation Tech Lab stands as a strategic asset for fostering regional innovation, strengthening academia-industry linkages, and nurturing a new generation of professionals equipped for the demands of the green and digital economy.

5. Planned Equipment and Resources

Equipment	Technical Description / Specifications	QTY	Purpose and Teaching Use
Interactive panel 86 inches DigiTouch T5-86	Large interactive display with high-resolution touchscreen	1	Visual collaboration, interactive lessons, hybrid and remote teaching
System unit PIXEL i5-12400F / RTX 3060 / 32GB RAM / SSD 1000GB / Win 11 Pro	High-performance PC for simulations, modeling, and rendering	12	Used by students for sustainability modeling, bioinformatics simulations, and software development
Monitor Lenovo L24e-40	24-inch HD monitor	12	Additional screen space for multitasking and detailed visualization
Keyboard Lenovo 510 Wireless Combo GX31F38001	Wireless keyboard and mouse combo	12	Input devices for student workstations
3D scanner Shining 3D EinScan-SP	High-precision scanner for reverse engineering and design	1	Creation of digital twins, engineering design, bio-structural scanning
3D printer Creality K1 Max	High-speed AI-supported printer with large build volume	1	Rapid prototyping for biotechnology and environmental solutions
Video conferencing kit Logitech GROUP	HD audio-video system for hybrid collaboration	1	Online guest lectures, virtual conferences, collaboration with partner universities
Computer desk Defender Ferox RGB	Ergonomic workstation desks with lighting	12	Student stations for project-based learning
Computer chair ZETA No. SLRC-02	Adjustable ergonomic chairs	12	Comfortable long-term work and learning environment

6. Linkage to Courses – IMPORTANT

Supported Course	Course Title (from CDP)	Specific Laboratory Role / Learning Activities
Course 1	Green Area Environmental Science and Technology for Biotechnology / Bachelor's degree	Environmental modeling, 3D visualization of ecosystems, sustainability assessments

Course 2	Digital Area Digital Tools for Sustainability for Biotechnology / Bachelor's degree	Application of digital platforms, interactive simulations, software development
Course 3	Business Area Green Entrepreneurship and Innovation for Biotechnology / Master's Degree	Prototyping of eco-innovations, business model testing, presentation tools for pitching projects

7. Staffing Plan

Period	Type of Staff	Allocation (FTE / Hours)	Main Responsibilities
During Project	Academic Coordinator (Professor / PhD holder)	0.5 FTE	Overall supervision of laboratory activities, integration with CDP courses in Biotechnology and Software Engineering, coordination with project partners, quality assurance, and project reporting.
During Project	Technical Specialist (Digital Tools & Bioinformatics Expert)	0.5 FTE	Installation and configuration of new equipment (interactive panel, 3D scanner/printer, video conferencing system), software setup, and support for students and faculty in digital simulations, bioinformatics tools, and modeling.
During Project	Research Assistant / Graduate Student	0.5 FTE	Assisting in lab sessions for "Digital Tools for Sustainability" and "Green Entrepreneurship" courses, testing equipment, supporting project-based learning, and participating in data collection and applied research activities.
During Project	Lab Administrator	0.5 FTE	Organizing procurement and logistics, maintaining lab usage schedules, inventory control, and coordinating with administrative and facility teams during the upgrade phase.
Post-Project	Academic Lead / Course Instructor	0.5 FTE	Delivering updated curricula on sustainability, biotechnology, and software engineering; mentoring student thesis and innovation projects using lab infrastructure.
Post-Project	Technical Support Staff	0.5 FTE	Providing ongoing technical support for lab equipment (e.g., 3D tools, collaboration platforms), maintaining digital systems for

			simulations, and supporting data processing and visualization tools.
Post-Project	Innovation Facilitator	0.5 FTE	Guiding interdisciplinary student teams in developing green-tech solutions using lab resources; facilitating partnerships with industry and international stakeholders for collaborative projects.

4.3 Almaty Technological University, Kazakhstan (ATUKZ)

1. Institutional Information	
Institution Name	Almaty Technological University
Country	Kazakhstan
Faculty / Department	Faculty of Engineering and Information Technology
2. Laboratory Name and Thematic Focus	
Laboratory Official Name	Center for Virtual Technologies and Digital Twins
Primary Thematic Focus	The Center for Virtual Technologies and Digital Twins specializes in the integration of digital twins, virtual technologies, smart technologies, robotics, Internet of Things (IoT), and information systems to support the Twin Green and Digital Transition. The primary focus is on developing intelligent control systems, 3D modeling, and simulations for energy-efficient smart manufacturing, predictive analytics, autonomous robotic platforms, and sensor-based monitoring of industrial processes.
3. Current Laboratory Status and Planned Reinforcement	
Current Laboratory Description	The Center is currently equipped with a basic set of computer equipment, network infrastructure, and virtual reality (VR) headsets. The existing resources allow for initial research and educational activities in the field of 3D modeling and fundamental virtual technologies (VR). The Center is used for training undergraduate and graduate students in courses related to 3D modeling, programming, and the Internet of Things (IoT). Current activities include coursework, laboratory classes, and small-scale research projects. To expand the scientific and educational capabilities of the Center, further upgrades and expansion of the material and technical base are planned. This is necessary for conducting more complex and large-scale research, developing and testing digital twins in

	conditions close to real production processes, as well as for organizing modern training courses in smart technologies, robotics, and IoT integration into industrial and information systems.	
Reinforcement through GreenTech Horizons	EU funding under the GreenTech Horizons initiative will significantly improve, modernize and expand the capabilities of the Center for Virtual Technologies and Digital Twins. It is planned to purchase modern equipment, including high-performance computers (for example, Alienware Aurora 13), VR headsets (Meta Quest Pro and Valve Index), GoPro MAX cameras, tablets (iPad Pro and iPad), VR projectors and augmented reality smart glasses (Glass Enterprise Edition 2). This equipment is necessary for the creation and testing of digital twins, the implementation of projects in the field of smart manufacturing and robotics, as well as to improve the quality of educational programs. This will enable students and undergraduates to provide training with a focus on green and digital technologies, including energy-efficient manufacturing, predictive analytics, IoT integration, and the use of digital twins to optimize energy consumption and reduce the carbon footprint.	(Describe how expand laborat Green & Digita
Contribution to Learning Ecosystem	The Center for Virtual Technologies and Digital Twins makes a significant contribution to the learning ecosystem by providing students, undergraduates and teachers with access to modern technologies and equipment in the field of digital twins, smart manufacturing, VR/AR and IoT. The Center is becoming a platform for the implementation of interdisciplinary training programs combining engineering, information and management competencies. By integrating the latest technologies, the Center promotes the development of practice-oriented learning, the formation of skills in working with digital and green technologies, which is especially important in the context of sustainable development and digital transformation of industry. Cooperation with industrial partners and participation in international projects enhances the applied aspect of the Center's educational activities.	(Explain how re delivery of Twi modernized cu
4. Revised Laboratory Mission Statement		
<p>The Center for Virtual Technologies and Digital Twins has been significantly strengthened through the GreenTech Horizons project, as well as with additional funding provided by the university. This reinforcement has enabled the Center to:</p> <ul style="list-style-type: none"> • Upgrade and expand its material and technical base (high-performance computers, VR/AR equipment, drones, sensors, 3D printers, etc.). 		

- Organize practical classes and student projects, providing hands-on experience with modern technologies.
- Develop research activities for students and graduate researchers in the fields of digital, IoT, smart manufacturing, and sustainable development.
- Create conditions for interdisciplinary projects combining engineering, information technology, and management competencies.
- Thus, the laboratory serves as a platform for integrating education and research, fostering the development of skills in digital and green technologies, and preparing specialists for digital and environmentally sustainable industry.

5. Planned Equipment and Resources

Equipment	Technical Description / Specifications	QTY	Purpose and Teaching Use
High-performance PC, Dell Preci 3680	Capable of handling data analysis, simulations, and modeling, ensuring students can engage effectively with diverse sustainability topics	1	3D modeling, digital twin development, simulations, smart manufacturing education
VR Headsets Headset Pico 4 ultra 12+256GB	Offer immersive learning experiences that transcend traditional boundaries, fostering a deeper understanding of sustainability concepts	1	VR-based training, immersive learning, visualization of digital twins
GoPro MAX Camera	Enhances hands-on experiences by capturing real-world environmental changes and sustainability-related activities, providing valuable documentation for research and coursework	1	VR content creation, recording environmental simulations, coursework documentation
Tablets 11-inch iPad Pro WiFi 512GB with Standard glass	Empower students to access a wide array of resources, applications, and digital content tailored to sustainability studies	2	IoT system management, mobile programming, accessing educational content
VR Projector	Facilitates collaborative learning and visualization exercises, enhancing comprehension and engagement in renewable	1	Immersive visualization for smart manufacturing and sustainability education

	energy engineering and related subjects		
DJI Mini 2 Fly More Combo Drone	Lightweight UAV (≤ 249 g), 4K video camera, GPS-assisted flight, up to 31 min flight time	1	Urban data collection, environmental monitoring, spatial mapping for smart city digital twins (Courses 1, 3)
3D Printer FlyingBear GHOST 6	FDM 3D printer, large build volume, high-precision printing, PLA/ABS/PETG support	1	Prototyping of urban and industrial components, visualization of green technologies (Courses 1, 3)
37 in 1 Arduino Sensor kit for Arduino 31in1	Multi-sensor kit (temperature, humidity, gas, light, motion, etc.)	2	IoT system programming, sensor data acquisition for sustainability analysis (Courses 1, 2, 4)
Raspberry Pi 5 Model B (8 GB)	ARM-based single-board computer, 8 GB RAM, GPIO, Ethernet, USB, HDMI	2	Edge computing, IoT gateways, data processing for digital twin platforms (Courses 1, 2, 4)
Starter Kit STEM kit is an educational robotics kit based on the Arduino microcontroller	Educational robotics kit with Arduino controller, motors, and sensors	2	Robotics fundamentals, automation, intelligent control system development (Courses 1, 3)
Arduino Environmental Monitoring Kit	Environmental sensors for air quality, temperature, humidity, pressure	2	Environmental monitoring, energy efficiency assessment, sustainability indicators (Courses 2, 4)
Xiaomi Air Detector 9 in 1 Air Quality Monitor (CGS1). Black	Air quality monitor (PM2.5, CO ₂ , VOC, temperature, humidity)	1	Indoor environmental quality assessment, smart building analysis (Courses 1, 2, 4)
Thermal imagerHIKMICRO M11	Portable thermal camera, high-resolution thermal imaging	1	Energy loss detection, thermal diagnostics,

			efficiency analysis (Courses 2, 4)
6. Linkage to Courses - IMPORTANT			
Supported Course	Course Title (from CDP)	Specific Laboratory Role / Learning Activities	
Course 1	Smart Cities and Urban Green Innovation	Development and testing of digital twins, 3D modeling, IoT system programming, VR/AR simulations, and data analysis exercises	
Course 2	Digital Tools for Sustainability	Predictive analytics, energy efficiency simulations, IoT-based monitoring projects, collaborative research work, VR-based presentations	
Course 3	Managing Green and Sustainable Projects	Smart city simulations, AR-enhanced urban modeling, 3D visualization of green technologies, group projects using digital twin models	
Course 4	Sustainable Business Strategy	Virtual modeling tools are used to assess sustainability scenarios and resource efficiency. Students use IoT data and predictive analytics to design data-driven strategies that support green and digital transformation.	
7. Staffing Plan			
Period	Type of Staff	Allocation (FTE / Hours)	Main Responsibilities
During Project	Academic Staff	0.5 FTE	Development of course content, delivery of lectures and practical classes, supervision of student projects, integration of new technologies into teaching
	Academic Staff	0.5 FTE	Development of course content, delivery of lectures and practical classes, supervision of student projects, integration of new technologies into teaching
	Technical Staff (Lab Technicians, IT Specialists)	0,5 FTE	Installation and configuration of equipment, technical support, maintenance, assistance during laboratory classes
	Center Administrator	0.25 FTE	Coordination of lab activities, scheduling, resource management, administrative support

Post-Project	Academic Staff	0.25 FTE	Ongoing teaching activities, course updates, supervision of research and projects
	Academic Staff	0.25 FTE	Ongoing teaching activities, course updates, supervision of research and projects
	Technical Staff (Lab Technicians, IT Specialists)	0,5	Continuous maintenance of laboratory equipment, technical assistance, support for student projects
	Center Administrator	0.25 FTE	Laboratory operations management, administrative tasks, ensuring continuity of lab usage

4.4 Mongolian University of Science and Technology, Mongolia (MUST)

1. Institutional Information	
Institution Name	Mongolian University of Science and Technology /MUST/
Country	Mongolia
Faculty / Department	Graduate School/Digital Engineering Department
2. Laboratory Name and Thematic Focus	
Laboratory Official Name	VIRTUAL INNOVATION LAB
Primary Thematic Focus	<p>The Virtual Innovation Lab focuses on accelerating the Twin Transition-green and digital-by serving as an interdisciplinary hub for research, prototyping, and policy experimentation. The lab integrates advanced digital technologies (such as AI, IoT, digital twins, and immersive environments) with sustainable development goals (SDGs) to support smart campus modeling, green infrastructure planning, and digital education innovation. It fosters collaboration among academia, industry, and government to co-create scalable solutions for sustainable, digitally empowered futures.</p> <p>Key Thematic Pillars: Smart & Sustainable Campus Development, Digital Education and Future Skills, Green Innovation & Applied Research, Cross-sectoral Co-Creation & Policy Support</p>
3. Current Laboratory Status and Planned Reinforcement	
Current Laboratory Description	<p>Lab No.1. Smart City Technologies Open Research Laboratory</p> <p>Focus: Urban data analytics, IoT-based infrastructure, and smart mobility.</p> <p>Teaching Use:</p>

	<ul style="list-style-type: none"> • Supports graduate courses in smart infrastructure, urban analytics, and sustainability • Used for student capstone projects and applied research <p>Lab No.2. Virtual Reality Laboratory Focus: Immersive learning, digital twin environments, and 3D visualization Teaching Use:</p> <ul style="list-style-type: none"> • Integrated into digital design, architecture, and engineering curricula • Enables students to build and experience virtual prototypes and simulations <p>These laboratories form the foundation for scaling up to a broader Virtual Innovation Lab that integrates sustainability and digital transformation themes across disciplines and stakeholders.</p>
<p>Reinforcement through GreenTech Horizons</p>	<p>Through the GreenTech Horizons Erasmus+ Project, EU funding will play a transformative role in upgrading, modernizing, and expanding the existing laboratory infrastructure at the MUST. This reinforcement directly supports the university’s strategic commitment to advancing the Twin Transition-green and digital-within higher education and applied research. By reinforcing laboratory capacity through GreenTech Horizons, MUST will be better equipped to educate future-ready professionals, co-create policy-relevant solutions, and serve as a regional model for integrated digital and green transition in higher education.</p> <p>Key Enhancements: Laboratory Modernization, Capacity Expansion, Curriculum-Linked Infrastructure, Open Access and Collaboration, Sustainability Impact</p>
<p>Contribution to Learning Ecosystem</p>	<p>The reinforcement of laboratory infrastructure at MUST through the GreenTech Horizons project will significantly enhance the university’s learning ecosystem by embedding Twin Green and Digital Transition principles into academic delivery and competency development.</p> <p>In sum, the upgraded laboratory ecosystem will be central to equipping students with the skills, mindsets, and experience necessary to lead and support the Twin Transition—making the university a driver of sustainable, tech-enabled development in Mongolia and the region.</p> <p>Key Contributions: Competency-Based Learning for the Twin Transition, Curriculum Modernization & Integration, Project-Based & Experiential Learning, Faculty Development & Pedagogical Innovation, Stronger University-Industry-Community Linkages</p>
<p>4. Revised Laboratory Mission Statement</p>	

The **Virtual Innovation Lab at the Mongolian University of Science and Technology (MUST)** has been reinforced through **EU funding under the GreenTech Horizons Erasmus+ project** to serve as a strategic platform for advancing the **Twin Green and Digital Transition** in higher education, research, and innovation. The laboratory is **fully integrated into updated graduate and postgraduate curricula**, supporting the delivery of future-oriented competencies in **digital transformation, sustainability, smart cities, and green innovation**. Through hands-on experimentation, immersive technologies, and data-driven tools, the lab enables students to acquire practical skills aligned with emerging labor market needs and national development priorities.

Following the completion of the project, the Virtual Innovation Lab will operate as a **permanent teaching, training, and applied research facility**, aligned with **national and regional workforce development strategies** and Mongolia's long-term digital and green transition agenda. It will support interdisciplinary learning, applied research, and policy-relevant experimentation across engineering, sustainability, and digital education domains.

The laboratory will also function as a **capacity-building and continuous upskilling center** for **students, academic staff, and external stakeholders**, including industry partners, public administration, and innovation ecosystems. By fostering cross-sectoral collaboration and co-creation, the Virtual Innovation Lab will contribute to strengthening university–industry–government linkages and positioning MUST as a regional leader in sustainable, digitally enabled higher education and innovation.

5. Planned Equipment and Resources

Equipment	Technical Description / Specifications	QTY	Purpose and Teaching Use
Alienware Aurora R16	Intel Core Ultra 9-285K, NVIDIA GeForce 5080, 64GB DDR5, 2TB SSD, Win11 Home	1	<p>Purpose: A high-performance desktop computer designed for demanding workloads such as AI development, VR content creation, and real-time 3D rendering.</p> <p>Teaching Use:</p> <ul style="list-style-type: none"> • Running advanced simulations and machine learning models • Supporting VR and AR development using Unity or Unreal Engine • Processing large datasets for data science courses • Powering immersive educational software and 3D modeling tools

Alienware Display	Alienware WQHD curved 34.inch, WQHD 3440x1440, 180Hz, VA, 1ms (extreme mode)	1	<p>Purpose: A premium display with high refresh rate and color accuracy, ideal for visual-intensive applications.</p> <p>Teaching Use:</p> <ul style="list-style-type: none"> • Clear visualization of 3D models and simulation results • Enhancing the VR experience when using PC-tethered devices like Valve Index • Supporting design, video editing, and creative work • Presenting educational content in high clarity
Valve Index VR Kit	Valve Index VR HMD, Black, 1440 x 1600 Resolution, 110 Degrees FOV, Inside-Out Tracking, Windows 10, PlayStation Vita Compatible	1	<p>Purpose: A high-fidelity VR headset designed for immersive experiences with precise motion tracking and hand controllers.</p> <p>Teaching Use:</p> <ul style="list-style-type: none"> • Conducting realistic virtual lab simulations (engineering, physics, biology) • Visualizing architectural and structural models in VR • Participating in collaborative virtual classrooms and projects • Training students in environments that require spatial awareness
Meta Quest 3 Advanced All- in-One VR Headset (512GB)	512GB of Internal Storage Full-Color Passthrough 2064 x 2208 Resolution per Eye XR2 Gen 2 Snapdragon Processor Ring-Free Touch Plus Controllers TruTouch Haptic Feedback 40% Slimmer Than Quest 2 Built-In 3D Spatial Audio Works with All Quest Apps &	2	<p>Purpose: A wireless VR headset with built-in computing and pass-through mixed reality features.</p> <p>Teaching Use:</p> <ul style="list-style-type: none"> • Delivering portable, interactive VR lessons without needing a PC • Accessing educational VR applications (e.g., virtual tours, anatomy models)

	Games Adjustable Strap, Lens Depth & IPD		<ul style="list-style-type: none"> Supporting AR-based content and classroom engagement Ideal for individual learning and quick deployment
GoPro MAX camera	HERO12 Black Action Camera Volta Battery Grip, Light Mod Media Mod with Built-In Microphone Mounting Buckle, Curved Adhesive Mount	1	<p>Purpose: A 360-degree action camera designed for capturing immersive video and virtual reality footage.</p> <p>Teaching Use:</p> <ul style="list-style-type: none"> Creating 360° educational videos and virtual field trips Documenting student projects and outdoor experiments Producing VR content for playback on headsets like Meta Quest or projectors Encouraging media production and storytelling in education
Wacom Cintiq 24 Creative Pen Display (2025)	20.7 x 11.7" Active Area 23.6" 2560 x 1440 IPS Display 350 cd/m ² Brightness 178°/178° Viewing Angles 1000:1 Contrast Ratio 100% sRGB 16.7 Million Colors 8192 Levels of Pressure Sensitivity VESA Mount Compatible (75 x 75mm) Includes Pro Pen 3 and Stand Mac, Windows, and Android Compatible	2	<p>Purpose: Wacom Cintiq 24 Creative Pen Display (2025) is an advanced pen-based display built to support professional digital creation, and it is highly valuable in education, particularly in fields requiring precision drawing, modeling, visualization, scientific explanation, and interactive teaching.</p> <p>It brings natural handwriting, accurate drawing, and professional creative tools into the classroom—making it ideal for STEM, arts, engineering, architecture, media, and digital learning environments.</p> <p>Teaching Use:</p> <ul style="list-style-type: none"> Digital Art & Design Education Engineering & Architecture Visualization Scientific Visualization & STEM Teaching

			<ul style="list-style-type: none"> • Interactive Lecturing & Annotation • Media Production & Digital Storytelling Classes • Hybrid & Online Teaching
<p>HUAWEI IdeaHub K3</p>	<p>HUAWEI IdeaHub K3, IHK3-86SA, Intelligent Collaboration Device 86-inch infrared screen, Titanium grey, overseas, OPS, I7-12700,DDR4 16GB, 512GB SSD, Windows11 IOT Enterprise SAC, DC19V, Max 90W, 195mm, 180mm, 30mm, HUAWEI Ideahub Gray Rolling Stand II (65/75/86 inches) 2xHDMI IN, 1xUSB2.0, 2xUSB 3.0, 1xUSB</p>	<p>1</p>	<p>Purpose: The Huawei IdeaHub is an all-in-one, intelligent interactive display for modern offices, combining 4K touch screens with integrated cameras, microphones, and speakers for seamless video conferencing and digital whiteboarding, featuring low-latency writing, wireless projection (like Wi-Fi 6), AI-powered features (auto-framing, voice tracking), and compatibility with major cloud platforms for effortless team collaboration in any meeting space. It supports interactive lectures, digital content delivery, hybrid learning, and STEM-focused education while simplifying classroom technology management.</p> <p>Teaching Use:</p> <ul style="list-style-type: none"> • Interactive Teaching • Multimedia Lesson • Smart Whiteboard • Hybrid / Online Learning • STEM & Technical Education • Collaborative Learning • Assessment & Feedback • Classroom Management

6. Linkage to Courses - IMPORTANT

Course: Smart Cities and Urban Green Innovation
The Virtual Innovation Lab at MUST will serve as a cross-cutting educational and research environment that supports the development of future-ready competencies in sustainable urban development and digital transformation. It will act as a living learning ecosystem, enabling students in the Smart Cities and Urban Green Innovation master’s program to design, simulate, and co-create next-generation smart and green city solutions.

Laboratory Role

To integrate advanced digital tools and green transition technologies into teaching and research, providing students with immersive, collaborative, and data-driven environments for problem-solving and innovation.

Course: Digital Literacy and Transformation for Sustainability

The Virtual Innovation Lab serves as an enabling environment for delivering the practical component of the “Digital Literacy and Transformation for Sustainability” course. It supports experiential learning, digital skill development, and collaborative innovation, all aligned with the twin green and digital transition agenda.

Laboratory Role

To function as a practice-based learning environment that bridges digital skill development with sustainability goals through experimentation, visualization, and real-world problem-solving using digital platforms.

Course: Green and Sustainable Project Management

The Virtual Innovation Lab supports the Green and Sustainable Project Management course by providing an experiential learning environment where students can apply project management principles to real-world sustainability contexts using digital tools, data-driven analysis, and collaborative platforms.

Laboratory Role

To act as a simulation and co-creation environment where students design, plan, and evaluate green projects using digital project management tools, sustainability data, and immersive technologies.

Supported Course	Course Title (from CDP)	Specific Laboratory Role / Learning Activities
Green	Smart Cities and Urban Green Innovation	Key Learning Activities: <ul style="list-style-type: none"> • Smart City Digital Twin Development • Green Infrastructure Simulation & scenarios in resilient urban ecosystems • Immersive Urban Planning & Design • IoT and Real-Time Data Experimentation • Policy Innovation & Multi-Stakeholder Prototyping • Smart City Simulation with AI
Digital	Digital Literacy and Transformation for Sustainability	Key Learning Activities: <ul style="list-style-type: none"> • Digital Tool Proficiency Workshops • Sustainability Data Literacy Projects • Immersive Sustainability Experiences • Digital Mindset & Ethics Discussions • Innovation Challenges and Peer Co-Creation

		<ul style="list-style-type: none"> • Sustainability-Focused AI Projects
Business	Green and Sustainable Project Management	<p>Key Learning Activities:</p> <ul style="list-style-type: none"> • Digital Project Planning Simulations • Sustainability Metrics and Impact Assessment • Stakeholder Mapping and Risk Analysis • Immersive Project Scenarios and Simulations • Group-Based Capstone Projects • AI-Assisted Project Decision-Making

7. Staffing Plan

Period	Type of Staff	Allocation (FTE / Hours)	Main Responsibilities
During Project	Lab Coordinator		<ul style="list-style-type: none"> • Coordinate general lab operations • Facilitate training, workshops, and curriculum integration • Oversee lab booking, usage, and outreach
	Technical Support Staff		<ul style="list-style-type: none"> • Maintain computer systems, VR/AR devices, and lab software • Support digital tools (non-GPU-based) • Plan infrastructure upgrade for future AI/GPU integration
	Digital Learning Specialist		<ul style="list-style-type: none"> • Assist in development of virtual learning environments • Support use of cloud-based tools for sustainability & digital skills • Curate educational content and assist instructors
Post-Project	Lab Coordinator		<ul style="list-style-type: none"> • Maintain operational continuity of the lab • Coordinate usage scheduling and user support • Liaise with departments for curriculum integration • Organize outreach, lab tours, and innovation events
	Digital Learning Specialist		<ul style="list-style-type: none"> • Update and manage digital content for lab-related courses

		<ul style="list-style-type: none"> • Support blended learning and remote access to lab tools • Assist faculty with pedagogy-technology alignment
	AI/Data Science Advisor	<ul style="list-style-type: none"> • Mentor students on applied AI projects • Curate and update AI/ML learning materials • Support publication of research using lab resources

4.5 National University of Mongolia, Mongolia (NUM)

1. Institutional Information	
Institution Name	National University of Mongolia
Country	Mongolia
Faculty / Department	Department of Information and Computer Sciences
2. Laboratory Name and Thematic Focus	
Laboratory Official Name	VIRTUAL INNOVATION LAB
Primary Thematic Focus	<p>This laboratory is primarily focused on equipping students and academic staff with the skills and competencies required for the Twin Transition - the convergence of digital transformation and green sustainability. It emphasizes the practical integration of AI, VR/AR, big data analytics, immersive technologies, and digital sustainability tools into higher education curricula and applied research.</p> <p>Through interdisciplinary and project-based learning, the lab aims to serve as a central hub for advancing digital literacy, green innovation, and technology-driven solutions for sustainable urban development, energy systems, environmental planning, and responsible business practices.</p>
3. Current Laboratory Status and Planned Reinforcement	
Current Laboratory Description	<p>The current facility is a standard computer laboratory equipped with desktop PCs only. It is primarily used for general-purpose instruction in computer literacy, basic programming, and software-based analysis. The lab supports foundational teaching activities but lacks the specialized hardware and immersive technologies needed to deliver advanced digital and sustainability-focused courses. Equipment performance is limited for running AI simulations, VR/AR applications, and high-volume data processing tasks.</p>

<p>Reinforcement through GreenTech Horizons</p>	<p>With support from the EU-funded <i>GreenTech Horizons</i> project, the laboratory will significantly transform into a state-of-the-art educational and innovation space aligned with the Twin Green and Digital Transition goals. The upgrade will include high-performance desktop systems (Alienware Aurora R16), VR/AR headsets (Valve Index, Meta Quest Pro), 360° video equipment (GoPro Max), high-resolution displays, immersive projectors, and mobile devices (iPad Pro). This reinforcement will enable the lab to host hands-on learning in AI, data science, sustainable energy systems, urban innovation, digital tools for sustainability, and immersive virtual environments.</p>
<p>Contribution to Learning Ecosystem</p>	<p>The reinforced laboratory will serve as a cornerstone for implementing updated curricula that address the evolving skill demands of the green and digital economy. It will enable project-based, interdisciplinary learning experiences through advanced simulation, data modeling, immersive virtual environments, and interactive digital design.</p> <p>Students will engage with cutting-edge technologies - including artificial intelligence, extended reality (VR/AR), big data analytics, and sustainability-focused digital platforms - equipping them with practical, future-ready competencies to tackle real-world sustainability and digital transformation challenges. At the same time, instructors will benefit from enhanced infrastructure and specialized toolkits that support the development and delivery of innovative, competency-based teaching methodologies.</p>

4. Revised Laboratory Mission Statement

This laboratory was established and enhanced with support from the EU-funded *GreenTech Horizons* project. It is fully integrated into the updated academic curricula to equip learners with essential competencies for the Twin Green and Digital Transitions. Designed as a future-oriented facility, the laboratory will serve as a permanent hub for teaching, applied research, and innovation. It will be vital in advancing national and regional priorities in sustainability, digital transformation, and workforce development. In addition, the laboratory will function as a capacity-building center, providing continuous upskilling and hands-on learning opportunities for students, academic staff, and external stakeholders, including industry professionals, public sector representatives, and civil society.

5. Planned Equipment and Resources

Equipment	Technical Description / Specifications	QTY	Purpose and Teaching Use
Dell Alienware Aurora R16	Intel Core Ultra 9-285K, NVIDIA GeForce 5080, 64GB DDR5, 2TB SSD, Win11 Home	1	<p>Purpose: A high-performance desktop computer designed for demanding</p>

			<p>workloads such as AI development, VR content creation, and real-time 3D rendering.</p> <p>Teaching Use:</p> <ul style="list-style-type: none"> • Running advanced simulations and machine learning models • Supporting VR and AR development using Unity or Unreal Engine • Processing large datasets for data science courses • Powering immersive educational software and 3D modeling tools
Dell Alienware Display	Alienware WQHD curved 34.inch, WQHD 3440x1440, 180Hz, VA, 1ms (extreme mode)	1	<p>Purpose: A premium display with high refresh rate and color accuracy, ideal for visual-intensive applications.</p> <p>Teaching Use:</p> <ul style="list-style-type: none"> • Clear visualization of 3D models and simulation results • Enhancing the VR experience when using PC-tethered devices like Valve Index • Supporting design, video editing, and creative work • Presenting educational content in high clarity

Valve Index VR Kit	Valve Index VR HMD, Black, 1440 x 1600 Resolution, 110 Degrees FOV, Inside-Out Tracking, Windows 10, PlayStation Vita Compatible	1	<p>Purpose: A high-fidelity VR headset designed for immersive experiences with precise motion tracking and hand controllers.</p> <p>Teaching Use: Conducting realistic virtual lab simulations (engineering, physics, biology) Visualizing architectural and structural models in VR Participating in collaborative virtual classrooms and projects Training students in environments that require spatial awareness</p>
Meta Quest 3 Advanced All-in-One VR Headset	512GB of Internal Storage Full-Color Passthrough 2064 x 2208 Resolution per Eye XR2 Gen 2 Snapdragon Processor Ring-Free Touch Plus Controllers TruTouch Haptic Feedback 40% Slimmer Than Quest 2 Built-In 3D Spatial Audio Works with All Quest Apps & Games Adjustable Strap, Lens Depth & IPD	2	<p>Purpose: A wireless VR headset with built-in computing and pass-through mixed reality features.</p> <p>Teaching Use:</p> <ul style="list-style-type: none"> • Delivering portable, interactive VR lessons without needing a PC • Accessing educational VR applications (e.g., virtual tours, anatomy models) • Supporting AR-based content and classroom engagement • Ideal for individual learning and quick deployment

GoPro MAX camera 360	HERO12 Black Action Camera Volta Battery Grip, Light Mod Media Mod with Built-In Microphone Mounting Buckle, Curved Adhesive Mount	<p>Purpose: A 360-degree action camera designed for capturing immersive video and virtual reality footage.</p> <p>Teaching Use:</p> <ul style="list-style-type: none"> • Creating 360° educational videos and virtual field trips • Documenting student projects and outdoor experiments • Producing VR content for playback on headsets like Meta Quest or projectors <p>Encouraging media production and storytelling in education</p>
Wacom Cintiq 24 Creative Pen Display	20.7 x 11.7" Active Area 23.6" 2560 x 1440 IPS Display 350 cd/m ² Brightness 178°/178° Viewing Angles 1000:1 Contrast Ratio 100% sRGB 16.7 Million Colors 8192 Levels of Pressure Sensitivity VESA Mount Compatible (75 x 75mm) Includes Pro Pen 3 and Stand Mac, Windows, and Android Compatible	<p>Purpose: To provide a professional-grade pen display for precise digital drawing, design, annotation, and content creation in teaching and research activities.</p> <p>Teaching Use: Used for digital illustration, UI/UX and graphic design exercises, interactive content creation, real-time annotation during lectures, and student project development in creative, engineering, and digital technology courses.</p>

<p>HUAWEI IdeaHub K3 Intelligent Collaboration Board IHK-86SA</p>	<p>HUAWEI IdeaHub K3, IHK3-86SA, Intelligent Collaboration Device 86-inch infrared screen, Titanium grey, overseas, OPS, I7-12700, DDR4 16GB, 512GB SSD, Windows 11 IOT Enterprise SAC, DC19V, Max 90W, 195mm, 180mm, 30mm, HUAWEI Ideahub Gray Rolling Stand II (65/75/86 inches)</p>	<p>1</p>	<p>Purpose: To enable interactive, collaborative, and hybrid teaching through a large-format intelligent display with integrated annotation, wireless sharing, and video conferencing capabilities. Teaching Use: Used for interactive lectures, group collaboration, hybrid classes, presentations of digital learning content, student project showcases, and online/offline seminars.</p>
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6. Linkage to Courses

Supported Course	Course Title (from CDP)	Specific Laboratory Role / Learning Activities
Course 1	Sustainable Energy Systems	<ul style="list-style-type: none"> • Simulation of renewable energy systems • Hands-on activities with energy modeling software • Exploring fuel transition scenarios using digital tools
Course 2	Smart Cities and Urban Green Innovation	<ul style="list-style-type: none"> • Urban infrastructure modeling using GIS tools • Interactive planning using VR for green city concepts • Simulations of mobility and sustainable urban design
Course 3	Digital Tools for Sustainability	<ul style="list-style-type: none"> • Data visualization exercises with sustainability indicators • Use of IoT and digital platforms for resource monitoring • Project work using real-world sustainability datasets
Course 4	Managing Green and Sustainable Projects	<ul style="list-style-type: none"> • Project management simulation using digital tools • Budgeting and sustainability impact analysis

			<ul style="list-style-type: none"> • Risk mapping and scenario planning using case-based software
7. Staffing Plan			
Period	Type of Staff	Allocation (FTE / Hours)	Main Responsibilities
During Project	Laboratory Technician	0.5 FTE	<ul style="list-style-type: none"> • Installation and maintenance of equipment • Technical support during teaching sessions • VR/AR setup & troubleshooting
	Teaching Assistant (TA)	10 hours/week	<ul style="list-style-type: none"> • Assisting in lab-based instruction • Preparing and organizing teaching materials • Supporting students in simulations and software use
	Research Assistant (RA)	0.25 FTE	<ul style="list-style-type: none"> • Assisting with data collection, analysis, and reporting • Supporting project-based student research • Documenting best practices for lab use
Post-Project	Laboratory Technician	0.25 FTE	<ul style="list-style-type: none"> • Ongoing maintenance of equipment • Technical support for regular lab use • Updating system software and tools
	Teaching Assistant (TA)	6 hours/week	<ul style="list-style-type: none"> • Supporting implementation of sustainability and digital courses • Assisting with practical lab sessions
	Research Assistant (RA)	As needed (per project)	<ul style="list-style-type: none"> • Assisting in sustainability-related institutional research • Supporting student-led innovation and capstone projects

5. CONCLUSION

Content related instructions: Key outcomes achieved.

Deliverable D2.3 successfully established a comprehensive competency-oriented curriculum model that integrates academic content with practical learning environments. The development of the Course Development Plan (CDP) and the Laboratory Development Plan (LDP) provides a coherent framework for implementing future-oriented, competency-based education across partner higher education institutions. The deliverable also strengthened institutional alignment around shared educational standards and priorities related to green and digital transitions.

Deliverables aligned with project objectives.

The outcomes of D2.3 directly support the project's objective of fostering green and digital skills through higher education modernization. By translating identified labor market needs and policy priorities into structured curricula and laboratory upgrades, the deliverable ensures strong alignment between educational provision, industry relevance, and regional development goals. It also creates a clear link between strategic project objectives and subsequent implementation-focused deliverables.

Recommendations for continuous improvement.

To ensure long-term relevance and sustainability, partner institutions are encouraged to periodically review and update the curriculum model in line with evolving technological, environmental, and labor market trends. Continuous engagement with industry stakeholders, policymakers, and students is recommended to maintain relevance and impact. Additionally, systematic monitoring of learning outcomes and graduate employability should be used to inform future curriculum refinements and institutional capacity-building efforts.

6. APPENDICES

Appendix 1: [Template Example - Course Development Plan]

Appendix 2: [Template Example - Laboratory Development Plan]

● REFERENCES AND RELATED DOCUMENTS

ID	Related Document	Source or Link/Location
1	Course Selection Table	LINK
2	Course Development Plan	LINK
3	Laboratory Development Plan	LINK
4	Deliverable Template	LINK