GreenTech HORIZONS

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

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Deliverable 2.1
State-of-the-art report “Green & digital transition: opportunities, challenges and gaps”

WP2 - Design a Competency-Oriented Learning Ecosystem

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Table with Acronyms

Acronym	Full Form
AI	Artificial Intelligence
ATU	Azerbaijan Technological University
ATUKZ	Almaty Technological University
AzET	Azerbaijan Scientific-Research and Design-Prospecting Power Engineering Institute
AzTU	Azerbaijan Technical University
CPF	Country Partnership Framework
EA	European Academy
EdTech	Educational Technology
EPG	Power Progress Group
GDPR	General Data Protection Regulation
HEI	Higher Education Institution
ICT	Information and Communication Technologies
IoT	Internet of Things
KazNU	Al-Farabi Kazakh National University
KTU	Kaunas University of Technology
METU	International Engineering Technological University
MUST	Mongolian University of Science and Technology
MSU	Mingachevir State University
NUM	National University of Mongolia
RES	Renewable Energy Sources
RRP	Recovery and Resilience Plan
RTU	Riga Technical University
SME	Small and Medium-sized Enterprise
SRD	Strategy for Responsible Development
UNIST	University of Split
UNS	University of Novi Sad
UITM	University of Information Technology and Management in Rzeszow
VERTO	Verto Business Limited Liability Partnership
WP	Work Package

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EXECUTIVE SUMMARY

The **GreenTech Horizons** project has commissioned a comprehensive **State-of-the-Art Report on Green and Digital Transition**, aiming to weave these critical elements into the higher education frameworks of Azerbaijan, Kazakhstan, and Mongolia. This pivotal document maps the current educational, industrial, and policy landscapes to guide the development of a competency-oriented learning ecosystem, in line with the project's objectives.

The research methodologies employed—**desk research, online surveys, and interviews with HEIs**—have been instrumental in identifying key skill shortages, industry demands, and policy barriers that impact workforce readiness for the green and digital transitions. This approach has enabled a thorough assessment of existing HEI programs, national sustainability strategies, and global competency frameworks, which are crucial for creating a structured approach to curriculum enhancement.

By aligning academic endeavors with workforce requirements, the report lays the foundational groundwork for a learning ecosystem that supports the green and digital transitions in Neighbourhood East, Central Asia, and Asia. The GreenTech Horizons project delves into the nuances of these transitions within Azerbaijan, Kazakhstan, and Mongolia, assessing policies, workforce needs, and the alignment of curricula at higher education institutions. Through extensive desk research that includes the analysis of over **100 reports**, reviews of national contexts, assessments of the job market across more than **50 sectors**, and evaluations of curricula in **over 40 HEI programs**, the study pinpoints both significant challenges and emerging opportunities.

The survey, which garnered responses from **895 industry professionals**, reveals substantial skill gaps, with 75% of respondents indicating deficiencies in AI, IoT, and green energy. Furthermore, 60% of these respondents face difficulties in hiring sustainability experts. Interviews with **125 HEIs representatives** have shown that only 30% of their programs currently incorporate green and digital competencies effectively. Notable regional challenges include Azerbaijan's heavy reliance on fossil fuels, which constitutes 85% of its economy, regulatory barriers in Kazakhstan that affect 55% of businesses, and Mongolia's limited adoption of renewable energy curricula, which is present in only 20% of universities.

To address these issues, the report advocates for **a shift towards competency-based learning** and recommends strengthening collaborations between HEIs and over 100 enterprises. It also suggests implementing policy incentives to hasten the educational and industrial sectors' transition, which is essential for fostering workforce readiness and promoting sustainable economic growth.

This thorough analysis not only identifies gaps and areas for improvement but also offers actionable recommendations for aligning educational outputs with the evolving demands of the green and digital economy. The report is a strategic asset for the GreenTech Horizons project, ensuring that the educational systems in Azerbaijan, Kazakhstan, and Mongolia are equipped to meet the challenges of the future effectively.

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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.

1.1. Rationale for the State-of-the-art Report "Green & digital transition: opportunities, challenges and gaps"

Given the complexity of the twin green and digital transition, the diversity of regional contexts, and the evolving skill requirements across the Neighbourhood East, Central Asia, and Asia regions—particularly in Azerbaijan, Kazakhstan, and Mongolia—the need for a dedicated State-of-the-art Report is evident. While general policy frameworks and sectoral studies provide valuable insights, the scale and specificity of the GreenTech Horizons initiative necessitate a focused document that systematically examines opportunities, challenges, and existing gaps in green and digital transition efforts. This report plays a

crucial role in mapping the emerging skill needs associated with the twin transition, ensuring that the competency-oriented learning ecosystem developed within GreenTech Horizons aligns with industry demands and sustainability goals. By synthesizing regional trends, best practices, and policy frameworks, the report will serve as a foundation for targeted educational and training interventions, facilitating cross-regional coordination and supporting a modern workforce capable of driving sustainable growth and job creation.

1.2. Objectives of the State-of-the-art Report

This State-of-the-art Report aims to provide a structured and in-depth analysis of the opportunities, challenges, and gaps associated with the twin green and digital transition in the Neighbourhood East, Central Asia, and Asia regions, with a specific focus on Azerbaijan, Kazakhstan, and Mongolia. Its key objectives include:

- **Mapping the transition landscape:** Analyze the current state of green and digital transition efforts across the targeted regions, identifying key trends, policies, and initiatives.
- **Identifying skill needs and gaps:** Assess the emerging skill requirements for the modern workforce, highlighting competencies essential for sustainable growth and job creation.
- **Examining challenges and barriers:** Investigate structural, economic, and policy-related obstacles hindering the effective integration of green and digital skills.
- **Highlighting opportunities for synergy:** Identify potential areas for collaboration between industry, academia, and policymakers to enhance the effectiveness of skill development initiatives.
- **Informing curriculum development:** Provide evidence-based insights to guide the design of the GreenTech Horizons competency-oriented learning ecosystem, ensuring alignment with market demands and sustainability goals.
- **Recommending best practices and strategies:** Outline recommendations and actionable strategies to enhance education-led responses to the twin green and digital transition.

1.3. Alignment with Project Goals

The State-of-the-art Report “Green & Digital Transition: Opportunities, Challenges, and Gaps” aligns directly with the GreenTech Horizons project’s goal of analyzing evolving skill requirements driven by the twin green and digital transitions in Neighbourhood East, Central Asia, and Asia, with a specific focus on Azerbaijan, Kazakhstan, and Mongolia. By mapping current and future skill demands, the report provides a data-driven understanding of regional workforce needs, enabling Higher Education Institutions (HEIs) to adapt their curricula accordingly. It identifies gaps between industry expectations and existing educational frameworks, ensuring that graduates are equipped with relevant expertise to meet future workforce challenges. Furthermore, by analyzing regional trends and fostering cross-country comparisons, the report supports harmonized educational responses, facilitating collaboration and knowledge exchange among HEIs and industry stakeholders. This ensures that the State-of-the-art Report serves as a strategic resource, reinforcing the GreenTech Horizons project’s mission to develop a skilled workforce capable of driving sustainable growth and innovation in the green and digital economy.

2. RESEARCH METHODOLOGY FOR GREEN & DIGITAL TRANSITION

The research methodology for the State-of-the-art Report "Green & Digital Transition: Opportunities, Challenges, and Gaps" is designed to provide a comprehensive and evidence-based understanding of the evolving skill demands associated with the twin green and digital transitions. By employing a multi-method approach, this report ensures a robust analysis of national contexts, job market trends, and higher education curricula, while also incorporating insights from industry professionals and academic stakeholders. This methodological framework facilitates the identification of key opportunities, challenges, and skill gaps across Azerbaijan, Kazakhstan, and Mongolia, supporting the development of targeted educational interventions. To achieve these objectives, the research integrates qualitative and quantitative data collection methods, combining desk research, surveys, and interviews to capture a holistic perspective on emerging skill needs. This approach enables a cross-sectoral comparison, ensuring that findings are relevant for both industry and academia, and ultimately strengthening the alignment between workforce demands and educational provisions.

2.1. Research Components

The research includes the following parts, based on diverse qualitative and quantitative data collection methods:

1. **Desk Research**
    - National context analysis (country level)
    - Job Market analysis (country level)
    - Curriculum review (institution level)
    - European benchmarking analysis
2. **Online Survey with Industry Professionals**
    - **Target**: 600 responses from industry representatives.
    - **Purpose**: To gather insights into green, digital, and business skill needs, trends, and challenges.
3. **Interviews with HEI Faculty/Administrators**
    - **Target**: 120 responses.
    - **Purpose**: To understand how HEIs currently integrate green, digital, and business competencies into their curricula.

These research components ensure that findings are grounded in real-world data, providing a solid foundation for recommendations and guiding the development of an innovative competency-oriented learning ecosystem within the GreenTech Horizons project.

2.2. Desk Research Objectives and Implementation Strategy

The desk research component of the research is structured to achieve a comprehensive understanding of the national, industry, and educational dimensions of the twin green and digital transitions. It includes four main objectives while the implementation strategy leverages diverse data sources and focuses on specific thematic areas, ensuring a robust and comprehensive analysis.

1. **National context analysis (country level):** to establish a comprehensive understanding of policies, drivers, barriers, and initiatives related to Dual Green and Digital Transitions.
    - **Data Sources:** National policies and strategies, reports from international organizations and case studies of flagship projects.

- **Focus Areas:** The analysis summarizes government policies that support the twin green and digital transitions, providing a clear overview of national strategies and frameworks. It identifies key drivers that enable progress as well as barriers that hinder implementation, offering insights into the factors influencing success. Additionally, the research highlights significant national initiatives and flagship projects, showcasing innovative approaches and best practices that demonstrate progress in these transitions.

2. **Job market analysis (country level):** to assess the demand for green, digital, and business skills needed for dual green and digital transitions across industries.
    - **Data Sources:** Job advertisements, labour market reports, and industry analyses.
    - **Focus Areas:** The analysis documents in-demand skills in green, digital, and business areas. It identifies industry sectors that lead in adopting green and digital strategies. It highlights competency gaps in the workforce.
3. **Curriculum review (institution level):** to evaluate how HEI curricula align with green, digital, and business skill demands.
    - **Data Sources:** Course catalogues, syllabi, academic materials, and institutional reports.
    - **Focus Areas:** The analysis assesses the coverage of green, digital, and business skills in existing HEI curricula. It identifies missing competencies and gaps in skill training. It proposes recommendations to align academic programs with workforce needs.
4. **European context analysis:** to conduct a comprehensive analysis of European policies and strategies out coming the key insights on Green and Digital Transtion for Azerbaijan, Kazakhstan, and Mongolia.
    - **Data Sources:** National policies and strategies in the Europe.
    - **Focus Areas:** The analysis summarizes the Europe policies and strategies that support green and digital transitions. It highlights insights that progress twin green and digital transitions in Neighbourhood East, Central Asia, and Asia.

By addressing these objectives through a structured implementation strategy, the desk research will provide a thorough understanding of the opportunities, challenges, and gaps in the twin green and digital transitions. These insights will guide the development of targeted interventions and recommendations within the GreenTech Horizons project.

Partners from Azerbaijan, Kazakhstan, and Mongolia have implemented the desk research analysis using standardized templates (see Appendices). They have utilized **Appendix 1: Template for National Context Analysis** to examine government policies, drivers, and barriers related to the green and digital transitions. For assessing industry skill demands, they have applied **Appendix 2: Template for Job Market Analysis**, documenting in-demand competencies and workforce trends. In evaluating how HEI curricula align with these skill requirements, they have used **Appendix 3: Template for Curriculum Review** to identify gaps and areas for improvement. These structured templates ensure consistency in data collection and facilitate a comprehensive cross-country analysis.

2.3. Online Survey and it Implementation

To gather industry insights on the green, digital, and business skill requirements, gaps, and the role of Higher Education Institutions (HEIs) in supporting the Dual Green and Digital Transitions in Azerbaijan, Kazakhstan, and Mongolia, an online survey has been designed and implemented. This survey aims to capture both quantitative and qualitative data, providing actionable recommendations to align HEI curricula with industry needs.

The outputs of the survey include:

- **Quantitative insights:** data collected from 600+ industry professionals on skill requirements and workforce gaps.
- **Qualitative insights:** Open-ended responses exploring industry challenges, the role of HEIs, and future needs.
- **Actionable recommendations:** Tailored strategies for improving HEI curricula and fostering academia-industry collaboration.

The survey consists of five structured sections, incorporating both Likert-scale and open-ended questions to obtain comprehensive insights:

- Section I: **Demographics:**
  - collects respondent information, including gender, age, and country;
  - captures industry sector, company size, and job position for contextual analysis.
- Section II: **Green, digital, and business skills:**
  - assesses knowledge and competencies in green, digital, and business domains;
  - includes up to 10 competencies per category, ranked using a 5-point Likert scale (1 = Not important at all, 5 = Extremely important).
- Section III: **Green, digital, and business skill gaps:**
  - uses open-ended questions to identify specific gaps in green-related skills, digital-related skills and business-related skills essential for the twin transition.
- Section IV: **HEI's role:**
  - explores the potential contributions of HEIs through open-ended questions:
  - opportunities for academia-industry collaboration;
  - suggestions for curriculum updates;
  - interest in certification programs related to green and digital competencies.
- Section V: **Key challenges for green and digital transition:**
  - identifies future workforce needs and industry perspectives on: emerging skill requirements and challenges in implementing green and digital transitions.

The template for the survey structure and the questions that were included in every section are provided in **Appendix 4**.

To ensure the clarity, relevance, language (as survey was implemented in kazakh, mongolian, azerbaijani and english languages) and effectiveness of the survey, a validation and piloting phase was conducted prior to full deployment. A pretesting process was implemented, involving 6 industry professionals, who review the survey to assess question clarity, structure, language and length. Based on their feedback, necessary revisions were made to enhance the user experience and ensure that questions are comprehensible and aligned with the research objectives. Additionally, ethical considerations were prioritized, with a consent statement included at the beginning of the survey to ensure compliance with GDPR and other data protection laws, protecting respondent anonymity and data privacy.

The survey was administered through a structured approach to maximize industry engagement and ensure accurate data collection. SurveyMonkey was used as the primary platform for designing and distributing the questionnaire, with measures implemented to prevent duplicate responses through IP or email tracking. Separate survey collectors were created for each country—Azerbaijan, Kazakhstan,

and Mongolia—so that response rates can be monitored and balanced data collection ensured. A minimum of 60 responses were expected to be collected by each country partner from industry professionals. To enhance participation, targeted promotion strategies were employed, including email invitations and reminders, survey distribution on professional networks such as LinkedIn, and promotion through industry-specific forums and organizational networks. These strategies were designed to ensure a representative and diverse dataset that reflects the perspectives of key industry stakeholders across the regions.

The online survey serves as a critical tool for gathering industry perspectives on the evolving skill requirements for the green and digital transitions, identifying existing gaps, and understanding the role of Higher Education Institutions (HEIs) in equipping the workforce with the necessary competencies. The insights derived from this survey contribute to evidence-based recommendations for aligning educational programs with industry needs and fostering stronger academia-industry collaboration.

2.4. Interviews with HEIs Faculty/Administrators

The interview process aims to collect comprehensive insights from Higher Education Institutions (HEIs) in Azerbaijan, Kazakhstan, and Mongolia regarding green, digital, and business skill requirements, existing gaps, and the role of HEIs in advancing the Dual Green and Digital Transitions. By engaging faculty members, administrators, and academic stakeholders, the study seeks to understand how HEIs currently address competency development, the challenges they face, and opportunities for curriculum enhancement.

The following outputs were expected from the interviews with HEIs:

- **Quantitative insights**: data gathered from 120+ HEI representatives on skill requirements and gaps.
- **Qualitative insights**: open-ended responses exploring university courses, interventions, challenges, skill validation, and assessment methods.
- **Actionable recommendations**: identification of key green, digital, and business competencies essential for HEIs to integrate into curricula.

To ensure consistency and structured data collection, an interview guide were developed (see **Appendix 5**), consisting of three key sections:

- **Section I**: General Information:
  - collects details about interview participants, including the number of respondents, the interview modality (online/in-person), and the country;
  - records participant details such as full name, role, affiliated HEI, and contact email to maintain a structured database of responses.
- **Section II**: Interview Questions:
  - provides guidance for interviewers by open-ended, unbiased discussions and provides clarifications on Dual Green and Digital Transition concepts if needed;
  - open-ended questions cover: understanding of the Dual Green and Digital Transition concept; current interventions in HEIs that address green, digital, and business competences; key challenges faced by HEIs in integrating Dual Green and Digital Transition-related skills; methods of validation and assessment of these competencies; the extent of recognition of green, digital, and business skills within academic frameworks; and final remarks as well as recommendations from the interviewees.

- **Section III:** Reporting the Outcomes:
  - interviewers summarized critical ideas discussed during the interview;
  - unexpected findings were noted to highlight emerging themes beyond the initial research scope;
  - valuable insights were documented to support curriculum development and policy recommendations;
  - the most important green, digital, and business competencies mentioned by HEI representatives were listed for further analysis.

The implementation of the interviews followed a structured and standardized approach to ensure diverse and representative insights from HEI faculty, administrators, students, and/or EdTech professionals. Each HEI partner was responsible for identifying a minimum of 15 potential interviewees, ensuring a balanced mix of academic and non-academic staff, undergraduate and graduate students, and/or EdTech professionals. This approach ensured that key perspectives on green, digital, and business skill development within HEIs are captured effectively, supporting the objectives of the state-of-the-art report.

3. European Strategies for the Twin Green and Digital Transition

This section provides an overview of key European strategies, policies, and initiatives that serve as benchmarks for aligning the green and digital transitions in Azerbaijan, Kazakhstan, and Mongolia with European frameworks. The European Union has established a robust policy framework to facilitate sustainable energy transitions, digital transformation, and workforce development to meet the needs of a rapidly evolving technological landscape. This benchmarking analysis outlines relevant EU strategies and action plans that can guide the adaptation of policies and practices in the target regions.

3.1. European Strategies and Policy Frameworks for the Twin Transition

The **European Green Deal** serves as the foundation for Europe's transition towards a climate-neutral economy by 2050. This strategy includes ambitious goals to reduce greenhouse gas emissions, promote energy efficiency, and accelerate the adoption of renewable energy.

- The **Energy Union Strategy** (COM/2015/080): This framework aims to ensure energy security, integrate energy markets, enhance energy efficiency, and support decarbonization efforts. EU member states are required to submit National Energy and Climate Plans (NECPs) outlining their strategies to achieve climate targets.
- The **Renewable Energy Directive** (RED): Establishes sector-specific renewable energy targets, aiming for 42.5% of total EU energy consumption from renewables by 2030, with additional measures to simplify permitting processes for renewable energy projects.
- Europe's **Industrial Strategy** promotes the digitalization of traditional sectors, particularly in manufacturing, transport, and energy. The strategy encourages the deployment of Digital Innovation Hubs (DIHs), fostering technological advancements that align with sustainability goals.
- **Roadmap 2050**: A strategic guide for achieving 80-95% CO2 emission reduction by 2050, focusing on large-scale renewable energy integration and infrastructure synchronization.

These policies highlight best practices in renewable energy deployment, emissions reductions, and energy efficiency improvements, providing a model for the target regions to develop climate-resilient energy systems.

The **EU's Digital Decade Strategy** aims to accelerate the digital transformation of European industries and public services while ensuring sustainability and technological sovereignty. Key components include:

- The **EU Cybersecurity Strategy** for the Digital Decade (2020): Focuses on strengthening cybersecurity resilience, improving ICT infrastructure security, and expanding digital skill development.
- **Digital skills and education**: The EU has set a target for 80% of adults to have basic digital skills by 2030, recognizing the need for lifelong learning initiatives.
- **Digital Markets Act (DMA)** and **Digital Services Act (DSA)**: Establish regulatory frameworks ensuring fair competition and consumer protection in digital markets.
- **Artificial Intelligence and data governance**: The **AI Act** and **European Data Governance Act (DGA)** promote responsible AI use, data security, and digital ethics.

These digital policies serve as a benchmark for improving digital infrastructure, upskilling professionals, and ensuring regulatory compliance in the target regions.

To drive competitiveness and innovation in green and digital industries, the EU promotes:

- **The Horizon Europe Framework Programme (2021–2027):** Supports research in climate-neutral solutions, smart cities, AI-driven sustainability, and clean technology development.
- **The European Industrial Strategy:** Encourages the integration of **GreenTech and CleanTech solutions** to support digital and environmental transitions.
- **Erasmus+ and Capacity Building in Higher Education (CBHE):** Facilitates international collaboration in education and skills development, aligning academic curricula with labor market needs.
- The **2022 Strategic Foresight Report** explores the interplay between digital and green transformations in a changing geopolitical landscape. It highlights the need for innovation, workforce upskilling, and transnational cooperation to address climate change and sustainability challenges.
- The **European Green Digital Coalition** is a commitment from major EU digital firms to develop environmentally sustainable digital technologies. By leveraging AI, blockchain, and cloud computing, this initiative supports businesses in reducing their environmental footprint while fostering economic resilience.
- **The EU4Digital Initiative** aims to support digital reform in Eastern European and Central Asian countries, including Azerbaijan, Kazakhstan, and Mongolia. It facilitates knowledge transfer, cybersecurity enhancements, and the adoption of EU digital market standards

These initiatives offer models for integrating green and digital skills into education systems and industry partnerships in Azerbaijan, Kazakhstan, and Mongolia.

3.2. The Horizon Europe Research and Innovation Framework

The Horizon Europe framework (2021-2027) funds research and innovation in climate-neutral solutions, smart cities, AI-driven sustainability, and clean technology development. Key areas include:

- **GreenTech and CleanTech advancements:** Investments in renewable energy innovation, AI for sustainability, and smart infrastructure

- **Digital Education and Training Initiatives:** Erasmus+ and Capacity Building in Higher Education (CBHE) programs support lifelong learning, upskilling, and industry-academic collaboration
- **Circular Economy and Industrial Innovation:** Strengthening sustainable industrial practices, waste reduction, and resource efficiency

These initiatives set a framework for fostering technological innovation and green economic development.

3.3. Europe Insights on Green and Digital Transtion for Azerbaijan, Kazakhstan, and Mongolia

Based on the European strategies and policy frameworks, the following key lessons and adaptation strategies can help align regional efforts with EU best practices:

- **Policy and regulatory alignment:**
  - Develop national energy and digital transition plans modeled on EU Green Deal policies and NECPs.
  - Establish clear renewable energy targets and regulatory frameworks to support green investments.
  - Align digital transformation policies with GDPR, Cyber Resilience Act, and AI governance standards.
- **Education and workforce development:**
  - Integrate digital skills and sustainability education into national curricula.
  - Expand lifelong learning opportunities and vocational training aligned with EU digital skills strategies.
  - Establish emerge technology-based certification mechanisms to enhance credential transparency
- .**Investment in Green and Digital infrastructure:**
  - Increase investment in renewable energy projects, energy efficiency, and smart grids.
  - Strengthen broadband access, cloud computing, and AI infrastructure.
  - Develop innovation hubs, R&D partnerships, and industry-academic collaboration models
- .**Cross-border collaboration and international partnerships:**
  - Engage in EU-led initiatives like Erasmus+ CBHE and Horizon Europe.
  - Foster collaboration between universities, industries, and policymakers to ensure effective knowledge transfer.
  - Participate in global sustainability and digitalization networks.

By adopting these best practices, Azerbaijan, Kazakhstan, and Mongolia can accelerate their green and digital transitions while aligning with European sustainability and digital innovation strategies.

4. State of Green and Digital Transitions in the Neighbourhood East, Central Asia, and Asia

4.1. Mapping the Green and Digital Transition Landscape in Azerbaijan

Azerbaijan is making significant strides in its twin green and digital transitions by implementing national policies, government programs, and infrastructure projects aimed at sustainable development and technological innovation. The country's strategic approach is guided by key national policies, which integrate environmental sustainability with digital transformation.

The **National Sustainable Development Strategy** plays a crucial role in advancing environmentally friendly technologies, energy efficiency, and greenhouse gas reduction, aligning with the UN Sustainable Development Goals (SDGs). This strategy directly contributes to the green transition by reducing environmental impact. It includes digitalization elements for environmental performance monitoring and reporting.

The **State Program "Digital Azerbaijan"** is central to the digital transition, focusing on e-government, 5G development, and AI integration, as well as the implementation of smart cities and smart grids. This promotes digital transition, including environmental elements such as energy efficiency and monitoring of resource consumption through digital technologies.

Azerbaijan's National Renewable Energy Sources (RES) Development Program promotes solar, wind, and hydropower projects, including large-scale initiatives in the Karabakh region, reducing the country's reliance on fossil fuels. This program complies with the green transition by reducing dependence on fossil fuels as well uses digital technologies to manage and monitor energy systems.

Complementing this, **Energy Infrastructure Reform** seeks to modernize energy networks through smart energy management and digital accounting systems, reinforcing the synergy between digital and green objectives. In this way, it complies with the double transition, combining digitalization with increased energy efficiency.

The **Digitalization of Agriculture Program** is another transformative initiative aimed at integrating precision farming technologies, digital platforms for soil monitoring, and advanced irrigation systems. This initiative supports the green transition through sustainable resource use while simultaneously contributing to the digital transition by leveraging IT solutions for enhanced agricultural productivity.

4.2. Green and Digital Transition Policies and Strategies in Kazakhstan

Kazakhstan has developed a comprehensive policy framework to drive its twin green and digital transitions, focusing on economic modernization, environmental sustainability, and technological advancement. The country's long-term vision integrates renewable energy development, carbon neutrality strategies, digital transformation, and AI-driven innovation to position Kazakhstan as a leader in sustainable economic growth.

Kazakhstan's **Concept for the Transition to a Green Economy (2013)** lays the foundation for a systemic economic transformation, emphasizing sustainable resource management, carbon emissions reduction, and modernization of industries. The policy aims to improve living standards, boost energy efficiency, and establish renewable energy infrastructure, ensuring that Kazakhstan ranks among the top 30 most developed nations globally while minimizing its environmental impact.

The **Strategy for Achieving Carbon Neutrality by 2060** outlines long-term decarbonization plans, focusing on low-carbon investments, renewable energy expansion, and regulatory reforms to encourage a green economy shift. This policy incorporates digital solutions, such as AI-driven emissions monitoring, space-based environmental tracking, and smart energy grids, reinforcing the synergy between green and digital transitions.

Other key policies, such as the **National Climate Change Adaptation Plan**, emphasize climate resilience, water resource conservation, and disaster risk reduction, leveraging digital tools for climate modeling

and forecasting. Additionally, the **Circular Economy Development Plan** promotes waste reduction, recycling, and industrial resource optimization, integrating digital tracking systems for waste management.

Kazakhstan has undertaken significant digital transformation initiatives to modernize governance, industries, and infrastructure. The **Concept for Digital Transformation, ICT Development, and Cybersecurity (2023-2029)** provides a strategic framework for public administration digitalization, AI integration, and e-government services. This policy aims to enhance innovation, support a diversified economy, and strengthen Kazakhstan's global digital competitiveness.

The **Digital Kazakhstan Program (2022)** is a key driver of digital transformation, promoting widespread ICT adoption across multiple sectors. The program encompasses:

- Industry digitalization, including energy, transport, agriculture, and logistics.
- E-commerce and financial technology expansion, fostering cashless transactions and digital banking.
- Smart city development, leveraging IoT, AI, and blockchain for urban management and energy efficiency.
- Digital literacy initiatives, ensuring that citizens and workforce members acquire the necessary skills for the digital economy.

Kazakhstan's **Concept for the Development of Artificial Intelligence (2024-2029)** focuses on AI-driven innovation, targeting areas such as high-quality data management, advanced infrastructure, human capital development, and regulatory frameworks. This initiative is expected to enhance ICT exports, AI-based decision-making, and economic productivity.

Kazakhstan's **Industry 4.0 Program** is a cross-cutting initiative that drives both green and digital transitions by integrating automation, AI-driven smart manufacturing, and IoT-enabled energy-efficient systems. Similarly, the **National Energy Efficiency Program** promotes smart grid technologies, IoT-based energy monitoring, and data-driven energy optimization, ensuring a sustainable and digitally connected energy sector.

Kazakhstan's **Education for Sustainable Development Program** aligns with both transitions by incorporating sustainability and digital innovation into the national education system. This initiative ensures that the future workforce is equipped with green skills, digital literacy, and knowledge of advanced technologies, fostering a new generation of sustainability-focused professionals.

4.3. Government initiatives and policies for Green and Digital Transition in Mongolia

Mongolia is actively pursuing dual green and digital transitions through national policies, government initiatives, and international collaborations. The country's approach is guided by several key policies that emphasize sustainability, climate resilience, digital transformation, and economic modernization.

One of the major guiding documents is **Mongolia's Long-Term Development Policy – Vision 2050**, which outlines a three-phase approach to integrating green and digital strategies into national development. The plan emphasizes climate adaptation, e-governance, digital infrastructure, and AI-based innovations, positioning Mongolia for sustainable economic growth through technological advancements. Mongolia aims to implement national programs to adapt to climate change, reduce disaster risk to ensure environmental sustainability and ecosystem balance in 2021-2030. It also aims to implement environmentally friendly projects with public and private technology and international financial support and to establish a national green system. Besides this, it aims to develop e-governance, create a unified digital database, and implement policies to increase efficiency and launch public services on digital platforms between 2021-2030. In addition, from 2031-2040, it will implement policies to develop

innovative products based on information technology and artificial intelligence and to export them to regional and multi-market markets. The developments outlined in the "Vision 2050" document aim to prioritize sustainable development and technological innovation as the foundation of Mongolia's development and to foster a large-scale green and digital transition.

Another critical policy, the **State Policy on Development of Information and Communication Technology (2017-2025)**, focuses on expanding ICT infrastructure, promoting digital literacy, and enabling e-governance, aligning digital transformation with green sustainability goals. This policy is directly relevant to digital transition and contributes to some aspects of the green transition. By developing digital infrastructure, it is possible to support environmentally friendly and sustainable development, so it can be considered that this government policy belongs to green and digital transition.

Mongolia's National Green Development Policy (2014-2030) is another cornerstone strategy that fosters environmental sustainability, renewable energy, and waste reduction efforts. The country has committed to large-scale green programs such as the "Billion Trees" National Movement, which aims to combat desertification, enhance carbon sequestration, and promote ecological restoration.

In the digital sphere, government-backed programs like E-Mongolia and the E-Government National Program focus on developing digital services, expanding broadband connectivity, and integrating technology into governance and public services. Additionally, Smart Government II, a World Bank-supported initiative, is set to improve digital service efficiency, economic competitiveness, and job creation in Mongolia's digital economy.

4.4. Strategic Objectives and Goals

Azerbaijan has outlined a comprehensive strategy for advancing the twin green and digital transition, integrating sustainability goals with technological advancements (Table 1). These objectives focus on carbon neutrality, renewable energy expansion, waste management, digitalization, and Artificial Intelligent (AI) adoption, reinforcing the country's commitment to sustainable economic growth and technological modernization. These initiatives are expected to drive economic growth, enhance quality of life, and position Azerbaijan as a regional leader in green and digital advancements.

Kazakhstan's green and digital transition objectives are centered on achieving carbon neutrality by 2060, increasing the share of renewable energy to 30% by 2030, and fostering a circular economy through waste reduction and sustainable resource management (Table 2). The country aims to modernize its energy sector, industrial processes, and urban infrastructure using smart technologies, AI-driven monitoring, and IoT-enabled energy systems. In parallel, Kazakhstan's digital transition goals focus on expanding nationwide 5G coverage, improving digital literacy to 85% by 2030, and developing a unified e-government platform to enhance public services. The integration of AI, big data, and automation across sectors is expected to boost economic competitiveness while ensuring environmental sustainability and efficient resource utilization.

Table 1. Strategic Objectives and Goals in Azerbaijan

Green transition goals	Digital transition goals	Key policies/ strategies	Timeline
Carbon neutrality by 2050.	Deployment of 5G networks and provision of high-speed Internet access throughout the country.	National Sustainable Development Strategy, State Program "Digital Azerbaijan".	2050 – carbon neutrality, 2030 – 5G.

Achieving a 30% share of renewable energy sources (RES) in total energy consumption.	Digitalization of the public sector through the development of e-government.	National RES Development Program, E-Government Development Program.	2030 for renewable energy, 2025 for electronic transformation.
Waste reduction and development of recycling infrastructure.	Improving digital literacy among the population, especially in rural areas.	Sustainable Waste Management Program, Digital Literacy Education Initiatives.	Ongoing measures with key milestones by 2030.
Sustainable water resources management and minimization of their losses.	Development and introduction of artificial intelligence in priority sectors of the economy.	Water Resources Policy, AI Strategy.	Ongoing implementation with key milestones by 2035.
Development of sustainable mobility, including environmentally friendly transport.	Large-scale introduction of smart technologies, including smart cities and smart grids.	Sustainable Transport Policy, National Smart Cities Strategy.	Ongoing measures with key milestones by 2040.

Table 2. Strategic Objectives and Goals in Kazakhstan

Green transition goals	Digital transition goals	Key policies/ strategies	Timeline
The main priority tasks facing the country for the transition to a “green economy” are: 1) increasing the efficiency of use of resources (water, land, biological, etc.) and their management; 2) modernizing existing and building new infrastructure; 3) improving the well-being of the population and the quality of the environment through cost-effective ways to mitigate pressure on the environment; 4) increasing national security, including water security.		Concept for the transition of the Republic of Kazakhstan to a "green economy"	The concept for the transition of the Republic of Kazakhstan to a “green economy” will be implemented in three stages: 2013–2020 – during this period, the main priority of the state will be to optimize the use of resources and increase the efficiency of environmental activities, as well as the creation of “green” infrastructure; 2020-2030 - on the basis of the formed "green" infrastructure, the transformation of the national economy will begin, focused on the careful use of water, encouragement and stimulation of the development and widespread introduction of

			renewable energy technologies, as well as the construction of facilities based on high energy efficiency standards; 2030-2050 - the transition of the national economy to the principles of the so-called "third industrial revolution", requiring the use of natural resources subject to their renewable and sustainable nature.
	A Unified Platform of "Electronic Government" will be created, providing for end-to-end interdepartmental digitalization of processes and the creation of a comprehensive organizational and technical infrastructure for both the provision of services and the operation of the public administration system. A national artificial intelligence system will be created based on Smart Data Ukimet. Data processing centres will appear in all regions of the country. Considering that the 5G mobile communications infrastructure allows working on the principle of "always online", while being characterized by low energy consumption and, together with Big Data analysis and the Internet of Things (IoT), is intended to become one of the foundations and the main driving force of the digital economy. For data transit and participation in the global market for the development of digital services, data	Concepts of digital transformation, development of the information and communication technology industry and cybersecurity for 2023 - 2029	Expected results by 2029: achieving at least 30th place in the IMD Digital Competitiveness Ranking; achieving at least 15th place in the UN E-Government Ranking; telecommunications infrastructure index – 0,86; achieving at least 80% of the share of local content in IT services; achieving at least 20th place in the Global Cybersecurity Index in 2025, and at least 15th place in 2029; the volume of innovative products is 3,4 trillion tenge; growth of labour productivity in the Information and Communications industry to 34,4% of the 2019 level by 2025.

	centres will be built and deployed.		
Kazakhstan has made long-term commitments to achieve carbon neutrality. The policy is aimed at diversifying the economy and promoting renewable energy sources and sustainable technologies	Transition to digital platforms for processing, control and monitoring; Digitalization of business processes in basic industries; development of a target program for monitoring satellite data on emission control	Strategy for achieving carbon neutrality of the Republic of Kazakhstan until 2060	By 2060, landfilling will be largely replaced by more sustainable waste management strategies such as recycling and energy recovery. Key measures to reduce emissions and decarbonize the economy: • abandonment of new coal generation projects and gradual abandonment of coal combustion (2021-2025); • implement a program to plant 2 billion trees (2025); • double the share of renewable energy in electricity generation (2030); • 100% sorting of municipal solid waste (2040); • sustainable agriculture on 75% of arable land (2045); • 100% electrification of personal passenger transport (2045); the use of “green” hydrogen and the complete abandonment of coal production starting in 2050.

Mongolia's green and digital transition objectives focus on achieving carbon neutrality by 2050, increasing the share of renewable energy in the national grid, and enhancing sustainable water and waste management systems. The country aims to modernize its power supply, agriculture, and urban infrastructure by integrating smart technologies, AI-driven environmental monitoring, and digital solutions for resource efficiency. On the digital front, Mongolia seeks to expand nationwide high-speed internet access, enhance digital literacy, and implement e-government services to improve public administration and business competitiveness. The adoption of AI, big data, and smart technologies

across industries is expected to support economic diversification while ensuring sustainable and resilient development.

4.5. Key Projects Supporting Green and Digital Transition

The **Green Energy for Karabakh Project** is a large-scale initiative aimed at integrating renewable energy sources into Azerbaijan's national energy system. Focused on the Karabakh and Eastern Zangezur regions, this project involves the construction of solar and wind power plants to support **Azerbaijan's green transition goals**. By expanding the country's renewable energy capacity, the project will help reduce dependency on fossil fuels and promote environmental sustainability. The project directly contributes to Azerbaijan's carbon neutrality targets by increasing the share of renewables in the national energy mix. Additionally, smart monitoring and energy management systems will be implemented to optimize energy consumption and efficiency, reinforcing the digital transition in the energy sector.

The **Digital Smart Cities Initiative** is a transformative project aimed at modernizing Azerbaijan's urban infrastructure through digital and green solutions. The initiative focuses on creating smart cities in the restored regions of Karabakh and other urban centres, leveraging advanced digital technologies such as IoT-based urban management systems, AI-driven traffic control, and smart waste management solutions. By integrating smart city technologies, this project contributes to both the green and digital transitions by enhancing energy efficiency, reducing environmental impact, and optimizing public services. The introduction of intelligent urban planning will help minimize carbon footprints, improve resource management, and create sustainable, digitally connected urban environments.

Kazakhstan's commitment to green and digital transformation is evident through large-scale projects focused on renewable energy, smart cities, agriculture, and digital infrastructure.

The **Kazakhstan-2050 Strategy** is a long-term vision aimed at sustainable economic development and the transition to a green economy. It sets goals for renewable energy adoption, carbon emission reductions, and environmentally friendly economic growth. The strategy represents a new approach to economic development by integrating sustainability principles into national planning and policy frameworks. The Kazakhstan-2050 Strategy plays a fundamental role in the twin green and digital transitions by transforming the country's economic growth model into an environmentally sustainable and technology-driven framework. By emphasizing green growth, the strategy seeks to address ecological challenges while leveraging digital solutions to improve resource efficiency and governance.

Kazakhstan's **National Plan for the Transition to a Green Economy** outlines measures to enhance energy efficiency, promote renewable energy sources, and protect the environment. The plan supports solar and wind energy development in key regions such as Zhambyl and Almaty, increasing the share of clean energy in the national energy mix. By promoting renewable energy projects, the plan accelerates the green transition while integrating digital energy management systems to optimize energy consumption. Smart monitoring tools and IoT-based energy tracking help improve grid efficiency, reduce waste, and enable data-driven decision-making in the energy sector.

The **Digital Kazakhstan Program** aims to drive economic transformation through digitalization, enhancing public services, business competitiveness, and technological infrastructure. The program promotes e-government services, AI-driven data analysis, smart city development, and digital literacy initiatives. This program advances both the green and digital transitions by integrating digital technologies across key industries such as agriculture, energy, and transportation. By optimizing efficiency and reducing environmental impact, the initiative contributes to sustainable development while ensuring broad access to digital services.

Kazakhstan's **Renewable Energy Integration Program** is designed to incorporate solar and wind power into the national electricity grid, reducing dependence on fossil fuels. The project utilizes smart energy monitoring systems to manage energy production, storage, and distribution efficiently. The program significantly contributes to the green transition by expanding the share of renewable energy in the country's power grid. At the same time, digital monitoring systems ensure optimal energy distribution, reducing waste and inefficiencies. However, this raises the challenges such as high initial costs for renewable energy infrastructure and technology deployment; and limited energy storage capacity to balance intermittent power supply from renewables.

The **Smart Agriculture Initiative** integrates precision farming technologies in Kazakhstan, such as smart irrigation systems and IoT-enabled crop monitoring, to promote sustainable agricultural practices. The project aims to reduce water and fertilizer waste, enhance productivity, and support environmental conservation. By combining green and digital solutions, the initiative helps improve resource efficiency while increasing agricultural output. IoT-based monitoring enables data-driven farming, reducing environmental impact and ensuring sustainable food production. However, this faces the challenges such as limited access to IoT infrastructure and digital tools in rural areas; and lack of technical expertise among farmers in using smart agricultural technologies.

The **Smart City Development Initiative** in Almaty aims to enhance urban sustainability through digital technologies, improving transportation, energy management, and public services. The project includes the deployment of smart traffic systems, digital waste management solutions, and AI-driven urban planning. This initiative supports the twin green and digital transitions by integrating energy-efficient infrastructure, waste reduction technologies, and intelligent transport systems. The result is a digitally connected, sustainable urban environment with reduced carbon emissions and improved quality of life.

The **Sustainable, Resilient, and Green Cities Project**, initiated by the United Nations, is a significant effort to address climate change impacts and promote sustainable urban development in Mongolia. The project will be implemented in Ulaanbaatar, Erdenet, and Darkhan, three of Mongolia's major urban centres, and is part of a broader initiative spanning 20 countries. Currently in the research phase, the project is set to commence in 2026 and will run for five years, focusing on 11 sectoral indicators related to environmental sustainability, waste management, and urban resilience.

Among the selected cities, Darkhan has been identified as a priority location due to its favourable demographic and geographic conditions, which provide strong potential for expanding green spaces, improving waste management systems, and fostering economic growth. This project aligns with Mongolia's broader green transition objectives, helping urban areas become more climate-resilient, resource-efficient, and economically sustainable.

The **Smart Government II Project**, supported by the World Bank Group (WBG), plays a crucial role in Mongolia's digital transformation efforts. As part of the Country Partnership Framework (CPF) for FY21–25, the project aims to modernize digital governance, enhance public service delivery, and strengthen economic competitiveness. The initiative is designed to act as a cross-sector digital enabler, providing a robust technology platform to support economic governance, business innovation, and digital infrastructure development across various sectors in Mongolia.

The **Smart Government II Project** will contribute to improving Mongolia's government efficiency and accountability, ensuring better public service delivery and greater transparency in governance. Additionally, the project will help increase productivity in Mongolia's non-mining sectors, fostering economic diversification and job creation in the digital economy. A crucial component of the initiative is its cross-cutting focus on climate change, which will integrate digital tools and AI-driven solutions to support Mongolia's climate resilience and environmental sustainability goals.

Co-funded by
the European Union

These two projects—the **Sustainable, Resilient, and Green Cities Project** and the **Smart Government II Project**—illustrate Mongolia's commitment to leveraging technology and sustainability to drive economic development, digital modernization, and climate resilience. By focusing on urban sustainability and digital transformation, Mongolia is taking essential steps toward achieving its twin green and digital transition goals.

4.6. Drivers for Azerbaijan's Green and Digital Transition

Azerbaijan's green and digital transition is strongly supported by political commitment and international cooperation. The country actively participates in global sustainability initiatives such as the **Paris Agreement** and has developed national strategies, including the **National Renewable Energy Sources Program** and the **State Program "Digital Azerbaijan"**, which serve as key frameworks guiding the twin transition.

Azerbaijan possesses significant renewable energy potential, particularly in solar and wind power, with regions like Karabakh and the Absheron Peninsula offering ideal conditions for the expansion of clean energy projects. This geographical advantage plays a crucial role in reducing reliance on fossil fuels and accelerating the shift toward green energy solutions.

The rapid adoption of digital technologies is another major driver of the transition. The introduction of 5G networks, the expansion of e-government services, and the digitalization of key economic sectors are transforming Azerbaijan into a more technologically advanced and interconnected economy. These advancements are enhancing efficiency, transparency, and innovation across industries and public services.

International organizations such as the **World Bank, UNDP, and the European Union** provide investments and technical assistance that facilitate the integration of modern technologies and environmental standards. Their support is helping Azerbaijan modernize its infrastructure, improve sustainability efforts, and foster climate resilience.

Public awareness and engagement are also playing a crucial role in the transition. **Environmental education campaigns** and the promotion of digital literacy are encouraging greater citizen participation in sustainability initiatives. By increasing public involvement in green and digital programs, Azerbaijan is fostering a more informed and proactive society that supports long-term economic and environmental transformation.

4.7. Drivers for Kazakhstan's Green and Digital Transition

Kazakhstan's green and digital transition is supported by comprehensive government policies, technological advancements, and strong public engagement. The country has established a clear policy framework through initiatives such as the **National Strategy for the Transition to a Green Economy** and **Digital Kazakhstan 2025**, which provide structured objectives for sustainability, technological innovation, and economic modernization. These policies emphasize environmental safety, renewable energy expansion, and digital transformation across all sectors.

Foreign investments and technological partnerships play a critical role in accelerating Kazakhstan's transition. The government actively attracts international funding and collaborations for the development of green technologies, renewable energy infrastructure, and digitalization projects. Additionally, start-ups and small and medium-sized enterprises (SMEs**)** are receiving increasing support to foster clean technology innovation and digital solutions for sustainability.

Public awareness and activism are also contributing significantly to the transition. Growing concerns about environmental issues have led to increased NGO and civil society involvement in promoting green

initiatives and climate-conscious policies. This widespread public engagement is helping drive sustainable consumption practices, resource conservation efforts, and renewable energy adoption.
Kazakhstan's expanding digital infrastructure is another key driver of the twin transition. Investments in 5G networks, IoT solutions, and AI-driven automation are enhancing energy efficiency, enabling smart urban planning, and facilitating digital public services. Increased access to high-speed internet and mobile communication is further supporting the digitalization of industries, allowing businesses and the public sector to operate more efficiently and sustainably.
The private sector is actively engaging in the transition, with companies investing in renewable energy, energy-efficient technologies, and digital tools to improve market competitiveness and resource optimization. These collective efforts—government leadership, public participation, foreign investments, and private-sector initiatives—are positioning Kazakhstan as a regional leader in the green and digital economy.

4.8. Drivers for Mongolia's Green and Digital Transition

Mongolia's 2050 Vision and other national policy documents emphasize green development, digitization, and climate resilience as core priorities for long-term economic growth. The government's strategic focus on sustainable energy, digital transformation, and climate adaptation has created a strong foundation for policy-driven initiatives supporting the twin transition.
One of Mongolia's greatest advantages is its vast territory and low population density, which provide ideal conditions for the implementation of large-scale renewable energy projects. The country has significant potential to expand wind and solar power infrastructure, leveraging its abundant natural resources to reduce dependence on fossil fuels and move toward a cleaner energy system.
Additionally, international cooperation and investment are playing a crucial role in technology transfer, green financing, and infrastructure development. Partnerships between renewable energy and ICT infrastructure projects are increasing, facilitating the integration of digital technologies into energy management systems and enhancing cross-sectoral synergies for sustainability.
Public concerns about air and soil pollution, climate change, and health risks have led to growing demand for sustainable solutions. Public participation in green initiatives such as reforestation, waste management, and environmental conservation is increasing, reinforcing the social push for eco-friendly policies and sustainable urban development.
At the same time, Mongolia is making significant strides in digital transformation, with e-governance, digital education, and ICT infrastructure development laying the foundation for a modern digital economy. Expanding internet accessibility, digital literacy, and technology-driven public services will further support Mongolia's transition toward a knowledge-based, digitally connected society.

4.9. Barriers for Green and Digital Transition

Through various governmental policies, initiatives and strategies Azerbaijan committed to sustainability and technological advancement, however several economic, educational, and structural barriers continue to hinder the effective implementation of its twin green and digital transition (Table 3).

Table 3. Barriers for Green and Digital Transition in Azerbaijan

Barrier	Description

Limited Investment and Private Sector Engagement	Although international organizations provide financial support for green and digital initiatives, overall investment in renewable energy, smart technologies, and ICT infrastructure remains limited. The private sector's low participation in sustainability-driven projects further restricts the expansion of clean energy and digital innovation, making it challenging to scale up nationwide transformation efforts.
Shortage of Skilled Personnel	Azerbaijan faces a shortage of trained experts in renewable energy systems (RES), artificial intelligence (AI), and digitalization. The lack of specialists with expertise in smart energy management, AI-driven automation, and advanced ICT solutions slows the adoption of innovative technologies and affects the country's ability to compete in a knowledge-based, technology-driven global economy. Expanding vocational training and educational programs in these fields is essential to address this skills gap.
Digital Divide in Rural Areas	The unequal distribution of digital infrastructure between urban and rural areas presents a major challenge to Azerbaijan's digital transition. In remote regions, limited internet connectivity and low digital literacy rates prevent communities from fully accessing digital services, online education, and economic opportunities linked to digital innovation. Without nationwide high-speed internet expansion, the benefits of digital transformation will remain concentrated in major cities, leaving rural populations at a disadvantage.
Dependence on Fossil Fuels	Azerbaijan's long-standing reliance on the oil and gas industry continues to slow down the shift toward renewable energy. While the government has introduced initiatives to diversify the energy sector, fossil fuels still dominate the national economy, making it difficult to accelerate the transition to sustainable energy alternatives. Greater investment incentives, policy reforms, and financial mechanisms are needed to encourage a stronger focus on renewable energy adoption.

Despite Kazakhstan's strong policy frameworks and ongoing efforts toward a sustainable and digital economy, several financial, infrastructural, and regulatory barriers hinder the full realization of the twin green and digital transition (Table 4).

Table 4. Barriers for Green and Digital Transition in Kazakhstan

Barrier	Description
Lack of Funding	A major challenge in Kazakhstan's green and digital transformation is insufficient funding for large-scale projects, particularly for small and medium-sized enterprises (SMEs) and startups in clean technology and digital innovation. While government programs provide some financial support, high initial costs and limited private sector investment slow down the adoption of renewable energy, digital infrastructure, and technological advancements. This challenge is especially pronounced in rural areas, where budget constraints limit internet expansion, energy grid upgrades, and access to digital services.
Weak Infrastructure	Kazakhstan's outdated energy grids and industrial infrastructure present a significant barrier to transitioning toward renewable energy sources and digital transformation. Many traditional industries, such as heavy manufacturing and agriculture, still rely on obsolete technologies, making it difficult to integrate energy-efficient systems, automation, and smart solutions. Additionally, underdeveloped digital infrastructure in remote regions creates disparities in access to digital services and ICT-based economic opportunities.
Shortage of Skilled Workers	A lack of trained professionals in key fields such as renewable energy, artificial intelligence (AI), and digital transformation is another critical barrier. Kazakhstan faces a shortage of specialists with expertise in sustainable technologies, smart energy systems, and AI-driven automation, which slows the adoption of green and digital solutions. Without stronger education and training programs, industries will struggle to integrate and optimize new technologies.
Regulatory and Legislative Barriers	Kazakhstan's regulatory and institutional framework remains fragmented and outdated, creating obstacles for green and digital projects. Complex permitting processes, bureaucratic inefficiencies, and unclear legislation delay project approvals and discourage

	private investment in renewable energy and digital solutions. Furthermore, inconsistent policies and a lack of coordinated government support make it difficult for businesses to navigate the legal landscape of the sustainability and technology sectors.
Resistance to Change	In some sectors, there is reluctance to embrace green and digital transformation due to conservatism, lack of awareness, and concerns over high transition costs. Many traditional industries, including agriculture and manufacturing, have been slow to adopt energy-efficient technologies and digital solutions due to limited understanding of their long-term benefits. Without incentives and awareness campaigns, businesses may continue relying on outdated methods, slowing the country's progress toward its green and digital transition goals.
Economic Dependence on Fossil Fuels	Kazakhstan's historical reliance on hydrocarbons poses a major barrier to green energy adoption. As a leading exporter of oil and gas, the country's economy is heavily dependent on fossil fuels, making the shift toward renewable energy sources challenging. While there is a growing commitment to decarbonization, the transition away from traditional energy production requires long-term investments, policy adjustments, and industry incentives to ensure a smoother, more sustainable shift.

Despite Mongolia's commitment to sustainability and digital transformation, several structural, economic, and technological barriers hinder the full realization of its twin green and digital transition (Table 5).

Table 5. Barriers for Green and Digital Transition in Mongolia

Barrier	Description
Limited Funding and high initial costs	Mongolia's state budget constraints make it difficult to independently finance large-scale green and digital transition projects, increasing reliance on foreign aid and investment. However, the high initial costs of renewable energy infrastructure, ICT projects, and smart technologies further slow down implementation, making it difficult to scale up nationwide.
Shortage of Skilled Personnel	A lack of trained experts in renewable energy, software development, and information technology is a major barrier to Mongolia's transition. The limited availability of skilled workers in these fields delays project execution, reduces technological efficiency, and affects the adoption of modern solutions in clean energy and digital transformation. Expanding vocational training and education programs is essential to closing this skills gap.
Weak Policy Enforcement and Bureaucratic Barriers	The lack of strong enforcement mechanisms in environmental protection, information security, and digital infrastructure policies slows the progress of sustainability and digitalization efforts. Additionally, bureaucracy and corruption create inefficiencies in policy implementation, making it difficult to achieve the country's sustainability and innovation goals. Streamlined governance and regulatory reforms are needed to ensure effective implementation of transition initiatives.
Environmental Challenges and Urban Issues	Mongolia's severe air and soil pollution, traffic congestion, and reliance on coal-based heating in urban areas, particularly in Ulaanbaatar, pose significant obstacles to the green transition. These issues divert government resources and attention away from renewable energy, digital transformation, and sustainable urban development projects. Additionally, inefficient urban planning exacerbates pollution and congestion problems, further delaying eco-friendly infrastructure initiatives.
Lack of Infrastructure in Remote Areas	The development of green and digital industries in rural Mongolia is severely hindered by the absence of essential infrastructure, including roads, electricity grids, and digital connectivity. Limited access to high-speed internet and digital services prevents rural communities from fully benefiting from digital education, e-government services, and economic opportunities linked to technology-driven industries.

Limited Engagement of Key Stakeholders	The government, private sector, and civil society remain under-involved in advancing Mongolia's green and digital transformation. Weak collaboration and coordination between these stakeholders hinder policy implementation, investment mobilization, and public awareness efforts. Encouraging public-private partnerships, greater community involvement, and cross-sector cooperation will be crucial in overcoming this barrier.

5. State on Workforce Readiness for the Green and Digital Transition

5.1. Green skill demands across industries

The twin green and digital transition is driving new skill demands across industries in Azerbaijan, Kazakhstan, and Mongolia. Enterprises in these countries increasingly require professionals with expertise in renewable energy, digital technologies, and sustainable business strategies. As a result, workforce development efforts must focus on equipping employees with green, digital, and business competencies necessary for economic modernization and environmental sustainability.

In all three countries, there is a high demand for professionals who can support the transition to renewable energy, energy efficiency, and sustainable resource management. Specifically:

- **Azerbaijan**: Enterprises seek professionals with knowledge of solar, wind, and hydropower plant management to advance the country's clean energy sector. Sustainable resource management expertise is also in demand to develop eco-friendly production processes. The list of the green skills is as follows:
  - Knowledge of solar, wind and hydropower plant management.
  - Skills in developing environmentally friendly production processes.
- **Kazakhstan**: Companies require specialists in energy-saving technologies, AI-driven optimization for energy efficiency, and circular economy practices. There is also a growing need for engineers in renewable energy sources to meet national sustainability goals. The full list of skills is as follows:
  - Skills in energy saving and efficiency – specialists are needed to implement heat and energy conservation strategies using AI, Big Data, and digital optimization tools to enhance sustainability.
  - Skills in solar and wind energy – workforce expertise is required in designing, implementing, and marketing solar and wind power systems, particularly for small and medium-scale renewable energy projects.
  - Skills in renewable energy management – the demand is growing for professionals capable of developing, promoting, and maintaining renewable energy infrastructures, including solar, wind, and hydroelectric power plants.
  - Skills in sustainable resource management – businesses need specialists to optimize natural resource usage, integrate eco-friendly industrial practices, and apply digital tools for sustainability monitoring.
  - Skills in environmental compliance and standards – professionals must be trained to align businesses with international environmental regulations, ensure low-carbon product development, and integrate sustainable solutions in industries.

- Skills in eco-friendly product and service development – high demand exists for specialists capable of designing and implementing environmentally friendly goods and services, focusing on reducing industrial carbon footprints.
- Skills in green transport and mobility – expertise is needed for the introduction of environmentally neutral electric vehicles, eco-buses, and green transport solutions into urban infrastructures.
- Skills in sustainable agriculture and food systems – a rising demand for professionals specializing in structural agricultural changes, such as reducing meat consumption, promoting sustainable farming practices, and developing low-carbon cereal crop varieties.
- Skills in green energy transition knowledge – training is required to support the phase-out of fossil fuels and facilitate the transition to renewable energy sources, such as wind and solar power.
- Skills in digital optimization for carbon footprint reduction – engineers and data scientists are needed to leverage AI, IoT, and Big Data to optimize industrial processes, energy consumption, and livestock farming, ensuring reduced carbon emissions.

- **Mongolia**: The demand for skills in designing, installing, and maintaining renewable energy technologies is rising. Additionally, disaster risk reduction, environmental impact assessments, and sustainable agricultural practices are crucial to supporting climate adaptation measures. The full list of the green skills is as follows:
  - Skills in designing, installing, and maintaining renewable energy technologies.
  - Skills in efficiently using natural resources such as water, forests, and land.
  - Skills in conducting environmental impact assessments.
  - Skills in disaster risk reduction and climate adaptation measures.
  - Skills in sustainable agricultural practices, waste management, and resource restoration.

5.2. Digital skill demands across industries

Digital transformation plays a **crucial role** in enabling smart energy management, automation, and industry modernization. Enterprises are seeking workers proficient in advanced digital technologies such as AI, IoT, and blockchain:

- **Azerbaijan**: Companies require specialists in artificial intelligence (AI) for optimizing processes in energy and transport. There is also a growing demand for IoT and blockchain experts to develop digital platforms for monitoring energy systems and enhancing cybersecurity. The summarized list of the skills:
  - Skills in AI to optimize processes in energy and transport.
  - IoT and blockchain skills.
- **Kazakhstan**: Demand for big data analytics, digital recycling solutions, and SCADA systems for industrial modernization is rising. Businesses need professionals who can digitize outdated industries, integrate automation technologies, and support smart infrastructure projects. The summarized list of the skills:

- Skills in digital recycling – the growing need for robotic automation in waste management requires specialists proficient in machine vision technology and AI-driven sorting systems to enhance waste processing efficiency.
- Skills in modernizing outdated production facilities – expertise is required in converting high-carbon legacy industries into digital factories using SCADA systems for real-time process monitoring and AI-based automation to reduce environmental impact.
- Skills in project management for green and digital initiatives – strong project leadership and implementation abilities are needed to drive technological advancements in renewable energy, industrial automation, and smart infrastructure projects.
- Skills in adapting business models to the digital economy – specialists must be capable of integrating digital technologies across various industries, including manufacturing, biotechnology, food production, agriculture, and energy, ensuring data-driven business transformation.
- Skills in AI, cloud computing, and big data processing – with government-backed initiatives focusing on technological investment and workforce development, professionals skilled in AI integration, cloud-based digital infrastructure, and data analytics are in high demand.
- Skills in digital controllers for renewable energy – the deployment of digital controllers for solar and wind power plants requires expertise in technical maintenance, system adjustments, and financial modelling to expand renewable energy adoption.
- Skills in digital processing of secondary raw materials – the transformation of waste recycling facilities into AI-driven, robotics-assisted processing centres necessitates advanced digital engineering skills to optimize automated sorting and material recovery.
- Skills in integrating digital standards into industrial production – specialists must be trained to introduce green technology standards, improve emissions tracking, and implement digital monitoring solutions in large-scale manufacturing industries.

- **Mongolia**: Key skill gaps include cybersecurity, digital system protection, and data analytics. Enterprises also require specialists in managing digital infrastructure, network operations, and implementing AI-driven decision-making tools with the following skills:
  - Skills in advanced digital technologies such as artificial intelligence, blockchain and the Internet of Things;
  - Skills in data science, big data analysis, and digital system protection;
  - Skills in cybersecurity and data privacy;
  - Skills in managing digital infrastructure, including digital databases and network design, operation, and maintenance;
  - Skills in developing and implementing digital government services for transparency and accessibility;
  - Skills in using and integrating ICT tools in public and private sector activities.

5.3. Business skill demands across industries

As the green and digital economy expands, businesses require strategic management and financial expertise to integrate sustainability and technology-driven solutions:

- **Azerbaijan**: Enterprises prioritize strategic project management for renewable energy and financial management of green economy initiatives to ensure economic viability and investment growth.
- **Kazakhstan**: Demand is high for specialists in sustainable resource management, energy-efficient business operations, and financial planning for clean technology ventures. There is also a need for digital entrepreneurship and innovative business development strategies. The list of skills required is as follows:
    - Skills in renewable energy entrepreneurship – high demand exists for specialists capable of developing, managing, and scaling renewable energy startups, particularly in solar energy projects in regions with high solar radiation potential.
    - Skills in electric vehicle adoption and promotion – businesses require professionals who can analyze and demonstrate the financial, environmental, and operational benefits of transitioning urban transportation to electric mobility to reduce carbon emissions and air pollution.
    - Skills in sustainable resource management – a growing need for experts in resource efficiency, environmental impact assessments, and sustainable business strategies, ensuring economic growth aligns with sustainability principles.
    - Skills in financial modeling for green investments – companies and investors require specialists in developing financial and credit instruments to support large-scale implementation of renewable energy technologies, such as wind and solar power plants.
    - Skills in marketing sustainable technologies – businesses need professionals skilled in marketing eco-friendly solutions, renewable energy services, and green technologies, ensuring their successful adoption in consumer and industrial markets.
    - Skills in strategic planning for sustainable business – specialists who can integrate green and digital initiatives into long-term corporate strategies, helping businesses transition toward low-carbon, digitally driven operations.
    - Skills in digital finance and investment for green projects – experts in green finance, investment management, and impact-driven capital allocation are needed to support the growth of sustainable enterprises and digital economy ventures.
    - Skills in innovation-driven business development – entrepreneurs and business leaders must be trained to leverage digital tools, AI, and data analytics to create scalable, high-impact business models that align with sustainability goals.
- **Mongolia**: Companies require professionals skilled in green investment management, sustainability reporting, and stakeholder collaboration. There is also a need for leaders capable of driving sustainable transitions and fostering innovation across industries with the following skills in:
    - managing natural resources such as water, land, and forests sustainably;
    - designing and maintaining renewable energy systems, including solar and wind technologies;

- energy efficiency strategies to reduce carbon footprints and optimize resource use;
- assessing and mitigating environmental impacts of business operations;
- resource management, including reducing, recycling, and efficient utilization;
- supporting green investments and preparing world-class sustainability reports;
- managing complex projects, particularly those integrating green and digital goals;
- developing long-term strategies for sustainability and digital transformation;
- leading teams through transitions and fostering a culture of innovation and sustainability;
- stakeholder collaboration to engage effectively with diverse partners;
- identifying market opportunities and driving sustainable growth through innovative solutions.

5.4. Industry-Specific Trends in the Green and Digital Domains

The twin green and digital transition is transforming industries across Azerbaijan, Kazakhstan, and Mongolia, with key sectors emerging as leaders in sustainability and technological innovation. Each country is leveraging its natural resources, industrial strengths, and policy frameworks to advance renewable energy, digital transformation, and eco-friendly business practices (Table 6).

In **Azerbaijan**, green and digital transitions are being actively implemented in sectors such as energy, transport, agriculture and construction.

Industry-Specific Trends for green domain in Kazakhstan:

- **Energy**: Dzhambyl TPP operates on natural gas, positive experience has been accumulated in its operation. A project for a nuclear power plant is being implemented, which should reduce the share of coal generation.
- **Transport**: An electric bus is being used experimentally in Astana and Almaty, 90% of Almaty buses operate on natural gas, the experience of Almaty is being extended to other cities.
- **Agricultural sector**: Crop rotation of grain crops with maximum positive absorption of carbon during photosynthesis has been established. Sustainable agricultural methods are being introduced, including precision farming and resource-saving irrigation systems, and biotechnology is being developed.
- **Nuclear Power Plant (NPP)**: Kazakhstan plans to build a nuclear power plant to decrease reliance on coal-based power generation and reduce carbon dioxide emissions. The project aims to ensure stable energy supply and promote the development of high-tech industries.

Industry-Specific Trends for digital domain in Kazakhstan:

- **Energy**: A decision has been made to convert a number of thermal power plants and thermal power plants operating on coal to natural gas. The development of industry till automation level up to level 5 will give assurance of proper automotive control solutions application for industrial processes and relevant infrastructure, e.g. SCADA.
- **Transport**: In Almaty, 10% of transportation has been converted to natural gas, and the share of electric vehicles has increased from 0.1% to 5%. Emissions are monitored using digital sensors.
- **Agricultural sector**: Digital technologies are used in greenhouses, while biogas plants in animal husbandry convert methane to heat farms and homes. KazNU has patented an IoT system for digital control of biogas plants.

- **Nuclear Power Plant (NPP):** Kazakhstan plans to construct a nuclear power plant to reduce dependence on coal-based power generation and lower carbon dioxide emissions. The project is aimed at ensuring sustainable energy supply and fostering the development of high technologies.

Industry-Specific Trends in Mongolia:

- The renewable energy sector is beginning to develop in Mongolia. Wind and solar power projects are being successfully implemented in Mongolia. Work is ongoing to develop various renewable energy systems in remote rural areas.
- To attract environmentally friendly travellers, the tourism sector in Mongolia is implementing an ecotourism policy. Renewable energy solutions are being introduced in resorts and tourist areas.
- The mining sector is developing rapidly in Mongolia, and in line with this, specific activities are being planned to reduce the impact on the environment. In addition, water recycling systems are being introduced into operations. Renewable energy is being used for power mining facilities. Afforestation and grassland restoration are being carried out to restore mined land.
- Mongolia has a vast territory and is a leader in agriculture and livestock farming. Renewable energy is being used in water pumps and irrigation systems. Farmers are increasingly pursuing organic farming and waste-to-energy projects.
- In the construction sector, Mongolians use energy-efficient buildings and renewable energy systems in new residential buildings to improve energy efficiency and reduce emissions.

However, in line with technological developments and current needs, Mongolia faces the following challenges in digital transition. These include:

- Artificial intelligence is needed in water pumps and irrigation systems to optimize resource use in the agriculture and livestock sectors.
- Introducing innovative systems in green buildings to improve energy efficiency and operational performance in the construction sector.
- The potential of digital tools to support ecotourism in the tourism sector, such as online booking platforms for sustainable tourism and AI-powered guest management systems.
- The introduction of information technology AI and IoT-based methods to optimize the production and distribution of renewable energy in the renewable energy sector.
- Introduce information technology, artificial intelligence, and IoT-based methods to reduce the environmental impact of the mining industry and improve efficiency.

Table 6. Leading industries in the Green and Digital Domains

Country	Domain	Industry sectors
Azerbaijan	Digital domain	Transport Energy
	Green domain	Energy Agriculture.
Kazakhstan	Digital domain	Energy Transport Agricultural sector Information Technology Nuclear Power Plant (NPP)
	Green domain	Energy Transport

		Agricultural sector Nuclear Power Plant (NPP)
Mongolia	Digital domain	Agriculture and livestock sectors Construction sector Tourism sector Renewable energy sector Mining industry
	Green domain	Renewable energy sector Tourism sector Mining sector Agriculture and livestock farming Construction sector

5.5. Competency gaps in Green and Digital Transition

The green and digital transition in Azerbaijan, Kazakhstan, and Mongolia is progressing, but significant competency gaps remain across key industries. These gaps hinder the effective integration of sustainability practices and digital transformation efforts. Table 7 provides information on the green competency gaps within Azerbaijan, Kazakhstan, and Mongolia industries.

Table 7. Green competency gaps in the industries

Country	Competency	Description
Azerbaijan	Limited expertise in renewable energy system integration	The country lacks specialists trained in solar, wind, and hydro-based energy solutions, which slows down the expansion of renewable energy projects.
	Weak knowledge of energy efficiency strategies	Businesses require professionals who can analyze and implement energy-saving solutions for industrial and public infrastructure.
	Deficit in sustainability policy and emissions reduction expertise	Azerbaijan lacks specialists who can develop and implement carbon neutrality strategies and green policy frameworks.
Kazakhstan	Shortage of professionals in circular economy practices	There is a need for specialists in waste reduction, sustainable production, and recycling technologies to meet environmental sustainability targets.
	Gaps in energy transition and smart energy management skills	The country requires engineers and technicians to modernize power grids, optimize energy consumption, and develop AI-driven energy solutions.
	Lack of sustainable resource management expertise	Kazakhstan faces a skills gap in eco-friendly resource utilization, particularly in agriculture, water conservation, and mining sectors.
Mongolia	Deficit in green construction and urban sustainability skills	Mongolia lacks experts trained in eco-friendly building design, smart urban planning, and sustainable housing solutions.
	Weak expertise in renewable energy infrastructure maintenance	The country needs technicians and engineers capable of maintaining solar, wind, and geothermal energy systems.
	Limited competencies in climate adaptation and ecosystem protection	Mongolia requires more professionals specializing in biodiversity conservation, land restoration, and climate risk assessment.

Digital competency gaps in Azerbaijan, Kazakhstan, and Mongolia present significant challenges to the adoption of smart technologies, automation, and digital sustainability solutions (Table 8).

Table 8. Digital competency gaps in the industries

Country	Competency	Description
Azerbaijan	Insufficient expertise in AI and data-driven decision-making	The country lacks skilled professionals who can apply AI for forecasting, industrial process optimization, and smart energy management.
	Lack of expertise in IT implementation, like blockchain and IoT integration	Businesses need specialists trained in deploying blockchain for supply chain transparency and IoT for smart city and infrastructuresolutions management.
	Lack of cybersecurity professionals	Azerbaijan requires more cybersecurity experts to protect its digital infrastructure, public services, and critical sectors from cyber threats.
Kazakhstan	Shortage of professionals in digital recycling and automation	The country needs specialists capable of implementing robotic waste sorting systems and AI-driven waste management.
	Lack of digital infrastructure engineers	There is a growing demand for technicians capable of maintaining and expanding broadband networks, smart grids, and e-governance platforms.
	Gaps in integrating smart city technologies	Kazakhstan needs urban planners and engineers with expertise in autonomous industry, big data analytics, digital transport systems, and smart energy monitoring.
Mongolia	Limited expertise in digital finance and e-governance	Mongolia faces a shortage of specialists capable of expanding digital public services and financial technologies (FinTech).
	Deficit in digital skills for rural industries	There is a need for professionals trained in applying AI and digital monitoring tools in agriculture, mining, and logistics.
	Weak capacity in software development for sustainability	Mongolia requires IT professionals with expertise in developing digital platforms for green initiatives, carbon tracking, and environmental data management.

Business competency gaps in Azerbaijan, Kazakhstan, and Mongolia slow the integration of sustainability and digitalization in economic strategies (Table 9).

Table 9. Business competency gaps in the industries

Country	Competency	Description
Azerbaijan	Shortage of green business strategists	Businesses require professionals who can align corporate growth with sustainability and digitalization goals.
	Lack of investment specialists for renewable energy	Azerbaijan needs experts in green finance, financial modeling, and sustainability-driven investment management.
	Limited leadership in digital entrepreneurship	The country requires business leaders and innovators who can leverage AI, blockchain, and big data for economic transformation.

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Kazakhstan	Gaps in electric vehicle market development	The country needs specialists who can demonstrate the financial and environmental advantages of EV adoption to accelerate sustainable transport solutions.
	Deficit in business model adaptation for digitalization	Companies require professionals trained in transitioning business operations to AI, cloud-based solutions, and data-driven decision-making.
	Shortage of green marketing and financial experts	Kazakhstan lacks professionals who can develop green financing tools and promote sustainability-driven products and services.
Mongolia	Limited expertise in sustainable resource management for business	There is a demand for specialists who can develop policies and strategies for responsible resource consumption in mining, energy, and manufacturing.
	Weak capacity in impact-driven business planning	Mongolia requires professionals trained in integrating sustainability metrics into business operations and investment planning.
	Gaps in sustainable entrepreneurship and eco-innovation.	There is a need for business leaders who can develop scalable green and digital business models to attract investments.

The green and digital transition in Azerbaijan, Kazakhstan, and Mongolia is hindered by critical competency gaps in renewable energy, digital technologies, and sustainable business models. Each country faces specific skill shortages that must be addressed through:

- Targeted education and workforce training programs;
- Stronger public-private partnerships;
- Investment in digital infrastructure and sustainability leadership.

Bridging these gaps will be essential for accelerating industrial modernization, achieving sustainability goals, and ensuring economic competitiveness in the global green and digital economy.

6. STATE ON HEIS CURRICULA ALIGNMENT WITH GREEN, DIGITAL AND BUSINESS SKILLS

6.1. Curricula in the Azerbaijan Technical University

The review of the Bachelor's and Master's curricula for Electric and Electronic Engineering and Electrical Engineering at Azerbaijan Technical University highlights both strengths and areas for improvement in aligning with the competencies needed for the twin green and digital transitions. While the curricula offer valuable foundational knowledge, significant gaps remain in green, digital, and business skills that need to be addressed to fully prepare students for the evolving demands of the engineering industry. The twin transformation of higher education in Azerbaijan aims to position AzTU and its partner universities on the international education stage. This transformation will not only redefine knowledge acquisition and university management through digital technologies but also reshape the very nature of knowledge while fostering digital, green and business competencies in future graduates.

In terms of **green competencies**, the curriculum offers minimal integration of sustainability and energy efficiency across core courses. While subjects like *Electromechanical Energy Conversion* touch on energy systems, there is insufficient focus on renewable energy integration, energy-efficient system design, and the use of sustainable materials. Additionally, there is a lack of interdisciplinary approaches that blend engineering with environmental principles, which are necessary for tackling the sustainability challenges of modern industry.

Digital competencies are more prominently featured in courses such as *Machine Learning in Engineering*, *Neural Networks and Applications in Energy*, and *Artificial Intelligence Methods*. These courses provide advanced knowledge in digital technologies; however, practical exposure to real-world applications remains limited. Courses like *CAD-Based Technical Graphics*, *Digital Electronics and Programmable Integrated Circuits*, and *3D Graphics and Modeling* lay a solid foundation in digital tools but lack the integration of emerging technologies like the Internet of Things (IoT), digital twins, blockchain, and cybersecurity for critical infrastructure. These advanced technologies are increasingly essential for modern engineering practices, particularly in smart grids, automation, and energy systems. To address this gap, more hands-on projects and industry collaborations are needed to provide students with practical skills in these emerging areas.

Business competencies are only lightly addressed in the current curriculum, primarily through the *Fundamentals of Entrepreneurship and Introduction to Business* course. While this offers basic knowledge in entrepreneurship, it does not provide students with the necessary skills in financial analysis, market trends, and the commercialization of technological innovations. These skills are critical for engineers, especially those working on cutting-edge green and digital technologies. Incorporating business-focused case studies, interdisciplinary projects, and modules on financial management and market strategies would help bridge this gap and better prepare students for the commercial challenges they will face in their careers.

To address these identified gaps, several key changes are recommended. Firstly, **green competencies** should be more thoroughly integrated into the curriculum by introducing mandatory modules on renewable energy systems, energy-efficient technologies, and sustainable design. Interdisciplinary projects that combine engineering and environmental science can provide students with a holistic approach to sustainability. Secondly, **digital competencies** should be expanded by incorporating advanced technologies such as IoT, blockchain, digital twins, and cybersecurity. Industry partnerships and hands-on projects will ensure that students gain practical experience with these technologies, making them more competitive in the job market. Furthermore, practical exposure to advanced tools, including virtual reality for simulating operations, robotization of office processes for operational efficiency, and digital tools for managing energy facilities, remains limited. The absence of training on the use of digital end-to-end technologies in the energy sector further widens the gap, especially in areas such as determining the constructive profile of equipment and digital control systems for energy facilities. Lastly, **business competencies** can be strengthened by incorporating advanced modules on financial analysis, market strategy, and entrepreneurship. These should be linked with technical courses, allowing students to apply business concepts to engineering challenges, particularly those related to green and digital innovations.

By addressing these gaps, the Electric and Electronic Engineering and Electrical Engineering curricula can be better aligned with the competencies required for the twin green and digital transitions. This will not only enhance the educational experience for students but also equip them with the skills needed to lead the development of sustainable, digitally advanced technologies in the global market.

6.2. Curricula in the Azerbaijan Technological University

The Curriculum review for **Azerbaijan Technological University** provides an assessment of how study programs align with the competency needs of the twin green and digital transition (Table 10).

Table 10. Study programs overview in ATU

Study programme	Type	Course Title	Competency Coverage	Identified Competency Gaps	Recommendations

Transport logistics	Master	Fundamentals of management in logistics systems	Green: Low	Lack of practical applications	Include hands-on project components.
			Digital: Medium	Insufficient focus on emerging tech	Add modules on AI and IoT applications.
			Business: Medium	Limited training in entrepreneurial skills	Introduce a startup workshop module.
Environmental engineering	Bachelor	Human ecology and sustainable development	Green: Medium	There is no connection to sustainability practices	Develop a sustainability component.
			Digital: Low	Limited digital tool application	Include training on industry-specific tools.
			Business: Medium	Limited training in leadership	Include training on industry-specific leading practices.
Environmental engineering	Bachelor	Sustainable management of natural resources	Green: Medium	There is no connection to sustainability practices	Develop a sustainability component.
			Digital: Low	Limited digital tool application	Include training on industry-specific tools.
			Business: Medium	Limited training in leadership	Include training on industry-specific leading practices.
Process automation engineering	Bachelor	The theory of automatic control	Green: Medium	There is no connection to sustainability practices	Develop a sustainability component.
			Digital: Low	Limited digital tool application	Include training on industry-specific tools.
			Business: Medium	Limited training in leadership	Include training on industry-specific leading practices.
Tourism management	Bachelor	Environmental economics	Green: Medium	No connection to sustainability practices	Develop a sustainability component.
			Digital: Low	Limited digital tool application	Include training on industry-specific tools.
			Business: Medium	Limited training in leadership	Include training on industry-specific leading practices.

It outlines the current curriculum structure, competency gaps, and recommendations for improvement. The reviewed programs cover a range of subjects related to engineering, logistics, and management**.** However, the integration of green, digital, and business competencies varies significantly across faculties.

- **Green competencies** are moderately covered but often lack practical applications and industry-relevant sustainability content.
- **Digital competencies** are limited**,** with low exposure to emerging technologies such as AI, IoT, and automation**.**
- **Business competencies** are moderate**,** with some entrepreneurship and management skills present, but a lack of startup development training**.**

The review identified specific strengths and gaps in key programs:

- **Transport Logistics (Master's level):**

- **Green competency**: Low – Courses do not emphasize sustainable logistics or environmental efficiency.
- **Digital competency**: Moderate – Basic digital tools are introduced, but advanced applications like AI and IoT are missing.
- **Business competency**: Moderate – Some management principles are covered, but entrepreneurial training is lacking.

Recommendations: Integrate sustainability-focused logistics training, introduce AI and IoT applications, and enhance startup development modules**.**

- **Environmental Engineering & Process Automation Engineering (Bachelor's level):**
  - **Green competency:** Medium – The curriculum addresses environmental concerns but lacks practical sustainability components.
  - **Digital competency:** Low – Courses offer limited exposure to industry-specific digital tools.
  - **Business competency:** Moderate – Leadership and project management training require further development.

Recommendations: Strengthen sustainability applications, incorporate digital industry tools, and introduce leadership training.

- **Tourism Management (Bachelor's level):**
  - **Green competency:** Medium – Some sustainability topics are included but are not deeply integrated into the business aspects of tourism.
  - **Digital competency**: Low – There is minimal focus on digital transformation in the tourism industry.
  - **Business competency**: Moderate – Management skills are covered, but entrepreneurial and leadership training needs improvement.

Recommendations: Enhance digital literacy in tourism, integrate sustainability-focused business models, and introduce leadership development programs**.**

6.3. Curricula in the Mingachevir State University

The curriculum review at Mingachevir State University (MSU) was conducted to evaluate how the university's programs align with green, digital, and business skill demands. The review focuses on bachelor's and master's programs in Environmental Engineering, offered by the Department of Physics and Ecology within the Faculty of Engineering (Table 11).

The reviewed study programs cover environmental engineering, sustainability, and ecological management. However, the integration of green, digital, and business competencies varies across courses.

- **Green competencies** are moderately covered but lack practical applications and sustainability-focused training.
- **Digital competencies** are low, with minimal integration of AI, IoT, and other emerging technologies.
- **Business competencies** are low, with limited entrepreneurial training and industry-relevant business education.

Table 11. Study programs overview in MSU

Study programme	Type	Course Title	Competency Coverage	Identified Competency Gaps	Recommendations
Environmental Engineering	Master	1.Efficient use of natural environment and natural resources	Green: Medium	Develop a sustainability component.	Trainings on industry based practices and industry specific tools
			Digital: Low	Insufficient focus on emerging tech	Add modules on AI and IoT applications.
			Business: Low	Limited training in entrepreneurial skills	Introduce a startup workshop module.
	Master	2.History and methodology of environmental engineering	Green: Medium	No connection to sustainability practices	Develop a sustainability component.
			Digital: Low	Limited digital tool application	Include training on industry-specific tools.
			Business: Low	Limited training in leadership	Include training on industry-specific leading practices.
	Master	3. Techniques and technologies of environmental protection	Green: Medium	Lack of practical applications	Training of industry-specific leading practices and industry-specific tools
			Digital:	Law provision of high-tech technology	
			Business:		
	Master	4. Contemporary problems of environmental engineering	Green: Medium	Lack of practical applications	Trainings on industry specific leading practices
			Digital: Low		
			Business: Low		
	Master	5. Environemntal forecasting	Green: Medium		
			Digital: Low		
			Business: Low	Limited digital tools application, lack of practical application	Providing relevant trainings
	Master	6. Ecological management	Green: Medium		
			Digital: Low		
			Business: Low	Limited training in entrepre-neurial skills	Introduce a startup workshop module.

	Master	7. Applied Ecology Social Ecology	Green: Medium		
			Digital: Low	Lack of advanhced technology	Industry-specific tools training
			Business: Low		

The review identified strengths and gaps in Master's Program in Environmental Engineering:

- **Efficient Use of Natural Environment and Natural Resources**
  - **Green competency**: Medium – Needs a stronger sustainability component.
  - **Digital competency**: Low – Limited exposure to AI, IoT, and digital tools.
  - **Business competency**: Low – Lack of entrepreneurial training.

Recommendations: Introduce sustainability-focused training, AI and IoT modules, and a startup workshop.

- **History and Methodology of Environmental Engineering**
  - **Green competency**: Medium – Lacks direct **sustainability applications**.
  - **Digital competency**: Low – Few digital tool applications.
  - **Business competency**: Low – Limited leadership training.

Recommendations: Enhance sustainability content, integrate digital tools, and provide leadership training.

- **Techniques and Technologies of Environmental Protection**
  - **Green competency**: Medium – Lacks industry-specific practical applications.
  - **Digital competency**: Low – Insufficient high-tech tool integration.
  - **Business competency**: Low – Needs stronger industry-business connections.

Recommendations: Develop industry-based sustainability practices and integrate digital technologies.

- **Contemporary Problems of Environmental Engineering**
  - **Green competency**: Medium – Lacks practical applications.
  - **Digital competency**: Low – Insufficient technology use.
  - **Business competency**: Low – Needs entrepreneurial skill training.

Recommendations: Introduce industry-based case studies and startup-oriented training.

- **Environmental Forecasting**
  - **Green competency**: Medium – Requires enhanced sustainability application.
  - **Digital competency**: Low – Lacks digital forecasting tools.
  - **Business competency**: Low – Needs industry-relevant business applications.

Recommendations: Implement digital forecasting tools and provide business strategy training.

- **Ecological Management**
  - **Green competency**: Medium – Covers key ecological concepts but lacks **practical integration**.
  - **Digital competency**: Low – Limited digital modeling and assessment tools.
  - **Business competency**: Low – Lacks entrepreneurship training.

Recommendations: Introduce digital modeling tools and offer sustainability entrepreneurship programs.

- **Applied Ecology and Social Ecology**
  - **Green competency**: Medium – Needs more real-world applications.
  - **Digital competency**: Low – Lacks advanced technology usage.
  - **Business competency**: Low – Minimal business integration.

Recommendations: Train students in industry-specific tools and enhance sustainability leadership training.

6.4. Curricula in the International Engineering-Technological University

The curriculum review at **International Engineering-Technological University (METU)** was conducted to assess the integration of green, digital, and business skills into existing study programs (Table 12). The university offers courses that encompass dual areas of business, green sustainability, and digital transformation on Software Engineering and Biochemical Engineering. The reviewed programs cover a range of subjects related to engineering, biotechnology, and computer sciences**.**

Table 12. Study programs overview in METU

Study programme	Type	Course Title	Competency Coverage	Identified Competency Gaps	Recommendations
Software Engineering	Bachelor's, Master's, Doctoral	Artificial Intelligence Systems, Robotics and Robotic Systems, Digital Circuitry, Computer Systems Architecture, Computer and Mathematical Modeling, Programming Languages and Technologies, Algorithmization and Programming, Information Theory, Information Processing Technologies, Numerical Methods, Parallel Computing, Organization of Computing Systems and Networks, Information Systems and Networks, Systems Programming, Software Development Tools, Internet and Web Programming	Digital: High	-	-
			Green: Low	Limited connection to ecological aspects	Include modules on applying technologies for sustainable development, develop ecology-related courses
			Business: Medium	Limited application of technologies for sustainability	Implement projects demonstrating the use of green technologies in software engineering
Biotechnology	Bachelor's, Master's, Doctoral	Molecular Research Methods, Cellular Biotechnology, Materials Science and Technology of New	Green: High	-	-
			Business: Medium	Insufficient connection to business aspects	Add courses on commercialization and

		Materials, General Chemical Biotechnology, Fermentation Production Technology and Winemaking, Winemaking Technology, Brewing Technology, Meat and Dairy Product Technology, Food Chemistry, Basics of Food Technologies, Safety and Techno-Chemical Control of Food Products, Production Equipment and Food Product Studies, Basics of Chemical and Biological Safety, Inorganic, Organic, and Analytical Chemistry, Physical and Colloid Chemistry, Plant Biotechnology, Animal Biotechnology, Environmental Biotechnology, Basics of Raw Material Processing, Hydrocarbon Raw Material Processing Technologies, Secondary Raw Material Processing Technologies, Basics of Heat Engineering, Theoretical Basics of Electrical Engineering, Management Systems, Quality Control and Evaluation, Metrology, Methods, and Measurement Tools			project management in biotechnology
			Digital: Medium	Limited digitization of processes	Strengthen the use of digital technologies in biotechnological processes

However, the integration of green, digital, and business competencies varies significantly across faculties.

- **Green competencies** are low in software engineering but well integrated into biotechnology courses**.**
- **Digital competencies** are high in software engineering but medium in biotechnology due to limited digitization of processes.
- **Business competencies** are moderate across all programs, with limited entrepreneurial and commercialization-focused training.

The review identified specific strengths and gaps in key programs:

- **Software Engineering (Bachelor's, Master's, Doctoral levels):**
  - **Green competency**: Low – The curriculum lacks ecological and sustainability-focused content**.**
  - **Digital competency**: High – Strong coverage in AI, robotics, programming, and information systems**.**
  - **Business competency**: Medium – Limited emphasis on sustainable technology applications and entrepreneurship**.**

Recommendations: Introduce sustainability-related modules in software development, integrate case studies on green technology applications, and develop project-based learning on AI for sustainability**.**

- **Biochemical Engineering (Bachelor's, Master's, Doctoral Levels)**
  - **Green competency**: High – Well-integrated environmental biotechnology and sustainability-related courses**.**
  - **Digital competency**: Medium – Some courses cover automation and digital processing, but more advanced digitization of biotechnological processes is needed.
  - **Business competency**: Medium – There is a limited connection between biotechnology and commercialization strategies**.**

Recommendations: Strengthen the use of digital technologies in biotechnological processes and introduce courses on commercialization and project management in biotechnology**.**

6.5. Curricula in the Al-Farabi Kazakh National University

The curriculum review at **Al-Farabi Kazakh National University (KAZNU)** was conducted to assess how the university's academic programs align with green, digital, and business skill demands. The review focused on bachelor's and master's programs under the Faculty of Information Technology, Department of Artificial Intelligence and Big Data (Table 13).

Table 13. Study programs overview in KazNU

Study programme	Type	Course Title	Competency Coverage	Identified Competency Gaps	Recommendations

6B07113 Intelligent Control Systems	Bachelor	Big Data and Cloud Computing; Deep Learning Models; Human-machine interaction in IoT; Integrated Automation Environment; Inter-machine interaction M2M; Introduction to Big Data using SQL; Introduction to data mining; Introduction to Digital Production; M2M Simulation Modeling System; Machine learning; PLC programming; Programming of microcontrollers; Simulators of human-machine interaction; TIA Portal 1 Simulators; TIA Portal human-machine interface; Big Data analysis tool; Cloud Application Development Foundations; Computer Vision in IoT; Design of intelligent control systems; Digital devices and microprocessors; Industrial networks; Intelligent production process management systems; Introduction to Blockchain; Lean manufacturing; Modeling and Optimizing of IIoT Device Control; Project on intellectualization of mechatronic systems; The theory of automatic control.	Green: Low	No connection to sustainability practices	Undergraduate courses could include courses that help develop the skills and knowledge needed to work in the field of green technologies and sustainable development. This could include using IT to monitor and manage environmental processes, including energy management systems and smart grids. Renewable energy courses, such as solar, wind, hydro and geothermal energy, and the technologies for using them.
			Digital: High	All disciplines of the program are aimed at digital competencies	no recommendations
			Business: Low	Limited training in entrepre-neurial skills	Introduce a startup workshop module.

Co-funded by the European Union

7M07128 Intelligent Control Systems	Master	Construction and Analysis of Algorithms; Controllers and Simulators in the Design of «Industry 4.0» Solutions; Intelligent Control Systems in IIoT; Mathematical Methods for Calculating the Impact of IoT Systems on Business Performance; Software and Hardware for IoT; Theory of Nonlinear Multidimensional Technological Process Control Systems; Analysis and Design of Embedded IoT Systems; Big Data Analytics in Internet of Things; Discrete Technological Process Control; Modeling the Decision-making Process in Automated Systems; Robustness and Controllability of Collective Robots Matlab; Visualization in Intelligent Control Systems.	Green: Low	No connection to sustainability practices	In the Master's program, we propose introducing a training path that combines green technology competencies and business skills. Provide courses that will help develop the ability to conduct research and develop new technologies aimed at solving environmental problems. Master's students will be able to learn how to educate and inform the public about the importance of sustainable development and "green" technologies.
			Digital: High	All disciplines of the program are aimed at digital competencies	no recommendations
			Business: Low	Limited training in leadership	Include training on industry-specific leading practices.

The reviewed study programs primarily focus on digital technologies and intelligent control systems, with varying levels of green, digital, and business skill integration.

- **Green competencies** are low, with no direct connection to sustainability practices in the curriculum.
- **Digital competencies** are high, with strong coverage in AI, IoT, cloud computing, and automation.
- **Business competencies** are low, with limited training in entrepreneurship and leadership.

The review identified strengths and gaps in key programs:

- **6B07113 Intelligent Control Systems (Bachelor's Program):**
  - **Green competency**: Low – No connection to sustainability-related courses or environmental applications.
  - **Digital competency**: High – Strong focus on AI, IoT, machine learning, cloud computing, and automation.
  - **Business competency**: Low – Limited entrepreneurial training.

Co-funded by the European Union

Recommendations: Introduce sustainability-related IT applications (smart grids, energy management systems) and develop a startup workshop module.

- **7M07128 Intelligent Control Systems (Master's Program):**
  - **Green competency**: Low – No emphasis on green technology applications.
  - **Digital competency**: High – Comprehensive coverage of advanced AI, IIoT, and Industry 4.0 solutions.
  - **Business competency**: Low – Limited leadership and business management training.

Recommendations: Include sustainability-focused research projects, develop leadership training in industry best practices, and integrate green technology components.

6.6. Curricula in the Almaty Technological University

The curriculum review at **Almaty Technological University (ATU KZ)** was conducted to assess how academic programs align with green, digital, and business skill demands. The review focused on bachelor's and master's programs under the Faculty of Engineering and Information Technology, Department of Automation and Robotics, and Department of Information Systems (Table 14).

The reviewed study programs focus on robotics, industrial automation, and information systems, with varying levels of green, digital, and business skill integration.

- **Green competencies** are low, with minimal application of sustainability-focused technologies in engineering and automation.
- **Digital competencies** are high, covering robotics, AI, IoT, and industrial automation.
- **Business competencies** are moderate, with some entrepreneurship and financial literacy content but lacking dedicated business courses.

Table 14. Study programs overview in ATUKZ

Study programme	Type	Course Title	Competency Coverage	Identified Competency Gaps	Recommendations
6B07104 Robots and robotic systems	Bachelor	Module of Economics, Entrepreneurship, Law and Financial Literacy; Robotics Basics and Arduino; Programming Algorithms and data structures; Details of mechatronic modules, robots and their design; Java programming: Electronic devices of mechatronic and robotic systems; Digital Signal; Processing Software Development Tools; Kinematics and dynamics of robots ; Modeling of robots and robotic systems; Industrial robots and manipulators: Python programming;Mechanics of controlled motion of autonomous robots;	Green: [Low]	Lack of practical applications	Include hands-on project components for the application of green technologies in smart systems and robotic complexes.
			Digital: [High]	disciplines of the program are aimed at digital competencies	Add modules on IoT applications.
			Business: [Medium]	There are minor programs, but there is no specific course on business skills.	Introduce a startup workshop module.

		Fundamentals of artificial intelligence; Fundamentals of machine learning; Navigation systems of autonomous robots; Drives for mechatronic and robotic systems: Modeling of robot control systems and robotic systems: Autonomous Multi-Agent Robotic Systems; Robotics-intensive systems software; AI tools; Control systems for intelligent mobile robots: Intelligent control systems for mobile robots; Remote control technologies for autonomous robots; Minor (Fundamentals of economics, Business fundamentals, Business planning)			
6B07108 Industrial Robotics	Bachelor	Module of Economics, Entrepreneurship, Law and Financial Literacy Engineering and computer graphics Algorithm and data structure Details of industrial robots and manipulators Basics of interchangeability Programming robots in Python Computer programs (Compass, Compass 3D) Introduction to Industrial robotics The basics of artificial intelligence Electronic devices of mechatronic and robotic systems Electrical engineering Elements and modules of robotic systems Microprocessor technology in mechatronics and robotics Material science in robotics Mechatronic and robotic system drives Programming in a high-level language Occupational health and safety in the operation of equipment Economics and organization	Green: [Low]	Lack of practical applications	Include practical components of the project on the application of "green" technologies in the maintenance of industrial technologies and principles of lean manufacturing
			Digital: [Medium]	disciplines of the program are aimed at digital competencies	Add a module on using AI and the Internet of Things for smart manufacturing
			Business: [Medium]	There are minor programs, but there is no specific course on business skills.	Introduce a startup workshop module.

		of production Mathematical and computer modeling 3D modeling and printing CMD of robotics Technical measurement and instruments Technical calculation and design documentation Industrial robotic operations Simulation of CMD on labview; Installation and commissioning of industrial robots Software for robotic systems Digital design of industrial robots Designing industrial robots Diagnostics and reliability of industrial robots Industrial robot control system Repair and operation of industrial robots Simulation of industrial robots			
[7M06101 Information systems]	Master	Foreign language (professional) History and philosophy of science Higher School Pedagogy Psychology of management Multi-criteria decision making problems Web-interface design and analysis Information systems design using modern DBMS System analysis and operation research Web-site design and development tools Big data storage and processing technologies Analysis modeling and design of information systems Architecture of IoT networks Knowledge engineering and intelligent systems Integrated security of information technologies and systems Methods and means of protecting computer information Data mining methods Multithreaded programming IoT network design Development of information systems using visual programming tools	Green: [Low]	Lack of practical applications	The Master's degree program offers a new direction combining green technology competencies with entrepreneurship skills. The program's courses are aimed at developing research skills and the ability to develop innovative technologies to solve environmental problems. Special attention is paid to the module on the development of information systems for monitoring and managing green technologies. Undergraduates will also learn how to effectively inform the public and raise

		Modern IT-project management methodologies Image recognition technologies IT - project and process management Digital image processing			awareness about the importance of sustainable development and the use of "green" technologies.
			Digital: High	All disciplines of the program are aimed at digital competencies	no recommendations
			Business: [Medium]	Limited training in leadership	The Master's degree program offers a new direction combining green technology competencies with entrepreneurship skills. The program's courses are aimed at developing research skills and the ability to develop innovative technologies to solve environmental problems. Special attention is paid to the module on the development of information systems for monitoring and managing green technologies. Undergraduates will also learn how to effectively inform the public and raise awareness about the importance of sustainable development and the use of "green" technologies.

The review identified strengths and gaps in key programs:

- **6B07104 Robots and Robotic Systems (Bachelor's program):**

- **Green competency**: Low – Lacks sustainability applications in robotics and automation.
- **Digital competency**: High – Strong focus on AI, automation, and control systems.
- **Business competency**: Medium – Some financial literacy and business fundamentals included.

Recommendations: Introduce sustainability-focused robotics projects, IoT applications for smart manufacturing, and a startup workshop module.

- **6B07108 Industrial Robotics (Bachelor's program):**
  - **Green competency**: Low – Lacks practical applications of green technologies in industrial robotics.
  - **Digital competency**: Medium – Covers digital competencies but lacks AI-driven smart manufacturing applications.
  - **Business competency**: Medium – Some business fundamentals are present, but entrepreneurship training is missing.

Recommendations: Integrate green technology applications in industrial automation, add AI and IoT modules for smart manufacturing, and introduce a startup incubator program.

- **7M06101 Information Systems (Master's program):**
  - **Green competency**: Low – Lacks environmental sustainability applications in IT systems.
  - **Digital competency**: High – Strong coverage in big data, IoT, AI, and digital security.
  - **Business competency**: Medium – Some leadership training but limited business development content.

Recommendations: Introduce courses on AI for environmental monitoring, expand digital solutions for green technology applications, and enhance leadership training for IT professionals.

6.7. Curricula in the National University of Mongolia

The curriculum review at **National University of Mongolia (NUM)** was conducted to assess the alignment of study programs with green, digital, and business skill demands. The review analyzed bachelor's and master's programs under the Department of Information and Computer Sciences and the Department of Green Energy and Engineering (Table 15).

The reviewed study programs primarily focus on software engineering, data science, and digital technologies, with varying levels of integration of green, digital, and business skills.

- **Green competencies** are low, with limited sustainability-related applications in the curriculum.
- **Digital competencies** are high, covering AI, IoT, and software development, but lack focus on emerging sustainability technologies.
- **Business competencies** are low, with limited entrepreneurship and leadership training.

Table 15. Study programs overview in NUM

Study programme	Type	Course Title	Competency Coverage	Identified Competency Gaps	Recommendations
Software Engineering	Master	Computer Science research methodology, Advanced algorithms, Datamining,	Green: [High/Medium/Low]	Lack of practical applications	Include hands-on project components. Add to the curriculum or modify the content of the course subjects that provide competency in the basic concepts and knowledge of
			Digital: [High/Medium/Low]	Insufficient focus on emerging tech	

		Special Topics in software engineering, Programming technologies, Programming for smart devices, BioInformatics, Information Security advanced topics, System modeling and formal methodology, Advanced Operating systems concepts, Computer graphics issues, Applied mathematics, Simulation Methods, Communication embeded systems	Business: [High/Medium/Low]	Limited training in entrepre-neurial skills	sustainable development, the goals of sustainable development, and a detailed understanding of the interrelationships between the environment, economy, and society. Digital solutions for e-transition and sustainability, combining technology with environmentally friendly solutions, should be added to the curriculum Environmental protection Digital security provides information and network security. It is required to ensure digital infrastructure security for environmental and green technologies' information protection. Add modules on AI and IoT applications. 12. Introduce a startup workshop module.
Data Science	Master	Computer Science research methodology, AI and Machine Learning, IoT, Bio-Embedded system, Datamining, Database Management, Special Topics in database, Nonparametric statistics, Monte Carlo simulation, statistical analysis of categorical data, optimization,	Green: [High/Medium/Low]	Lack of practical applications	Include hands-on project components. Economic analysis for green economy and e-transition, including analyzing and analyzing environmentally friendly business models and the economic benefits and impacts of e-transition, should be added to the curriculum
			Digital: [High/Medium/Low]	Insufficient focus on emerging tech	Add modules on AI and IoT applications.
			Business: [High/Medium/Low]	Limited training in entrepre-neurial skills	Introduce a startup workshop module. Financial models related to e-business finance, green investments, and environmental risk assessment should be added to the curriculum Competency in interdisciplinary approach or solving environmental,

		statistical analysis of multidimensional data, linear models in statistical applications, internship			economic, and social problems with a technological approach
Software Engineering	Bachelor	Fundamentals of Algorithms, Computer System Principles, Data Structure, Computer Organization and Architecture, Web application, Software design and Architecture, Object Oriented programming, Software quality and testing, Software construction, Internship, Thesis, SOA, Software documentation, Advanced web applications, Probability and statistics, IoT, Windows programming, Operating system concepts, Game programming, Parallel computing, AI, -	Green: [High/Medium/Low]	No connection to sustainability practices	Develop a sustainability component. Smart cities and digital solutions development should be added to the curriculum Green technology and innovation capabilities, including renewable energy, energy efficiency, and developing and implementing environmentally friendly technological solutions, should be added to the curriculum Environmental monitoring and resource management information systems, including optimizing energy consumption and developing environmentally friendly information systems, should be added to the curriculum
			Digital: High	Limited digital tool application	Include training on industry-specific tools.
			Business: [High/Medium/Low]	Limited training in leadership	Include training on industry-specific leading practices. Competency in managing digital and green projects, budget planning, resource management, and measuring results Economic analysis for green economy and e-transition, including analyzing and analyzing environmentally friendly business models and the economic benefits and impacts of e-transition, should be added to the curriculum

The review identified strengths and gaps in key programs:

- **Software Engineering (Master's program):**

- **Green competency**: Low – lacks practical sustainability applications.
- **Digital competency**: High – strong coverage of data mining, AI, smart devices, and programming.
- **Business competency**: Low – limited entrepreneurial training.

Recommendations: Introduce sustainability-focused IT applications, AI and IoT modules for smart green technologies, and a startup workshop module.

- **Data Science (Master's program):**
  - **Green competency**: Low – lacks eco-friendly business models and sustainability-focused data analysis.
  - **Digital competency**: High – comprehensive coverage of AI, machine learning, IoT, and data-driven solutions.
  - **Business competency**: Low – Minimal focus on financial modeling for green investments.

Recommendations: Incorporate AI for environmental monitoring, expand digital solutions for green technologies, and add business training for e-transition finance.

- **Software Engineering (Bachelor's program):**
  - **Green competency**: Low – No direct connection to green technology or sustainability solutions.
  - **Digital competency**: High – Strong focus on computer systems, AI, IoT, and digital infrastructure.
  - **Business competency**: Low – Limited leadership and business strategy training.

Recommendations: Introduce sustainability-related IT components, expand business training for project management, and integrate digital solutions for smart cities.

6.8. Curricula in the Mongolian University of Science and Technology

The curriculum review at **Mongolian University of Science and Technology (MUST)** was conducted to evaluate how its academic programs align with green, digital, and business skill demands. The review focused on bachelor's and master's programs in Information Technology, Data Science, Artificial Intelligence, Renewable Energy, Waste Recycling Technology, and Industrial Ecology Engineering (Table 16).

The reviewed study programs cover engineering, data science, IT, and environmental management, with varying levels of green, digital, and business competency integration.

- **Green competencies** are high in environmental and renewable energy programs but low in IT-related courses.
- **Digital competencies** are high in IT and AI programs but low in renewable energy and waste recycling.
- **Business competencies** are moderate across programs, but entrepreneurial training is lacking.

Table 16. Study programs overview in MUST

Study programme	Type	Course Title	Competency Coverage	Identified Competency Gaps	Recommendations
Information Technology	Master	Entrepreneurship and Innovation, Ethics and social responsibility, Capstone design, Research theory and	Green: Low	Lack of courses to green aspects	Include modules on design and implement sustainable practices in various contexts
			Digital: High		

		methodology, technology-based entrepreneurship, smart technologies and AI, Engineering modeling, Big data analysis and engineering, Professional development and leadership, Life-cycle assessment, Reflective thinking, Digital humanity, Smart city citizenship, Engineering Design, Quantitative methods in engineering design, Research English, Applied statistics, Advance IT, Virtual systems and services, IT Project management, Next generation database, Real-time analytics, Business data analysis, Graph theory and application, Big data, Data storage technologies, Business process modeling, AI and ML, Big data analytics, Data modeling and visualization, Advanced digital communication technology, IoT technologies and application, Embedded system, Robot path planning and navigation, Random process, Cyber security	Business: Medium	Insufficient in systems thinking skills	Implement Case-study project integrating green, digital, and business skills
Data Science	Bachelor	[Discret structure, Optimization theory, Programming technology and application, Web design, Database management system, Data analysis statistics methods, Data mining and ML, Computer network, Web system, and technology, Big data infrastructure and technology, Bid data analysis, Data	Green: Low	No connection to sustainability practices	Develop a sustainability module on environmental impact assessment techniques and circular economy principles
			Digital: High		
			Business: Medium	Limited training in critical and strategic thinking	Include training on industry-specific leading practices Include training on green entrepreneurship and

		authentication and security, Systems analysis and design, System and network administration, Virtual systems and services, Business data analysis, Data visualization, Data Science Project I, Ecology and nature conservation, Economics, Mathematics, Physics, Basics of Innovation and entrepreneurship, Object-oriented programming, Database, Design of HCI, Data structures and algorithms, Cryptography]			innovation and circular business models
AI	bachelor	Mathematics, Physics, Engineering economics, Programming fundamentals, ecology and nature conservation, basics of algorithm, Basics of programming languages, Computer network and cyber security, Algorithm analysis and design, Data structures and algorithms, Python programming, Basics of AI, Knowledge visualization and data processing, Software engineering I, Database, Probability theory and mathematics statistics, Object-oriented programming, Computer graphics, Bioalgorithms, Web design, Design of HCI, Data mining and ML, Computer network I, Computer network II, Business project planning and management, Fundamentals mathematical	Green: Low	No connection to sustainability practices	Develop a sustainability module on environmental impact assessment techniques and circular economy principles
			Digital: High		
			Business: Medium	Limited training in leadership entrepreneurs hip and innovation	Include training on circular business models, resource management, and waste reduction strategies Adda course on green entrepreneurship and innovation

		calculation, Fundamentals of nanoscience			
Renewable Energy	Bachelor	Renewable energy plant control and monitoring, Operation and maintenance of renewable energy equipment, Hydropower plant, Power transmission grid, and steady-state operation, Energy conversion and storage technology, Resource of energy source, Conversion of solar energy into heating, Wind energy equipment, Solar photovoltaic station, Management, and marketing in the Energy Industry, Engineering Economy, Programs Language of Algorithm	Green: High		
			Digital: Low	-openness to lifelong learning and continuous digital skill improvement	Our goal is to equip students with skills using digital technologies.
			Business: Medium	-entrepreneurial and leadership abilities, -effective communication, negotiation, and stakeholder engagement	Redesigning and implementing the curriculum is a way to develop the 6th goal of Mongolia's long-term development policy document, Vision-2050, Green Development.
Waste Recycling Technology	Bachelor	Programs Language of Algorithm, Basis of water treatment, Sources of Solid Wastes, Environmental Management and Assessment, Solid Waste Treatment I, II, Environmental Pollution and Remediation, Operation and Maintenance of Solid Waste Treatment 3 D Facility, Air Quality Control System, Resource Recycling, Ecology and Environment Protection, Health and Safety in Construction, Green building design, Water Supply and Sewerage Automation, Construction management	Green: High		
			Digital: Low	-openness to lifelong learning and continuous digital skill improvement	Our goal is to equip students with skills using digital technologies.
			Business: Low	-adaptability to learn and integrate digital and smart technologies, -strategic thinking and decision-making, project management	Redesigning and implementing the curriculum is a way to develop the 6th goal of Mongolia's long-term development policy document, Vision-2050, Green Development.
	Bachelor		Green: High		

Industrial Ecology Engineering		Ecology I, II, Ecological law, Methods to Study of the Environmental Pollution, Environmental Monitoring, Basis of water treatment, Environmental monitoring Methodology I, II, Ecological modeling, Environmental Risk Management, Environmental Engineering I, II, Ecology and Environment Protection, Environment and Sustainable Development, Rehabilitation standards, Environmental Management, Theory of Economics, Ecological economics	Digital: Low	proficiency in digital tools and platforms relevant to the field (e.g., analytics software, collaborative tools),	knowledge of digital technologies like AI, blockchain, IoT, digital transformation trends in industries, smart technologies for sustainability, sustainable digital infrastructure, green computing, and ICT
			Business: Medium		
More than 100 Programs of MUST, except for Ecological, Management and Computer Sciences specialties	Bachelor	**Compulsory Study Courses:** U.IT101 Information Technology I /3Cu/ 3, U.CS101 Algorithms and Programming /3Cu/, S.PM101 Fundamentals of Economic Theory /3Cu/, B.TM102 Microeconomics /3Cu/, B.TM103 Macroeconomics /3Cu/ **Elective Study Courses:** S.EG101 Ecology and nature conservation /3Cu/, S.SS115 Human development /3Cu/, U.IT101 Information Technology II /3Cu/, U.CS102 Programming Languages /3Cu/, S.PM101 Fundamentals of Economic Theory /3Cu/, B.TM102 Microeconomics /3Cu/, B.TM103 Macroeconomics /3Cu/	Green: Low		Including these elective courses as compulsory courses in the curriculum will be in line with the 6th goal of Mongolia's long-term development policy document, Vision-2050, Green Development.
			Digital: Medium		Our goal is to equip students with skills using digital technologies.
			Business: Medium		Redesigning and implementing the curriculum is a way to develop the 6th goal of Mongolia's long-term development policy document, Vision-2050, Green Development.

The review identified key strengths and gaps in various programs:

- **Information Technology (Master's program):**

- **Green competency**: Low – Lacks courses focused on sustainability and green IT practices.
- **Digital competency**: High – Strong coverage of AI, big data, cybersecurity, IoT, and automation.
- **Business competency**: Medium – Limited focus on systems thinking and sustainability-driven business strategies.

Recommendations: Introduce sustainability-focused IT courses, integrate AI for green technologies, and implement case studies connecting green, digital, and business skills.

- **Data Science (Bachelor's program):**
  - **Green competency**: Low – No sustainability-related content in the curriculum.
  - **Digital competency**: High – Covers big data, AI, ML, cybersecurity, and network administration.
  - **Business competency**: Medium – Lacks critical thinking and strategic decision-making training.

Recommendations: Develop sustainability modules on environmental impact assessment and circular economy principles, and introduce green entrepreneurship training.

- **Artificial Intelligence (Bachelor's program):**
  - **Green competency**: Low – Lacks sustainability applications in AI solutions.
  - **Digital competency**: High – Strong emphasis on AI, data processing, and computer networks.
  - **Business competency**: Medium – Lacks leadership and entrepreneurship components.

Recommendations: Incorporate AI applications for environmental sustainability, add leadership and entrepreneurship modules, and integrate circular business models.

- **Renewable Energy (Bachelor's program):**
  - **Green competency**: High – Strong focus on solar, wind, and hydropower technologies.
  - **Digital competency**: Low – Limited exposure to digital tools for smart energy management.
  - **Business competency**: Medium – Needs stronger entrepreneurial and leadership training.

Recommendations: Integrate digital tools for energy efficiency, enhance sustainability-focused leadership training, and introduce entrepreneurship modules for renewable energy startups.

- **Waste Recycling Technology (Bachelor's program):**
  - **Green competency**: High – Focuses on environmental management and solid waste treatment.
  - **Digital competency**: Low – Limited digital integration in waste processing and automation.
  - **Business competency**: Low – Lacks project management and entrepreneurship training.

Recommendations: Incorporate digital technologies for smart recycling, develop sustainability-driven business strategies, and integrate leadership training.

- **Industrial Ecology Engineering (Bachelor's program):**
  - **Green competency**: High – Well-integrated environmental monitoring and management courses.

- **Digital competency**: Low – Lacks training in AI, blockchain, and IoT for environmental sustainability.
- **Business competency**: Medium – Lacks financial management and commercialization training.

Recommendations: Enhance digital skills for environmental applications, introduce AI and IoT for ecological monitoring, and offer business-planning courses for sustainability projects.

7. Industry Insights on Skill Gaps and HEI Role in Green and Digital Transitions

To assess industry insights on green, digital, and business skill requirements and gaps, as well as the role of Higher Education Institutions (HEIs) in supporting the dual green and digital transitions in Azerbaijan, Kazakhstan, and Mongolia, an online survey has been designed and implemented. This survey gathers both quantitative and qualitative data to identify key skill shortages and align HEI curricula with evolving industry needs. By analyzing industry demands and expectations, the findings will provide actionable recommendations to enhance workforce readiness and foster sustainable economic growth in the region.

7.1. Demographic characteristics of the respondents

The online survey gathered responses from **895 participants**, providing a diverse representation of professionals across industries in Azerbaijan (272 respondents), Kazakhstan (283 respondents), Mongolia (312 respondents) and other countries (28 respondents). The respondents included 50.06% male, 48.83% female, and 1.12% who preferred not to disclose their gender. The completeness rate of the survey is 79% for 895 participants; however, for 680 participants, it was 100%. The survey captured insights from individuals across various age groups, with the following distribution (Fig. 1):

- **18-24 years**: 291 respondents
- **25-34 years**: 221 respondents
- **35-44 years**: 182 respondents
- **45-54 years**: 116 respondents
- **55-64 years**: 57 respondents
- **65+ years**: 17 respondents

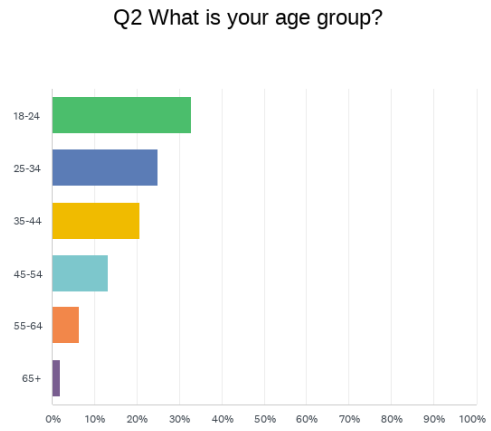

Figure 1. Age group distribution of survey respondents

The survey respondents represented a diverse range of sectors, with 53.31% affiliated with academia/education (459 respondents), 30.66% from the industry/private sector (264 respondents), and 16.03% from the public sector/government (138 respondents). This broad representation ensures a well-rounded perspective from key stakeholders, including educators, industry professionals, and policymakers, contributing to a comprehensive analysis of skill gaps and the role of Higher Education Institutions (HEIs) in supporting the dual green and digital transitions.

Survey respondents came from organizations of varying sizes, with 12.26% (32 respondents) from micro enterprises (1–9 employees), 22.61% (59 respondents) from small businesses (10–49 employees), 28.74% (75 respondents) from medium-sized companies (50–249 employees), and 36.40% (95 respondents) from large enterprises (250+ employees). Regarding job levels, 17.44% identified as entry-level specialists, 27.13% as mid-level professionals, and 27.52% as senior professionals. Additionally, 17.05% held managerial or director-level roles, while 4.26% were executive or C-level experts. A further 6.59% indicated diverse roles beyond the predefined categories.

Figure 2 shows that a wide range of industries are presented by the survey participants, reflecting the diverse professional landscape in Azerbaijan, Kazakhstan, and Mongolia.

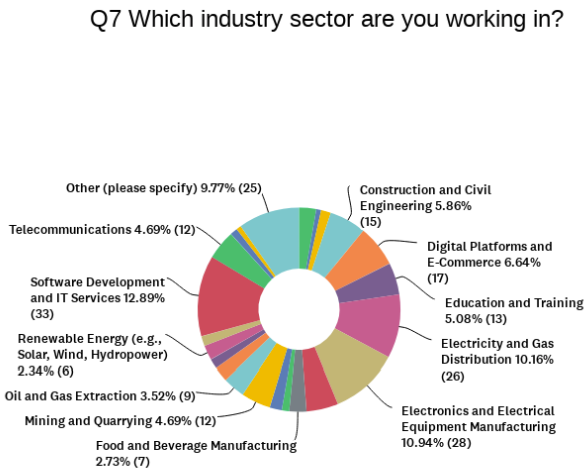

Figure 2. Range of industry sectors represented by the survey participants

The largest share of respondents came from the software development and IT services sector (12.89%), followed by electronics and electrical equipment manufacturing (10.94%), and electricity and gas distribution (10.16%). Other sectors with notable representation included digital platforms and e-commerce (6.64%), construction and civil engineering (5.86%), education and training (5.08%), and financial and professional services (5.08%). Industries such as mining and quarrying (4.69%), telecommunications (4.69%), and oil and gas extraction (3.52%) were also represented. Smaller shares of respondents worked in fields such as agriculture, forestry, and fishing (2.73%), food and beverage manufacturing (2.73%), renewable energy (2.34%), and public sector and non-profits (2.34%). Additionally, 9.77% (25 respondents) selected “Other”, with specific mentions of instrumentation and control engineering, power plants, cybersecurity, banking, and IT.

7.2. Green, digital, and business skills

The survey assessed respondents' self-reported knowledge of the green and digital transition (Fig. 3).

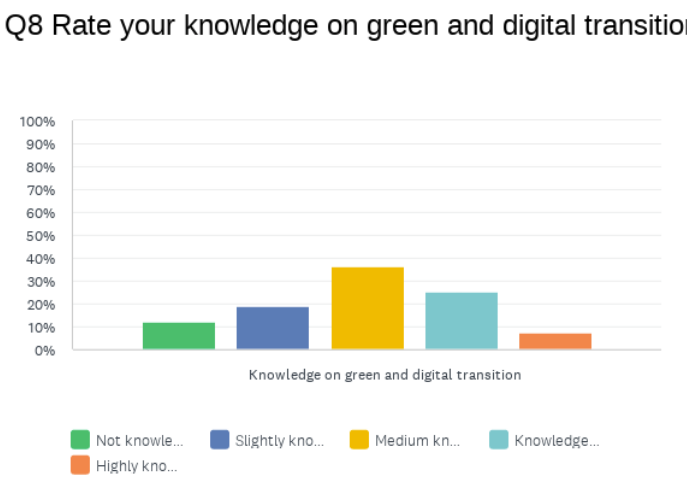

Figure 3. Self-reported knowledge of the green and digital transition

With an average knowledge score of 2.96 on a scale from 1 (Not knowledgeable at all) to 5 (Highly knowledgeable), the results suggest that while some respondents possess strong expertise, a significant portion still has limited familiarity with green and digital transition concepts. These insights highlight the need for enhanced education, training, and upskilling efforts to bridge knowledge gaps and support industry adaptation to sustainable and digital transformation.

Survey respondents ranked various green-focused competencies based on their perceived importance for a "Green Transition" expert (Fig. 4).

Q9 Rate which green-focused competences do you consider most important for a „Green transition" expert:

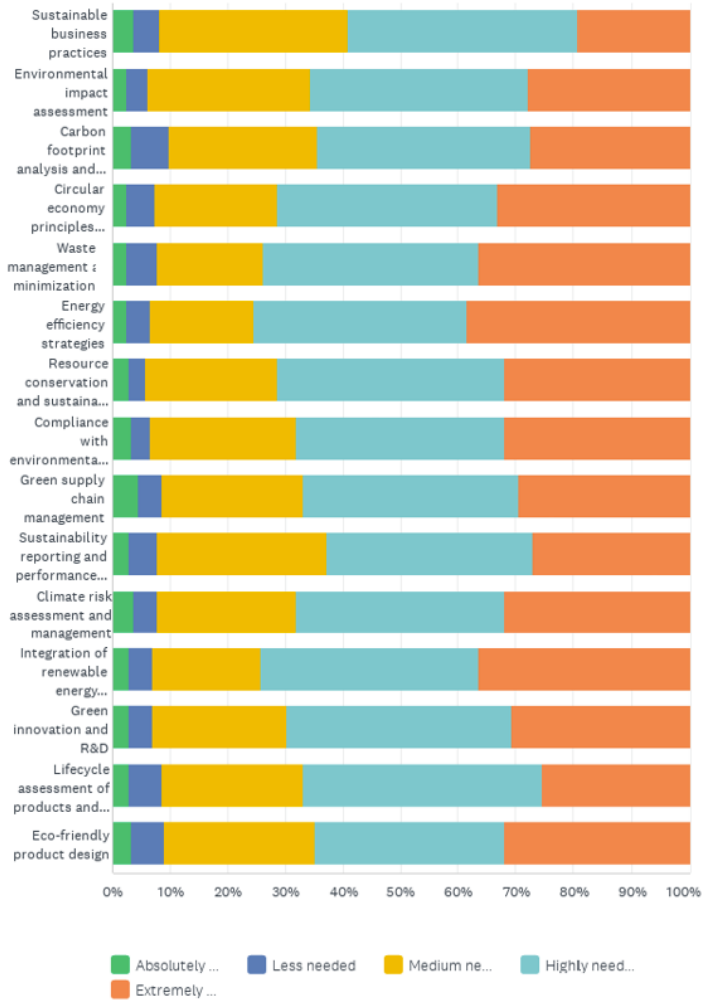

Figure 4. Rating of competencies for a Green Transition expert

Below is a summary of the key competencies and their average importance ratings (on a scale from 1 (Absolutely not needed) to 5 (Extremelly needed)):

- **Energy efficiency strategies** (4.05) – highly regarded, with 38.52% rating it as "very important."
- **Integration of renewable energy solutions** (4.01) – valued by 36.48% as "very important."
- **Waste management and minimization** (4.00) – a top priority, with 36.48% considering it crucial.
- **Circular economy principles** (3.95) – significant emphasis, particularly on reuse and recycling.
- **Resource conservation and sustainable sourcing** (3.95) – a priority for sustainable production.
- **Compliance with environmental regulations and standards** (3.90) – essential for ensuring adherence to legal frameworks.
- **Green innovation and R&D** (3.91) – recognized as a driver of sustainable solutions.
- **Climate risk assessment and management** (3.89) – important for mitigating environmental threats.
- **Green supply chain management** (3.83) – important for improving sustainability in procurement and logistics.

- **Sustainability reporting and performance measurement** (3.79) – necessary for tracking progress and impact.
- **Lifecycle assessment of products and services** (3.81) – ensures holistic sustainability evaluation.
- **Eco-friendly product design** (3.84) – helps create sustainable alternatives for consumers.

The results emphasize that a Green Transition expert should have strong knowledge of energy efficiency, waste management, renewable energy, and regulatory compliance, along with expertise in sustainable supply chains and product lifecycle management.

Survey respondents ranked various digital competencies based on their perceived importance for a "Digital Transition" expert (Fig. 5). Below is a summary of the key competencies and their average importance ratings (on a scale from 1 (Absolutely not needed) to 5 (Extremelly needed)):

- **Data collection, analysis, and interpretation** (3.96) – highly valued, with 33.47% rating it as "very important" and 36.02% as "important."
- **Cybersecurity** (3.94) – essential for safeguarding digital assets, with 38.56% rating it as "very important."
- **Artificial intelligence and machine learning** (3.88) – a key emerging field, valued by 31.78% as "very important."
- **Workflow automation (e.g., RPA software)** (3.86) – crucial for streamlining operations, rated highly by respondents.
- **Programming and software development** (3.85) – considered fundamental, with 40.25% rating it as "important."
- **Cloud computing (e.g., AWS, Azure, Google Cloud)** (3.79) – important for digital infrastructure and remote access.
- **IT basics (e.g., Microsoft Office, Google Workspace)** (3.79) – recognized as essential for all professionals.
- **User experience (UX/UI) design** (3.77) – important for creating user-friendly digital solutions.
- **Emerging technologies (e.g., Blockchain, IoT, AR, VR)** (3.74) – growing in significance as industries evolve.
- **Digital marketing techniques (e.g., SEO, social media, advertising)** (3.72) – important for reaching and engaging audiences.

These insights suggest that a Digital Transition expert should have expertise in data analysis, cybersecurity, AI, workflow automation, and software development, alongside foundational knowledge in cloud computing, digital marketing, and emerging technologies.

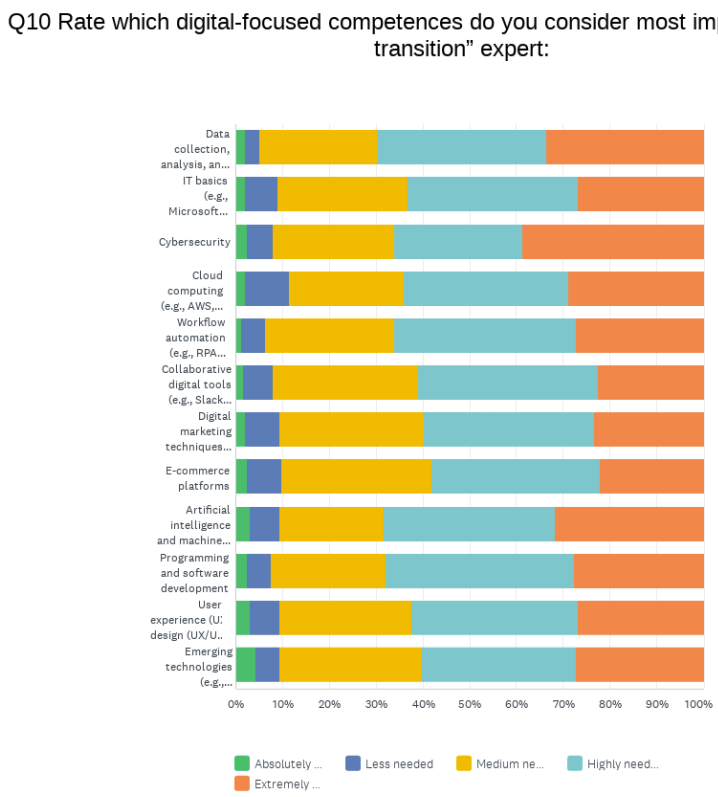

Figure 5. Rating of competencies for a Digital Transition expert

Survey respondents ranked various business competencies based on their perceived importance for a "Twin Green and Digital Transition" expert (Fig. 6).

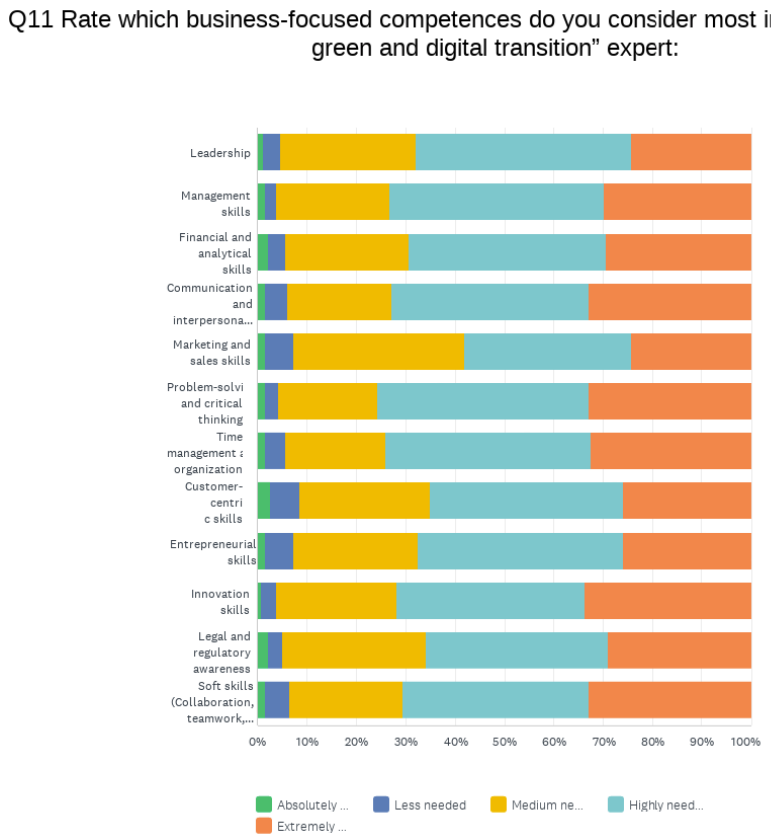

Figure 6. Rating of competencies for a Twin Green and Digital Transition expert

A summary of the key competencies and their average importance ratings (on a scale from 1 (Absolutely not needed) to 5 (Extremelly needed)):

- **Problem-solving and critical thinking** (4.03) – Considered the most essential, with 42.86% rating it as "important" and 32.90% as "very important."
- **Innovation skills** (4.01) – Highly valued for fostering new solutions, with 33.77% rating it as "very important."
- **Time management and organization** (3.99) – Essential for productivity in dynamic environments.
- **Communication and interpersonal skills** (3.98) – Recognized as critical for collaboration and stakeholder engagement.
- **Management skills** (3.97) – Key for overseeing projects and teams, with 29.87% rating it as "very important."
- **Soft skills (Collaboration, teamwork, mentoring, and coaching)** (3.95) – Crucial for fostering a supportive work environment.
- **Financial and analytical skills** (3.91) – Important for data-driven decision-making.
- **Legal and regulatory awareness** (3.87) – Necessary for ensuring compliance in green and digital policies.
- **Leadership** (3.86) – Essential for guiding organizations through sustainable transitions.
- **Entrepreneurial skills** (3.84) – Important for driving innovation and business growth.

These results indicate that a Twin Transition expert must possess a blend of strategic thinking, leadership, innovation, communication, and management skills to effectively support sustainable and digital transformation.

Survey respondents provided insights into the green skills actively utilized within their companies (Fig. 7).

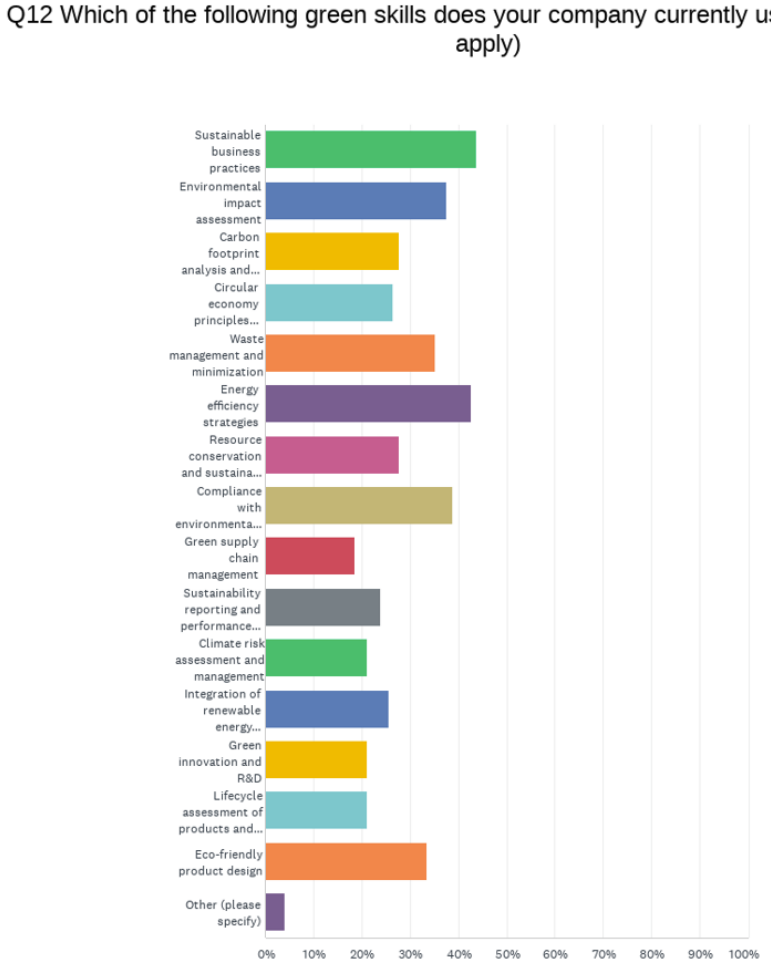

Figure 7. Rating of green skills currently used in companies

The results highlight that sustainable business practices (43.61%), energy efficiency strategies (42.73%), and compliance with environmental regulations (38.77%) are among the most commonly applied competencies in the workplace.

Survey respondents provided insights into the digital skills actively utilized within their companies (Fig. 8). The results indicate that data collection, analysis, and interpretation (69.16%) is the most widely applied digital skill, followed by IT basics (63.00%), and cybersecurity (48.90%). Below is a summary of the key digital skills currently in use:

- **Data collection, analysis, and interpretation** – 69.16%
- **IT basics (e.g., Microsoft Office, Google Workspace)** – 63.00%
- **Cybersecurity** – 48.90%
- Cloud computing (e.g., AWS, Azure, Google Cloud) – 44.93%
- Programming and software development – 44.05%
- Workflow automation (e.g., RPA software) – 41.85%
- E-commerce platforms – 37.00%
- User experience (UX) design (UX/UI design, customer-centric design) – 33.48%
- Artificial intelligence and machine learning – 31.72%

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- Collaborative digital tools (e.g., Slack, Trello) – 30.40%
- Digital marketing techniques (e.g., SEO, digital advertising, social media marketing) – 28.63%
- Emerging technologies (e.g., Blockchain, IoT, AR, VR) – 25.99%
- Other (please specify) – 2.64%

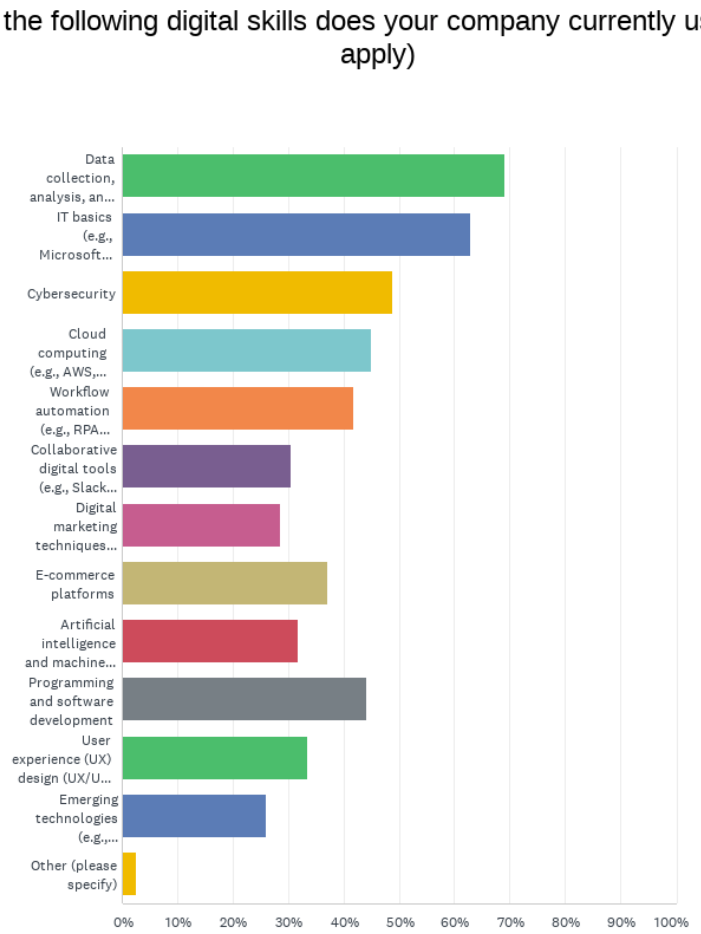

Figure 8. Rating of digital skills currently used in companies

Survey respondents provided insights into the business skills actively utilized within their companies (Fig. 9). Below is a summary of the key business skills currently in use:

- **Management skills – 66.08%**
- **Leadership – 59.03%**
- **Problem-solving and critical thinking – 52.42%**
- **Communication and interpersonal skills – 50.66%**
- **Time management and organization – 50.66%**
- **Financial and analytical skills – 50.22%**
- Soft skills (Collaboration, teamwork, mentoring, and coaching) – 49.34%
- Marketing and sales skills – 40.09%
- Innovation skills – 40.53%
- Legal and regulatory awareness – 40.53%
- Customer-centric skills – 33.48%
- Entrepreneurial skills – 33.92%
- Other (please specify) – 1.76%

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The findings suggest that companies place strong emphasis on leadership, management, problem-solving, communication, financial and analytical skills, which are crucial for organizational growth and adaptability. However, entrepreneurial and customer-centric skills are less commonly applied, highlighting potential areas for development.

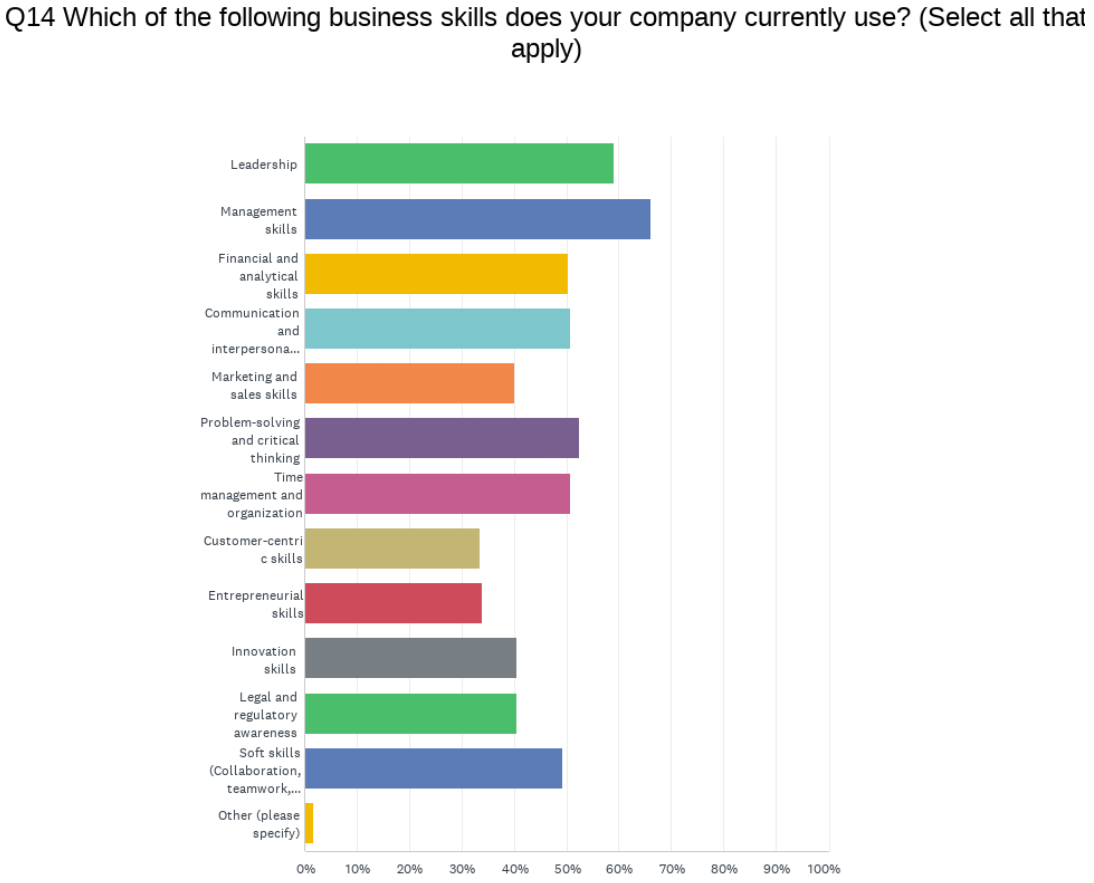

Figure 9. Rating of business skills currently used in companies

7.3. Green, digital, and business skill gaps

Survey respondents identified the key green-related skills they expect employees or recent graduates to bring to their organizations (Fig. 10). Below is a summary of the key green skills expected:

- **Skills in environmental science and technology** – 14.22%
- **Skills in renewable energy engineering** – 14.22%
- Skills in sustainable engineering – 12.44%
- Skills in sustainable energy systems – 12.00%
- Skills in waste management and recycling technologies – 12.00%
- Skills in green business and corporate social responsibility – 10.22%
- Skills in environmental policy and compliance – 10.22%
- Skills in circular economy and resource management – 6.22%
- Skills in water resource management – 6.67%
- Other (please specify) – 1.78%

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Q15 What specific green-related skills (e.g., knowledge of circular economy practices, carbon management, or environmental compliance) do you expect employees or recent graduates to bring to your organization?

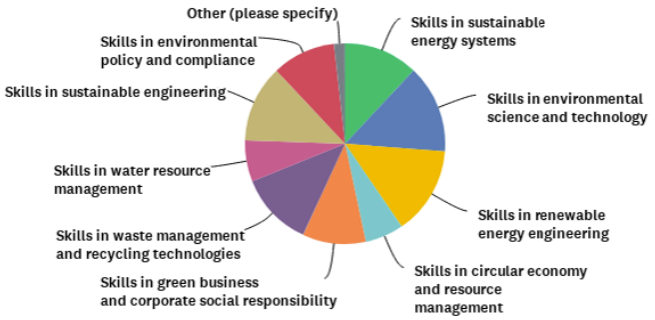

Figure 10. Expectations of companies on green-related skills

These findings indicate that organizations are looking for employees who possess technical expertise in environmental science, renewable energy, and sustainable engineering, as well as practical knowledge of waste management, corporate social responsibility, and environmental compliance. The relatively lower emphasis on circular economy and water resource management suggests that these areas may require further awareness and integration into business operations.

Survey respondents identified the most critical digital-related knowledge that employees or recent graduates should master to support their organization's digital transformation goals (Fig. 11). Digital transformation and sustainability knowledge (21.17%) is considered the most critical, reflecting the growing demand for professionals who can integrate digital tools with sustainability initiatives. Smart technologies for sustainability (17.57%) and AI & Machine Learning (15.77%) are highly valued, highlighting the role of automation and intelligent systems in optimizing digital operations. Green computing and ICT (10.36%) and data analytics for sustainability (9.46%) emphasize the need for energy-efficient digital systems and data-driven decision-making. Cyber-sustainability (6.31%) and IoT (5.86%) indicate a growing but still emerging focus on cybersecurity and connected devices for sustainability efforts. Blockchain (1.80%) and Digital Twins (3.60%) are currently the least prioritized, possibly reflecting a slower adoption rate in sustainability-related applications.

These insights suggest that Higher Education Institutions (HEIs) should focus on equipping students with digital transformation strategies, AI, smart technologies, and green computing to align with industry needs. There is also an opportunity to enhance training in cyber-sustainability, IoT, and data-driven decision-making, ensuring that future professionals can drive sustainable and digitally optimized business practices.

Survey respondents highlighted key business skills that employees and graduates need to effectively integrate digital and sustainability initiatives with strategic business goals, such as cost savings, market competitiveness, and customer satisfaction (Fig. 12). Sustainable project management (16.36%) and green entrepreneurship & innovation (15.91%) are the most critical business skills, highlighting the need for professionals who can lead and implement sustainability-driven projects.

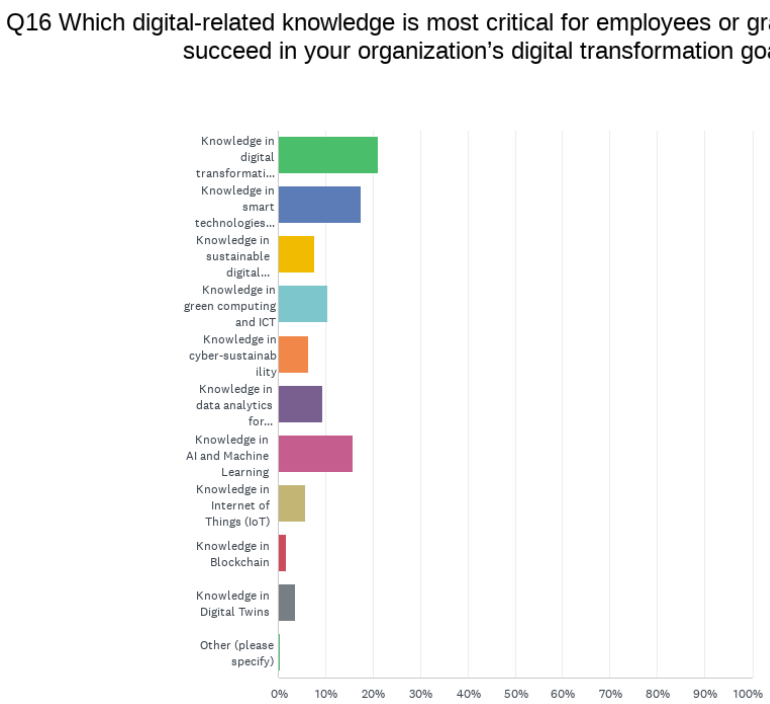

Figure 11. Expectations of companies on digital-related knowledge

Environmental risk assessment (11.82%) and corporate social responsibility (10.45%) are highly valued, emphasizing the role of compliance and ethical business practices. Sustainable business communication (10.00%) and sustainable economy knowledge (10.45%) reinforce the importance of aligning sustainability strategies with broader economic and corporate goals. Green marketing (5.00%) and sustainable supply chain management (5.91%) indicate a need for expertise in promoting and optimizing sustainability-driven products and processes. Circular business models (3.64%) and carbon accounting (3.18%) are less prioritized, suggesting that these areas might still be emerging or require further industry awareness.

Q17 What business skills, such as aligning digital or sustainability initiatives with strategic goals (e.g., cost savings, market competitiveness, or customer satisfaction), are essential for employees or graduates entering your industry?

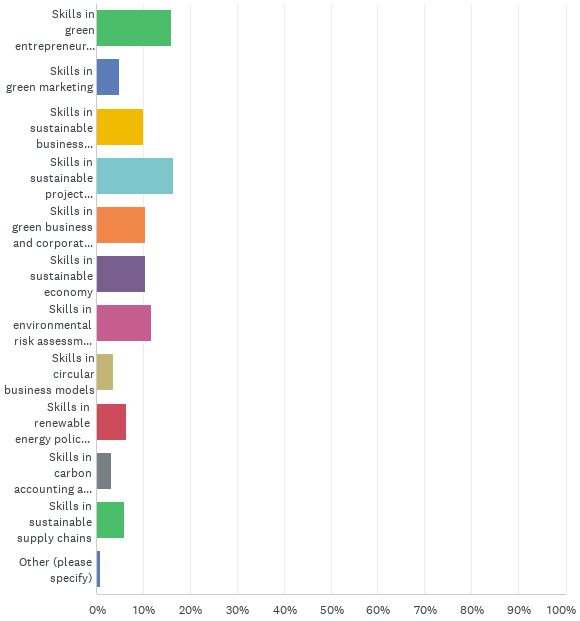

Figure 12. Expectations of companies on digital-related knowledge

These insights suggest that Higher Education Institutions (HEIs) should prioritize training in sustainable project management, green entrepreneurship, and environmental risk assessment, while also integrating CSR, supply chain sustainability, and strategic communication into business education.

7.4. Role of HEIs in supporting the dual green and digital transitions

Survey respondents identified key study areas in Higher Education Institutions (HEIs) that should primarily focus on addressing the twin green and digital transitions. The results highlight that Engineering Sciences (60.97%), Computer Sciences (49.94%), and Technological Sciences (49.69%) are seen as the most relevant fields for preparing students for sustainable and digital transformation.

Survey respondents ranked the most effective strategies for Higher Education Institutions (HEIs) to collaborate with industries and ensure graduates are equipped with relevant skills for sustainability and digital transformation. The highest-ranked priorities emphasize curriculum development, industry collaboration, and skill-specific certifications. Below is the ranking of collaboration strategies based on their importance (1 = highest importance, 10 = lowest importance):

- **Top Priorities for HEI-Industry Collaboration:**
  - **Developing industry-relevant curricula** (8.70 average ranking) – The highest priority, with 44.19% ranking it as the most important strategy, emphasizing the need to integrate practical and industry-aligned content into academic programs.
  - **Developing industry-relevant study modules** (8.44 average ranking) – Ensuring that specific courses and modules reflect the latest advancements in green and digital skills.
  - **Providing specialized training for green and digital skills** (7.72 average ranking) – Industry expects graduates to be job-ready with specialized skills in sustainability, digitalization, AI, and emerging technologies.

- **Enhancing opportunities for academia-industry collaboration through joint research and innovation hubs** (6.99 average ranking) – Promoting real-world problem-solving and innovation through joint study programs, applied research, and innovation labs.
- **Participating in industry-driven internship and apprenticeship programs** (6.29 average ranking) – Hands-on experience is essential for bridging skill gaps between academic knowledge and workplace expectations.

- **Medium Priority Areas**
  - **Conducting applied research on sustainability and digital transformation challenges specific to the country's industry** (5.06 average ranking) – Addressing local industry challenges through academic research and innovation.
  - **Hosting workshops and seminars** (3.90 average ranking**)** – While helpful, workshops are ranked lower in importance compared to hands-on experiences and curriculum integration.
  - **Creating flexible and modular learning programs (e.g., micro-credentials) for industry professionals** (3.42 average ranking) – Industry professionals require upskilling, and HEIs should offer flexible programs tailored to working professionals.
- **Lower Priority Areas**
  - **Providing access to academic expertise and resources to solve practical industry challenges** (2.76 average ranking) – Industry values academic partnerships but ranks this lower compared to curriculum development and hands-on training.
  - **Providing specialized certifications for green and digital skills** (1.72 average ranking) – While ranked lowest, this reflects the expectation that certifications alone are not enough—HEIs must integrate practical learning alongside certification programs.

Survey respondents ranked key digital skills that Higher Education Institutions (HEIs) should prioritize to better align with the demands of the green and digital transition (Fig. 13).

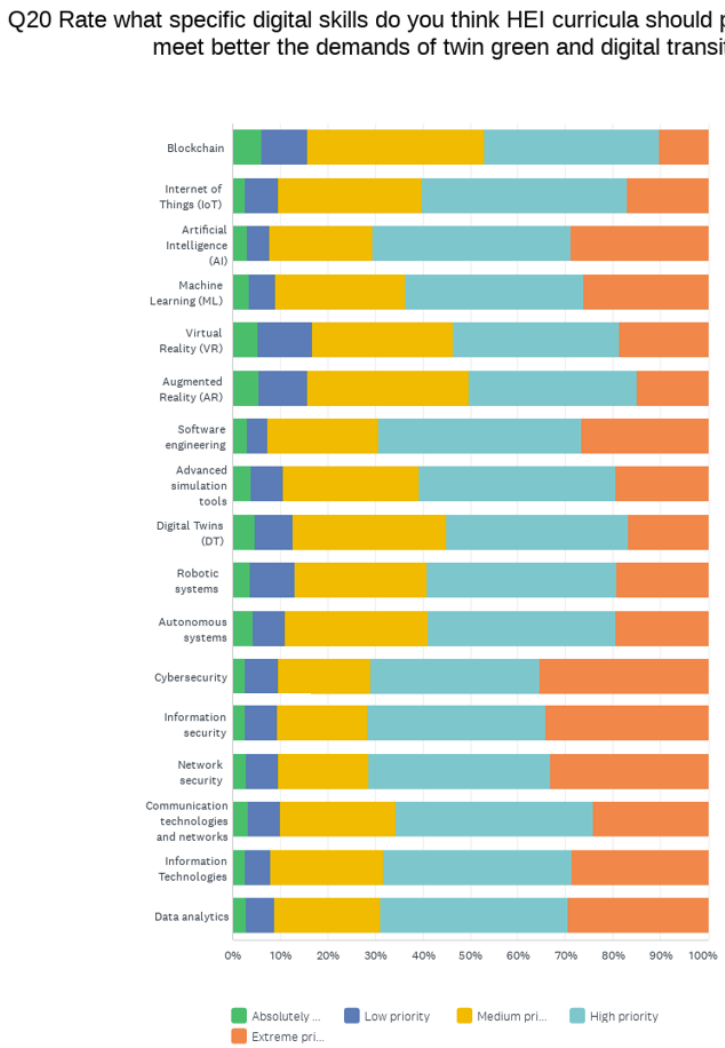

Figure 13. Priority on digital skills in HEI curricula

Below is a ranking of the most critical digital skills based on their importance (on a scale from 1 (absolutely no priority) to 5 (Extreme priority)):

- **Top Priority Digital Skills for HEIs:**
  - **Artificial Intelligence (AI)** – 3.89
  - **Cybersecurity** – 3.94
  - **Information Security** – 3.94
  - **Software Engineering** – 3.85
  - **Data Analytics** – 3.87
  - **Network Security** – 3.92
  - **Information Technologies (IT) –** 3.86
  - **Machine Learning (ML) – 3.77**
  - **Communication Technologies and Networks** – 3.76
- **Medium-Priority Digital Skills for HEIs**
  - Advanced Simulation Tools – 3.66

- Internet of Things (IoT) – 3.65
- Autonomous Systems – 3.63
- Robotic Systems – 3.62
- Digital Twins (DT) – 3.54
- Augmented Reality (AR) & Virtual Reality (VR) – 3.44–3.50
- Blockchain – 3.35

Survey respondents ranked key green skills that Higher Education Institutions (HEIs) should prioritize to better align with the demands of the twin green and digital transition (Fig. 14). **Top Priority Green Skills for HEIs:**

- **Recycling Technologies** – 3.86
- **Advanced Waste Management** – 3.80
- **Environmental Impact Assessment Techniques** – 3.79
- **Sustainable Engineering** – 3.76
- **Sustainable Energy Systems** – 3.75
- **Safety Protocols for Green Technology Implementation** – 3.75
- Decision-Making Frameworks for Environmental Compliance – 3.74
- Risk Assessment – 3.72
- Lifecycle Assessment (LCA) – 3.69
- Circular Design Principles – 3.53

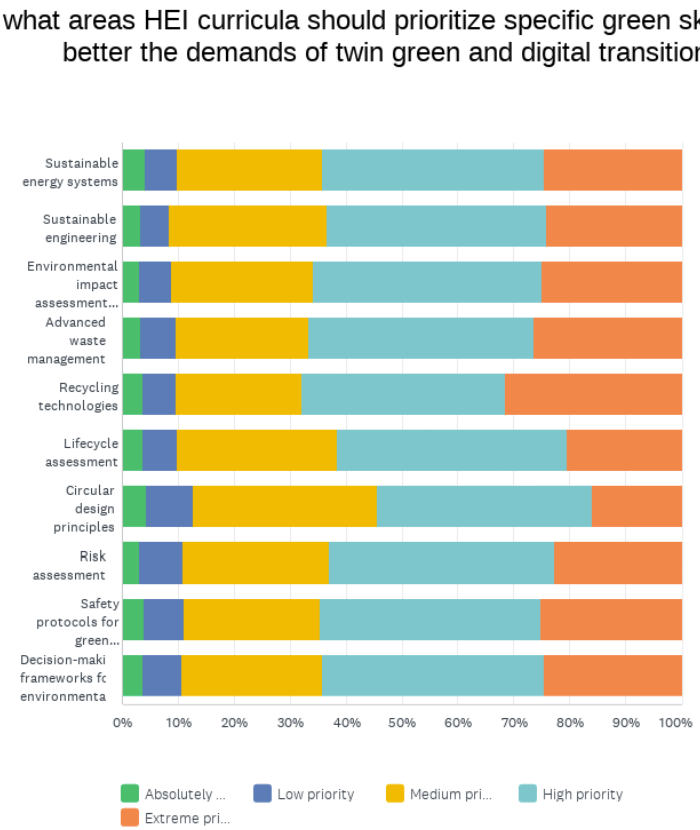

Figure 14. Priority on green skills in HEI curricula

Survey respondents identified key business skills that Higher Education Institutions (HEIs) should prioritize to better align with the twin green and digital transition (Fig. 15). The highest-ranked skills

include problem-solving and critical thinking (3.90), innovation skills (3.89), and time management and organization (3.87), emphasizing the need for adaptable and strategic professionals. Communication and interpersonal skills (3.85), management skills (3.84), and soft skills such as collaboration, teamwork, mentoring, and coaching (3.83) were also highly rated, highlighting the importance of leadership in sustainability and digital transformation. Financial and analytical skills (3.81) and legal and regulatory awareness (3.78) were seen as crucial for ensuring compliance and strategic decision-making. Leadership (3.75), customer-centric skills (3.71), and entrepreneurial skills (3.71) ranked slightly lower but remain essential for driving sustainable business models and innovation. Marketing and sales skills (3.62), while important, were rated the lowest among business competencies, suggesting that technical and strategic business acumen should take precedence in HEI curricula.

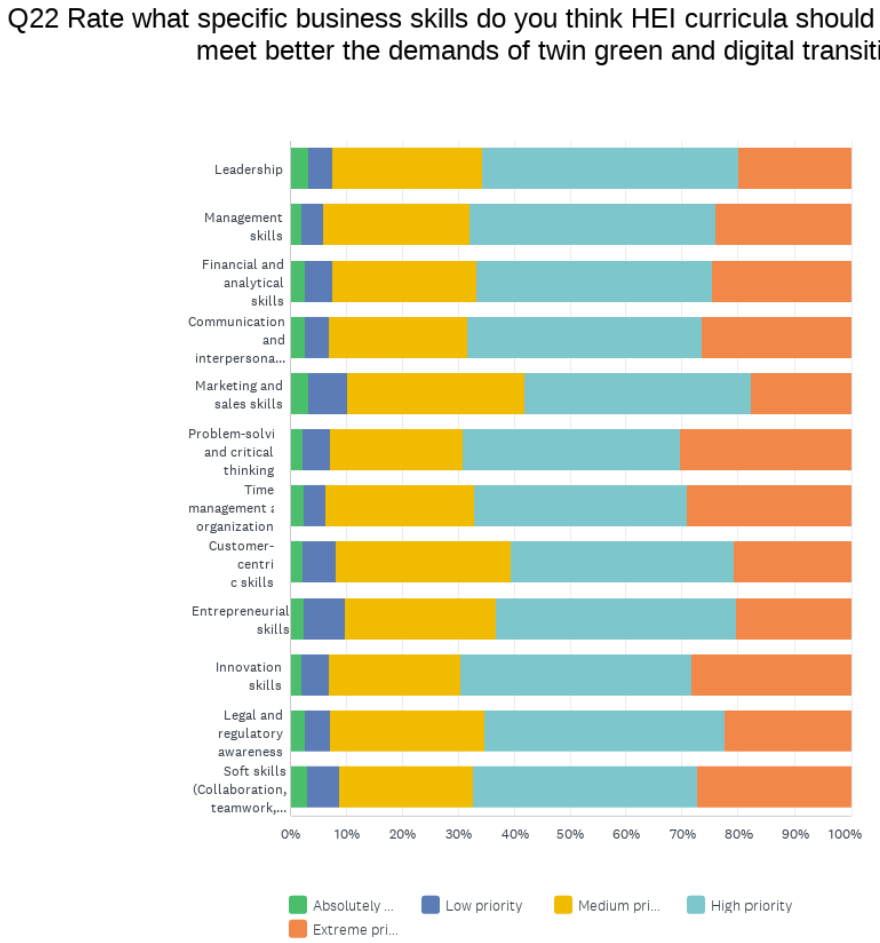

Figure 15. Priority on business skills in HEI curricula

Survey respondents also strongly support the inclusion of certifications related to green skills, digital skills, and sustainable business practices in Higher Education Institution (HEI) programs to enhance employability, with an average rating of 4.07 on a 5-point scale.

7.5. Key challenges for green and digital transition

As industries adapt to the twin green and digital transitions, the workforce must develop a set of key skills and competencies to thrive in the evolving job market. Based on the analysis of industry expectations, the following three – green, digital, business- domains require the following skills and competencies over the next 5–10 years:

- **Digital skills and technological proficiency:**

  - Digital literacy
  - Artificial intelligence (AI) skills
  - Machine learning
  - Data analytics and big data management
  - Cybersecurity
  - Blockchain technology
  - Cloud computing
  - Internet of Things (IoT)
  - Virtual Reality (VR) and Augmented Reality (AR)
  - Software engineering
  - IT and information system management
  - Digital culture and humanities
  - Digital engineering
  - UI/UX design
  - Virtual system and cloud management
  - Automation and robotics
  - Programming and coding
  - Cybersecurity and data protection
  - Information security and privacy laws
  - Digital transformation and platform adoption
- **Green and sustainability skills:**
  - Green technology knowledge
  - Renewable energy expertise (solar, wind, hydro, etc.)
  - Circular economy models
  - Energy efficiency and resource conservation
  - Environmental sustainability knowledge
  - Sustainable design and development
  - Carbon management and climate risk assessment
  - Environmental impact assessment
  - Green marketing
  - Waste management and recycling
  - Green entrepreneurship and innovation
  - ESG (Environmental, Social, and Governance) expertise
  - Sustainable supply chain management
  - Environmental policy and regulatory compliance
  - Sustainability reporting and performance measurement

  - Green business practices
  - Eco-friendly product development
  - Environmental ethics and responsibility
- **Business, leadership and adaptive skills:**
  - Systems thinking
  - Interdisciplinary collaboration
  - Cross-functional teamwork
  - Problem-solving in complex systems
  - Decision-making
  - Risk management
  - Leadership and management
  - Innovation and creativity
  - Soft skills (e.g., adaptability, communication, teamwork)
  - Effective communication skills
  - Time management
  - Critical thinking and analytical reasoning
  - Change management and adaptability
  - Lifelong learning and continuous upskilling
  - Resilience and persistence
  - Knowledge of sustainability laws and digital regulations
  - Ethical considerations in digital and environmental transitions
  - Social responsibility and governance
  - Business acumen related to sustainability and green economies
  - Human-centered design and ethical AI usage
  - Sustainable finance and investment strategies
  - Entrepreneurial mindset in green and digital industries
  - Corporate sustainability and compliance management

The survey responses also highlight several key challenges in preparing the current and future workforce for the twin green and digital transitions and propose potential solutions. The main obstacles include:

1. Skills Gap and Mismatched Education

- Many workers lack the necessary technical expertise in green and digital technologies.
- The education system is slow to adapt to emerging skill demands, making it difficult for graduates to find relevant employment.
- Training programs often fail to keep pace with rapid technological advancements.

Proposed Solutions:

- Implement continuous upskilling and reskilling programs tailored to industry needs.
- Strengthen collaboration between HEIs, businesses, and government to ensure that curricula align with emerging workforce demands.

- Increase the availability of hands-on learning opportunities, such as internships, apprenticeships, and real-world projects.

2. Resistance to Change and Cultural Barriers

- Some industries and workers resist adopting new technologies due to job security concerns and a reluctance to change existing workflows.
- A lack of awareness and poor understanding of the benefits of the green and digital transition hinders workforce adaptability.

Proposed Solutions:

- Promote lifelong learning and adaptability as core professional values.
- Provide financial incentives and awareness campaigns to encourage upskilling efforts.
- Foster a culture of innovation and inclusivity where digital and green transitions are seen as opportunities rather than threats.

3. Limited Access to Training and Infrastructure Inequality

- Workers in rural or underdeveloped areas often have limited access to training programs, digital tools, and green technology resources.
- High costs of training and education create barriers for professionals looking to transition into sustainable industries.

Proposed Solutions:

- Develop inclusive education policies and expand digital infrastructure to bridge regional inequalities.
- Offer affordable and accessible online training programs, micro-credentials, and modular courses.
- Provide government and corporate-sponsored scholarships and funding programs for skill development in underserved communities.

4. Financial and Technological Constraints

- Many companies, especially SMEs, struggle with the high costs of adopting new green and digital technologies.
- The rapid pace of innovation often requires continuous investment, making it difficult for organizations to keep up.

Proposed Solutions:

- Governments and financial institutions should offer grants, subsidies, and low-interest loans to support businesses in adopting sustainable practices.
- Encourage public-private partnerships to drive investments in green and digital technology.
- Develop cost-effective solutions and scalable training programs that allow smaller businesses to transition without significant financial strain.

8. INSIGHTS FROM HEIS IN ADVANCING THE TWIN GREEN AND DIGITAL TRANSITION

A total of **125 participants** from eight Higher Education Institutions (HEIs) across Azerbaijan, Kazakhstan, and Mongolia took part in the interview, offering a diverse range of perspectives on the green and digital transitions in higher education. While the interviewees shared a common institutional affiliation, ensuring a certain level of homogeneity, their backgrounds were sufficiently varied to enable the exploration of contrasting viewpoints. The participants included academic faculty, such as professors, associate professors, senior lecturers, and doctoral researchers; higher education

administrators, including vice-rectors, deans, department heads, and directors of innovation and digitalization; and non-academic professionals, such as specialists in innovation centers, IT professionals, and regulatory representatives. Additionally, students at various stages of study (bachelor's, master's, and PhD candidates) contributed their insights, further enriching the discussion. This broad representation allowed for a comprehensive examination of the challenges and opportunities associated with digitalization and sustainability in higher education, incorporating perspectives from academic governance, educational policy, technological development, and student experience.

8.1. Concept of Twin Green and Digital transition

The interviews from AzTU, ATU, and MSU in Azerbaijan highlight the importance of integrating green and digital transitions by emphasizing multidisciplinary knowledge, essential competencies, and attitudes necessary for success in these evolving domains. Green and digital transitions require expertise across multiple disciplines, including ecology, technology, and business. Understanding environmental issues, principles of sustainable development, and renewable energy technologies is crucial for those working on sustainability. At the same time, mastering digital tools such as AI, big data, blockchain, IoT, cloud computing, and cybersecurity is essential for professionals in the digital field. Additionally, an understanding of sustainable business models, circular economy practices, and entrepreneurship supports the economic and strategic dimensions of these transitions.

To succeed in these areas, individuals must develop technological literacy, ecological responsibility, and a strong foundation in sustainable development principles. Prior knowledge of environmental sciences, digital technologies, and economics forms the basis for acquiring essential skills in resource sustainability, digital tool application, and entrepreneurial problem-solving. For professionals specializing in renewable energy and eco-technologies, expertise in sustainable development, climate change, renewable energy systems, and energy modeling is critical. Practical applications require big data analysis and process optimization to ensure that technological solutions align with sustainability goals. Furthermore, cybersecurity and strategic planning play a key role in protecting digital infrastructure while promoting sustainable business models. Circular economy practices, waste management, and alternative energy solutions are also fundamental competencies in addressing environmental challenges.

A collaborative mindset, openness to innovation, and critical thinking are essential to integrating these competencies effectively in both academic and business environments. To develop these skills, interactive learning methods such as project-based learning, specialized training programs, and industry-recognized certifications are necessary. Azerbaijan's carbon certification for renewable energy-based plants serves as an example of how structured sustainability initiatives can foster innovation and responsible resource management. The application of AI, blockchain, IoT, and simulation technologies further enhances energy efficiency and digital sustainability efforts. Additionally, IT literacy, engineering knowledge, and operations management skills are vital for addressing technical and managerial challenges in green and digital business (GDB).

The interviewees provided several recommendations for strengthening green and digital competencies. One key proposal was to establish an ECO CLUB, with a unique logo, to promote sustainability awareness and engagement. They also emphasized the need to organize international and local training courses on recycling, waste reduction, and energy efficiency. Expanding IT knowledge and increasing the application of artificial intelligence in both business and education were seen as essential steps forward. Additionally, there is a growing demand for developing professional specialists in Green Digital

Business (GDB) skills, which requires formal education and certification programs. The interviewees also highlighted the importance of enhancing social media advertising to raise awareness and encourage participation in sustainability initiatives.

The green and digital transition in Kazakhstan's HEIs, including KazNU, METU, and ATUKZ, is centered around achieving sustainable development while advancing digitalization across various economic sectors. KazNU's approach to the Twin Green and digital transition emphasizes reducing carbon emissions, promoting renewable energy, and ensuring the efficient use of resources. The integration of clean energy, waste recycling, and sustainable agriculture is seen as essential for sustainability. Additionally, the digitalization of industry, transport, and services enhances efficiency and transparency. The university recognizes the importance of preparing the workforce for digital transformation, as technologies such as artificial intelligence, big data, and the Internet of Things (IoT) drive new business models. The development of smart cities and digital solutions also plays a crucial role in optimizing resource and energy use, demonstrating how digital tools can support environmental sustainability initiatives.

At **ATUKZ**, respondents unanimously agreed that knowledge of sustainability, ecology, digital technologies, programming, and management is critical for green and digital competency development. Essential skills identified include project management, strategic planning, data analysis, and digital tools application. Additionally, fostering an attitude of environmental responsibility and readiness for innovation is considered vital. A key takeaway from the responses was the need for continuous learning and adaptation in the face of rapid advancements in ecology and digital technologies, as well as changing regulatory frameworks. To address this challenge, participants emphasized the necessity of establishing a system of continuous education to ensure professionals remain updated with new technological and environmental developments.

At **METU**, respondents echoed the importance of sustainability, digital literacy, programming, and management skills in developing green, digital, and business competencies. Critical skills identified included strategic planning, data management, and the use of modern digital tools. Participants also highlighted the role of environmental consciousness and innovation-oriented mindsets in integrating sustainable solutions into business and industry. The concept of harmonizing ecology and technology was particularly emphasized, ensuring that professionals can implement sustainable approaches in real-world business applications. The use of digital tools for environmental monitoring and impact assessment was identified as an essential practice. One of the most pressing concerns was the rapid pace of technological and environmental changes, requiring professionals to continuously update their knowledge. To address this, respondents recommended creating structured professional development programs, including workshops, conferences, and online courses, as well as the introduction of interdisciplinary academic programs that integrate ecology, digital technologies, and business strategies.

At **NUM** (National University of Mongolia), the development of green, digital, and business competencies is rooted in a comprehensive knowledge base that integrates environmental science, digital transformation, and sustainable economic principles. Fundamental pre-knowledge includes an understanding of sustainability principles, climate change, renewable energy technologies (such as wind, solar, and hydropower), circular economy practices, and carbon management. In the digital domain, basic knowledge of AI, blockchain, IoT, big data analysis, and decision-making processes is considered crucial. From a business perspective, students are expected to be familiar with green marketing strategies, consumer behavior, waste reduction techniques, resource efficiency, and innovative business models that align with sustainability goals. These multidisciplinary foundations

ensure that students acquire a holistic approach to addressing green and digital transitions in modern industries.

At **MUST** (Mongolian University of Science and Technology), the importance of pre-knowledge, skills, and attitudes for green, digital, and business transitions is emphasized through a structured and interdisciplinary approach. Key pre-knowledge includes environmental science, sustainability principles, climate change adaptation strategies, renewable energy integration, circular business models, and carbon management. In the digital domain, students must develop a strong foundation in AI, blockchain, IoT, and emerging digital transformation trends, enabling them to leverage smart technologies and green computing for industrial and environmental applications. Additionally, an understanding of entrepreneurship, business innovation, and green marketing strategies is necessary for professionals seeking to develop sustainable enterprises and environmentally responsible business models.

Beyond foundational knowledge, MUST highlights a diverse set of skills required for green, digital, and business competencies. In the green sector, professionals must be proficient in analyzing sustainability challenges, conducting environmental impact and life-cycle assessments, optimizing resource efficiency, and implementing waste management strategies. The digital domain requires skills such as proficiency in digital tools and platforms, basic programming, software development, and data analytics, which are crucial for leveraging digital solutions in sustainability projects. In the business field, professionals must develop systems thinking for addressing environmental challenges, adaptability to digital technologies, strategic planning, project management, leadership, financial literacy, and stakeholder engagement.

In addition to knowledge and skills, NUM and MUST emphasize attitudes and values that support green and digital competency development. Students and professionals must demonstrate a commitment to environmental responsibility, ethical decision-making, openness to lifelong learning, and a proactive approach to technological advancements. The ability to adapt to rapid changes in digital and environmental sectors is critical, as is an entrepreneurial mindset that fosters innovation and problem-solving.

8.2. Interventions to address green, digital and business competencies

The development of green, digital, and business competencies is a priority for educational institutions aiming to equip students with the skills required for the modern workforce. Universities like **Azerbaijan Technical University (AzTU)** have adopted a blended learning approach that integrates traditional classroom training, online courses, and practical applications. This method combines e-learning platforms, workshops, mentoring programs, and gamified learning to create a well-rounded educational experience. Additionally, dual training programs and laboratory-based practical sessions are incorporated to ensure that students gain real-world exposure and hands-on skills.

To strengthen practical skill development, simulations and interactive workshops provide students with hands-on experience in green and digital technologies. For instance, project-based learning enables students to tackle real-world challenges such as energy modeling and system optimization, which enhances critical problem-solving skills. At AzTU, emphasis is placed on project-based training, industry collaborations, and real-world research projects to develop applied competencies. Advanced training programs, involving partnerships with industry experts, facilitate knowledge-sharing and skill enhancement, while doctoral candidates engage in cutting-edge research to drive innovation in sustainable energy solutions.

To align with sustainable development goals, key topics such as artificial intelligence (AI), data analysis, and smart city concepts have been introduced into mandatory courses. However, some challenges

persist, including limited access to updated laboratory facilities and the insufficient integration of modern tools such as AI and IoT into curricula. Strengthening university-industry collaborations, integrating advanced simulation platforms, and utilizing IT tools such as analytics software and project management applications can help bridge these gaps. Furthermore, enhancing access to learning materials, including translations to overcome language barriers, is essential to improving education and accessibility for students and professionals.

The approach to competency development at institutions like **Azerbaijan Technological University (ATU)** follows a multifaceted strategy, blending theoretical and practical learning to accommodate diverse educational needs. Traditional classroom instruction serves as the foundation, complemented by online courses and self-paced e-learning platforms, allowing students flexibility in their studies. Blended learning, which merges online and in-person sessions, is widely utilized to create an adaptable and effective learning experience. Mentoring programs also play a crucial role in guiding students, while gamified learning and simulations transform theoretical knowledge into real-world problem-solving exercises.

Additional teaching methods include one-on-one tutoring for personalized learning, team-based collaborative projects, and self-study initiatives that encourage independent knowledge expansion. These diverse educational methods ensure that students are actively engaged and develop skills that are applicable in professional settings.

Green, digital, and business competencies are reflected in current course offerings at Azerbaijan Technological University and similar institutions, where curricula are regularly updated to align with industry trends and global sustainability goals. Green competency courses focus on sustainable development, environmental management, and renewable energy technologies, ensuring that students develop expertise in ecological sustainability. For digital competencies, coursework emphasizes emerging technologies such as AI, data analytics, and cybersecurity, with a focus on both technical applications and ethical considerations. Business competency courses cover essential topics such as management, financial planning, and entrepreneurship, integrating modern business models that emphasize innovation and sustainability.

Despite these advancements, there is a growing demand for more interactive and industry-relevant coursework. Enhancements such as practical applications, increased industry collaboration, and specialized courses in advanced digital technologies and the green economy are recommended to prepare students for global competitiveness.

To promote competency development, Azerbaijan Technological University and other institutions employ formal, non-formal, and informal learning strategies. Formal education integrates these competencies into core curricula, reinforced by practical assignments to develop applied skills. Non-formal education involves industry partnerships, hands-on training programs, and professional seminars, exposing students to real-world business environments. Informal learning, facilitated by online platforms such as Coursera and edX, provides additional certifications and self-directed learning opportunities, further enhancing students' expertise.

At **MSU University**, online classes, digital libraries, mobile applications, and face-to-face training sessions form the backbone of the learning experience. However, to keep pace with rapid technological advancements, it is essential to increase practical experience and real-world project engagement. Making courses more interactive, aligning them with labor market demands, and incorporating international best practices and innovative teaching methods will further strengthen education in green, digital, and business competencies.

At **KazNU**, interventions to develop green, digital, and business competencies are focused on formal education, experiential learning, and institutional sustainability initiatives. The university offers courses and programs in sustainable development, ecology, and resource management, ensuring that students receive foundational knowledge in these areas. Faculty members actively organize events related to sustainable development goals (SDGs), raising awareness and engagement among students. The KazNU campus holds the status of a Green Campus, with management prioritizing green technology adoption to improve the environmental impact of university operations. The Faculty of Geography houses 10 laboratories dedicated to environmental research, leveraging digital technologies to enhance their work.

KazNU employs diverse teaching methods, including traditional lectures, seminars, online courses, and simulators. The university has an online course platform offering 127 different courses, covering green, digital, and business technologies. A problem-oriented and project-based approach is emphasized in student learning, combining formal education methods (classroom hours, practical sessions, and laboratory classes) with informal learning tools such as massive online courses. To enhance digital integration, KazNU has acquired Coursera licenses, expanding access to 2000 licenses in 2024 for students to engage in self-paced learning.

A key area of focus at KazNU is the support for startups and projects related to environmentally friendly technologies and business models. Mentoring programs and funding for new business ideas are identified as crucial components of building an innovative ecosystem for green and digital transformation. To ensure the integration of green, digital, and business skills, the university recognizes the need for interdisciplinary courses that prepare specialists capable of working in sustainable and digital businesses. Additionally, strong partnerships with companies are encouraged to develop market-driven curricula that reflect industry needs and emerging trends. These measures aim to create a more sustainable, digital, and competitive economy, ensuring students and professionals are equipped to handle modern challenges.

At **ATUKZ**, interventions focus on blended learning, digital education tools, and experiential learning. The university actively incorporates online courses, self-paced learning materials, and e-learning platforms into its teaching approach. Master classes, mentoring programs, and training sessions are widely utilized to enhance student engagement. The importance of gamified learning and simulations is strongly emphasized as a method to increase motivation and improve knowledge retention.

A key strategy at ATUKZ is project-based and practice-oriented learning, ensuring that students develop real-world problem-solving skills in ecology and digitalization. This approach prepares students not only theoretically but also through practical experience, improving their ability to transition smoothly into the workforce. By engaging in hands-on learning, students are better equipped to address complex environmental and digital challenges.

At **METU**, similar interventions are highlighted, with a strong emphasis on gamification, simulations, and interactive learning environments. These methods create an engaging and practical learning experience, facilitating better knowledge retention and real-world application. A project-based and practice-oriented approach is a central intervention, designed to enhance problem-solving skills and prepare students for real-world challenges in sustainability and digitalization.

METU also stresses the importance of interdisciplinary learning, integrating ecological, digital, and business knowledge into curricula. This approach fosters a comprehensive understanding of green and digital transition concepts, ensuring students develop the ability to address complex challenges that require expertise across multiple fields.

Recommendations for strengthening interventions:

- **Expand the use of digital tools and platforms** (e.g., virtual labs, AI-driven simulations, and interactive online learning).
- **Introduce more real-world projects** through collaborations with industry partners, allowing students to apply theoretical knowledge in practical settings.
- **Enhance practical training opportunities** by incorporating internships, fieldwork, and hands-on projects into the learning process.
- **Develop interdisciplinary programs** that combine sustainability, digital transformation, and business innovation, equipping students with multidisciplinary skills.
- **Strengthen startup and entrepreneurial support** by offering mentorship programs, funding opportunities, and networking initiatives to encourage green and digital entrepreneurship.

At **NUM** (National University of Mongolia), a variety of instructional methods are used to develop green, digital, and business competencies. While classroom-based training remains the primary approach, the university also incorporates fully online courses, e-learning, blended learning, workshops, seminars, guided lectures, mentoring programs, simulations, self-directed learning, and collaborative projects. These diverse learning strategies ensure that students acquire both theoretical knowledge and practical skills in their respective fields.

NUM utilizes several digital platforms to enhance learning, research, and project management. The SiSi Learning Management System (LMS) provides a comprehensive framework for students and faculty, offering access to curriculum details, course descriptions, syllabi, learning outcomes, and essential documents. Additionally, NUM has implemented the Project Management Registration System, the Research Management Information System, and an advanced digital library system, all of which contribute to seamless access to educational and research resources.

A strong emphasis is placed on the digital and green transition, as reflected in NUM's Strategic Plan 2025-2030, which sets ambitious goals for digital transformation. The School of Business, in collaboration with UNDP, has conducted green development and technology training for faculty members, while the School of Information Technology and Electronics is preparing to introduce AI and big data courses for all students. Additionally, the Teacher and Development Center actively organizes faculty training programs to improve teaching methodologies and competency development.

NUM has also fully digitized internal operations, minimizing manual processes and improving efficiency in administrative functions, such as faculty recruitment. However, while students have the option to take AI and data processing courses from other universities, access remains limited due to faculty resource constraints. The university recognizes the need for comprehensive IT solutions and powerful digital tools to effectively teach green and digital transition concepts. These tools should support course creation, delivery, assessment, and monitoring. The interview participants at NUM expressed a strong desire to enhance human resource capabilities, develop new courses, and improve existing course content to better align with modern industry needs.

At **MUST** (Mongolian University of Science and Technology), classroom-based training remains the primary teaching method, but the university has also widely adopted online courses, e-learning platforms, blended learning, workshops, mentoring programs, simulations, and team-based learning. Since 2003, the UNIMIS Management Information System has played a crucial role in managing the university's educational activities, while the UNI LMS e-learning system, launched in 2010, facilitates distance and blended learning. These systems support the organization and delivery of digital education at the university.

MUST offers strong programs in Computer Science and Business, with a well-established digital curriculum for IT-related disciplines. However, during the interviews, it was noted that green

competencies are underrepresented in the university's course offerings. Currently, there is only one mandatory green course—Ecology and Nature Conservation, which is required for all undergraduate programs. While business programs offer a variety of courses such as Engineering Economics, Microeconomics, Macroeconomics, Fundamentals of Economic Theory, Entrepreneurship, and Innovation, non-business students have limited exposure to these topics.

Similarly, for non-computer science students, digital education is restricted to basic programming and IT application courses, whereas AI and data analysis courses are absent from most curriculums. To promote a more balanced competency development, it is recommended that courses on Smart City Citizenship and Human Development, currently electives, should be made mandatory. This shift would align with Mongolia's long-term development policy, Vision-2050, which prioritizes Green Development as its sixth goal.

MUST also provides professional training for consulting and certified engineers through specialized courses. The Open Education Center at MUST plays a key role in public education, offering Massive Open Online Courses (MOOCs) that extend learning opportunities beyond the university. These interventions highlight the university's commitment to improving access to digital and sustainability education while addressing gaps in green competency development.

8.3. Challenges

Each country faces unique challenges in developing green and digital specialists. In many regions, limited access to education, technological infrastructure, and insufficient legal regulations make it difficult to implement advanced green and digital solutions. These constraints require professionals to seek international certification programs and global collaboration opportunities. Green energy projects and digital transformation initiatives provide valuable exposure, helping professionals gain the necessary competencies for these rapidly evolving fields.

General challenges in Green and Digital Transitions:

- **Limited access to education and technological Infrastructure:**
  - Inadequate educational programs focused on green and digital skills.
  - Lack of modern equipment and technological resources.
- **Regulatory and legal barriers:**
  - Insufficient policies and legal frameworks to support green and digital initiatives.
- **Financial constraints:**
  - High costs of green and digital transformation projects.
  - Limited investment opportunities, especially in developing regions.
- **Skills and knowledge gaps:**
  - Need for international certification programs.
  - Limited expertise in AI, smart technologies, and digital systems.
- **Challenges in curriculum integration:**
  - Educational institutions struggle to integrate green and digital skills into curricula.
  - Lack of interdisciplinary training programs.
- **Technological limitations:**
  - Limited familiarity with AI, cybersecurity, and digital simulation software.
  - Restricted access to global resources due to language barriers.

The challenges faced by different countries and institutions in fostering green and digital specialists are diverse and influenced by factors such as technological infrastructure, financial resources, education system readiness, and policy frameworks. Below is a Table 17 summarizing these challenges, providing a clearer understanding of the specific obstacles encountered in each region and institution.

Table 17. Country and institution-specific challenges

Country/ Institution	Challenges	Description	Recommendations
Azerbaijan	Technological infrastructure development	Slow progress in upgrading digital and green technology infrastructure.	Increase investments in technology and digital infrastructure.
	Education system gaps	Necessity for continuous learning in AI, smart technologies, and sustainability.	**Develop specialized courses** and integrate AI-driven solutions.
KazNU	Curriculum limitations	Lack of integration of digital skills, green technologies, and entrepreneurship in educational programs.	**Expand curricula to include interdisciplinary courses** focusing on sustainability and digital transformation.
	Technological advancement challenges	Rapid obsolescence of digital tools requiring continuous updates.	Implement **continuous training programs**, invest in digital tools, and promote skill enhancement initiatives.
	Awareness and policy issues	Limited awareness of the importance of green and digital competencies, coupled with inconsistent public policies.	Strengthen **public-private partnerships**, launch awareness campaigns, and advocate for stronger policy support.
ATUKZ	Continuous knowledge updates	Professionals struggle to keep up with rapidly evolving ecological and digital technologies due to a lack of structured continuous education.	Implement **continuous training programs**, establish **self-education platforms**, and facilitate participation in **professional courses**.
	Interdisciplinary knowledge gaps	Difficulty integrating ecology, digital technologies, and business, making it challenging to develop sustainable solutions.	Develop **interdisciplinary curricula**, promote **industry collaboration**, and encourage global knowledge-sharing initiatives.
METU	Fast-paced technological and environmental changes	The continuous evolution of digital tools, regulations, and environmental practices requires frequent competency updates for students and professionals.	Implement **adaptive learning models**, provide **continuous training programs**, and integrate real-world applications into curricula.
	Lack of interdisciplinary integration	Fragmented educational approaches make it difficult for students to apply systematic solutions to sustainability and digital transformation challenges.	Develop **integrated curricula** connecting digital tools, environmental impact monitoring, and sustainable business strategies.
NUM	Structural and policy barriers	Limited market growth due to Mongolia's small population and lack of government policies supporting green and digital transitions.	Promote **government incentives**, strengthen policy frameworks, and increase public awareness campaigns.
	Harsh climate and energy challenges	Mongolia's extreme climate affects renewable energy	Invest in climate-resilient green technologies and **develop**

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		performance, and reliance on coal slows green initiatives.	**transition strategies** for sustainable energy sources.
	knowledge and skills gaps	Professionals and students lack comprehensive training in digital technology, environmental engineering, and business management.	Implement **multi-tiered education approaches**, encourage dual majors, and introduce **specialized postgraduate courses**.
MUST	Interdisciplinary challenges	Difficulty in balancing sustainability principles with digital technologies like AI, IoT, and blockchain due to a lack of green-related competencies.	Develop **integrated curricula** covering sustainability and digital technologies and enhance exposure to green competencies.
	Practical skills deficiency	Insufficient training in data analytics, cybersecurity, and AI ethics, which are essential for managing environmental data.	Introduce **hands-on training**, industry collaboration, and certification programs.
	Financial constraints	Limited financial resources restrict access to international courses and certifications, reducing global competitiveness.	Secure funding through **scholarships, grants, and partnerships** with **international institutions.**
	Networking and collaboration gaps	Lack of cross-sectoral networking among academia, industry, and policymakers slows green and digital initiatives.	Strengthen **industry-academia partnerships**, foster policy dialogue, and create collaborative innovation hubs.
	Keeping up with technological advancements	Difficulty aligning emerging digital technologies with sustainability objectives.	Implement **continuous learning initiatives,** encourage research in GreenTech, and promote adaptive digital strategies.
	Leadership and stakeholder management	Challenges in balancing economic growth, regulatory compliance, and environmental impact.	Develop **leadership programs**, improve stakeholder communication skills, and promote multidisciplinary decision-making approaches.

To drive progress in green and digital transitions, it is essential to invest in technology and digital infrastructure while expanding interdisciplinary curricula that integrate sustainability and digital transformation. Specialized courses and AI-driven solutions should be incorporated into education systems, supported by continuous training programs, self-education platforms, and professional development opportunities. Strengthening public-private partnerships, increasing policy advocacy, and launching awareness campaigns will enhance institutional and governmental support. Additionally, fostering industry collaboration, global knowledge-sharing initiatives, and adaptive learning models will ensure students and professionals stay updated with evolving technologies. Financial accessibility must also be addressed through scholarships, grants, and funding partnerships. Encouraging hands-on training, interdisciplinary education, and leadership development will equip professionals with the skills needed to balance economic growth, regulatory compliance, and environmental sustainability. Ultimately, a comprehensive, multi-tiered approach is necessary to bridge knowledge gaps, advance research in GreenTech, and build resilient green and digital economies.

8.4. Validation and assessment of green, digital, and business competencies

At **Azerbaijan Technical University (AzTU)**, the validation and assessment of green, digital, and business competencies are conducted through a combination of project-based assignments, simulations, and written exams. Students are evaluated based on teamwork, analytical thinking, and problem-solving skills, particularly through collaborative projects and practical sessions. Simulations, such as energy modeling and system optimization exercises, provide valuable hands-on experience in measuring practical competencies. To align with modern industry standards, MATLAB, Python, and cloud platforms are used extensively in assessments.

Despite these efforts, the absence of a comprehensive competency validation framework results in inconsistencies across programs. While international frameworks such as GreenComp, DigComp, and EntreComp offer structured guidelines for assessing competencies, their implementation remains in the early stages. To improve the accuracy and efficiency of evaluation, advanced IT tools such as simulation software, analytics platforms, and e-learning systems like Moodle and Canvas are being introduced. Additionally, AzTU has begun integrating ISO 9001 standards into its competency assessment framework to align with global educational benchmarks. Moving forward, recommendations include developing standardized assessment frameworks that align with the European Qualifications Framework (EQF) and ESCO (European Skills, Competences, Qualifications, and Occupations). Strengthening industry collaborations, expanding access to IT tools, and establishing modern laboratories are also essential steps to enhancing competency validation.

At **Azerbaijan Technological University (ATU)**, a mixed-method approach is employed to validate students' green, digital, and business skills. The assessment process plays a crucial role in ensuring that students are well-prepared for real-world challenges. By incorporating performance-based assessments, digital platforms, simulations, and mentorship programs, ATU has developed a comprehensive competency evaluation system.

- **Green Competencies**:
  - Assessment focuses on environmental protection and sustainable development principles.
  - Project-based learning, environmental workshops, and carbon footprint calculations help measure students' understanding of sustainability concepts.
  - Some institutions offer green diploma programs and environmental certifications, serving as formal validations of students' competencies in environmental stewardship.
- **Digital Competencies:**
  - These are assessed through practical applications, coding assignments, and real-world problem-solving exercises.
  - International certifications such as Microsoft Office and Python programming validate students' digital literacy.
  - Simulations and virtual environments provide hands-on experience, mirroring real-world digital workspaces.
- **Business Competencies:**
  - Simulations and real-world projects are used to evaluate business skills.
  - Students develop business plans, conduct market analyses, and make strategic decisions using case study methods and simulation programs.

— Mentoring sessions and participation in business projects provide practical exposure, assessing students' strategic thinking and management abilities.

The integration of IT tools is essential in assessing and enhancing competencies. Learning management systems such as Moodle, Blackboard, and Canvas, along with simulation programs like MATLAB and EnergyPlus, provide interactive and immersive learning experiences. These platforms help in tracking progress, offering feedback, and ensuring effective competency measurement.

Data analytics and visualization tools like Tableau and Power BI further support assessment by providing a detailed analysis of students' learning outcomes. Additionally, collaborative platforms such as Microsoft Teams and Slack facilitate teamwork and project management skills, while gamification tools enhance student engagement and motivation in the learning process.

The REFRESH project at Azerbaijan Technological University integrates various international and local reference frameworks to standardize competency assessment. These include:

- **European Qualifications Framework (EQF)** – Aligns competency assessments with European education standards, balancing theoretical and practical knowledge.
- **Digital Competence Framework (DigComp)** – Provides a structured approach for assessing digital literacy and technological proficiency.
- **Green Competence Framework (GreenComp)** – Focuses on ecology and sustainable development, ensuring students' environmental competencies align with global sustainability priorities.
- **Business Competency Frameworks** – Includes standards such as EFMD Global's EPAS and PMI (Project Management Institute) guidelines, assessing planning, strategic thinking, and leadership in business education.

Projects, independent work, presentations, and performance-based tasks are used for assessment in the **Mingachevir State University (MSU).** These tools allow students to measure their practical skills in addition to theoretical knowledge. Important IT tools for this include learning management systems such as Moodle, simulation programs, and testing platforms.

At **KazNU**, the validation and assessment of green, digital, and business competencies are considered essential for ensuring that students acquire and demonstrate relevant skills for modern industries. A key method of validation is the certification of educational programs, which undergo both national and international accreditation. This process ensures that students develop recognized competencies in sustainability, digitalization, and business management.

KazNU employs an integrated approach that combines theoretical knowledge with practical skill evaluation. The university uses various assessment methods, including testing, digital tool application exercises, real-world business scenario analysis, and decision-making evaluations. These methods not only determine the competency level of students but also highlight areas for further development. Additionally, the university places emphasis on team management skills and strategic problem-solving abilities, ensuring graduates are prepared for leadership roles in the green and digital economy.

At **ATUKZ**, a structured competency assessment system is used, incorporating assessment tests, project assignments, online exams, and case studies. The integration of IT tools, such as online testing platforms and learning management systems (LMS) like Moodle and Canvas, enables real-time monitoring of student progress and ensures transparency in evaluation results. A combination of traditional assessment methods and digital platforms enhances the effectiveness of competency validation, making it possible to evaluate both theoretical understanding and practical application skills.

ATUKZ utilizes the HeRo Study Space platform, which allows universities to organize, manage, and analyze educational processes using a data-driven approach. This digital tool enhances student tracking and performance monitoring, making assessment more structured and transparent. Furthermore, the university follows a documented procedure known as the "Regulations on the Assessment of the Integral GPA, Research Skills, and Social Activity of Students", ensuring a standardized and fair evaluation system across disciplines.

At **METU**, the validation and assessment of competencies are carried out through specialized IT platforms that enable comprehensive tracking of academic progress in green, digital, and business disciplines. The university employs two primary platforms:

- **AIS KazETU** – An educational management system that provides tools for monitoring academic performance, conducting online assessments, and tracking student achievements in real-time.
- **Platonus** – A student assessment system that facilitates knowledge evaluation, curriculum management, and automated grading. It is widely used for recording intermediate and final exam results and streamlining learning processes.

To ensure a well-rounded evaluation of student competencies, METU applies various assessment methods:

- **Online Testing** – Digital exams and quizzes help assess theoretical knowledge in a structured manner.
- **Project-Based Assessment** – Students upload individual and group projects through the platforms and receive detailed feedback from instructors, ensuring the validation of practical skills.
- **Interactive Learning Tools** – Simulations and real-world scenario exercises help students develop sustainable competencies by applying their knowledge in practical, hands-on settings.

At **NUM** (National University of Mongolia), validation and assessment of green, digital, and business competencies follow a structured approach to ensure graduates meet international academic and industry standards. The university maintains a list of graduate attributes that all students must acquire, alongside course-specific learning outcomes and program educational objectives. These are assessed through progress tests, course exams, and final examinations, ensuring that students demonstrate competency development throughout their academic journey.

To align with global best practices, NUM structures its curricula based on internationally recognized frameworks. For instance, the Department of Information and Computer Sciences has developed all its programs in accordance with IEEE and ACM competency frameworks, ensuring that students receive training in line with the latest technological standards. This approach guarantees that graduates possess industry-relevant digital competencies, making them competitive in both local and international job markets.

At **MUST** (Mongolian University of Science and Technology), hands-on approaches and applied tasks play a crucial role in validating digital competencies. Students engage in coding exercises, IoT implementations, and data analysis challenges, using industry-standard tools such as MATLAB, Python, and GitHub. These assessments help evaluate students' ability to apply digital skills in practical scenarios, ensuring they are well-prepared for real-world challenges.

Beyond technical assessments, MUST incorporates case studies and problem-solving tasks to evaluate critical thinking and decision-making abilities in sustainability and digital transformation projects. The university also organizes industry evaluations, where professionals assess student capstone projects and research deliverables, providing direct feedback on technical and business applications.

To effectively track and assess student performance in green and digital modules, MUST relies on data-driven learning management systems (LMS) such as UNILMS. For coursework submission and academic integrity, tools like Turnitin are used for plagiarism checks, while Google Forms supports quick surveys and assessments. Virtual learning is facilitated through Zoom and Microsoft Teams, while AWS Educate and Google Cloud provide students with cloud computing experience for digital coursework. For machine learning and data science challenges, platforms like Kaggle are utilized.

MUST's academic programs follow rigorous competency frameworks to maintain high standards of digital and engineering education. Curricula in Computer Science, Software Engineering, AI, IT, Information Systems, and Data Science are based on the IEEE ACM competency framework, ensuring that students develop advanced technical skills. Additionally, the Project Management course follows the PMBOK framework, providing students with globally recognized project management methodologies.

The university adheres to international education quality management systems, including ISO 21001:2018, which defines standards for educational organizations. To further enhance assessment and instructional design, MUST applies Bloom's Taxonomy, which categorizes learning objectives from basic knowledge retention to advanced problem-solving and innovation. Furthermore, several programs, particularly in business and communication engineering, have earned international accreditations such as ABET, ASIIN, ACBSP, and EUR-ACE, ensuring that graduates meet globally recognized competency benchmarks.

8.5. Recognition of green, digital, and business competencies

Green, digital, and business competencies are not yet systematically adopted in Azerbaijan. Most universities, including **AzTU**, lack certification systems for validating these skills. This limits professionals' ability to demonstrate their qualifications in the job market, reducing competitiveness in industries requiring these competencies. However, some progress has been made. AzTU offers programs in sustainable development and business administration, supported by international accreditation through TEMPUS and Erasmus+ projects.

Azerbaijan Technological University recognizes the critical importance of acquiring competencies in green, digital, and business-related fields. The university's curriculum is designed to prioritize these areas, integrating them strongly into students' educational experiences through courses and projects associated with the REFRESH initiative. The university commits to modern educational and developmental approaches, equipping students with essential skills that prepare them for future careers. These competencies are foundational across ecology, technology, and the broader business environment, reflecting the demands of Azerbaijan's labor market. Azerbaijan's public and private sectors echo this prioritization by supporting the development of green technologies, digital skills, and business acumen. This aligns with the country's sustainable development goals and the broader economic shift towards modern technologies and innovations.

Nationally, the Azerbaijani government has delineated these competencies as top priorities, evident in strategic documents like the "Azerbaijan 2030: Sustainable Development Goals" strategy. The integration of digital skills and sustainable development into national policy underscores their critical role in the evolving economic landscape. Numerous government and business initiatives aim to foster advancements in digitalization and sustainability. State programs support digital transformation and a burgeoning startup ecosystem within the business sector. These competencies have steadily gained recognition in the Azerbaijani job market, where they are increasingly demanded by employers and seen as pivotal for professionals.

At the university level, Azerbaijan Technological University fosters these competencies through a curriculum and projects focused on sustainable development, digital technology applications, and business management. Students are encouraged to engage in hands-on activities that apply green technologies, use digital tools, and develop business plans that solve real-world problems. This practical approach ensures that students are not only learning but also applying these competencies in meaningful ways. Consequently, students graduating from the university with these skills are highly sought after by both local and international companies. The university emphasizes cooperation with these companies to facilitate job opportunities for its graduates.

In sum, Azerbaijan Technological University and the broader national framework highlight the emphasis placed upon green, digital, and business skills. These competencies are valued as crucial for both personal growth and competitiveness in the modern job market, with substantial support from educational institutions, government policies, and private sector initiatives. This comprehensive recognition and integration at both university and national levels ensure that graduates are well-prepared to contribute meaningfully to Azerbaijan's economic and technological future.

Mingachevir State University has participated in various projects related to climate change, including three important international projects, funded by the European Union's Erasmus+ program. These include the "New Courses in Geospatial Engineering for the Adaptation of Coastal Ecosystems to Climate Change" (GEOCLIC) project, Green and sustainable global economic improvement at Azerbaijani Universities: renewable energy and climate change mitigation – REFRESH project, and the "Strengthening the Sustainable Entrepreneurship Ecosystem in Azerbaijani Universities" (ENGAGE) project, in which it is the coordinator. The employees of the university organize environmental awareness trainings both within the university and in other educational institutions and actively participate in conferences. The research topics of TEC are dedicated to climate change, further emphasizing the university's commitment to sustainability and environmental innovation.

At **KazNU**, the recognition of green, digital, and business competencies is part of Kazakhstan's broader strategy for sustainable development and a "green economy". The Green Economy program aims to reduce greenhouse gas emissions and promote resource efficiency, supported by the establishment of "green" competence centers. Additionally, the Digital Kazakhstan program focuses on digitalizing business processes to improve management efficiency and risk reduction. However, despite these efforts, there is a lack of formal certification systems to validate green competencies in the labor market. While digital and business competencies can be confirmed through vendor certifications from companies such as Microsoft, Cisco, and Huawei (MBA programs, etc.), there is currently no recognized certification system for green competencies. This gap makes it difficult for professionals with green skills to have their expertise formally acknowledged, limiting their employment opportunities in sustainability-related sectors.

ATUKZ recognizes green, digital, and business competencies through diplomas, certificates, and standardized testing. In some cases, certification is supported by industry associations, which helps increase recognition in the labor market. Additionally, these competencies are validated through state education standards, reinforcing the importance of governmental support in developing highly qualified specialists for sustainable development and digital transformation. However, while there is some level of recognition at the national level, there is a pressing need for clearer mechanisms to align competencies with international standards, ensuring that graduates are competitive in the global job market.

At **METU**, the recognition of green, digital, and business competencies is achieved through certification programs and the issuance of diplomas, formally confirming students' knowledge and skills. These

certificates and diplomas comply with international standards, facilitating recognition at both national and global levels. METU ensures that these competencies are recognized by integrating competency assessments into training programs, applying quality assurance standards, and collaborating with industry partners. This approach ensures that graduates possess qualifications aligned with labor market demands, enhancing their employment prospects.

At **NUM** (National University of Mongolia), the recognition of green, digital, and business competencies is primarily focused on digital and business fields, with few certification systems available at the national level. One of the key recognized certification exams is the ITPEC (Information Technology Professionals Examination Council) standard examination. ITPEC serves as an IT human resources assessment tool, evaluating the skills and knowledge of IT engineers. This certification is based on the Information Technology Engineers Examination administered by Japan's Information-Technology Promotion Agency (IPA). The ITPEC exam is conducted in English across more than 10 countries, ensuring consistency and equivalence in IT skill assessment worldwide. The questions are developed collaboratively by ITPEC member countries alongside the Japanese Question-Making Committee, ensuring the reliability and international recognition of the exam. Given that ITPEC is officially recognized at the national level, certificates are issued by each government, making it one of the most credible IT competency validations in Mongolia.

At **MUST** (Mongolian University of Science and Technology), recognition of professional and consulting engineering certifications is well established in the engineering sector. However, formal certification of green and business competencies is not yet available at the university level. At the country level, several international and national certification systems are in place to validate digital and business skills, but an official examination system for green competencies has yet to be developed.

MUST recognizes three key ITPEC exams that measure various levels of IT competencies:

1. ITPassport (Information Technology Passport) Examination – Measures basic IT knowledge, serving as a foundational IT competency benchmark.
2. FE (Fundamental Information Technology Engineer) Examination – Evaluates core IT knowledge and technical skills, ensuring proficiency in fundamental IT concepts.
3. AP (Applied Information Technology Engineer) Examination – Assesses applied-level IT knowledge and skills, focusing on problem-solving, software development, and IT management.

These exams have gained significant recognition among IT companies in Mongolia, serving as a key validation of IT expertise in the job market. Additionally, the PMI-Mongolia Chapter organizes the Project Management Professional (PMP) certification, a globally recognized credential for business and project management professionals. At the national level, there is an official business competency certification exam, but no equivalent system currently exists for validating green-related competencies.

8.6. Recommendations

To successfully navigate the twin transition of green and digital transformation, universities must adopt innovative approaches that integrate green, digital, and business competencies. A curriculum review from HEIs, along with interviews with academic institutions and an online survey with industry stakeholders, was conducted to align educational programs with evolving workforce needs. The Table 18 provides the list of skills and competencies for green and digital transition based on industry demand and gaps in HEIs curricula.

Table 18. List of identified skills and competencies for Green and Digital Transition

Green skills and competencies	Digital skills and competencies	Business skills and competencies

GreenTech HORIZONS

— Renewable energy expertise (solar, wind, hydro, etc.) — Integration of renewable energy systems — Energy conservation and resource efficiency — Environmental science & sustainability principles — Climate change adaptation and mitigation strategies — Environmental impact assessment — Carbon management and emission reduction — Biodiversity & ecosystem management — Circular economy models and waste management — Recycling and sustainable resource management — Green technology knowledge and applications — Sustainable design and development — Sustainable business practices — Green entrepreneurship and innovation — ESG (Environmental, Social, and Governance) expertise — Green infrastructure & smart cities — Environmental policy and regulatory compliance — Sustainable supply chain management — Sustainability reporting and performance measurement — Eco-friendly product development — Environmental ethics and responsibility — Climate change risk assessment — Sustainable project execution and eco-technology integration — Green marketing strategies	— Digital literacy — Artificial intelligence (AI) skills — Machine learning — Big data analysis and data science — Cloud computing and digital platforms — Cybersecurity and digital risk management — Blockchain technology and its applications — Internet of Things (IoT) and smart technologies — Automation and robotics — Software engineering and programming — UI/UX design — IT and information system management — Virtual Reality (VR) and Augmented Reality (AR) — Digital transformation in business and industry — Simulation tools for energy modeling and smart city planning — Digital twin & simulation technologies — Cybersecurity and AI ethics — Information security and privacy laws — Digital culture and humanities — Virtual system and cloud management — E-Government & smart solutions — Digital engineering and platform adoption — Advanced software applications and programming — Blockchain for green certifications	— Systems thinking — Interdisciplinary collaboration — Cross-functional teamwork — Problem-solving in complex systems — Decision-making — Risk management — Leadership and management — Innovation and creativity — Adaptability and change management — Effective communication skills — Time management — Critical thinking and analytical reasoning — Lifelong learning and continuous upskilling — Resilience and persistence — Ethical considerations in digital and environmental transitions — Social responsibility and governance — Business acumen related to sustainability and green economies — Human-centered design and ethical AI usage — Sustainable finance and investment strategies — Entrepreneurial mindset in green and digital industries — Corporate sustainability and compliance management

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	— AI, IoT, and Big Data for sustainability — Data-driven decision-making and analytics	

The findings provide research-based recommendations to guide the development of the GreenTech Horizons competency-oriented learning ecosystem, ensuring that higher education curricula are designed to match market demands and sustainability goals.
Enhancing education through interdisciplinary collaboration, practical training, and industry partnerships will ensure students are well-prepared for the evolving job market. The following recommendations outline key strategies for it:

- **Modernizing certification and validation mechanisms**

To enhance the credibility and transparency of credentialing, universities should implement blockchain-based certification systems. Aligning certification with national initiatives such as the "Digital Economy" and "Green Economy" will promote broader recognition. Additionally, adopting the European Quality Framework (EQF) and incorporating global best practices will ensure that competency assessment meets international standards.

- **Strengthening university-industry collaboration**

Universities must establish strong partnerships with industries to provide students with real-world project experience, internships, and mentorship programs. Engaging industry experts in curriculum design and sustainability projects will ensure education remains relevant to labour market demands. Expanding interdisciplinary cooperation between engineering, business, and environmental sciences will further enhance students' ability to tackle real-world challenges.

- **Transitioning to experiential and interdisciplinary learning**

Educational institutions should move away from theory-based learning and incorporate experiential learning methods such as gamification, simulations, and collaborative projects. These approaches will improve problem-solving, analytical thinking, and strategic decision-making skills. Interdisciplinary programs integrating ecology, digital technologies, and business should be developed to prepare students for sustainability challenges.

- **Expanding digital integration in education**

Universities should embed AI, big data, cloud computing, and digital platforms into curricula to ensure students gain multidisciplinary expertise. Increasing access to online learning platforms, coding courses, and specialized training programs will help professionals stay competitive. Strengthening modern laboratories, startup incubators, and IT infrastructure will further support technological experimentation and entrepreneurship.

- **Enhancing practical training and industry readiness**

To improve students' employment prospects and industry readiness, institutions must prioritize hands-on training and project-based learning. Strengthening laboratory facilities, expanding access to IT tools, and introducing market-relevant courses will provide students with valuable technical experience. Establishing structured training programs for dual experts in the green and digital transition will ensure students are prepared for emerging job markets.

- **Aligning academic programs with sustainability goals**

Higher education institutions should integrate global sustainability policies, such as the Paris Agreement and the UN's Sustainable Development Goals (SDGs), into coursework. Encouraging interdisciplinary collaboration and aligning academic programs with international sustainability standards will ensure students develop a global perspective on green innovation and digital transitions.

- **Implementing sustainable campus initiatives**

Universities can lead by example by adopting sustainability initiatives on campus. Establishing student-led self-governing clubs dedicated to environmentally friendly activities will foster leadership and engagement in sustainability efforts. Effective waste management systems, including strategically placed trash bins and recycling programs, should be implemented, with student-led monitoring and awareness campaigns to encourage eco-friendly behaviours.

- **Advancing dual-degree programs for Green and Digital expertise**

To align national policies with global sustainability goals, universities should offer dual-degree programs combining sustainability and digital technology. Students specializing in engineering, IT, or business should have the opportunity to study environmental science, circular economy, or business management. This approach will equip professionals with multidisciplinary expertise, enabling them to bridge the gap between technology, sustainability, and business innovation.

- **Increasing awareness and continuous learning opportunities**

Educators and students must continuously upskill to keep pace with advancements in artificial intelligence and digital tools. Hosting seminars, conferences, and workshops will foster knowledge exchange, promote interdisciplinary cooperation, and enhance global collaboration. Raising awareness through media coverage and academic forums on sustainability and digital transformation will further encourage active participation in the twin transition.

9. CONCLUSION

The State-of-the-art Report on Green and Digital Transition has successfully mapped the opportunities, challenges, and gaps in Azerbaijan, Kazakhstan, and Mongolia, aligning with the objectives of the GreenTech Horizons project. Through comprehensive desk research, the report has analyzed key trends, policies, and initiatives that shape the integration of sustainability and digitalization across various sectors. It has provided insights into government strategies and public-private initiatives that support the transition while also assessing workforce competency gaps related to green, digital, and business skills, which are crucial for sustainable growth and job creation.

Industry-specific demands for green, digital, and business competencies have been analyzed through online surveys and job market assessments, revealing skill shortages and future labor market needs. Additionally, the report has investigated structural, economic, and policy-related barriers that hinder the development of green and digital competencies, highlighting the insufficient integration of sustainability concepts in higher education curricula and the limited adoption of digital tools in learning environments.

To address these challenges, the report has identified collaborative opportunities between academia, industry, and policymakers to enhance skill development and workforce readiness. It emphasizes the need for stronger HEI-industry partnerships, particularly in project-based learning, internships, and digital learning environments, to ensure that students acquire practical experience and industry-relevant skills.

Additionally, the report outlines best practices and actionable strategies to enhance the education sector's role in supporting the twin green and digital transition. By integrating global standards,

promoting interdisciplinary learning, and fostering university-industry collaboration, these recommendations aim to equip students with the skills necessary to navigate and lead sustainable digital transformations in their respective fields. The findings and recommendations from this report will serve as a foundation for future policy actions and curriculum improvements, supporting the successful implementation of green and digital transition strategies in the target regions.

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10.2. Related Documents

ID	References and related documents	Source or Link/Location
1	D2.1_ Desk research/Curriculum Review	Link to folder
2	D2.1_Desk research/European benchmarking analysis	Link to folder
3	D2.1_ Desk research/Job market analysis	Link to folder
4	D2.1_ Desk research/National context analysis	Link to folder
5	D2.1_Interview_with_HEIs/Report from partners	Link to folder
6	D2.1_Online_survey	Link to folder

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- **APPENDICES**

APPENDIX 1: Template for National Context Analysis

NATIONAL CONTEXT ANALYSIS REPORT FOR [Fill in your Country Name]

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

Acronym: GreenTech Horizons

Project Title:	**Fostering Dual Green and Digital Transitions through Education and Innovation in the Neighbourhood East, Central Asia, and Asia**
Project Acronym:	**GreenTech Horizons**
Project partner:	*Fill in the Title of Your institution*
Submitted by (Name & Role):	*Fill in Your Name, Surname and Role in the project*
Date:	*Fill in the date of the submission*
Contact Information:	*Fill in your email address*

Objective

To establish a comprehensive understanding of policies, drivers, barriers, and initiatives related to Dual Green and Digital Transitions.

Section 1: Policies and Strategies (max 1 page)

- **Overview of Key Policies:**

Please fill in the Table 1 by providing information on how is the twin green and digital transition perceived in your country of study and are there any government policies promoting the twin green and digital transition:

Table 1. Key Policies*

Policy	Description	Relevance to Twin green and digital transition
[Policy Name 1]	Brief description	Describe how this policy is relevant to green and digital transitions
[Policy Name 2]	Brief description	Describe how this policy is relevant to green and digital transitions

**You can add as much rows as you need in Table 1.*

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- **Overview of Strategic Objectives and Goals:**

Please fill in the Table 2 by describing key national goals for the twin green and digital transition in your country:

Table 2. Strategic Objectives and Goals*

Green transition goals	Digital transition goals	Key policies/ strategies	Timeline
Brief description of key environmental objectives (e.g., carbon neutrality, renewable energy targets, waste reduction, sustainable mobility, *etc.*).	Brief description of key digital objectives (e.g., 5G deployment, digital literacy, AI adoption, e-government, *etc.*).	Title of key national strategies or policies supporting these goals (e.g., National Green Deal, Digital Transformation Strategy).	Deadline or milestones for achieving the goals

**You can add as much rows, as you need in Table 2.*

- **Overview of Government Initiatives:**

Please fill in the Table 3 by describing of flagship programs/projects (e.g., funding schemes, public-private partnerships):

Table 3. Government Initiatives*

Program/ Project Name	Type	Focus Area	Description
[Program Name 1]	Specify type (e.g., funding scheme, public-private partnership, *etc.*)	Indicate if it supports green transition, digital transition, or both.	Brief summary of the program/project's objectives and activities.

**You can add as much rows, as you need in Table 3.*

Section 2: Drivers and Barriers (max 0.5 page)

- **Overview of Drivers and Barriers:**

Please describe what are major drivers and barriers for the twin green and digital transition in your country:

Drivers: List and describe key enabling factors (e.g., policy frameworks, industry support, public awareness):

_____

_____

_____

Barriers: Highlight challenges (e.g., funding gaps, skill shortages, regulatory issues):

_____
_____
_____

Section 3: Key Projects (max 0.5 page)

- **Overview of Key Projects:**

Please describe is there any case studies or flagship projects that are relevant to the twin green and digital transition in your country:

Project Name 1:

- **Objectives**: provide brief description about the project:

_____
_____
_____

- **Impact**: provide brief description how it supports the twin green and digital transition:

_____
_____
_____

Project Name 2:

- **Objectives**: provide brief description about the project:

_____
_____
_____

- **Impact**: provide brief description how it supports the twin green and digital transition:

_____
_____
_____

References

Please provide a list of related references*:

ID	Reference name	Source or URL link
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4		
5		

**You can add as much rows, as you need in this table.*

APPENDIX 2: Template for Job Market Analysis

JOB MARKET ANALYSIS REPORT FOR [Fill in your Country Name]

Project Title: Fostering Dual Green and Digital Transitions through Education and Innovation in the Neighbourhood East, Central Asia, and Asia
Acronym: GreenTech Horizons

Project Title:	**Fostering Dual Green and Digital Transitions through Education and Innovation in the Neighbourhood East, Central Asia, and Asia**
Project Acronym:	**GreenTech Horizons**
Project partner:	*Fill in the Title of Your institution*
Submitted by (Name & Role):	*Fill in Your Name, Surname and Role in the project*
Date:	*Fill in the date of the submission*
Contact Information:	*Fill in your email address*

Objective

To assess the demand for green, digital, and business skills needed for dual green and digital transitions across industries.

Section 1: Skill demand (max 0.5 page)

- **Overview of Skill Demand:**

Please describe are the twin green and digital transition competences and skills requested by enterprises (for example, if a company is looking for an engineer, do they ask knowledge in understanding renewable energy systems and sustainable resource management or in digital tools and platforms (e.g., AI, IoT, Blockchain, *etc*.):

Green Skills: List and describe skills and their demand level:
_[Skill 1]: Description and demand level_____
_[Skill 2]: Description and demand level _____
_[Skill …]: Description and demand level _____

Digital Skills: List and describe skills and their demand level:
_[Skill 1]: Description and demand level_____
_[Skill 2]: Description and demand level _____
_[Skill …]: Description and demand level _____
Business Skills: List and describe skills and their demand level:
_[Skill 1]: Description and demand level_____

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_[Skill 2]: Description and demand level _____
_[Skill …]: Description and demand level _____

Section 2: Industry-Specific Trends (max 0.5 page)

- **Overview of Leading Industries:**

Please describe which industries are adopting green and digital strategies in your country:

Leading Industries in Green Transition: List and describe industries and their adoption status of green transition:
_[Industry 1]: Description and adoption status_____
_[Industry 2]: Description and adoption status_____
_[Industry …]: Description and adoption status_____

Leading Industries in Digital Transition: List and describe industries and their adoption status of digital transition:
_[Industry 1]: Description and adoption status_____
_[Industry 2]: Description and adoption status_____
_[Industry …]: Description and adoption status_____

Section 3: Competency gaps (max 1 page)

- **Overview of Competency gaps:**

Please describe are there any statements related to the twin green and digital transition within annual reports from companies in your country and what competencies are lacking in relation to the twin green and digital transition?

Green Competencies: List and briefly describe gaps:
_[Gap 1]: Brief description_____
_[Gap 2]: Brief description_____
_[Gap …]: Brief description_____

Digital Competencies: List and briefly describe gaps:
_[Gap 1]: Brief description_____
_[Gap 2]: Brief description_____
_[Gap …]: Brief description_____

Business Competencies: List and briefly describe gaps:
_[Gap 1]: Brief description_____
_[Gap 2]: Brief description_____
_[Gap …]: Brief description_____

References
Please provide a list of related references*:

ID	Reference name	Source or URL link
1		

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2		
3		
4		
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**You can add as much rows, as you need in this table.*

APPENDIX 3: Template for Curriculum Review

CURRICULUM REVIEW REPORT FOR [Fill in your HEI Name]

Project Title: Fostering Dual Green and Digital Transitions through Education and Innovation in the Neighbourhood East, Central Asia, and Asia
Acronym: GreenTech Horizons

Project Title:	**Fostering Dual Green and Digital Transitions through Education and Innovation in the Neighbourhood East, Central Asia, and Asia**
Project Acronym:	**GreenTech Horizons**
Project partner:	*Fill in the Title of Your institution*
Submitted by (Name & Role):	*Fill in Your Name, Surname and Role in the project*
Date:	*Fill in the date of the submission*
Contact Information:	*Fill in your email address*

Objective

To evaluate how HEI curricula align with green, digital, and business skill demands.

Section 1: Study Programmes and Courses (max 2 pages)

- **Overview of Study Programmes and Courses:**

Please fill in the Table 1 by providing information on any specific study programs and/or modules/ courses on acquiring the twin green and digital transition competences in your Higher Education Institution:

- Are your HE institution public or private?
- Which kind of course (semestral course, specialization, master, undergraduate, *etc.*)?
- What is the duration of these courses?
- Which Faculty/Department is providing these courses?
- Are the twin green and digital transition topics provided as a whole study program, or are they provided as a course or module within it?

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Table 1. Study programmes and courses*

Study programme	Type	Course Title	Competency Coverage	Identified Competency Gaps	Recommendations
[Programme name 1]	[Bachelor/ Master/ Specialization, *etc*.]	[Course Name 1]	Green: [High/Medium/Low]	Lack of practical applications	Include hands-on project components.
			Digital: [High/Medium/Low]	Insufficient focus on emerging tech	Add modules on AI and IoT applications.
			Business: [High/Medium/Low]	Limited training in entrepreneurial skills	Introduce a startup workshop module.
[Programme name 2]	[Bachelor/ Master/ Specialization, etc.]	[Course Name 2]	Green: [High/Medium/Low]	No connection to sustainability practices	Develop a sustainability component.
			Digital: [High/Medium/Low]	Limited digital tool application	Include training on industry-specific tools.
			Business: [High/Medium/Low]	Limited training in leadership	Include training on industry-specific leading practices.

**You can add as much rows, as you need in Table 1.*

References

Please provide a list of related references*:

ID	Reference name	Source or URL link
1		
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**You can add as much rows, as you need in this table.*

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APPENDIX 4: Survey Structure

ONLINE SURVEY FORM

Project Title: Fostering Dual Green and Digital Transitions through Education and Innovation in the Neighbourhood East, Central Asia, and Asia
Acronym: GreenTech Horizons

Project Title:	**Fostering Dual Green and Digital Transitions through Education and Innovation in the Neighbourhood East, Central Asia, and Asia**
Project Acronym:	**GreenTech Horizons**
Period for data collection:	**From 12th of December, 2024 to 12th of January, 2025**
URL link:	https://www.surveymonkey.com/r/LN6QGYZ

Document content

Dear participant,

We invite you to share your valuable insights through a brief, anonymous survey focused on the skill needs arising from the twin green and digital transition in the Neighborhood East, Central Asia, and Asia. Your input will play a key role in helping Higher Education Institutions adapt to meet emerging industry demands and bridge skill gaps for the future. Completing the survey will take no more than 10 minutes of your time.

Your expertise is vital to shaping strategies for a sustainable and digital future. Thank you for your time and input!

Your participation in this survey is voluntary, and your responses will be anonymized and used solely for project GreenTech Horizons (Project no. 101177203 ERASMUS-EDU-2024-CBHE} purposes. By continuing, you agree to the collection and processing of your data in compliance with the applicable EU, international and national law on data protection (in particular, Regulation 2016/679, Directive 95/46/EC ("GDPR")).

Please note: You can select your preferred language in the top-right corner of this survey window for a smoother experience.

Section I: Demographic questions

1. **What sex were you assigned at birth?** (Please select one)
   - ☐ Male
   - ☐ Female

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☐ Prefer not to say

2. **What is your age group?** (Please select one)
   - ☐ 18-24
   - ☐ 25-34
   - ☐ 35-44
   - ☐ 45-54
   - ☐ 55-64
   - ☐ 65+

3. **What is your country of residence?** (Please select one from the list)
   - ☐ Azerbaijan
   - ☐ Croatia
   - ☐ Kazakhstan
   - ☐ Latvia
   - ☐ Lithuania
   - ☐ Mongolia
   - ☐ Poland
   - ☐ Serbia
   - ☐ Other (please specify): _____

4. **Which sector best describes your primary area of affiliation?** (Please select one)
   - ☐ Industry/Private Sector
   - ☐ Academia/Education
   - ☐ Public Sector/Government
   - ☐ Other (please specify): _____

If your answer to this question was "Academia" or "Public Sector", please proceed directly to question 18 to continue. If not, please proceed with the next question.

5. **What is the size of the institution that you are working in?** (Please select one)
   - ☐ Micro (1–9 employees)
   - ☐ Small (10–49 employees)
   - ☐ Medium (50–249 employees)

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☐ Large (250+ employees)

6. **What is your current job position?** (Please select one)
   - ☐ Entry-level specialist
   - ☐ Mid-level professional
   - ☐ Senior professional
   - ☐ Manager/Director
   - ☐ Executive/C-level expert
   - ☐ Other (please specify) _____

7. **Which industry sector are you working in?** (Please select one)
   - ☐ Agriculture, Forestry, Fishing
   - ☐ Automotive and Transportation Equipment Manufacturing
   - ☐ Chemical and Pharmaceutical Manufacturing
   - ☐ Construction and Civil Engineering
   - ☐ Digital Platforms and E-Commerce
   - ☐ Education and Training
   - ☐ Electricity and Gas Distribution
   - ☐ Electronics and Electrical Equipment Manufacturing
   - ☐ Financial and Professional Services
   - ☐ Food and Beverage Manufacturing
   - ☐ Healthcare and Life Sciences
   - ☐ Media and Creative Industries
   - ☐ Mining and Quarrying
   - ☐ Oil and Gas Extraction
   - ☐ Public Sector and Nonprofits
   - ☐ Real Estate Development
   - ☐ Renewable Energy (e.g., Solar, Wind, Hydropower)
   - ☐ Retail, Consumer, and Hospitality
   - ☐ Software Development and IT Services
   - ☐ Steel, Metalworking, and Fabrication
   - ☐ Telecommunications

☐ Transport and Logistics

☐ Water Supply and Waste Management

☐ Other (please specify)_____

Section II: Green, digital, and business skills

8. Rate your knowledge on green and digital transition:

Knowledge on green and digital transition	Not knowledgeable at all	Slightly knowledgeable	Medium knowledgeable	Knowledgeable	Highly knowledgeable
	☆	☆	☆	☆	☆

9. Rate which green-focused competences do you consider most important for a „Green transition" expert:

Competency	1- Absolutely not needed	2- less needed	3-medium needed	4-highly needed	5-extremely needed
Sustainable business practices	☐	☐	☐	☐	☐
Environmental impact assessment	☐	☐	☐	☐	☐
Carbon footprint analysis and reduction	☐	☐	☐	☐	☐
Circular economy principles (e.g., reuse, recycling)	☐	☐	☐	☐	☐
Waste management and minimization	☐	☐	☐	☐	☐
Energy efficiency strategies	☐	☐	☐	☐	☐
Resource conservation and sustainable sourcing	☐	☐	☐	☐	☐
Compliance with environmental regulations and standards	☐	☐	☐	☐	☐
Green supply chain management	☐	☐	☐	☐	☐
Sustainability reporting and performance measurement	☐	☐	☐	☐	☐
Climate risk assessment and management	☐	☐	☐	☐	☐
Integration of renewable energy solutions	☐	☐	☐	☐	☐
Green innovation and R&D	☐	☐	☐	☐	☐
Lifecycle assessment of products and services	☐	☐	☐	☐	☐
Eco-friendly product design	☐	☐	☐	☐	☐

10. Rate which digital-focused competences do you consider most important for a „Digital transition" expert:

Competency	1- Absolutely not needed	2- less needed	3-medium needed	4-highly needed	5-extremely needed

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Data collection, analysis, and interpretation	☐	☐	☐	☐	☐
IT basics (e.g., Microsoft Office, Google Workspace).	☐	☐	☐	☐	☐
Cybersecurity	☐	☐	☐	☐	☐
Cloud computing (e.g., AWS, Azure, Google Cloud).	☐	☐	☐	☐	☐
Workflow automation (e.g., RPA software)	☐	☐	☐	☐	☐
Collaborative digital tools (e.g., Slack, Trello).	☐	☐	☐	☐	☐
Digital marketing techniques (e.g., SEO, digital advertising techniques, marketing in social media)	☐	☐	☐	☐	☐
E-commerce platforms	☐	☐	☐	☐	☐
Artificial intelligence and machine learning	☐	☐	☐	☐	☐
Programming and software development	☐	☐	☐	☐	☐
User experience (UX) design (UX/UI design, design tools, customer-centric design)	☐	☐	☐	☐	☐
Emerging technologies (e.g., Blockchain technology, IoT, AR, VR)	☐	☐	☐	☐	☐

11. Rate which business-focused competences do you consider most important for a "Twin green and digital transition" expert:

Competency	1- Absolutely not needed	2- less needed	3-medium needed	4-highly needed	5-extremely needed
Leadership	☐	☐	☐	☐	☐
Management skills	☐	☐	☐	☐	☐
Financial and analytical skills	☐	☐	☐	☐	☐
Communication and interpersonal skills	☐	☐	☐	☐	☐
Marketing and sales skills	☐	☐	☐	☐	☐
Problem-solving and critical thinking	☐	☐	☐	☐	☐
Time management and organization	☐	☐	☐	☐	☐
Customer-centric skills	☐	☐	☐	☐	☐
Entrepreneurial skills	☐	☐	☐	☐	☐
Innovation skills	☐	☐	☐	☐	☐
Legal and regulatory awareness	☐	☐	☐	☐	☐
Soft skills (Collaboration, teamwork, mentoring and coaching)	☐	☐	☐	☐	☐

12. Which of the following green skills does your company currently use? (Select all that apply)

☐ Sustainable business practices

☐ Environmental impact assessment

☐ Carbon footprint analysis and reduction

☐ Circular economy principles (e.g., reuse, recycling)

☐ Waste management and minimization

☐ Energy efficiency strategies

☐ Resource conservation and sustainable sourcing

☐ Compliance with environmental regulations and standards

☐ Green supply chain management

☐ Sustainability reporting and performance measurement

☐ Climate risk assessment and management

☐ Integration of renewable energy solutions

☐ Green innovation and R&D

☐ Lifecycle assessment of products and services

☐ Eco-friendly product design

☐ Other (please specify)_____

13. **Which of the following digital skills does your company currently use?** (Select all that apply)

☐ Data collection, analysis, and interpretation

☐ IT basics (e.g., Microsoft Office, Google Workspace).

☐ Cybersecurity

☐ Cloud computing (e.g., AWS, Azure, Google Cloud).

☐ Workflow automation (e.g., RPA software)

☐ Collaborative digital tools (e.g., Slack, Trello).

☐ Digital marketing techniques (e.g., SEO, digital advertising techniques, marketing in social media)

☐ E-commerce platforms

☐ Artificial intelligence and machine learning

☐ Programming and software development

☐ User experience (UX) design (UX/UI design, design tools, customer-centric design)

☐ Emerging technologies (e.g., Blockchain technology, IoT, AR, VR)

☐ Other (please specify)_____

14. **Which of the following business skills does your company currently use?** (Select all that apply)

- ☐ Leadership
- ☐ Management skills
- ☐ Financial and analytical skills
- ☐ Communication and interpersonal skills
- ☐ Marketing and sales skills
- ☐ Problem-solving and critical thinking
- ☐ Time management and organization
- ☐ Customer-centric skills
- ☐ Entrepreneurial skills
- ☐ Innovation skills
- ☐ Legal and regulatory awareness
- ☐ Soft skills (Collaboration, teamwork, mentoring and coaching)
- ☐ Other (please specify)_____

Section III: Green, digital, and business skill gaps

15. **What specific green-related skills (e.g., knowledge of circular economy practices, carbon management, or environmental compliance) do you expect employees or recent graduates to bring to your organization?** (Please select one)

- ☐ Skills in sustainable energy systems
- ☐ Skills in environmental science and technology
- ☐ Skills in renewable energy engineering
- ☐ Skills in circular economy and resource management
- ☐ Skills in green business and corporate social responsibility
- ☐ Skills in waste management and recycling technologies
- ☐ Skills in water resource management
- ☐ Skills in sustainable engineering
- ☐ Skills in environmental policy and compliance
- ☐ Other (please specify)_____

16. **Which digital-related knowledge is most critical for employees or graduates to master to succeed in your organization's digital transformation goals?** (Please select one)

☐ Knowledge in digital transformation and sustainability

☐ Knowledge in smart technologies for sustainability

☐ Knowledge in sustainable digital Infrastructure

☐ Knowledge in green computing and ICT

☐ Knowledge in cyber-sustainability

☐ Knowledge in data analytics for sustainability

☐ Knowledge in AI and Machine Learning for green solutions

☐ Knowledge in Internet of Things (IoT) for environmental monitoring

☐ Knowledge in Blockchain for sustainable supply chains

☐ Knowledge in Digital Twins

☐ Other (please specify)_____

17. **What business skills, such as aligning digital or sustainability initiatives with strategic goals (e.g., cost savings, market competitiveness, or customer satisfaction), are essential for employees or graduates entering your industry?** (Please select one)

☐ Skills in green entrepreneurship and innovation

☐ Skills in green marketing

☐ Skills in sustainable business communication

☐ Skills in sustainable project management

☐ Skills in green business and corporate social responsibility

☐ Skills in sustainable economy

☐ Skills in environmental risk assessment and management

☐ Skills in circular business models

☐ Skills in renewable energy policy and economics

☐ Skills in carbon accounting and offsetting strategies

☐ Skills in sustainable supply chains and their management

☐ Other (please specify)_____

Section IV: HEI's Role

18. **Which specific study areas in higher education institutions (HEIs) would primarily focus on addressing the twin green and digital transitions? (Select all that apply):**

☐ Educational Sciences

☐ Physical Sciences

☐ Humanities

☐ Computer Science

☐ Engineering Sciences

☐ Mathematical sciences

☐ Arts

☐ Social sciences

☐ Technological sciences

☐ Business and Public Management

19. How can HEIs collaborate more effectively with industries to align graduate competencies with current and emerging workforce demands in sustainability and technology? (Rank from 1-highest importance to 10-lowest importance)

1. ↔ Developing industry-relevant curricula
2. ↔ Developing industry-relevant study modules
3. ↔ Providing specialized training and certifications for green and digital skills
4. ↔ Enhancing opportunities for academia-industry collaboration through joint study and/or research projects and innovation hubs.
5. ↔ Participating in industry-driven internship and apprenticeship programs to bridge skill gaps for students and professionals.
6. ↔ Conducting applied research on sustainability and digital transformation challenges specific to the country industry.
7. ↔ Hosting workshops and seminars
8. ↔ Creating flexible and modular learning programs (e.g., micro-credentials) tailored to industry professionals.
9. ↔ Providing access to academic expertise and resources to solve practical industry challenges in green and digital transitions.
10. ↔ Other (please specify)_____

20. Rate what specific digital skills do you think HEI curricula should prioritize in order to meet better the demands of twin green and digital transition?

Digital skills in:	1-absolutely no priority	2-low priority	3-medium priority	4-high priority	5-extreme priority
Blockchain	☐	☐	☐	☐	☐
Internet of Things (IoT)	☐	☐	☐	☐	☐
Artificial Intelligence (AI)	☐	☐	☐	☐	☐
Machine Learning (ML)	☐	☐	☐	☐	☐
Virtual Reality (VR)	☐	☐	☐	☐	☐
Augmented Reality (AR)	☐	☐	☐	☐	☐

Software engineering	☐	☐	☐	☐	☐
Advanced simulation tools	☐	☐	☐	☐	☐
Digital Twins (DT)	☐	☐	☐	☐	☐
Robotic systems	☐	☐	☐	☐	☐
Autonomous systems	☐	☐	☐	☐	☐
Cybersecurity	☐	☐	☐	☐	☐
Information security	☐	☐	☐	☐	☐
Network security	☐	☐	☐	☐	☐
Communication technologies and networks	☐	☐	☐	☐	☐
Information Technologies	☐	☐	☐	☐	☐
Data analytics	☐	☐	☐	☐	☐
Other (please specify)_____	☐	☐	☐	☐	☐

21. Rate in what areas HEI curricula should prioritize specific green skills in order to meet better the demands of twin green and digital transition?

Areas for green skills:	1-absolutely no priority	2-low priority	3-medium priority	4-high priority	5-extreme priority
Sustainable energy systems	☐	☐	☐	☐	☐
Sustainable engineering	☐	☐	☐	☐	☐
Environmental impact assessment techniques	☐	☐	☐	☐	☐
Advanced waste management	☐	☐	☐	☐	☐
Recycling technologies	☐	☐	☐	☐	☐
Lifecycle assessment	☐	☐	☐	☐	☐
Circular design principles	☐	☐	☐	☐	☐
Risk assessment	☐	☐	☐	☐	☐
Safety protocols for green technology implementation	☐	☐	☐	☐	☐
Decision-making frameworks for environmental compliance	☐	☐	☐	☐	☐
Other (please specify)_____	☐	☐	☐	☐	☐

22. Rate what specific business skills do you think HEI curricula should prioritize in order to meet better the demands of twin green and digital transition?

Business skills	1-absolutely no priority	2-low priority	3-medium priority	4-high priority	5-extreme priority
Leadership	☐	☐	☐	☐	☐
Management skills	☐	☐	☐	☐	☐
Financial and analytical skills	☐	☐	☐	☐	☐

Communication and interpersonal skills	☐	☐	☐	☐	☐
Marketing and sales skills	☐	☐	☐	☐	☐
Problem-solving and critical thinking	☐	☐	☐	☐	☐
Time management and organization	☐	☐	☐	☐	☐
Customer-centric skills	☐	☐	☐	☐	☐
Entrepreneurial skills	☐	☐	☐	☐	☐
Innovation skills	☐	☐	☐	☐	☐
Legal and regulatory awareness	☐	☐	☐	☐	☐
Soft skills (Collaboration, teamwork, mentoring and coaching)	☐	☐	☐	☐	☐
Other (please specify)_____	☐	☐	☐	☐	☐

23. Rate: how important is the inclusion of certifications related to green skills, digital skills, or sustainable business practices (e.g., in AI, cybersecurity, ICT, data analytics, etc.) as part of HEI programs to enhance employability?

Absolutely not needed	Less needed	Medium needed	Highly needed	Extremely needed
☆	☆	☆	☆	☆

Section V: Key challenges for TG&DT

24. What specific skills and competencies do you anticipate will be most critical for the workforce over the next 5–10 years to thrive in the twin green and digital transitions?

Please write 2-3 competencies or skills here_____

25. What are the biggest challenges in preparing the current and future workforce for the demands of green and digital transitions, and how can these be addressed?

Please write your opinion here_____

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APPENDIX 5. Interview Guide

INTERVIEW WITH HIGHER EDUCATION INSTITUTION(S) REPORT FOR []

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

Acronym: GreenTech Horizons

Project Title:	**Fostering Dual Green and Digital Transitions through Education and Innovation in the Neighbourhood East, Central Asia, and Asia**
Project Acronym:	**GreenTech Horizons**
Project partner:	*Fill in the Title of Your institution*
Submitted by (Name & Role):	*Fill in Your Name, Surname and Role in the project*
Date:	*Fill in the date of the submission*
Contact Information:	*Fill in your email address*

Objective

To collect insights from Higher Education Institutions (HEIs) in Azerbaijan, Kazakhstan, and Mongolia on green, digital, and business skill requirements, gaps, and their role in advancing the Twin Green and Digital Transition.

Section 1: General information

— **Information about the interviewees**

Please provide details about the interviewees, including 1) the participants information—the number of participants, the interview modality (online or in-person), and the country; and 2) details of interviewees—the full name, role, Higher Education Institution (HEI), and email address for each participant, using a structured format in the online form of the List of Interviewees.

	In presence:	Online:
Number of participants	*Fill in number of participants*	*Fill in number of participants*

Country:	*Fill in Country Name*	

#	First Name	Last Name	Role	HEI name	email (optional)	Interview in presence (y/n)	Interview online (y/n)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

Section 2: Interview guide and questions

- **Guide for the interviews:**
  - The minimum number of interviewees is 15 per HEI.
  - The interviewees should be characterized by homogeneity, but with sufficient variation among participants to allow for contrasting opinions (e.g., academic, non-academic, students, EdTech personal)
  - Participants should be probed on their perceptions, opinions, beliefs, and attitudes regarding Twin Green and Digital transition.
  - Please record the interview session. It can help you to write a report.
- **Guide for the outline of the interview:**
  - Firstly, briefly introduce the GreenTech Horizons project and describe the aims of this interview.
  - Secondly, begin conducting interviews on the Twin Green and Digital transition, adhering to the outline provided below.

In the following, we are going to exchange our ideas regarding Twin Green and Digital transition.

Category of the questions	Questions
Concept of Twin Green and Digital transition	1. What (pre-)knowledge, skills, and attitudes are advantageous for the development of green, digital, and business competencies?
Interventions to address green, digital, and business competencies	2. Which instructional methods are used in your organization for competence development? (e.g., classroom-based training, online courses, e-learning platforms, blended learning (a combination of online and in-person training), workshops, seminars, mentoring programs, one-on-one sessions, gamified learning, simulations, self-directed learning resources such as books, manuals, or online tutorials, collaborative projects, team-based learning, etc.) 3. Would you say you are satisfied with the current courses offered that cover green, digital, and business competencies? 4. Are these competencies promoted at your university? If yes, how exactly? Do you use more formal, non-formal, or informal learning approaches? (HEI courses, training for the industry, micro-credentials, online courses on online platforms, *etc*.)
Challenges	5. What do you think are the greatest challenges in becoming a recognized Twin Green and Digital transition specialist in your country? What path should a professional take to become Twin Green and Digital transition specialist?
Validation & assessment of green, digital, and business competencies	6. Do you use a tool or a validation approach to assess green, digital, and business competencies at your university? If yes, which one? Please describe. 7. Are IT instruments needed for this? If so, could you please describe the specific IT instruments required? 8. Do you have a reference system or competence framework that you refer to by assessing green, digital, and business competences at your university? If yes, which one? Please describe. (You can give examples, like European Quality Framework (EQF); European Skills, Competences, Qualifications, and Occupations (ESCO); *etc*.)
Recognition of green, digital, and business competencies	9. Is your university certifying the acquisition of competencies related to green, digital, and business? And in your country? Are these competencies recognized?
Final remarks	10. Are there other recommendations/ suggestions/ comments on this topic, that you would like to make?

Section 3: Reporting the outcomes of the interviews (max 3-page report per HEI)

Please report the main outcomes from the interview focusing on the following elements:

- What were the most important issues or ideas discussed? What points should be highlighted?
- What findings were unexpected?
- Please describe the most valuable insights gained from your side during the interviews.
- From what was discussed in the interviews, what are the most important green, digital, and business competencies?

Provide your report in the frame of the outline that you have used during the interview (see Section 2):

Concept of Twin Green and Digital transition: _____

_____

Interventions to address green, digital, and business competencies: _____

_____

Challenges: _____

_____

Validation & assessment of green, digital, and business competencies: _____

_____

Recognition of green, digital, and business competencies: _____

_____

Final remarks: _____

_____

_____