# D1.2 - Report on policy barriers and requirements

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## Preface: Reflections on the alignment of universities and their leaderships by the ESEIA President Brian Norton

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### Introduction

With a multiplicity of missions, forms of statutory establishment and regulation, subject mixes and physical and cultural contexts, universities exhibit a wide, but necessary, diversity. Many comparative insights, lessons and trends thus can be drawn from across the multiple evaluations of universities conducted in the EUA-IEP and in other contexts. Many paradoxes can become apparent. One of these is that, **occasionally**, **"cause does not lead to effect".** More specifically, sometimes seemingly insightful and well-meaning university leaderships are demonstrably unsuccessful. Conversely, sometimes apparently successful institutions are "led" by seemingly very detached leaderships. **Usually there is some coherence between leadership and outcomes**. Even then, that does not inevitably lead to success. Some possible reasons underlying these institutional alignments and misalignments are examined in this short paper.

### Background

Each aspect of a university's work is evaluated differently. Evaluations of the effectiveness of leadership practice can take various forms. These include, for example, **objective assessments of the extent to which specified time-limited goals have been achieved**. Evaluations of quality vary depending on the specific outcomes being assessed. **For teaching and learning**, quality criteria can, again for example, include student progress and achievement, student satisfaction and relevance of graduate attributes. **For research, innovation and "third mission"** social and economic engagements, the quality of their impacts can be assessed by a variety of indices and evidence depending on the contexts of activity, discipline and operating environment.

An **indicative and illustrative subjective mapping of effectiveness of leadership practice** to the **corresponding quality of outcomes** is shown in Figure 1 (below).

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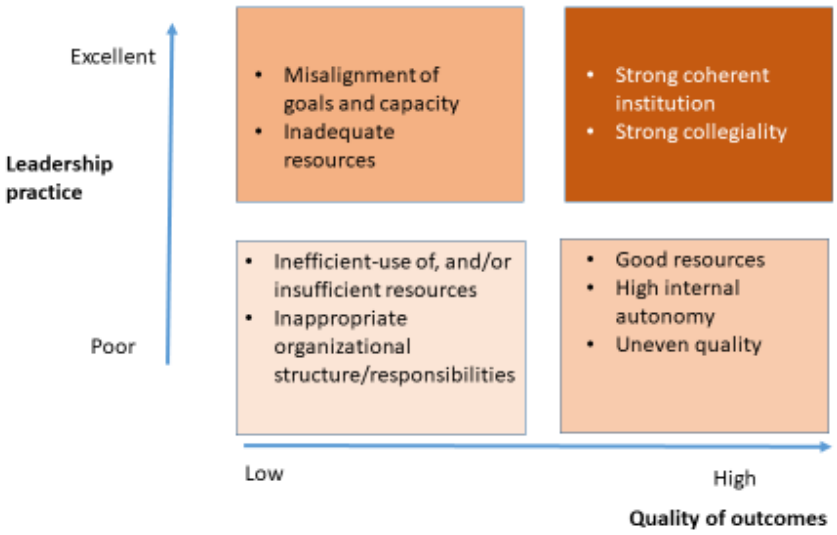


Figure 1. An indicative mapping of university leadership effectiveness to quality of outcomes

**Discussion**

As indicated in the upper left quadrant of Figure 1, the **ideal paradigm** is that leadership practice and outcomes are excellent meaning such institutions (as examples) have **clear achievable goals, excellent international communication and engagement with clear organizational responsiveness and responsibility**. This is combined with an **effective set of collegial decision-making processes and effective use of resources**. Obviously, this a utopia, real institutions will in certain aspects and at particular times fall short of this. However, many universities do approach this paradigm, not in some general sense but in the context of their own particular missions.

The **worst case** is indicated in the lower right-hand quadrant of figure 1. Again, as with the ideal paradigm, the worst case is, in its extremity, very rare. However, there are **many institutions do not have adequate resources** to achieve their goals but stubbornly **refuse to reset more attainable objectives**. This leads to **low morale and disenchantment**.

Equally common are **institutions with sensible goals but their organizational structures do not allocate clear responsibilities** for the execution of detailed plans to achieve those goals. This can ensue, for example, **when immutable structures are set by government statutes and/or key roles are neither resourced appropriately nor effectively embedded in decision-making processes**.

The upper-left and lower-right quadrants of figure 1 are intuitive. Less so are the circumstances in the lower-left and upper-right of figure 1, aspects of both of which are quite common.

The upper left quadrant is **where management practice is excellent but the quality of outcomes remains poor**. This can arise when goals are achieved but, perhaps because of legacy issues, those **goals are too limited** as much greater change and progress is necessary. This can be because there is a **low capacity for change across the institution as a whole**. That in turn may, at its root, be related to **inadequate resources**, often in the context of **low salaries** that inhibits the attractiveness of a university as an employer.

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**High student attrition**, particularly in the first year of programmes, can arise where national policies incentivize very large, but **largely unmotivated and uncommitted, initial student intakes**.

**Institutions that fall within the lower right-hand column** of figure 1 **are extremely well-resourced**. However much of those resources often accrue directly to **distinct parts of the university**. The latter leads to both extensive local autonomy and introduce and maintain a **multiplicity of sub-institutional cultures and practices**. **Such institutions succeed despite, rather than because of, their overall leadership.** In the extreme, overall university leadership roles becomes restricted in practice to advocacy, fundraising and celebration of achievement. However, even in such gilded settings challenges still arise. Most of these are caused by **increasingly uncontrolled unevenness** between different parts of the university, their facilities and their students' experiences. As a consequence, the **leadership role often becomes one of deciding what to do with the relatively failing** (that in another institution would be seen as successful) parts of their university.

**Conclusion**

The categorization of leadership and outcomes postulated in figure 1 is obviously presents a highly simplified perspective on the multifaceted challenges of maintaining a successful university.

Nevertheless, it **does provide a potential route to positioning institutional performance**, or the performance of part of an institution. **It essentially identifies whether it is a strategy (top-left quadrant) or its implementation (lower-left quadrant) that needs to be improved or, more often, fundamentally changed.**

It can also be concluded that whatever the current condition of a university, to avoid some of the pitfalls discussed, **a university must always maintain an inclusive capacity of objective self-analysis and change.** In support of the latter, **universities should consider objective external evaluation**, such as that as provided by the EUA-IEP.

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# Executive Summary

Higher Education Institutions in Widening Countries play an important role in fostering research and innovation for the green and digital transformation. Since the R&I performance of HEIs in Widening Countries lags behind the average performance in EU member countries, the EEI Initiative funds projects like INITIATE to discover ways of improving this situation.

This deliverable explores barriers that hinder best performance, both externally and internally, and highlights strengths and initiatives, defines key requirements, and discusses 20 good practice cases, and possibility of their replication. The review of best practices identifies key objectives, specific scenarios, technologies, target audience, and relevant stakeholders involved.

Finally, when it comes to institutional responsibility, the report also highlights ways to optimise institutional management in striving for excellence. One of the main conclusions drawn is that HEIs in the Widening countries should engage with European thematic alliances like ESEIA which facilitate access to funding, cutting-edge technologies, and global networks, and enable them to advance the green and digital transitions.

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# 1. Introduction

## 1.1 Background and Context

**Higher Education Institutions (HEIs) play a pivotal role for driving innovation, economic growth, and social progress in Europe.** They serve as hubs for knowledge creation, education, technological advancement, and societal innovation, which are essential for fostering sustainable development and competitiveness.

**If HEIs do not perform at their best they cannot be fully effective in driving our societies through research and innovation, let alone help tackle the energy and digital transitions** (ref. to Preface by **ESEIA President Brian Norton** who correlated leadership practice with success of HEIs). This is why the EC have created the **European Excellence Initiative (EEI) within HORIZON** as an action that engages with HEIs and empowers them further to be actors of change in R&I. It raises excellence in science and in **value creation through deeper and geographically inclusive cooperation in alliances of higher education institutions**.

## 1.2 Purpose of the Deliverable

This deliverable created by the **European Sustainable Energy Innovation Alliance - ESEIA** (ref. ESEIA in a Nutshell in Annex 5) in collaboration with ISCTE and INITIATE partners puts its fingers on main policy barriers and requirements in the Widening Countries. We ask why the performance of HEIs is lower by **identifying barriers and highlighting strengths** by pointing at opportunities and initiatives in a number of Widening countries (Chapter 2), to define **key requirements for success** and actions to be implemented more widely in Widening countries (Chapter 3), draws attention to **best practice in relation to green and digital transitions** to be followed (Chapter 4), and provides **recommendations for transformation** policies targeting a future HEI ecosystem (Chapter 5).

## 1.3 The importance of R&I in Widening Countries

The European Commission adopted the **Communication on a New ERA for Research and Innovation** in 2001 to improve the European research and innovation landscape, to accelerate the European Union's transition towards climate neutrality and digital leadership.

The Communication prioritises **investments and reforms in R&I,** to improve access to excellence for researchers across the EU, to enable research results to reach the market and the real economy and to strengthen the mobility of researchers and free flow of knowledge.

This deliverable is dedicated to the Widening countries because they have been identified as having **lower levels of research and innovation performance** compared to more advanced countries in the EU. They are also struggling more with the digital and energy transitions. To strengthen the European Research Area we need all European countries to perform better.

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15 EU Members States are among the Widening Countries

'**Widening Participation and Spreading Excellence'**

The term 'widening' describes the effort of broadening participation in R&I activities. The term 'excellence' is used to explain the aim of raising R&I capacity of widening countries by establishing permanent and pervasive sustainable infrastructure.

Widening measures under previous framework programmes have triggered advanced reforms and changes within national research and innovation systems, encouraged new partnerships and introduced new scientific curricula, extended networks, encouraged more peer reviewed international publications and opened up established research partnerships.

In recent years, the Widening countries have increased their participation under Horizon 2020. On average, as of February 2021, it represented 5.1% of the total Horizon 2020 budget allocated so far (up from 4.2% in the Seventh Framework programme, FP7 and 4.8% in 2018).

The **Widening actions receive 3.3% of the total Horizon Europe budget** and play a central role in strengthening the European Research Area.

### 1.4 R&I Performance of Widening Countries

The INITIATE partnership (ref. Annex 1) includes Higher Education Institutions (HEIs), Research Organisations (ROs), Businesses, and the European Sustainable Energy Innovation Alliance from the following countries:

- 6 EU Member States: **Austria** (only non-Widening Country), **Croatia, Cyprus, Portugal, Romania, Slovenia**
- 5 Associated Countries: **Bosnia-Herzegovina, Morocco, North Macedonia, Serbia, Ukraine** (Ukraine has been in a state of disruption caused by the war with Russia since Feb 2022.)

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14 Associated Countries and the Outermost Regions are eligible for hosting a Widening Coordinator

What becomes apparent from the 2024 European Innovation Scoreboard is that **the innovation divide persists** despite a slight decrease in the disparities in innovation performance across Europe. Europe will therefore need to **enhance cohesion among European players** to catch up with global R&I performance leader South Korea as well as Canada, the United States, and Australia.

According to the European Innovation Scoreboard R&I performance of the countries involved in INITIATE looks as follows:

- None of the INITIATE countries belong to the group of **Innovation leaders** with innovation performance well above the EU average. This group is headed by Switzerland followed by Denmark, Sweden, Finland and the Netherlands (in performance order).
- **Austria** (3rd rank after Norway) is among the **Strong Innovators** with performance above EU average. This group is led by Belgium. It is noteworthy that the Widening country **Cyprus** (7th after Germany) is also in this group. It had the largest performance increase since 2017.
- **Slovenia** leads the **Moderate Innovators** with performance below EU average and **Portugal** ranks 7th in this group.
- Finally, **Croatia** leads the **Emerging Innovators** with performance well below the EU average (below 70% of EU average) including **Serbia** (4th), **North Macedonia** (9th), **Romania** (10th), **Bosnia-Herzegovina** (11th), and **Ukraine** (12th).

Overall, **the Emerging Innovators demonstrated faster growth** on average than their EU peers15 from innovation leaders and strong innovators, pointing to a catching-up effect.

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# 2. Policy barriers and opportunities

This section synthesizes insights from the realms of **green transition (GT)**, **digital transition** (DT), and **research & innovation in** HEIs, focusing on both external challenges and internal strategies with some European countries as examples. The information gathered by country, both at external and internal levels, aims to

- **identify barriers** that slow down GT, digitalization and research & innovation (R&I) in HEI,
- **identify opportunities** that accelerate DT, digitalization and innovation in HEIs, and
- **identify and exploit the gaps between the Widening and non-Widening countries**.

A list of **ongoing initiatives** is also presented. Specifically, information is presented for the following Widening countries: **Cyprus, Croatia, North Macedonia, Portugal, Romania, Serbia, and Ukraine**. Non-Widening countries include **Austria**.

## 2.1 Main Findings

### Barriers to Green Transition

The GT faces several key external obstacles, including financial and regulatory barriers. These challenges include the absence of a connection fee for renewable energy sources (RES), insufficient incentives for investors, high initial costs, limited market access, and the complexity of backup systems. Additionally, a lack of legislation to support energy communities and outdated energy infrastructure—such as inadequate grids—further hinders progress. The regulatory framework adds another layer of difficulty, with bureaucratic procedures and rigid licensing processes slowing down the approval of green projects. Moreover, decision-making inertia, coupled with low environmental awareness and social acceptance, impedes the adoption of green technologies. Legacy systems, traditional academic culture, and a shortage of skilled workers also contribute to slow progress in advancing the GT. These factors combine to limit the innovation and technological advancements needed to drive sustainable energy solutions.

At internal level HEIs face significant challenges in their efforts to contribute to the GT. One of the primary obstacles is the struggle to secure adequate financing or subsidies for the high initial costs associated with green energy projects, which undermines economic sustainability across society. Additionally, legal restrictions on installing solar equipment due to property protection laws further limit HEIs' ability to implement renewable energy solutions. The lack of a coherent strategy or concrete plans for enhancing building energy efficiency, along with the absence of a specific timeline for reducing carbon footprints, also poses substantial barriers. Moreover, internal coordination deficiencies and a scarcity of industry-led R&I initiatives hinder progress. Structural challenges and organizational complexity contribute to this inertia, often exacerbated by an aging workforce and inadequate pay, which slows the transition to greener practices. These factors collectively impede HEIs' potential to lead and innovate in the pursuit of sustainability.

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### Opportunities to Green Transition

The GT offers substantial opportunities across various sectors, particularly in the energy industry. The shift towards cleaner and more technologically advanced energy practices is supported by strategies that emphasize the integration of digitalization and green initiatives. Legislative certainty enhances the viability of these initiatives, while national institutions actively promote social and scientific participation in the transition process. Additionally, long-term strategies incentivizing renewable energy installation through market premiums create a conducive environment for rapid growth in the renewable energy sector. The development of GT not only engages diverse stakeholders but also encourages educational institutions to incorporate cutting-edge technologies into their curricula, fostering a skilled workforce for the future. Furthermore, there are significant opportunities in establishing energy communities and promoting self-consumption of renewable energy, which can further accelerate the adoption of sustainable practices. Focusing on renewable energy, agri-food, and environmental technologies presents pathways for optimizing and digitizing processes, integrating advanced technologies, and supporting research and development in innovative environmental solutions. Attracting international investments is crucial for expanding these initiatives. Additionally, enhancing public and business awareness through educational campaigns can foster greater environmental consciousness and support for the GT, ultimately contributing to a more sustainable future.

At internal level HEIs have significant opportunities to contribute to the GT by leveraging their scientific potential and untapped human resources to enhance educational programs and drive initiatives. By fostering collaboration with industries and research institutions, HEIs can strengthen their academic impact while promoting energy efficiency strategies and demonstrating green energy technologies. Additionally, HEIs can innovate their education systems to encourage behavioral changes, stimulate the adoption of green technologies, and advance waste management and resource recovery through targeted education and awareness initiatives. Integrating knowledge with existing infrastructure, such as linking renewable energy installations with student activities, further amplifies these efforts. Moreover, HEIs can play a crucial role in establishing a decentralized and environmentally friendly energy framework by collaborating to develop shared green energy systems. Existing renewable energy installations and opportunities to retrofit damaged buildings for improved energy efficiency serve as drivers for the GT. By actively engaging in these initiatives, HEIs not only contribute to sustainability efforts but also prepare students to become leaders in the transition toward a more sustainable future.

### Barriers to Digital Transition

The DT faces in external level several significant barriers that impede progress across various sectors. A lack of funding for the private sector and inadequate financial support limit investments in digital technologies, while exposure to non-EU laws and political influences creates obstacles to digitalization and the maintenance of public electronic services. Additionally, the absence of a unified legislative and procedural framework, as well as a regulatory framework for the interoperability of government Information technology (IT) systems and data registers, further complicates the digital landscape. There are also insufficient mechanisms to sanction those that fail to comply with deadlines for implementing digital technologies. Additionally, low levels of digital skills and literacy among the population and workforce hinder effective engagement with new technologies. High costs and the unavailability of high-speed internet, particularly in rural areas, limit the usage of digital technologies. Outdated infrastructure often proves incompatible with modern devices, while employers may underestimate the benefits of digitalization, leading to resistance and slow adoption across sectors like education and industry. This reluctance, combined with a shortage of IT specialists and insufficient

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training in areas like digital literacy and cybersecurity, creates a skills gap that hampers innovation and global competitiveness. Concerns about digital sovereignty and cybersecurity risks further exacerbate these challenges, hindering the full embrace of digital transition.

The DT within HEIs faces numerous obstacles that impede effective implementation and progress. A significant barrier is the lack of funding for investments in digitalization, which limits the ability to upgrade outdated IT infrastructure and adopt modern digital learning platforms. Additionally, dependence on foreign technologies can restrict innovation and customization of digital solutions. The inherent complexity of higher education systems complicates the design of cohesive digital strategies, and the absence of technical support further hinders the successful operation of digital initiatives. Cultural resistance to change within university communities, alongside a lack of necessary digital skills among faculty, staff, and students, creates further challenges to the effective use of new technologies. Moreover, varying levels of digital literacy among faculty and staff present a significant hurdle, with many educators and administrators lacking the skills needed to utilize digital tools effectively. Insufficient training for both staff and students exacerbates these issues, limiting the successful implementation of new digital initiatives. The struggle to attract women to Information and Communication Technology (ICT) educational programs due to societal perceptions and a lack of role models further contributes to the shortage of qualified individuals capable of using advanced digital systems. Overall, these factors create a complex landscape that must be navigated to achieve a successful DT in higher education.

### Opportunities to Digital Transition

The opportunities for DT emphasize a range of collaborative and funding prospects, as well as strategic initiatives aimed at fostering digital transition across different sectors. International organizations and consulting services offer significant support through expertise, networking, and mentorship, helping organizations and start-ups enhance their digital capabilities. National programs, such as the National Recovery Program, the Smart Specialization Strategy, and Digital Croatia Strategy, provide a strong foundation for long-term digitalization, aiming to improve socioeconomic inclusion, bridge the digital divide, and drive digital innovation by tailoring training courses and boosting digital skills in local communities. Furthermore, opportunities for Small and medium-sized enterprises (SMEs), structural funds, and European Digital Innovation Hubs (EDIH) highlight the potential for fostering economic resilience, reducing costs, and enhancing productivity through digitalization. Several national strategies, like the National ICT Strategy 2021-2025 and INCoDe.2030, prioritize connectivity, research, and skill development. In addition, initiatives such as the Digitalization of Public Services and Global Digital Networks support cross-border cooperation, while EU integration aspirations and subsidized investments aim to accelerate digital adoption, increase competitiveness, and address the growing need for digital skills across industries.

Opportunities for digital transition in HEIs and businesses at internal level are diverse. Key initiatives include long-term DT strategies that integrate digital tools into research, education, curriculum delivery, and administrative processes. HEIs are enhancing their capabilities by developing tools such as project databases, matchmaking platforms that connect students with companies, and social internet tariffs to promote inclusivity. These digital tools aim to streamline workflows and boost research capacities while improving the overall learning experience for students. Moreover, there are opportunities for collaboration between HEIs, SMEs, and the government. HEIs offer customized training to upskill SME workforces, providing access to cutting-edge facilities and acting as networking hubs that connect businesses with experts and investors. Innovation ecosystems enable partnerships between students, researchers, and businesses to co-create digital solutions. Additionally, subsidized investments in digital skills have fostered collaboration between HEIs and both the private and public sectors, further driving digital adoption and enhancing workforce capabilities.

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### Barriers to Research & Innovation in Higher Education Institutions

Barriers to R&I in HEIs include inadequate funding, governance issues, and poor strategic planning, which limit their ability to innovate and contribute to a knowledge-based society. Additionally, restrictive legislation complicates the establishment of spin-offs from public universities, reducing opportunities for commercializing research and involving staff in entrepreneurial activities. Weak partnerships between universities, research institutes, and industry also impede the practical application of research results. Further challenges include barriers in doctoral education, such as a lack of defined research positions and restrictive employment policies, which lead to brain drain and hinder the recruitment and retention of young researchers. Bureaucratic obstacles and complex administrative procedures create delays in research and development, slowing down scientific work and innovation within HEIs.

**From an internal perspective**, barriers to R&I in HEIs include outdated career advancement guidelines, unclear intellectual property (IP) rights, traditional academic structures, and financial constraints. These factors, combined with inadequate R&I management, limit the ability of HEIs to foster a dynamic research environment. Additionally, HEIs face difficulties aligning doctoral education with economic needs, which undermines their success in addressing real-world challenges. Other significant barriers include complex administrative requirements, insufficient funding for interdisciplinary research, and limited private sector investment. Poorly defined research roles and the undervaluation of research compared to teaching contribute to the outflow of young talent, driven by inadequate support, incentives, and professional development opportunities. Moreover, insufficient infrastructure, such as outdated equipment and inaccessible data, hampers researchers' work. Local regulations can play a role in addressing these issues by enhancing HEIs' autonomy and supporting tailored academic careers and research agendas.

### Opportunities to Research & Innovation in Higher Education Institutions

Opportunities for R&I in HEIs include increased funding and strategic investments, such as those from Horizon Europe and the Fund for Innovation and Technological Development (FITD). These initiatives are essential for fostering knowledge-based economies and driving societal progress. Supporting research excellence and fostering cross-sector collaboration, particularly in alignment with EU policies on sustainable development and innovation, can further boost the impact of HEIs. Additionally, modernizing research infrastructure is key to enhancing research efficiency and innovation. Access to modern equipment allows universities to conduct high-quality research, while upgrading academic staff qualifications and developing professional skills unlock the innovative potential of HEIs. Collaboration with businesses, participation in EU programs, and international cooperation present further opportunities for sustainable development and industrial partnerships in the research landscape.

**At internal level**, opportunities for R&I in HEIs include leveraging infrastructure and laboratories to enhance collaboration with industry and increase participation in competitive funding. The introduction of the EU "HR Excellence in Research" award, along with local and regional government initiatives, promotes HEI research and highlights renowned researchers, elevating their global reputation. New regulations also support the creation of college spin-offs, enabling commercialization of research results and providing incentives for researchers while generating additional revenue streams for institutions. HEIs are strengthening their governance structures through faculty development programs, incubation and acceleration initiatives, and strategic funding mechanisms. Additionally, new support structures for managing interdisciplinary research in fields like energy, robotics, and health are being established. HEIs are further advancing research by engaging in international networks, industry partnerships, and interdisciplinary research centers, with local governments actively promoting collaboration and creating centers of global expertise.

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## 2.2 Green Transition

### 2.2.1. Barriers to Green Transition by Country

### Cyprus

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| EXTERNAL | • Limitation in economic activities and transition to green practices, as the Cypriot economy grew around economic activities such as tourism, trade and transport that mainly rely on suppliers from other countries to acquire innovations and new technologies.<br>• Cyprus is an island and in energy isolation – the power system is not connected to any other countries.<br>• Cyprus has yet to deliver the regulatory framework on energy communities, and consumers have no options in their electricity supply – EAC has the monopoly and generates electricity mostly from oil.<br>• Heavy reliance on PVs – no other RES and limitations of national infrastructure that cannot allow for a full-scale deployment of RES. |
| INTERNAL | • Lack of a unified strategy to transition the CyI campus buildings and energy sources to green alternatives. Scarce efforts are being made, either through individual renovations or ad-hoc projects, but a coherent strategy has not been developed.<br>• Funding limitations to integrate and maintain infrastructure promoting a GT, including renewables. |

### Croatia

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| EXTERNAL | • Missing fee for connection of renewable energy sources – since 2021 it is not possible to connect facility with higher production than 500 kW because of missing legislation (in general all legislation for grid connection was late) and, as final obstacle, the grid connection fee is not agreed between Ministry, System Operators and Energy Regulatory Agency<br>• Missing clear procedures for establishment of energy communities – energy communities represent possible means for inclusion of citizens in the energy market and lack of legislation that supports this represents a significant barrier to citizen inclusion in the energy transition<br>• Limited access to the market – currently there is no dynamic or variable pricing available on the residential level that would stimulate renewables on residential level as well as installation of smart applications such as batteries or electric vehicles (EVs). |

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| INTERNAL | • No plan for zero emission faculty is set out, thus there is no specific timeline on actions to be taken to reduce carbon footprint. Thus, the decarbonisation depends on various projects applied and implemented by individual employees of the faculty.<br>• Budget prioritisation (part of the budget spent on renovation of buildings) – direct investments in sustainability largely depend on private investments or external funding which are still low in comparison with national funding. |

## North Macedonia

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| EXTERNAL | • Social acceptance of enabling technologies for the green energy transition, such as EVs, batteries, heat pumps, may be hampered by the risk aversion and lack of awareness of citizens associated with these new technologies. Unwillingness to adapt individual behaviour, limited digital literacy, the potential trade-off with the welfare state and measures related to addressing poverty are additional obstacles to the adoption of new distributed energy technologies.<br>• Past decision-making inertia and investments in revitalization of old assets have slowed down the phase out of fossils fuels and caused infrastructure lock-in. In additional to this obstacle, public energy companies operate with poor economic efficiency and are overemployed. These conditions create an incentive for prolonging the operational period of fossil fuel-based assets and slow down the transition to renewable and sustainable energy.<br>• The GT in North Macedonia is hindered by a shortage of skilled workforce and expertise in both supply-side and demand-side technologies. Without a sufficiently trained workforce, poor practices may be applied, impeding progress toward sustainable energy goals and hindering the growth of the sector in the long term. HEI face challenges in producing graduates with the necessary expertise, further exacerbating the issue and slowing progress toward sustainable energy goals. |
| INTERNAL | • R&I efforts from HEI relevant for the energy sector lack internal coordination, which hinders their scale and impact, leaving human and laboratory potential underutilized. Cultural resistance among faculty and staff, bureaucratic challenges in policy implementation, and a lack of interdisciplinary collaboration hinder progress on the topic.<br>• Financial constraints limit the ability of HEI to access the state-of-the-art in sustainable energy technologies. This leads to insufficient staff training, gaps in research and development infrastructure, and outdated curricula that do not fully cover energy transition topics. These limitations prevent institutions from effectively engaging in and contributing to the energy transition.<br>• Companies in North Macedonia do not prioritize R&I for the GT, leading to a misalignment between academic research and industry needs. Consequently, existing R&I initiatives in HEI are driven by individual researchers' agendas rather than industry demands. There is a lack of mechanisms to bridge this gap and facilitate effective collaboration and alignment. |

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## Portugal

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| EXTERNAL | • Developing infrastructure for green hydrogen in Portugal faces substantial challenges, including the need for significant investments and technological advancements in electrolyser efficiency, compression, and liquefaction. Incompatibility of existing natural gas infrastructure due to hydrogen's small molecular size, requiring additional financial investments, and an inadequate legislative framework.<br>• Integrating backup power or energy storage systems to ensure consistent electricity supply during low renewable energy generation faces significant hurdles. Costliness and complexity hinder large-scale diffusion, potentially impeding GT. Grid integration complexities, including managing supply-demand fluctuations and updating infrastructure, require careful planning and investment, potentially delaying the seamless incorporation of intermittent renewable energy sources into the existing grid.<br>• The bureaucratic and time-consuming nature of regulatory and permitting processes for wind farm installations presents a significant obstacle. Complex regulatory frameworks and lengthy procedures lead to delays, hindering project progress. Multiple approval stages and stringent environmental criteria further exacerbate these challenges, making it difficult to navigate through the licensing process efficiently. |
| INTERNAL | • Despite legislative support like the "National Energy and Climate Plan (PNEC) 2021-2030", "Roadmap for Carbon Neutrality 2050", "Resolution of Council of Ministers No. 82/2021", and "Decree-Law No. 15/2022," complexities persist. Cumbersome licensing processes hinder HEIs from installing renewable energy systems like solar panels. Bureaucratic hurdles may render implementation unfeasible or significantly delay it, impeding the GT.<br>• Cultural heritage regulations pose obstacles to the adoption of green energy by Portuguese HEIs. Many HEIs are in historic buildings or protected areas, subject to preservation rules restricting structural modifications for renewable energy installations. Preservation rules prioritize architectural integrity and aesthetic value, limiting permissible renewable energy installations and hindering green energy adoption.<br>• While Portugal offers incentive programs for energy transition, HEIs struggle to secure sufficient financing or subsidies to cover high initial costs of green energy projects. Available financing mechanisms may not suit HEIs' needs, and fulfilling contractual goals can be complex amidst economic factors like inflation impacting funding and budgets. |

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## Romania

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| EXTERNAL | • The regulations in the renewable energy sector are sometimes unclear and contradictory, discouraging the investments in this field. The permitting process for new projects can be sometimes slow and difficult.<br>• The energy infrastructure in Romania, including the power plants and the distribution network (energy grid) need modernization while adoption of advanced technologies and innovations in the energy sector is often slow. These are significant factors that may slow down the GT.<br>• There is resistance from the public to major changes in energy policies, particularly in regions where fossil fuel (coal)-based industries are significant sources of employment.<br>• Although the past public policies (the green certificate scheme and other national subsidies granted for renewable energy) adopted in Romania have boosted green energy development, the current energy crisis underlines the need for further incentives, with a more predictable regulation framework to prevent the investment exodus while supporting the grid connectivity. |
| INTERNAL | • There is not a fully coherent strategy and the corresponding plans at the UTBV level for improving the building energy efficiency, for implementing renewable energy systems and for reducing the carbon footprint. |

## Serbia

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| EXTERNAL | • The regulatory framework in Serbia creates challenges in navigating approval processes for green projects. This complexity could lead to delays and discourages investments and slowing down the GT. Simplifying these regulations and making them more transparent could help accelerate green initiatives and attract more investors. A clear, streamlined regulatory environment is crucial for supporting sustainable energy development and boosting investor confidence.<br>• The high initial costs and limited funding for green technologies act as significant barriers to the adoption of renewable energy sources in Serbia. Many projects fail to advance due to insufficient financial support, impeding the overall progress of the GT. Without adequate funding mechanisms, it is challenging to drive the large-scale deployment of renewable energy solutions.<br>• Outdated grids and insufficient capacity in Serbia's energy infrastructure hinder the integration of RES. These infrastructure deficiencies pose significant challenges to the efficient and effective implementation of green energy projects. Upgrading and expanding the infrastructure is crucial for supporting the GT. Modernizing the grid and enhancing capacity can facilitate the integration of renewables, ensuring a stable and sustainable energy supply. |
| INTERNAL | • There is a certain inertia in the institutes and the HEI, which slows down the implementation of the GT. This may be a consequence of the structure of the employees, who are of an older age, which is caused by insufficiently paid jobs at the HEIs and institutes. |

This project has received funding from the European Union's Horizon Europe research and Innovation programme under grant agreement **No. 101136775**

## Ukraine

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| EXTERNAL | • Insufficient funding from the government to implement environmental programs and projects leads to a slowdown in the GT. Many institutions do not have sufficient funds to implement modern environmentally friendly technologies and practices.<br>• The absence of a clear and effective legal framework to support and incentivize green initiatives creates legal and administrative obstacles to the GT. This includes weak regulation in the areas of renewable energy and waste management.<br>• Low levels of environmental awareness and culture among the general public and in the business community hinder the GT. Lack of education and awareness about the importance of environmentally sustainable practices affects the willingness to change and adapt to new green technologies. |
| INTERNAL | • The GT, while economically feasible, is complicated by economic uncertainty and limited funding. In an environment of economic uncertainty, the university is under significant pressure to reduce costs, making it difficult or impossible to invest in green technologies and initiatives.<br>• University structures are quite complex and hierarchical, which makes decision-making and implementation of changes difficult. The decision-making process is complex, slow, and difficult due to the inconsistency in the work of university structures, as well as existing procedures and formalities that complicate changes and initiatives.<br>• University systems and procedures are not flexible and slow enough to implement new green initiatives. Bureaucratic obstacles and a lack of strategy can make it difficult to make decisions and implement changes. |

### 2.2.2 Opportunities to Green Transition by Country

## Cyprus

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| EXTERNAL | • Research, scientific excellence, technological development, innovation and entrepreneurship are currently being pushed to the frontline of the HEIs – e.g. through the Research and Innovation Foundation (national authority in charge of supporting and promoting research, technological development and innovation in Cyprus) and Cyprus Seeds (a non-profit organisation).<br>• Expanding Competencies with a focus in renewable energy, agrifood and environmental technologies. |
| INTERNAL | • Introduce new policies reflecting priorities of the GT, relative to all workplace practices (travelling, working remotely, limiting single use materials etc.) – under the umbrella of a GT strategy for the CyI. |

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## Croatia

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| EXTERNAL | • Smart specialisation strategy defined GT and digitalisation as key areas for which national resources will be used to promote and develop. This represents a baseline for establishing collaboration with industry and design of new projects and initiatives in the field.<br>• Market premium model for incentivising the installation of renewable energy – this model guarantees agreed price per MWh of produced energy to the investor and significantly reduces the risk of investment, making also easier to finance the investment in RES and benefits the feasibility of the investment.<br>• Law on electric markets enables establishment of aggregators, energy communities and other innovative concepts that increase flexibility of the energy system.<br>• National strategy for energy system development in Croatia until 2030 with outlook to 2050 – the strategy presents several scenarios for decarbonisation of energy system in Croatia. |
| INTERNAL | • Existing capacity and knowledge for gathering funding for local energy transition (e.g. national, EU, private). By combining the knowledge and existing infrastructure it can be possible to create technical and financial designs and implement installation of renewables.<br>• Existing installations such as heat pump installed in 2021.<br>• Connection of installation of renewables and decarbonisation with student activity and creation of infrastructure for experiments and funding of new research.<br>• Increase of energy efficiency through renovation of buildings damaged by the earthquake in Zagreb in 2020. The renewed buildings will implement energy efficiency measures that will lead to lower energy consumption. |

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## North Macedonia

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| EXTERNAL | • The certainty in the legislative development relevant to the energy sector is a key driver for the energy transition. North Macedonia is a signatory of the Energy Community Treaty, focused on supporting the creation of an integrated electricity and gas market between the EU and the Contracting Parties. This ensures alignment and transposition of the national legislation with relevant European Directives in the energy sector.<br>• The institutional agility of the Regulatory Commission on Energy and Water Services in North Macedonia demonstrated that an enabling framework for renewable energy integration can be swiftly introduced. This proved to be very important for supporting the rapid deployment of solar photovoltaic (PV) generation at a national level. Similar steps across the energy sector ecosystem can accelerate the energy transition and support innovation.<br>• Strategic clarity is a key driver for long-term commitments towards the GT. The Smart Specialization Strategy of North Macedonia identifies that the green energy transition has cross-cutting R&I potential with ICT, agriculture, buildings, and industry 4.0. More specific policies and measures for a cost-effective and just energy transition are outlined in the National Energy and Climate Plan and the Just Transition Plan.<br>• Suitable meteorological and framework conditions at a national level incentivize a fast-growing ecosystem of renewable energy installers, developers and engineers. This trend is further supported by the fact that companies improve their competitiveness by investing in renewable energy and energy efficiency. The challenges associated with high shares of renewable energy offer an opportunity for HEI to apply the scientific state-of-the-art and propose sophisticated solutions. |
| INTERNAL | • The energy transition presents an intellectual challenge to students and young engineers. By engaging students in research and projects, HEI can ensure a continuous influx of skilled human capital, limit brain drain, support sustainable research infrastructure, and enhance their position in the international R&I arena.<br>• HEI in North Macedonia can improve their success in academic publishing and securing R&I funding by aligning their activities with the green agenda. Hence, they can increase their societal impact while simultaneously strengthening their academic influence. This approach not only supports sustainable development but also raises the profile and relevance of their research, potentially attracting increased funding and collaboration opportunities. |

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## Portugal

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| EXTERNAL | • Repowering existing wind farms by replacing old turbines with newer, more efficient ones presents significant potential. This can nearly triple electricity output while reducing the number of turbines by a quarter, all within the same site.<br>• RES offer ideal conditions for green hydrogen production in Portugal. With a target of achieving 80% of electricity consumption from renewables by 2030, the country benefits from abundant and low-cost sources like wind and solar power. These factors contribute to establishing green hydrogen production with a compelling cost-benefit ratio.<br>• Portugal leads in solar energy due to abundant radiation, ranking among Europe's highest. The country enjoys optimal conditions with over 3.000 hours of sunshine annually, making it a prime location for solar investments. Regions like the sun-drenched Algarve offer ideal settings for PV systems, contrasting sharply with Glasgow, Scotland, receiving significantly less sunlight. Portugal's exceptional solar potential presents an attractive opportunity for renewable energy stakeholders and investors.<br>• Establishing energy communities and adopting self-consumption of green energy present pivotal opportunities for renewable energy expansion in Portugal. The nation, aligned with the European Union, prioritizes Energy Self-Sufficiency. Portugal has made commendable progress in reducing reliance on imported energy by increasing renewables in its portfolio, especially in electricity generation. Further amplification through active community participation and incentives is instrumental in advancing green energy production and consumption. |
| INTERNAL | • HEIs can promote energy efficiency strategies on campus, contributing to sustainable development and reducing the sector's environmental impact, thus aiding the GT.<br>• HEIs can support the implementation of demonstration projects and pilot programs to showcase green energy technologies in real-world settings. By providing expertise, conducting research, and evaluating outcomes, HEIs contribute to the validation and scaling up of innovative green energy solutions.<br>• HEIs innovate the education system by serving as hubs for energy education, fostering individual and collective behavioral changes crucial for the GT. For example, HEIs create environments promoting energy sufficiency through behavioral, lifestyle, and consumption pattern changes. Emphasis is placed on using energy only as necessary for basic needs and well-being, ensuring usage remains sustainable.<br>• HEIs in Portugal have a unique opportunity to lead the transition to a green energy system. Regulations promoting energy community formation offer a promising avenue for collaboration. By establishing shared green energy resources like PV installations, HEIs can foster decentralized, eco-friendly energy frameworks. This initiative aligns with sustainability goals, strengthens partnerships, drives innovation, and contributes to a sustainable future. |

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## Romania

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| EXTERNAL | • Romanian Energy Strategy 2016-2030, with an outlook to 2050 has five key strategic goals: clean energy, energy security, competitive energy markets along with good governance in the energy sector and affordable energy supplies, which entails the reduction of energy poverty and better protection of vulnerable consumers. To meet consumers' expectations in the long run, the Romanian energy sector must become cleaner and more economically and technologically advanced.<br>• Romania's Long-Term Strategy – the strategy is formulated based on several scenarios developed by considering the significant increase in the global share of RES in the gross final energy consumption and/or by reducing the net emissions (up to 99% by 2050 as compared to 1990) towards climate neutrality in Romania.<br>• Romania's Sustainable Development Strategy 2030 promotes the sustainable development of Romania by focusing on Sustainable Development's three dimensions: economic, social, and environmental. This strategy is citizen-centred and focuses on innovation, resilience, and the belief that the role of the state is to serve the needs of each citizen in a fair, efficient, and balanced manner, all within a clean environment. |
| INTERNAL | • The Universities (e.g. UTBV) have the scientific potential and human resources to develop projects in collaboration with companies acting in the field of energy, renewable energy systems, waste recycling, aiming at the design of environmentally friendly products and technologies.<br>• The Universities may serve as a hub of education and research by offering courses and educational resources in the field of energy/ green energy transition, decarbonization/ climate neutrality along with novel solutions for implementing renewable energy systems in the built environment. Several projects aiming at developing open educational resources in these fields were/are developed having UTBV as coordinator or as partner.<br>• Study programs in the field of energy, renewable energy systems, environmental protection run at UTBv at B.Sc. and M.Sc. levels, preparing young engineers, as professionals in these fields. |

## Serbia

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| EXTERNAL | • There is a significant potential of RES in Serbia: biomass, solar energy, wind energy and hydro energy. Foreign investors are increasingly interested in investing in the commercial use of RES.<br>• Recently in Serbia, state institutions have been encouraging projects related to the GT, as well as the participation of the scientific community in them.<br>• Improving business conditions through the optimization and digitalization of procedures enhances efficiency and reduces environmental impact. By streamlining processes in sectors such as waste management and energy, digital technologies can significantly contribute to the GT, making operations more sustainable and less resource-intensive. |

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| INTERNAL | • HEIs have the potential to involve several students and young engineers (through new educational programs and start-up companies) in the development and application of new GT technologies.<br>• Strengthening scientific activities in priority areas such as sustainable agriculture, energy efficiency, and green technologies promotes innovation and sustainability. By focusing research and development efforts on these sectors, Serbia can develop advanced solutions that contribute to a greener economy and environment, aligning with the strategic goals of sustainable development.<br>• Enhancing collaboration between research institutions and industries, particularly in green technologies, fosters innovation. Such partnerships can lead to the development of eco-friendly products and processes, driving both economic growth and environmental sustainability. This synergy is crucial for achieving a competitive and sustainable economy. |

## Ukraine

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| EXTERNAL | • Attracting international financial resources and investors can significantly accelerate the GT. Investments in RES, energy-efficient technologies, and infrastructure to reduce emissions will contribute to the country's sustainable development.<br>• Ukraine has a great potential for developing RES such as solar, wind, alternate solid fuels, and bioenergy. Stimulating the development of these industries can not only reduce dependence on fossil fuels, but also create new jobs.<br>• Supporting research and development of innovative environmental technologies can be a driving force for a GT. This includes the development of new materials, waste management technologies, and energy-saving solutions.<br>• Promoting educational components and campaigns to raise environmental awareness among the public and businesses can significantly contribute to a GT. Education on environmental practices and sustainable development will help change behavior and encourage responsible decisions. |

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| INTERNAL | • Universities have the potential to become key players in the GT thanks to their scientific capacity and technical developments. Their research can address complex issues related to energy efficiency, renewable energy, reducing emissions and creating sustainable and environmentally friendly technologies.<br>• With their scientific and technological potential, universities can play a key role in the GT, but they need support and funding to do so. Support from the government, industry, and other stakeholders can stimulate research and implementation of new technologies aimed at reducing carbon emissions, improving energy efficiency, and conserving natural resources. In addition, funding can be directed to translate research findings into practical applications, which will allow for faster turnaround time and facilitate a faster GT in various sectors of the economy. Thus, support and funding from various stakeholders is essential to enable universities to play their role in the GT by developing and implementing innovative solutions necessary for sustainable development of society.<br>• The university may develop waste management programs, including separate garbage collection, use of recycled products, and reduction of disposable materials.<br>• It is important to involve students, faculties and staff in the GT process by introducing educational components, events, workshops and courses on ecology and sustainability. This will help create a culture of environmental awareness and support for the university's green initiatives. |

### 2.2.3 Initiatives to Green Transition

## Widening Countries

**Cyprus**

- Externally, the Cypriot Recovery and Resilience Plan provides a tangible contribution of EUR 100 million to building a cross-border electricity interconnector with a total length of 1.208 km between Crete, Cyprus and Israel. This large investment will receive funding also from other sources, such as the Connecting Europe Facility, commercial loans and equity, and a loan from the European Investment Bank. The project aims to ensure security of supply and more competitive wholesale electricity prices in Cyprus. It should also enable the increased use of electricity from cleaner sources, in particular renewables, by connecting the electricity network of Cyprus to the EU continental system.
- Internally, the Green procurement policy established as an integral part of the CyI's commitment to sustainability (Cyi, 2024).

**Croatia**.

- Working group for citizen owned energy at City of Zagreb level – meetings on a monthly level to provide guidelines and suggestions to Zagreb city management to increase share of citizen energy and enable easier access and possibilities to citizens who would like to invest in RES.
- COMMUNITAS Horizon Europe project – This initiative aims at mapping legislation and concepts regarding energy communities in different countries. The project will produce a set of policy recommendations and technical solutions to promote establishment and operation of energy communities.

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**North Macedonia**

- From 2023-2025, Fund for Innovation and Technological Development (FITD) plans to launch the Green Business Facility initiative with a budget of 27 million euros. This includes 2 million euros for establishing the facility and 18 million euros for investing in green businesses from IPA III funds, plus 7 million euros from the state budget. The initiative aims to stimulate private investment in industrial innovation, circular economy, green buildings, clean energy, and sustainable mobility, incorporating a gender perspective (Fitr, 2024).

**Portugal.**

- The WindFloat Atlantic project, a pioneering semi-submersible floating wind farm, highlights Portugal's leadership in renewable energy. This initiative not only supports the GT but also sets a global precedent for similar technologies, showcasing Portugal's role in advancing floating offshore wind technology. The WindFloat Atlantic project provided significant benefits to local and national HEIs, particularly the Polytechnic Institute of Viana do Castelo (IPVC), the University of Minho, University of Lisbon, and University of Porto. These institutions engaged in renewable energy research, gained hands-on experience, and attracted funding. The project fostered innovation, knowledge transfer, and collaboration of regional universities (Windfloa, 2024).

**Romania**

- The Research and development (R&D) Institute of the Transilvania University, ICDT (Project: R&D Institute High – Tech Products for Sustainable Development, PRO-DD) was built following the concept “A Sustainable City in a City”. The ICDT consists of 12 low energy buildings (integrated by a central spine embedding novel solutions for reducing the energy losses, thus the energy consumption. The infrastructure also includes “Smart grid” systems, green IT systems, water and waste management systems.
- 30 research centers are active within ICDT. The RES REC (R&D Center): Renewable Energy Systems and Recycling) infrastructures include tracked PV platforms and fixed solar energy convertors including various solar-thermal collectors, systems for monitoring the weather input data (temperature, wind, solar irradiance), synthesis and characterization equipment for ViS/solar-active materials (Icdt, 2024).
- The Solar House, located on Colina Universitatii was built as a Nearly Zero Energy Building (nZEB) It has a passive solar design; it is powered by a 10 kWp PV array and is heated by the solar-thermal collectors – heat pump energy mix. It is part of the of the RESREC Infrastructure, developed through national and European grants. The Colina assembly represents also a training location for the B.Sc. students enrolled in the study programs of: Engineering of Renewable Energy Systems, Environment Engineering. Also, the M.Sc. students from the interdisciplinary program Product Design for Sustainable Development are using this infrastructure.
- More international projects run or are running on these topics as, e.g.: The project BioEnergyTrain (BET) (2015-2019), ESEIA Coordinator, UTBV- partner (EC, 2024). The project EnvEdu-OERs - Environmental Education – Open Educational Resources for Rural Citizens (2020-2023) – coordinated by UTBV (Envedu, 2024). The Project EDU4PlastiCircular - Education for Plastic in a Circular and Climate Neutral Economy - Preventing Waste Ending Up into the Environment (2023-2026).

**Serbia**

- The project "Clean energy and energy efficiency for citizens (SURCE)" is a five-year project of the Ministry of Mining and Energy and the World Bank, which provides subsidies to households for the implementation of energy efficiency measures (MRE, 2024).
- The project "Energy rehabilitation of residential, multi-family buildings connected to the district heating system - Public ESCO Project" foresees the allocation of grants for the

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implementation of energy rehabilitation measures of residential, multi-family buildings connected to the district heating system. The project is being prepared in cooperation with the European Bank for Reconstruction and Development (EBRD) (MRE, 2024a).

- In the VINČA Institute for Nuclear Sciences, several international (Horizon, IAEA, UNDP,...) and national projects (Science Fund, Innovation Fund) promoting the GT are being funded (VIN, 2024).

**Ukraine.**

- EU4Environment: An initiative of the European Union aimed at supporting environmental policies and practices in the Eastern Partnership countries, including Ukraine. The program provides financial and technical assistance for the implementation of environmental projects, stimulating a green economy and reducing environmental impacts. This includes the development of sustainable production, environmental management and public awareness.
- Energy efficiency program: Development and implementation of an energy efficiency program that will include assessment and modernization of heating, ventilation and air conditioning systems, installation of energy-saving lighting and insulation of buildings to reduce energy consumption.
- Student eco-projects: Create a program to finance and support student projects on sustainable development and ecology aimed at reducing the university's environmental impact.

## Non-Widening Countries

**Austria.**

- The Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation, and Technology (BMK) implements legislative measures and policies to promote sustainability and environmental protection (BMK, 2024).
- The Austrian Research Promotion Agency (FFG) offers funding programs to support green initiatives and sustainable research projects in universities (FFG, 2024).
- The Austrian Science Fund (FWF) provides research funding for sustainability-related projects in various disciplines, including environmental sciences, renewable energy, and climate change research (FWF, 2024).
- The Austrian Platform for Research and Technology Policy Evaluation (fteval) fosters partnerships and collaboration between universities, government agencies, industry partners, and civil society organizations to advance sustainability R&I (Fteval, 2024).
- University of Natural Resources and Life Sciences, Vienna (BOKU) has developed a comprehensive sustainability policy and action plan to integrate sustainability into all aspects of university operations (BOKU, 2024).
- **Graz University of Technology (TU Graz)** is the first Austrian university implementing a green campus initiative to become climate neutral by 2030, including energy-efficient buildings, sustainable transportation options, and waste reduction programs (HTUGraz, 2024). TU Graz founded the European Sustainable Energy Innovation Alliance (ESEIA) in 2009.
- Vienna University of Economics and Business (WU Wien) offers a wide range of courses and programs on sustainability, including a master's program in Socio-Ecological Economics and Policy (WU, 2024).
- University of Innsbruck hosts the Research Center for Alpine Environment, which focuses on interdisciplinary research on environmental sustainability in alpine regions (Uibk, 2024).

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## 2.3 Digital Transition

### 2.3.1 Barriers to Digital Transition by Country

### Cyprus

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| EXTERNAL | • Limited expertise in innovation and innovation management together with the lack of mature ecosystems to exploit research results for creating economic and societal impact are important barriers that will slow down Innovation in the HEIs of Cyprus.<br>• Lack of entrepreneurial spirit in the research community. |
| INTERNAL | • Many services and procedures have become paperless, but different systems do not communicate between them, limiting interoperability – a strategic vision is lacking.<br>• Smartness of buildings in campus is very limited.<br>• Low prioritization of data management practices. |

### Croatia

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| EXTERNAL | • Lack of understanding of the benefits of digitalisation in companies as well as public services. Employers don't think that the benefits of digitalisation will have an effect on employees.<br>• Lack of appropriate infrastructure as there are still some rural areas that don't have access to fast internet or old infrastructure not compatible with modern devices. Digital literacy is also one of the obstacles in this aspect (lack of it).<br>• Lack of standards and complex regulation often not uniquely applicable to all sectors, also regarding the data protection policies. |
| INTERNAL | • Lack of funding possibilities for investments in digitalization of HEI – HEI is highly dependent on the national funding (similarly as all HEI in Croatia) thus funds are often out of limits for digitalisation needs.<br>• High complexity of HEI (more than 500 employees, numerous departments, chairs and labs) making it more difficult to design joint approach for institution digitalization. |

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## North Macedonia

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| EXTERNAL | • Inadequate financial support from government and external funding bodies restricts the ability of HEIs to invest in essential digital infrastructure and technologies. Limited budget allocations mean that DT projects are often underfunded, delaying their implementation and reducing their effectiveness.<br>• The workforce in North Macedonia lacks the necessary digital skills to effectively engage with new technologies. There is a notable shortage of training programs and educational initiatives focused on digital literacy, cybersecurity, and advanced IT skills. This skills gap hampers the country's ability to innovate and compete in the global digital marketplace, slowing the overall DT. |
| INTERNAL | • Many HEIs in North Macedonia operate with outdated IT infrastructure that cannot support modern digital learning platforms and tools. This lack of up-to-date technology hampers the ability to deliver effective digital education and manage administrative tasks efficiently.<br>• Varying levels of digital literacy among faculty staff present a significant challenge. Many educators and administrators lack the skills needed to effectively utilize digital tools and platforms, leading to inefficient use of technology and resistance to adopting new digital methods.<br>• Adequate and continuous technical support is essential for HEIs undergoing DT, which involves integrating multiple new technologies. Without proper technical support, staff lack the capacity and confidence to effectively use digital tools, hindering the successful implementation and operation of digital initiatives. Ensuring robust technical support is crucial for fostering a smooth and effective DT. |

## Portugal

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| EXTERNAL | • Gender inequality persists in Portugal's ICT sector, with women underrepresented, particularly in leadership roles. Despite the influx of highly qualified women, few reach top positions in tech companies, limiting career advancement and diverse perspectives. This lack of gender diversity hampers innovation, constraining sector growth and competitiveness, and hindering overall progress within the ICT industry.<br>• Insufficient digital literacy, especially among Portugal's seniors, can impede the transition to a more digital society. Many elderly individuals may struggle with online banking services, limiting their ability to manage finances and access essential services. This dependence on others for basic financial tasks hinders societal progress, limiting participation in the digital economy and delaying overall advancement.<br>• Relying on non-Portuguese technologies poses challenges to the DT, impacting Portuguese and European digital sovereignty. Dependence on software and hardware from companies outside the EU, like Microsoft's Windows, subjects' technological infrastructure and data to non-EU laws, potentially exposing Portugal and the EU to cybersecurity risks and political influence. This reliance underscores the need for strategic initiatives to safeguard digital sovereignty and mitigate associated risks. |

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| INTERNAL | • HEIs face challenges in attracting women to ICT programs due to societal perceptions and a lack of role models, hindering their entry into the ICT workforce. In Portugal, the 'Gender@ICT' research project addresses this gap by exploring gender and technology interactions in education. Through activities with preschool and 9th-grade students, the project challenges gender stereotypes associated with ICT, aiming to foster an inclusive view of ICT careers.<br>• Insufficient digital literacy poses a significant challenge for Portuguese HEIs in today's technology-driven world. It impedes the successful implementation of digital initiatives crucial for modernizing education and research. Researchers lacking digital skills struggle to utilize advanced tools, hampering their contributions to cutting-edge research. Moreover, digital literacy enhances institutional efficiency by enabling effective use of digital tools for administration, communication, and collaboration, making it foundational for HEIs.<br>• Relying on non-Portuguese technologies presents multiple barriers for Portuguese HEIs during DTs. Higher costs from licensing fees, exchange rates, and import taxes strain budgets, affecting fund allocation for essential areas. Technical support and customization challenges arise, as foreign technologies may not meet specific needs. This dependence limits local tech industry growth, stifles innovation, and creates skill-job market mismatches, hindering HEIs' progress. |

## Romania

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| EXTERNAL | • Lack or poor digital skills at the level of population (especially the elder one) and among the workforce (e.g. in private sector), the insufficient specialists and human resources with necessary skills in the IT departments of public institutions and authorities, able to develop and maintain the public electronic services represent obstacles in the transition to a digital society.<br>• Lack of an efficient and effective IT architecture for the overall management of electronic public services. To facilitate the interaction between public administration institutions and sharing information across different databases, a framework and a secure and trustworthy way need to be developed.<br>• Lack of a unified and effective legislative and procedural framework to support the digitalization of the public services. This includes the lack of a regulatory framework for the interoperability of government IT systems and data register; the lack of mandatory enrolment of public institutions and authorities in the National Electronic Payment System (NEPS), coupled with the absence of a deadline for fulfilling the obligation; the lack of mechanisms to sanction institutions that do not respect the imposed deadlines for implementing the digital technologies.<br>• Lack of funding for the private sector for the adoption of advanced digital technologies with support (expertise/ consultancy) represents another barrier for digitalization. |
| INTERNAL | • Lack or poor digital skills and competencies among faculty, staff, and students represents an obstacle in using the new technologies.<br>• Faculty and staff may be resistant in adopting the new technologies due to the comfort with traditional methods or due to the fear of change. |

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## Serbia

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| EXTERNAL | • Slow adoption of new technologies in various sectors, including education and industry, hampers the DT in Serbia. Resistance to change and reliance on outdated systems prevent the country from fully embracing digital solutions. Rapid adoption of technology is key to advancing digitization. This requires investing in modern technologies and educating professionals to become competitive in a rapidly evolving digital environment.<br>• The varying level of knowledge in the application of digital skills among the workforce limits the effective use of digital tools and technologies. Therefore, it is necessary to introduce comprehensive education and training programs, which should increase the digital literacy of the entire population and thereby contribute to the successful digitization of the system.<br>• Concerns about cyber security and data protection represent significant barriers to digitization. Fear of cyber-threats and potential data damage reduce organizations' willingness to fully implement digital solutions, thus slowing down DT. Ensuring strong cyber security measures and creating a secure digital environment are critical to building trust and the adoption of digital technologies. |
| INTERNAL | • In the Institute, there is not enough trained people to use the E-Science system. The E-Science system still does not meet all the needs of HEIs. |

## Ukraine

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| EXTERNAL | • Lack of infrastructure, especially in rural and remote areas, significantly slows down the DT. The high cost and unavailability of high-speed internet limits the use of digital technologies.<br>• Low levels of digital literacy among the population and in the professional sphere are a significant obstacle to digitalization. The lack of skills and knowledge about the latest digital technologies makes it difficult to implement and use them.<br>• Insufficient funding and investment in digital technology and innovation are slowing down the development of this industry. Many businesses and organizations cannot afford to implement modern digital solutions due to high costs. |
| INTERNAL | • The university has an outdated technical infrastructure that makes it difficult to implement modern digital solutions. The lack of necessary software and limited opportunities for integrating new technologies can be significant obstacles.<br>• The introduction of new digital technologies often requires cultural change and adaptation within the university community. Lack of openness to change among academic staff and administrators, resistance to new ways of working, and lack of support from university leadership can make DT difficult.<br>• DT may require new knowledge and skills within the university community. Insufficient training of staff and students in digital tools and technologies can be an obstacle to the successful implementation of new digital initiatives. |

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### 2.3.2 Opportunities to Digital Transition by Country

## Cyprus

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| EXTERNAL | • Emerging areas of expertise, including, among others, advanced materials, digital technologies linked to advanced manufacturing, earth observation technologies, food technologies, and biotechnology.<br>• New Digital technological trends emerging from the market are driving the HEIs towards the development of a curricula that supports them.<br>• Research, scientific excellence, technological development, innovation and entrepreneurship are currently being pushed to the frontline of the HEIs – e.g. through the Research and Innovation Foundation (national authority in charge of supporting and promoting research, technological development and innovation in Cyprus) and Cyprus Seeds (a non-profit organisation). |
| INTERNAL | • Development of DT strategy for the CyI. |

## Croatia

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| EXTERNAL | • National recovery programme will support digitalisation in six different areas: Economy, Legal system and public offices, education and research, labour market and social protection, health, renewal of buildings.<br>• Smart specialisation strategy defined GT and digitalisation as key areas for which national resources will be used to promote and develop. This represents a baseline for establishing collaboration with industry and design of new projects and initiatives in the field.<br>• Structural funds are an opportunity to set digitalisation infrastructure that can later be utilized for achieving collaboration with the industry, application and design of new project and participation in horizontal projects regarding digitalisation.<br>• Digital Croatia strategy until 2032 set out key directions and vision for digitalisation. It recognises digitalisation as a key mean for development of the country and sets key objectives to be reached until 2032. |

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| INTERNAL | • Project database of all ongoing projects at the institution. The system provides a tool for the institution management to approve applications on different funding opportunities and also contains statistical data about the institution.<br>• Matchmaking tool for companies and students that allows students to publish their CVs and companies to explore and offer jobs to students. It is a new tool and will include more modules and features in future.<br>• Bachelor, Master and PhD thesis in digitalisation of different aspects connected to the faculty (e.g. digitalisation of energy parameters in faculty building).<br>• Schemes, information flows and procedures between departments and offices that are a basis on which horizontal digitalisation systems should be based at the institution. |

## North Macedonia

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| EXTERNAL | • The National ICT Strategy 2021-2025 aims to enhance DT across the country. It focuses on improving connectivity and government infrastructure, centralizing and rationalizing ICT services, boosting digital skills among citizens, workforce, and experts, promoting R&I, ensuring data protection, and expanding digital services.<br>• The establishment of a European Digital Innovation Hub (EDIH) in North Macedonia presents a significant opportunity to accelerate DT. EDIHs offer access to advanced digital technologies, expertise, and innovation networks, supporting businesses and public sector organizations through training, research, and development initiatives. Specifically, EDIHs facilitate better networking among economic entities and foster cooperation between academia, public administration, and the economy, creating robust bridges for collaborative digital advancement.<br>• The Smart Specialization Strategy (S3) in North Macedonia is a key opportunity for DT. S3 focuses on identifying and investing in specific areas of competitive advantage, fostering innovation through targeted policies and support. It promotes collaboration between research institutions, businesses, and government, driving digital transition by aligning resources and efforts towards high-potential sectors. This strategy enhances innovation ecosystems, encourages the adoption of digital technologies, and accelerates economic growth through smart, data-driven investments and coordinated development initiatives.<br>• North Macedonia's aspirations to integrate with the European Union act as a strong driver for digital transition. Aligning with EU digital standards and practices necessitates improvements in digital infrastructure, cybersecurity, and regulatory frameworks. This alignment not only accelerates digital adoption but also improves access to EU funding and collaboration opportunities. |

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| INTERNAL | • HEIs can leverage digital tools to modernize curriculum delivery through online courses, virtual classrooms, and interactive learning platforms. This approach makes education more accessible and flexible, catering to diverse student needs and learning styles. By adopting these technologies, HEIs can significantly improve student engagement and outcomes, ensuring a more effective and inclusive educational experience.<br>• Digital tools and platforms enable sophisticated data analysis, collaboration, and resource sharing, significantly boosting research capabilities. By adopting advanced technologies, HEIs can streamline research processes, facilitate interdisciplinary projects, and improve the efficiency and impact of their research activities. This enhances the institution's ability to conduct high-quality, impactful research.<br>• Offering training and professional development programs focused on digital skills can empower faculty staff to effectively utilize new technologies. By fostering a culture of continuous learning and digital competence, HEIs can ensure that their personnel are well-equipped to support and drive digital transition efforts.<br>• Digitalization can optimize administrative functions such as enrolment, scheduling, record-keeping, and communication. Implementing digital management systems enhances operational efficiency, reduces paperwork, and improves the accuracy and accessibility of information, freeing up staff to focus on more strategic tasks. |

## Portugal

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| EXTERNAL | • The digital transition initiatives, in the European context, offer significant opportunities, especially for SMEs. The Action Plan for DT focuses on Capacity Building, Business Transformation, and Public Service Digitization. Coordinated by the Portugal Digital Mission Structure, critical initiatives include Citizen Card, Digital Mobile Key, Zero Licensing, Medical e-Prescriptions, and e-Portugal. Additionally, programs like INCoDe.2030 aim to enhance digital competencies and advance research capacity through digital technologies.<br>• Introducing a Social Internet Tariff aligns with EU objectives, offering reduced rates to low-income families to bridge the digital divide. This initiative enhances digital participation, particularly in education, stimulating economic growth and facilitating access to e-government services. It promotes social inclusion by providing digital services to financially constrained individuals, crucial for healthcare access, thereby advancing Portugal's digital transition goals.<br>• Subsidized investments in digital skills, backed by the EU, create opportunities for HEIs to collaborate with private and public sectors. HEIs partner with institutions to develop digital skills programs. Private sector partnerships offer internships and job placements, providing practical experience. Government and EU support foster entrepreneurship, stimulating startups in the digital field, catalyzing collaboration, and benefiting the educational ecosystem and economy.<br>• Digitalization, special for SMEs, enhances productivity through streamlined operations and provides access to new markets via e-commerce and digital marketing. Improved customer engagement and data-driven decision-making are facilitated by digital platforms, fostering innovation. Automation reduces costs in the long term, and support initiatives like INCoDe.2030 and the UPSkill program aid SMEs in their digital journey, enhancing competitiveness in the evolving digital economy for sustainable growth. |

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| INTERNAL | • Incentives to improve digital skills, benefiting HEIs through vocational training, reskilling efforts, and aligning educational programs with the demands of the digital economy. Partnerships with digital hubs support the exploration of new technologies, fostering innovation and hands-on learning experiences. By digitizing public services and delivering transformative projects, HEIs play a crucial role in preparing students for success in increasingly digital work environments.<br>• Portugal's digital inclusion efforts aim to provide affordable digital and online access for low-income students, expanding their access to essential digital resources and helping to bridge the digital divide. This initiative enhances student engagement in online learning, supports remote education, and improves educational outcomes. It also enables HEIs to reach underrepresented communities, contributing to broader societal progress.<br>• The government fosters opportunities for both private and public sectors in the DT to boost competitiveness. Key initiatives focus on enhancing digital skills, protecting against cyber threats, creating tech job opportunities, promoting inclusion, and strengthening digital defenses. These efforts support economic recovery while advancing the efficiency of digital government and public services.<br>• HEIs provide specialized training, access to valuable resources, and serve as networking hubs that foster collaborations among SMEs, experts, and investors. They also offer consultancy on digital strategies and data management. Through innovation ecosystems, SMEs partner with HEIs to accelerate digitalization, boost competitiveness, and drive economic growth. |

## Romania

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| EXTERNAL | • Strategic initiative for Digitization of Education SMART-Edu 2021-2027.The aim is to reduce digital gaps and increase the socio-economic inclusion, by increasing digital skills and the internet use at the general population level and by organizing training sessions adapted to the needs of each community. It is outlined that digital education is a key goal for quality, accessible and inclusive assessment of teaching and learning, as well as the need for a strategic approach to digital skills acquisition at all levels of education. |
| INTERNAL | • Digital transition strategy in the Transilvania University of Brașov (2022-2032) is based on modernizing and developing the digital infrastructure for education, research and administration along with actions focused on the concept of cloud technologies. The following priorities are outlined: (1) creation of a digital culture for all users; (2) permanent integration of the infrastructures and services provided in agreement with the initiatives promoted by specialized institution both at national and European level; (3) comprehension of the development trends in various industries by strengthening and extending the collaboration with the partners in the social, economic and cultural environment. |

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## Serbia

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| EXTERNAL | • The formation of specialized firms for the provision of consulting services for HEIs and start-up companies enables them to be assisted in strategic planning and financial stability, enabling the effective application of digital technologies. This encourages innovation and sustainable growth, so these organizations have the ability to thrive in a digital environment that is also evolving all the time.<br>• Active participation in global digital networks increases competitiveness and drives innovation. By promoting cross-border cooperation and knowledge exchange, Serbia can significantly improve its position in the global digital economy, catalyzing digital innovation and economic growth. Embracing the possibilities of digital integration makes it easier to share best practices, access cutting-edge technologies, and explore new markets and partnerships.<br>• Strategic investments in digital research and development initiatives stimulate innovation and strengthen competitiveness in all industries. By creating a dynamic digital innovation ecosystem, Serbia can respond to important social challenges, attract talent and investment, and position itself as an important center for digital progress. These investments drive the development of revolutionary solutions, fueling economic growth and social progress. |
| INTERNAL | • Integrating digital tools into education improves students' ability to meet the demands of the new digital era. By creating a dynamic and interactive learning environment through digital platforms, HEIs can improve student engagement and expertise in digitized industries, laying a solid foundation for future career success and social progress. |

## Ukraine

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| EXTERNAL | • International organizations and programs can provide financial and technical support for the development of digital infrastructure and the introduction of digital technologies. This will facilitate a faster and more efficient transition to the digital economy.<br>• Ukraine has a strong IT sector that can become a key driver of the DT. Supporting and developing IT companies, as well as promoting the export of IT services, can significantly accelerate digital transition.<br>• The digitalization of public services and the introduction of e-government can significantly increase the efficiency and transparency of governance, as well as contribute to the development of the digital economy and improve the quality of life of citizens.<br>• Investments in digital education and training can significantly increase digital literacy and promote the adoption of new technologies. The development of education and retraining programs will help to overcome the skills shortage. |

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| | • The university can expand its presence in the online environment by offering more courses and learning resources through e-learning platforms for different categories of stakeholders. This will allow students and professionals who need additional skills and knowledge to access quality education regardless of their place of residence.<br>• The introduction of digital tools into university management can simplify administrative processes such as student registration, class scheduling, and financial management, resulting in increased productivity and reduced administrative costs.<br>• Digital technologies can be a powerful tool to support research at the university. The use of modern computer hardware and software, artificial intelligence, and analytical tools will allow researchers to solve complex problems and conduct innovative research more effectively.<br>• Digital transition will create opportunities for the development of online communities of students, teachers and researchers at the university level and at the inter-university international level. This will facilitate knowledge exchange, cooperation and collaboration between the participants of these communities, which will enrich both the educational process and scientific achievements. |

### 2.3.3 Initiatives to Digital Transition

## Widening Countries

**Cyprus**

- Human Resources: For all through the Human Resources Development Authority or Cyprus (a public law legal entity), with special focus on the unemployed (EU Structural funds) (Anad, 2024).

**Croatia**

- DABAR – Digital academic repository and archive (Dabar, 2024).
- **Croatia.** Creation of matchmaking tool between students and companies.

**North Macedonia**

- The "Call for Innovations through Digital transition," initiated by the FITD in 2023, supported 13 SMEs in the agricultural, food, and tourism sectors. This initiative enhances innovation and competitiveness by enabling these enterprises to implement digital solutions, driving digitalization and modernizing their operations (Fitr, 2024a).
- Over the past decade, UKIM developed the iKnow system, a central student information system for electronic student records. It tracks students from enrollment to graduation. The system records students' academic progress, including semesters, subjects, credits, and exam results, while also supporting the graduation process. This comprehensive digital platform enhances efficiency and accuracy in managing student information.

**Portugal**

- Part of the Portugal Digital initiative “The National Digital Skills and Jobs Coalition” represents a significant opportunity for Portugal. It focuses on enhancing digital skills, fostering economic growth, ensuring workforce competitiveness, transforming businesses, and promoting social

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inclusion through comprehensive upskilling and reskilling programs, educational integration, and public-private collaboration (Incode2030, 2024; Pontodigital, 2024).

- "The National Digital Skills and Jobs Coalition" has significantly benefited HEIs. Some Portuguese HEIs, e.g., University of Lisbon, ISCTE, and ISEG have seen improvements in curricula, research funding, faculty development, industry partnerships. For example, the creation of the UpSkill: Digital Skills & Jobs program by Iscte - University Institute of Lisbon exemplifies the tangible benefits brought by the coalition, enhancing digital education and skills across Portugal (ISCTE, 2024).

**Romania**

- Romania has developed the Recovery and Resilience Plan, that consists of investments, measures and reforms, which will help Romania to become more sustainable, resilient, and adaptable to the challenges and opportunities posed by the green and DTs. The plan is supported by an estimated €14.24 billion in grants and €14.94 billion in loans, 41% of the plan will contribute to the GT, while 20,5% of it will support the DT.
- DIGITOOLS – Innovative Tools for Enhancing E-Learning Solutions in Universities (2020-2023).
- Erasmus+ KA 226 Partnerships for Digital Education Readiness.

**Serbia**

- The Office for IT and eGovernment was established for the purpose of faster application of digitization in the Republic of Serbia. The Office carries out expert tasks related to designing, harmonizing, developing and functioning of eGovernment and information systems, as well as infrastructure of state administration bodies and Government services (ITE, 2024).
- The National Digitalization Strategy and the National Funds (Science Fund of the Republic of Serbia and Innovation Fund of the Republic of Serbia) synergistically drive Serbia's digital transition. The strategy sets clear objectives, while the National Funds offer financial support for digital projects within HEIs and the broader innovation ecosystem. Together, they promote the development and implementation of cutting-edge digital technologies, fostering innovation and enhancing Serbia's global competitiveness in the digital economy (Inovacionifond, 2024; Fondzanauku, 2024).
- The Ministry of Science, Technological Development and Innovation has created the necessary conditions for the development of the scientific R&I system, especially in relation to the digitization process and the establishment of an information platform, in the form of a unified national information system for scientific research activities: eScience (Enauka, 2024).
- In the VINČA Institute for Nuclear Sciences, several international (Horizon, IAEA, UNDP, ...) and national projects (Science Fund, Innovation Fund) promoting the GT are being funded (VIN, 2024).
- A local research network (Researcher Database) was formed at the Vinča Institute, which enables insight into the research results of all the Institute's researchers. The VINČA institute is multidisciplinary, and this Database encourages cooperation between researchers from different research fields.

**Ukraine**

- Diia is the national digital services platform in Ukraine that brings together all electronic services in one place. Diia includes a mobile application and a web portal that allows citizens to receive public services online, including obtaining documents, registering a business, filing tax returns, etc. The initiative aims to simplify the interaction of citizens with government agencies and increase the efficiency of governance through digital technologies.
- Developing and implementing virtual laboratories using modern simulation and modeling technologies, which will allow students to gain practical skills in an online environment.

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- Development and implementation of a digital university management and electronic document management system that will cover student account management, finance, human relations resources, and other aspects of administrative work.

## Non-Widening Countries

**Austria**

- The Austrian government's Digital Strategy aims to advance digitalization across various sectors, including education. It includes initiatives to improve digital infrastructure, promote digital skills development, and support digital innovation in universities (Digitalaustria, 2024).
- The Federal Ministry of Education, Science, and Research (BMBWF) implements the Digital Education Initiative to enhance digital learning and teaching practices in schools and universities. It includes funding programs, training initiatives, and digital resources for educators and students (Bmbwf, 2024).
- The National Broadband Strategy aims to improve broadband internet access and connectivity nationwide. Enhanced broadband infrastructure enables universities to leverage digital technologies for teaching, research, and administrative processes (RTR, 2024).
- **Graz University of Technology (TU Graz)** is responsible for the largest share of COMET Centres in Austria, including the KNOW CENTER which is a leading European innovation and cutting-edge research centre for trusted AI and Data Science. TU Graz is closely related to local businesses and also entertains a strong start-up culture (TU Graz, 2024).
- Vienna University of Technology (TU Wien) has developed a Digital transition Strategy to guide its digitalization efforts. The strategy outlines objectives, priorities, and action plans for integrating digital technologies into teaching, research, and university management (Tuwien, 2024).
- University of Graz provides digital learning platforms and tools to support online education and blended learning approaches. These platforms facilitate remote teaching, collaborative learning, and interactive engagement between students and instructors (ITUNI, 2024).
- Johannes Kepler University Linz (JKU) invests in research infrastructure enhancement to support digital research methodologies and data-driven innovation. This includes high-performance computing facilities, digital laboratories, and research data management systems (JKU, 2024).

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## 2.4 Research and Innovation in Higher Education Institutions

### 2.4.1 Barriers to Research & Innovation in Higher Education Institutions by Country

### Cyprus

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| EXTERNAL | • Lack in the legislation that directs the spin-off creation and the involvement of members of Staff of the public universities. Legislation plays a crucial role in shaping the environment for spin-offs. When there is a lack of specific laws or guidelines, several challenges arise: that include uncertainty as universities and researchers may be uncertain about the process of creating spin-offs, or even their potential involvement with them. |
| INTERNAL | • Non-streamlined internal procedures to promote links to industry and establishment of start-ups. |

### Croatia

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| EXTERNAL | • Lack of defined research positions in the Act on higher education and research activity – defined positions in HEI are assistant, senior assistant, assistant professor, associate professor and full professor. However, it remains unclear how will researcher that work on position of senior assistants advance in their careers after 4 years they are allowed at maximum to be on position of senior assistant.<br>• Non-standardised structure of universities and faculties as well as a large number of universities. There is need to consider restructuring of universities at national level (some have very little and none research activities and very low or no students) and to make the entire system more dynamic.<br>• Although there are some, there is in general lack of measures to stimulate researchers to apply and participate in programmes such as Horizon Europe or cooperation with the industry. These aspects are not appropriately included in the requirements for career advancement of professors and researchers. |

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| INTERNAL | • Set of guidelines for career advancement is not in line with the new national legislation. Currently set conditions such as minimum number of hours in teaching set additional obstacles that are not present in the national legislation.<br>• Large administrative requirements due to complex structures that slow down the process of acquiring funding of research and implementation of research.<br>• Research positions not clearly defined (also because of the national legislation) and research contributions are often in large measure less valued in terms of career advancements on HEI in comparison to teaching contributions. |

## North Macedonia

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| EXTERNAL | • The Law on scientific and research activity defines the legal framework for research activities in North Macedonia. Current R&I expenditures are very low compared to EU countries, and there is a declining trend in R&I investment. Under-funding of R&I by both the public and the private sectors are serious threats for the leading role of R&I in the creation of a knowledge-based society through GT and DT.<br>• Restrictive government policies on employment over the past 15 years have negatively impacted the research potential of HEIs. The Law on Higher Education does not allow the employing of young researchers without master's degree at HEIs, nor the employment of young researchers on international scientific projects. These constraints limit the influx of fresh talent and hinder the development of innovative research within HEIs.<br>• The weak connection between academia and industry in North Macedonia hampers collaborative research, innovation, and commercialization. This disconnection limits joint research initiatives and practical applications of academic findings. Additionally, inadequate industry investment in research stifles sustainable and institutional cooperation. Strengthening these ties and encouraging industry investment is crucial for fostering a robust and productive research ecosystem. |
| INTERNAL | • HEIs in North Macedonia struggle with low R&I management capacity and limited institutional support for researchers. There is a lack of qualified management and administrative staff, and institutional leadership has minimal influence on research. The governance system fails to support strategic research development, effective management, and the enhancement of research capabilities, leaving researchers highly autonomous but isolated.<br>• HEIs faces significant challenges due to a lack of funding, which restricts their ability to invest in scientific research. This financial constraint is particularly limiting for interdisciplinary research and collaboration, which are crucial for fostering innovation. The absence of strategic encouragement for such collaborative efforts further hampers the potential for groundbreaking discoveries and advancements in various fields.<br>• Lack of clearly defined IP rights within HEIs poses a significant internal barrier to R&I. Without clear policies and guidelines, there is uncertainty over the ownership and commercialization of research outcomes. This ambiguity can deter researchers from pursuing innovative projects and hinder collaborations, as potential conflicts over IP ownership may arise, ultimately stifling the institution's overall research productivity and innovation potential. |

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## Portugal

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| EXTERNAL | • Portugal encounters governance and funding challenges hindering R&I. Governance issues lead to inefficiencies and lack of direction, while limited funding restricts resources for projects and technological advancements. Addressing these barriers is vital for improving R&I output in Portuguese HEIs.<br>• Despite strides in expanding doctoral education in Portugal, challenges remain in aligning training with economic needs and improving program quality. Issues include inadequate training, limited market capacity to absorb skilled individuals, and lack of structured career plans. Addressing these barriers is essential for integrating doctoral training into the broader economic and innovation ecosystem, ensuring doctoral candidates contribute effectively to national development.<br>• An additional significant national barrier to the Portuguese R&I is the lack of planned academic careers, which limits R&I in HEIs. Without clear pathways for career progression, including recruitment, promotion, and retention policies, institutions struggle to attract and retain talented researchers. This uncertainty reduces motivation and productivity, hindering research output and innovation potential. |
| INTERNAL | • The lack of private sector funding and targeted grants for HEIs hinders R&I development. Insufficient regional networks and collaboration platforms limit partnerships between HEIs, local industries, and research institutions. Additionally, inadequate promotion of knowledge transfer between HEIs and local businesses stifles innovation and economic growth, impeding a more integrated approach to innovation.<br>• Expanding doctoral education in Portugal has been important for HEIs. However, challenges persist in aligning this training with the country's economic needs. Effective contributions from doctoral candidates are imperative for HEI success. Overcoming barriers such as inadequate training, limited market absorption, and the absence of structured career plans is essential. Portuguese HEIs must prioritize quality and integration into the broader socio-economic and innovation ecosystem.<br>• Regional regulations can bolster university research centers by mitigating national barriers related to academic careers. Local governments can form advisory work groups to enhance research performance and innovation. Granting HEIs greater autonomy in governance and decision-making enables them to align academic career paths and research agendas with strategic goals, thereby improving overall R&I output. |

## Romania

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| EXTERNAL | • In Romania the universities often struggle with limited financial resources for research and development. The national budget for R&I is relatively low compared to other EU countries, leading to a reliance on external funding sources, which can be uncertain.<br>• Collaboration between Romanian universities and international research institutions is rather limited, thus limiting the knowledge exchange and innovation. The rather weak collaboration between universities and industry limits the opportunities for applied research and commercialization of innovation. |

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| INTERNAL | *Nothing to report* |

## Serbia

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| EXTERNAL | • Limited financial resources for research and development within HEIs restrict their ability for innovation. Without adequate funding, HEI are unable to support cutting-edge research and innovative projects.<br>• Poor collaboration between HEIs and the industry limits the practical application of research findings. Strengthening partnerships between academia and industry (supported by the government) is essential to enhance the relevance and impact of academic research, driving innovation and technological development. |
| INTERNAL | • Traditional academic structures can limit creativity and innovation in HEIs. Promoting a more flexible and dynamic academic environment can encourage innovative thinking and facilitate research. |

## Ukraine

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| EXTERNAL | • Insufficient funding for R&I projects is a significant barrier to development. The lack of stable and sufficient funding limits the ability to conduct research and introduce new technologies.<br>• Complex administrative procedures and bureaucratic obstacles impede the effective work of scientists and the implementation of innovations. Delays in issuing permits, reporting, and other administrative issues slow down research and development activities.<br>• The outflow of talented scientists and researchers abroad due to insufficient support, low salaries, and lack of career prospects is a serious problem. This leads to a decline in the country's scientific potential. |
| INTERNAL | • Insufficient funding can be a serious constraint on R&I initiatives at universities. Most research requires significant expenditures on equipment, materials, and research personnel. Lack of funds can limit access to necessary resources and delay the development of research.<br>• Many scientific projects require specialized equipment to conduct research and experiments. Lack of access to such equipment or its obsolescence can limit the capabilities of researchers and delay project implementation. Access to up-to-date data, scientific publications, and other information resources is important for successful research. Lack of access to these resources can limit the capabilities of researchers and make it impossible to fulfill some aspects of research projects.<br>• Outflow of young and talented personnel: Insufficient support and incentives from university management can lead to an outflow of young and talented researchers to other institutions or the private sector. The lack of an effective incentive system, professional development opportunities, and competitive working conditions can make a university less attractive to young researchers, affecting its scientific potential and innovation. |

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### 2.4.2 Opportunities to Research & Innovation in Higher Education Institutions by Country

## Cyprus

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| EXTERNAL | • The Higher Education sector started to show a strong focus on Engineering & technology in terms of R&D investment. R&D spending gradually increased in absolute terms from € 47.5m in 2011 to €66.6m in 2020. |
| INTERNAL | • The R&I Management and Support Office (RIMS) facilitates R&I at CyI by identifying funding sources, assisting in proposal development and consortia building, reviewing and endorsing proposals, assisting in the negotiation of grants and funding agreements, liaising with funding agencies, interpreting guidelines and promoting compliance with the funding agencies and the CyI policies. |

## Croatia

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| EXTERNAL | • National plan for recovery recognised education and research as one of six priorities which will lead to big investments in this area, however mostly in infrastructure such as school renewals and similar.<br>• Existing Decisions by the Ministry of Education and Research on incentivising the applications and projects on Horizon Europe framework (new jobs, financial support to proposals that did not win funding but did win significant number of points). |
| INTERNAL | • New structure being introduced from autumn 2024 that should support the research on the HEI and provide research management services. It should include horizontal support to the HEI spanning over a wide range of areas – energy, robotics, health etc.<br>• New regulation for establishing spin offs of the faculty provides new opportunities for commercialization of research results of the faculty and provides additional incentives for the researchers as well as potentially additional revenue streams for the HEI.<br>• Existing infrastructure and laboratories that include wide range of areas such as energy, robotics, energy efficiency and other laboratories. This infrastructure can help stimulate cooperation with the industry and participation in competitive funds.<br>• Statue of the HEI defining the structure of the faculty, governing bodies, elections of management and similar procedures. |

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## North Macedonia

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| EXTERNAL | • The North Macedonian government's dedication to the new Smart Specialisation Strategy and the European Research Area (ERA) Policy Agenda prioritizes investments in R&I. This commitment aims to facilitate GT and DT and enhance researchers' access to top-tier facilities and infrastructures across the EU, thereby fostering a more robust and competitive research environment.<br>• FITD initiatives to support the Smart Specialisation Strategy priorities will significantly bolster its implementation. By facilitating the transfer of research results to the national economy, these initiatives will enhance the competitiveness of domestic companies and drive economic growth through innovation.<br>• Collaborating with industry partners can drive applied research and commercialization of academic findings. These partnerships provide practical insights, funding, and resources, facilitating the translation of research into marketable products and services. Such collaborations also help align academic research with industry needs, enhancing its relevance and impact.<br>• HEIs in North Macedonia have the opportunity to participate as equal partners in various European R&I programs such as Horizon Europe, LIFE, Digital Europe, EIT, and INTERREG. These programs offer significant funding, collaboration opportunities, and access to cutting-edge research networks, enabling HEIs to enhance their research capabilities, drive innovation, and increase their global competitiveness. |
| INTERNAL | • Implementing comprehensive faculty development programs focused on research skills, grant writing, and innovation can empower educators to excel in their research endeavours. By providing training and support, HEIs can enhance faculty competencies, increase successful grant applications, and foster a culture of continuous improvement and scholarly excellence.<br>• Establishing interdisciplinary research centers within HEIs can foster collaboration across various fields. These centers can bring together diverse expertise to tackle complex problems, leading to innovative solutions and groundbreaking research outcomes. By promoting interdisciplinary work, institutions can enhance their research capabilities and address pressing societal challenges.<br>• Developing strong partnerships with industry can significantly enhance R&I efforts. By collaborating with companies on research projects, internships, and innovation initiatives, HEIs can ensure their research is aligned with industry needs, increase funding opportunities, and provide practical experiences for students, fostering a more dynamic and relevant research environment.<br>• Leveraging connections with international research networks and consortia can facilitates new opportunities for collaboration and funding. By participating in global research initiatives, conferences, and exchange programs, HEIs can enhance their research capabilities, stay abreast of cutting-edge developments, and increase their visibility and reputation on the international stage. |

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## Portugal

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| EXTERNAL | • R&I offer substantial national opportunities, especially with support from national policy. Increasing funding for R&D, driven by a strategic approach, could elevate overall investment in research. This would equip HEIs with additional resources, fostering innovative research projects and contributing to societal advancement. Implementing control mechanisms can ensure excellence and return on investment in R&I.<br>• National frameworks and strategies focused on the internationalization of research centers can create numerous opportunities for Portuguese R&I centers. Strengthen international collaborations can inform national policy development, aligning Portuguese HEIs with global R&I trends. Additionally, partnerships with international entities can accelerate the transfer of knowledge and technology, driving innovation within the Portuguese economy. This approach enhances the global competitiveness and impact of Portuguese research initiatives.<br>• National frameworks and strategies focused on sustainable management create numerous opportunities for Portuguese R&I centers. Encouraging interdisciplinary collaboration among departments allows education institutions to engage local communities in sustainable practices, fostering a culture of sustainability beyond academia. Additionally, driving research in sustainable management, HEIs contribute to economic development through the creation of green jobs and the promotion of sustainable business practices.<br>• Initiatives like the Portuguese Atlantic International Research Center (AIRC) offer substantial opportunities for Portuguese R&I centers. These efforts, aiding green energy transitions in the Mediterranean region, address climate-related issues and align with the UN's Sustainable Development Goals (SDGs). Additionally, they expand the international network of Portuguese education institutions, fostering partnerships and research prospects, cementing their role in global sustainability efforts. |

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| INTERNAL | • Effective strategic funding and control mechanisms offer significant opportunities for HEIs. By ensuring adequate resources, HEIs can conduct innovative projects and attract top talent, thereby enhancing their contribution to societal advancement. These mechanisms are crucial for achieving research excellence, maximizing return on investment, and boosting competitiveness and reputation, which in turn help secure further funding and partnerships.<br>• Local governments can play a pivotal role in advancing the internationalization of R&I centers and aligning HEIs with global trends. By supporting international conferences and workshops, they facilitate valuable interactions, encourage technology transfer, and enhance collaborative opportunities. Such events significantly boost the visibility and reputation of HEIs, thereby fostering innovation within the Portuguese economy.<br>• Local governments can foster interdisciplinary collaboration among local R&I centers by establishing regional mechanisms facilitating knowledge and technology transfer. Initiatives like technology parks offer dedicated spaces where researchers from various fields can collaborate, fostering cooperation and knowledge exchange. Such efforts enhance innovation and strengthen ties between national and international partners, benefiting both local HEIs and the broader research community.<br>• Local public and private are key in fostering environments for hub, cluster, or multinational project development, benefiting local HEIs. Seizing this opportunity enhances R&I capabilities and contributes to global sustainability efforts. Marketing initiatives, both domestically and internationally, increase visibility and stakeholder engagement. Involving renowned Portuguese researchers inspires the next generation, reinforcing HEIs' pivotal role in transformative endeavours. |

## Romania

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| EXTERNAL | • The National Strategy for Research, Innovation and Smart Specialization (SNCISI) outlines the choice to support, recognize and reward excellence in basic and applied research, to stimulate the development of collaboration between the scientific and the private sectors to address economic and societal challenges, to formulate science, innovation and innovation entrepreneurship as successful models for the sustainable development of Romania in the local, national and international context. |
| INTERNAL | • Policy of the Transilvania University of Brasov on open, transparent and merit-based recruitment of researchers (OTM-R) aims to create the institutional framework for the efficient implementation of the recruitment, selection and integration of researchers. In 2021, the Transilvania University of Brașov adhered to the principles of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers (C&C). In 2023, UNITBV was granted the "HR Excellence in Research" award by the European Commission, which is both a recognition of the progress made in the implementation of the C&C principles and a commitment to continue and expand the efforts to align with European standards.<br>• The Projects Management Office was founded in 2011 to support the funding application, development and implementation of the projects in UTBv. |

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## Serbia

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| EXTERNAL | • The "Smart Specialization Strategy in the Republic of Serbia" for the period from 2020 to 2027 is an important instrument for improving the innovation and research ecosystem and directing future investment in industrial areas that, within the process, have been identified as priority areas: Food for the future, Machines and processes for the future, ICT and Creative Industries. The general vision implies that by 2027, the Serbian economy will largely be based on an economy based on knowledge and innovation.<br>• Increased funding from national and local budgets, as well as from international financial organizations, is driving innovation and technological progress at HEIs, which encourages partnerships between the academic community and industry. |
| INTERNAL | • The establishment of incubation and acceleration programs within the HEI supports the development of startups and innovative projects. These HEIs programs provide mentorship, funding and resources, helping entrepreneurs and innovators transform their ideas into sustainable products and services, thereby fueling economic growth.<br>• Promoting interdisciplinary collaboration between HEIs encourages innovative solutions to complex problems. The collaboration of experts from different fields results in discoveries and progress that benefit different sectors of society and economy.<br>• Facilitating international exchange programs for students and researchers exposes them to new ideas, practices, and technologies. These exchanges enhance the quality of education and research, lead to innovative solutions, and increase the global competitiveness of Serbian HEIs by integrating global best practices and fostering international collaboration. Support for such programs is provided by the government and relevant ministries. |

## Ukraine

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| EXTERNAL | • Participation in international grant programs and cooperation with foreign scientific institutions can provide additional funding and access to modern equipment and technologies. This will contribute to the development of R&I.<br>• Strengthening cooperation between universities and the private sector can help to commercialize research and promote innovation. Joint projects and investments from businesses can provide financial support and the introduction of scientific developments into production.<br>• Modernization of research infrastructure, including laboratories, research equipment, and information resources, can significantly increase the efficiency of research and stimulate innovation.<br>• Investments in advanced training of academic staff, participation in international conferences, internships, and exchange of experience will contribute to the development of the innovative potential of HEIs. |

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INTERNAL

- The university can develop partnerships with other universities and organizations for the exchange of students and young researchers. This will help to create an international environment for learning and research, as well as broaden the horizons for young people (NAWA, Horizon, etc.).
- The University can create specialized centers to facilitate international cooperation and project development involving stakeholders from different countries. These centers can offer advice, support in grant-making activities, and the organization of joint events.
- The university can actively cooperate with stakeholders from the private and public sectors to develop joint projects and initiatives. This will allow students and young researchers to gain practical work experience and provide the university with access to the latest technologies and innovative solutions.
- Modernization of scientific infrastructure can significantly improve the quality of research projects and contribute to their successful implementation. Here are some of the benefits of this approach:
  - ❖ Providing access to modern equipment: Modernization of research infrastructure allows universities to gain access to modern equipment and technologies that are essential for conducting high-quality research.
  - ❖ Increased productivity and quality of research: Thanks to modern infrastructure, research projects can be conducted at a higher level. This allows for more accurate results, more comprehensive data analysis, and the development of new approaches to solving scientific problems.
  - ❖ Return of talented scientists: Modernizing the research infrastructure can make a university more attractive to talented scientists and researchers. This can help attract new talent and stimulate cooperation with well-known scientists and research organizations.
  - ❖ Thus, modernization of scientific infrastructure plays an important role in improving the quality of research projects and ensuring their successful implementation. This is an investment in the future that contributes to scientific progress and the development of society.

### 2.4.3 Initiatives to Research & Innovation in Higher Education Institutions

## Widening Countries

**Cyprus**

- TREATY: Nurturing Tech Talents for Sustainable Energy Transition (treaty-project.eu) (Treaty, 2024).

**Croatia**

- ERA Agenda is the most important initiative for rising and enabling wide access to excellence.
- Creation of new structure that should horizontally support departments in project applications – in process of creation and to be presented to the ministry for approval.

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**North Macedonia**

- The Ministry of Economy issues funding calls aligned with the Smart Specialisation Strategy, available to support R&I and academia-industry collaboration.

**Portugal**

- The Portugal 2020 initiative exemplifies a national-level program offering opportunities for Portuguese HEIs. It is a partnership agreement between the Portuguese Government and the European Commission (EC), fostering economic, social, and territorial development, enhancing Portugal's competitiveness and internationalization (Portugal2020, 2024).
- Portugal 2020 has created significant opportunities for local and regional HEIs by leveraging regional strengths through smart specialisation strategies. It enhances the R&I system and promotes regional development by addressing local challenges. Increased funding opportunities, like the POSEUR program, support transitions to a low-carbon economy and fund renewable energy projects, enabling HEIs to pursue research and implement sustainable practices (POSEUR, 2024).

**Romania**

- The National Research, Development and Innovation Plan 2022-2027 (PNCDI IV) – is the main instrument for implementing the National Strategy for Research, Innovation and Smart Specialization (SNCISI). It aims to create the premises supporting the framework for RDI investment(s), encouraging partnerships between public and private actors to transfer research results to the market, stimulating the institutional performance and international collaborations.
- The PNCCDI IV research-development-innovation (RDI) programs are managed by the Executive Agency for Funding Higher Education, Research, Development and Innovation (UEFISCDI).
- The R&D Institute of the Transilvania University, ICDT (Project: R&D Institute High – Tech Products for Sustainable Development, PRO-DD). The strategic objectives of this project focus on increased competitiveness, transferability and visibility of R&D activities in high-tech products for sustainable development. The core activity of ICDT follows the scientific research strategy of the Transilvania University of Brasov and consists of fundamental and applied research, technological development and innovation in the fields of excellence of the Transilvania University of Brasov, while promoting sustainable development and interdisciplinary research. The specific research areas carried out in the 30 research centers of ICDT are defined in agreement with the national and European RDI priorities and the national development strategy.
- The Technology and Business Incubator (ITA) of UNITBv aims to facilitate the initiation and development of innovative enterprises, based on advanced technologies, in the research fields in the Transilvania University of Brasov. ITA support activities like: technology incubation activities for inventions and businesses; activities aimed at developing entrepreneurship (stimulating private initiative) among specialists, researchers, designers, teachers, students; activities aimed at developing entrepreneurship (stimulating private initiative) among specialists, researchers, designers, teachers, students, etc.; organizing events aimed at strengthening and expanding the university's collaboration with the economic environment, in order to increase economic competitiveness; promoting the principles of open science and the contribution of citizens to the generation of knowledge.
- The student project competition "Be in the Centre" aims at involving the students of the Transilvania University of Brasov in the development and optimization of the administrative, teaching and research processes and activities within the institution. The projects are granted by the Transilvania University of Brasov and the proposals are developed by teams of minimum 3 students in the following topics: digitalization of university processes, improvement of teaching activities, development of a Green Campus (Unitbv, 2024).

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**Serbia**

- In the VINČA Institute for Nuclear Sciences, several international (Horizon, IAEA, UNDP, ...) and national projects (Science Fund, Innovation Fund) promoting the GT are being funded (VIN, 2024).
- Every year, the VINČA Institute presents research results at the International Fair of Technology and Technical Achievements in Belgrade, and this year it presented seven innovations (VIN, 2024a).

**Ukraine**

- The Horizon Europe program aimed at supporting R&I provides funding for projects in various scientific fields, supports international cooperation and knowledge exchange. The participation of Ukrainian HEIs in this program can provide additional resources and opportunities for conducting advanced research and implementing innovative solutions.
- Implementation of the integrated program “Creation of Innovative Research Centers” to modernize the scientific infrastructure, attract external partners and support research projects. This initiative envisages the creation of specialized research centers equipped with modern technical facilities and capable of bringing together scientists from different fields to work together on innovative projects. These centers will work in close cooperation with industrial enterprises, NGOs, and government agencies to develop new technologies and address pressing societal issues. This will help to improve the quality of research, efficient use of resources, and rapid implementation of innovative solutions.

## Non-Widening Countries

**Austria**

- The COMET program (Competence Centers for Excellent Technologies) is a flagship research funding initiative in Austria managed by the Austrian Research Promotion Agency (FFG) and the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation, and Technology (BMK). It aims to strengthen Austria's innovation ecosystem by supporting collaborative research projects between universities, research institutions, and industry partners (FFG, 2024).
- The Austrian Research Association (ÖFG) facilitates collaboration and knowledge exchange among researchers, industry partners, and public stakeholders. It supports the establishment of research networks, joint research projects, and interdisciplinary initiatives to address societal challenges and foster innovation (FFG 2024).
- Vienna University of Technology (TU Wien) develops a comprehensive research strategy and agenda that aligns with its institutional priorities and strengths. The research strategy outlines thematic areas, interdisciplinary priorities, and funding priorities to guide research activities across faculties and departments (Tuwien, 2024a).
- University of Innsbruck establishes specialized research centers and institutes to promote interdisciplinary collaboration and address emerging research challenges. These research entities serve as hubs for cutting-edge research, technology development, and innovation in specific thematic areas (Uibk, 2024a).

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## 2.5 Policy Transformation

**Cyprus's** economy is primarily driven by sectors like tourism and trade, supported by evolving policy frameworks designed to strengthen these industries. To foster sustainable growth, policy reforms should focus on empowering local governments through a bottom-up approach that encourages citizen-led GT and DT. Strengthening synergies between research institutions, public bodies, grassroots initiatives, and NGOs is essential to bridge the gap between the public and private sectors, creating a more collaborative and resilient economic landscape.

In the area of green energy transition, **Croatia** recognizes the need for legislative and market reforms to accelerate progress. One key transformation would be the introduction of dynamic and variable pricing at the residential level, a move supported by numerous studies showing that it would drive investment in advanced technologies. This approach would also foster a deeper understanding among citizens and encourage more active participation, which is crucial, as the European Commission estimates that by 2050, citizens could produce up to 50% of the energy supply. In the realm of R&I within HEIs, **Croatia** acknowledges the need for more stringent requirements at both national and institutional levels. Criteria such as the number of published papers, participation in research projects, and securing research funding should play a greater role in career advancement. While these requirements are mentioned in existing policies, they are rarely quantified, and when they are, the standards tend to be low, especially given the favorable external conditions, such as the availability of abundant funding opportunities.

Efforts to improve R&I in **North Macedonia** require comprehensive policy reforms and initiatives. These should include establishing dedicated funding programs for higher education, increasing national investment in R&I, creating a robust national R&I program, and fostering an environment conducive to the development of Centers of Excellence. Additionally, a strategic plan with targeted measures to improve the quality of human resources in R&I is essential. These reforms are critical to cultivating a culture of excellence and advancement in the country's R&I landscape. To strengthen collaboration between academia and industry, **North Macedonia** needs targeted measures that provide increased financial support. One example is the adoption of a Technology Transfer Program to help R&I institutions enhance their capacity to commercialize inventions and improve overall efficiency in bringing innovations to market.

**Portugal** has several efforts aimed at improving Renewable Energy Partnership (REP) and fostering public-private partnerships in the renewable energy sector. One notable program is the Long-Term Strategy for Building Renovation (LTRS), part of the National Energy and Climate Plan 2030 (NECP 2030). This strategy includes measures to enhance energy efficiency and increase the use of renewable energy sources in buildings (DGEG, 2024). The LTRS aims to establish a supportive financial framework for energy renovations, promoting the development of financing programs and mobilizing public and private investments. The policy also emphasizes decentralized energy generation, including the creation of a digital marketplace for forming energy communities that can generate, share, and trade renewable energy—facilitating peer-to-peer energy trading. It offers tax incentives, community grants, and a supportive legal framework to encourage participation, while also providing training and public awareness campaigns. Additionally, the policy supports the development of microgrids and resource-sharing within communities, empowering local energy independence and resilience.

In **Romania's** GT, the development of robust national policies is essential to further promote the implementation of renewable energy systems. This requires the establishment of a stable and predictable legal framework, along with increased subsidies to incentivize green energy adoption. In the area of R&I within higher education, strengthening collaboration between universities, industry, and the business sector is crucial for facilitating technology transfer and the commercialization of

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inventions. Key measures should include simplifying administrative procedures, improving the IP framework, and providing enhanced support for researchers to access funding and navigate commercialization processes more effectively.

To advance **Serbia's** GT, a comprehensive renewable energy policy is essential to significantly reduce carbon emissions and promote sustainable development. This policy should include financial incentives, such as subsidies and tax breaks, to attract renewable energy investments, as well as the introduction of feed-in tariffs to encourage green energy projects. Modernizing the national grid with smart technologies and deploying advanced energy storage solutions will improve integration and reliability. Additionally, setting ambitious renewable energy targets and streamlining permitting processes are key to accelerating the adoption of RES. In terms of digitalization, **Serbia** requires a major policy shift through the development of a National Digital Infrastructure Plan. This plan should prioritize expanding high-speed internet access across the country, with a particular focus on rural and underserved areas, by investing in cutting-edge broadband networks and 5G technology. It should also include initiatives to improve digital literacy and skills training, ensuring that the workforce is equipped to leverage new technologies. By building a robust digital infrastructure and fostering digital skills, Serbia can fast-track its digital transition and stimulate economic growth. To drive innovation within HEIs in **Serbia**, a comprehensive policy reform is needed to establish Innovation Hubs at universities. These hubs would offer resources and support for research and development, encourage collaboration between academia and industry, and provide funding and mentorship for innovative projects. By embedding these hubs into the academic environment, universities can cultivate a stronger culture of innovation, foster entrepreneurial initiatives, and ensure that research is effectively translated into practical, marketable solutions.

To accelerate **Ukraine**'s GT, increased funding for environmental initiatives through dedicated funds and grant programs is essential, along with government support for investments in eco-friendly technologies. Comprehensive legislation should be developed to promote green initiatives, addressing renewable energy regulation, waste management, and environmental compliance monitoring. Raising environmental awareness among the public and businesses is equally important and can be achieved through educational programs and public campaigns that highlight the benefits of sustainable practices. Similarly, to fast-track **Ukraine**'s DT, greater investment is needed in digital initiatives through special funds and grant programs, backed by government support for cutting-edge digital technologies. Comprehensive legislation should be enacted to stimulate digital transition, focusing on the regulation of digital platforms, data protection, and mechanisms to ensure adherence to digital standards. Enhancing digital literacy among citizens and businesses is crucial, with educational programs and public campaigns promoting the importance of digital technologies in today's economy.

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# 3. Requirements for enhancing R&I excellence in Widening Countries

Based on barriers and opportunities (Chapter 2), this section defines **key requirements** and actions **for Widening countries** including Austria as an EU reference country (ref. INITIATE Consortium, Annex1).

The following requirements are in line with the requirements formulated in Widening participation and strengthening the European Research Area Work Programme 2023-25. They provide a common framework for intervention which all the Widening countries need to address in one way or another:

1. **Develop institutional framework conditions and research Infrastructures**: institutional reforms and transformation processes of the R&I system at institutional, regional, and national levels in Widening countries (i.e. institutional reform, leadership, sustainable infrastructure, green labs, smart campus, renewable energy facilities, data centre for sustainability, promote the creation of technology transfer offices, start-up incubators for green tech)
2. **Create Innovative Education and Training**: Foster brain circulation, including inter-sectoral mobility for researchers and innovators and turn it into brain gain for Widening countries (i.e. inter-sectoral mobility for researchers and innovators, interdisciplinary green program, digital learning platforms, digital literacy courses)
3. **Develop Research and Innovation capacity:** Increase participation and success rates of widening actors in research and innovation projects in other parts of Horizon Europe.
4. **Overcome Policy Barriers:** mobilise national investments in R&I capacity in Widening countries (ex. advocacy for sustainability policies, compliance with environmental regulations, advocacy for research-friendly policies)
5. **Nourish Local Ecosystems**: Develop and scale up local and regional breeding ground of actors. Foster collaboration with academic players in Widening countries with SMEs, start-ups as well as subsidiaries of larger international companies, governmental agencies, and local administrations to boost innovation potential.
6. **Boost Research and Innovation impact:** Promote research and innovative solutions with players from the innovation ecosystems, engage community, raise public awareness, and ensure sustainable funding.
7. **Enhance cooperation with international Alliances:** Raise the bar for excellence of R&I actors in Widening countries in partnership with outstanding European and international institutions (i.e. global research collaborations, EU research funding programs, joint, conferences and workshop, international student exchange programs)

To foster the green and digital transitions and the pursuit of research excellence in HEIs in specific Widening countries, there are distinct objectives, challenges, target audiences, and stakeholder groups that need to be addressed. **Table 1** below provides an overview by country.

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Table 1

| Country | Key Objectives | Specific Scenarios | Technologies | Target Audiences | Relevant Stakeholders |
|---|---|---|---|---|---|
| **Cyprus** | Green tech integration, digital innovation | Address energy isolation, boost digital literacy | Solar PV, digital learning platforms | HEIs, faculty, students | The Cyprus Institute, Research & Innovation Foundation |
| **Croatia** | R&I in renewable energy, digital education | Overcome grid limitations, smart education tech | Heat pumps, IoT, smart grid systems | Researchers, SMEs, policy-makers, innovation ecosystem | Ministry of Energy, Croatian Science Foundation, University of Zagreb, other local HEIs and ROs |
| **North Macedonia** | Energy modernization, workforce training | Improve infrastructure, reduce tech resistance | Living labs, digital twins | Faculty, public sector | Relevant Ministries, Regulatory Commission on Energy, FITD, Sc C-M Uni Skopje |
| **Portugal** | Hydrogen energy, digital transition | Develop hydrogen infrastructure, digital literacy | Hydrogen energy, online platforms | Researchers, energy firms, policy-makers | Ministry of Energy, Portuguese HEIs and research orgs such as LNEG |
| **Romania** | Smart grid research, digitizing education | overcome regulatory delays, smart grid deployment | Solar energy, smart grids, digital tools | Researchers, students | Transilvania University Brasov, national R&D agencies |
| **Serbia** | Develop green R&I initiatives, modernize energy infrastructure | outdated infrastructure, complex regulations | ICT, renewable systems | University researchers, industry | Vinča Institute, government (smart specialisation) |
| **Ukraine** | Build resilient energy systems, digital innovation | Weak legal frameworks, insufficient funding | Solar and wind energy systems, digital platforms | HEIs, public-private partnerships | government, international donors, HEIs, Kharkiv, Lviv |
| **Austria** | Promote green and digital R&I innovations | Strong legislative support for transitions | ICT, renewable energy systems, digital platforms | Students, industry, SMEs, start-ups, regional and local governments | Government, Austrian Research Promotion Agency, TU Austria |

For more country specific information, please refer to the sections below.

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| 1. CYPRUS | **CYPRUS**<br><br>• **Key Objectives:** Integrate renewable energy systems into campus operations and research. Promote digital innovation in teaching and learning. Build capacity for R&I in energy efficiency and environmental sustainability.<br>• **Specific Scenarios:** HEIs need to address the energy isolation of the island by researching solutions for renewable integration and energy storage. Develop online platforms for blended learning to enhance digital literacy.<br>• **Technologies:** Solar PV systems on university campuses. Digital learning platforms and smart campus technologies for energy management.<br>• **Target Audiences:** Students and faculty focusing on environmental sciences and engineering. Administrative staff for digital transition training.<br>• **Relevant Stakeholders:** The Cyprus Institute (ESEIA Member), Research and Innovation Foundation, Cyprus Seeds for collaboration on sustainability and energy R&I projects. |
| 2. CROATIA | **CROATIA**<br><br>• **Key Objectives:** Strengthen R&I in renewable energy and energy-efficient technologies. Digitize administrative processes and promote smart education technologies in HEIs.<br>• **Specific Scenarios:** HEIs must address legislative delays in adopting renewable energy projects and limited grid capacity by focusing on smart grid research. Integrate digital tools into curricula, particularly for engineering and IT programs.<br>• **Technologies:** Heat pumps for sustainable campus heating. IoT and smart campus systems for better energy management.<br>• **Target Audiences:** Researchers in environmental science and energy systems. Students in technical disciplines (engineering, IT).<br>• **Relevant Stakeholders:** Ministry of Energy, European Union funding bodies, University of Zagreb (ESEIA Member) local universities working on R&I projects. |

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| 3. North Macedonia | **North Macedonia**<br><br>• **Key Objectives:** Modernize energy infrastructure at HEIs to support renewable energy research. Build digital infrastructure to improve research capabilities and e-learning.<br>• **Specific Scenarios**: Universities face infrastructure challenges and resistance to digitalization and green technologies, requiring targeted investment. Promote workforce training programs in sustainable energy and digital innovation.<br>• **Technologies:** Investment in distributed energy resources (solar PV, heat pumps, electric vehicles, battery storage systems) and development of Living Labs and Digital Twins.<br>• **Target Audiences**: Faculty and students in STEM fields. Policy-makers focusing on energy and education reform.<br>• **Relevant Stakeholders**: Ministry of Energy, Mining, and Mineral Resources, Ministry of Education, and Ministry of Digitalisation, Regulatory Commission on Energy, Fund for Innovation and Technological Development (FITD), Ss. Cyril and Methodius University in Skopje. |

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| 4. Portugal | **Portugal**<br><br>• **Key Objectives:** Develop hydrogen energy research at HEIs and support broader integration of renewable energy. Foster digital transition across educational and administrative processes.<br>• **Specific Scenarios**: Challenges related to hydrogen infrastructure need to be addressed by research institutions, with a focus on developing expertise and technology for green hydrogen. Universities must increase digital literacy and prepare students for the future green economy.<br>• **Technologies**: Hydrogen technologies for energy research and application.Online learning platforms and digital resource management systems.<br>• **Target Audiences:** Researchers in energy fields. University administrators leading digitalization efforts.<br>• **Relevant Stakeholders:** Regional HEIs, Ministry of Energy, Portuguese HEIs and research organisations such as LNEG (ESEIA Member). |
| 5. Romania | **Romania**<br><br>• **Key Objectives:** Expand smart grid research and integration into university campuses. Increase digital capabilities by offering online education platforms and virtual laboratories.<br>• Specific Scenarios: HEIs must overcome regulatory barriers that delay the adoption of smart grids, while also pushing for clearer research policies to enable faster renewable adoption. Invest in digitizing education for engineering, ICT, and environmental studies programs.<br>• Technologies: Smart grids for campus energy management. Solar energy systems to power university buildings.<br>• Target Audiences: Students in ICT, engineering, and energy fields. University researchers focusing on renewable energy and sustainability.<br>• Relevant Stakeholders: Transilvania University of Brasov (ESEIA Member), national R&D agencies, Ministry of Education. |
| 6. Serbia | **Serbia**<br><br>• **Key Objectives:** Encourage R&I in renewable energy systems and ICT to facilitate the green and digital transitions. Modernize HEIs' energy infrastructure and integrate sustainability initiatives into research programs.<br>• **Specific Scenarios**: HEIs need to tackle outdated energy infrastructures and complex regulatory environments, focusing on applied research in energy and ICT. Promote technology transfer initiatives to commercialize university research.<br>• **Technologies:** ICT tools for e-learning and smart campus management. Renewable energy systems (solar, wind) for campus use.<br>• **Target Audiences:** University researchers in ICT and energy.Industry partners collaborating on R&I projects.<br>• **Relevant Stakeholders:** government (Smart Specialization Strategy), Vinča Institute, local government. |

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| 7. Ukraine | **Ukraine**<br><br>• **Key Objectives:** Build resilient energy systems on university campuses to support sustainable energy research. Promote digital innovation in higher education, integrating more e-learning solutions.<br>• **Specific Scenarios:** Country at war; HEIs face challenges with funding and legal frameworks, hindering the adoption of sustainable energy technologies. Institutions need to establish digital infrastructure to enhance online education and support R&I activities.<br>• **Technologies:** Solar and wind energy systems to power universities. Digital platforms to facilitate international collaboration in research and education.<br>• **Target Audiences:** Faculty and students involved in R&I. Public-private partnerships for infrastructure development.<br>• **Relevant Stakeholders:** Ukrainian government, private investors, international donors, Kharkiv Uni, Lviv Uni. |
| 8. Austria | **Austria**<br><br>• **Key Objectives:** Lead the development of green and digital innovation in HEIs. Promote research excellence by integrating digital tools into teaching and learning, while advancing sustainable energy research.<br>• **Specific Scenarios:** Austria's HEIs benefit from strong legislative support for green and digital transitions but need to focus on further international collaboration in these areas. Digitalization of administrative and educational processes is essential for improving efficiency and research output.<br>• **Technologies:** ICT solutions for education and research. Renewable energy systems (e.g., solar, wind) to power campuses.<br>• **Target Audiences:** Students in digital technologies and environmental sciences. Energy industry partners for R&I collaborations.<br>• **Relevant Stakeholders:** Government, Austrian Research Promotion Agency, TU Graz (Member of ESEIA), TU Vienna (Member of ESEIA); local universities, industry leaders. |

The above requirements provided a framework for the cases studies collected. A Review of Good Practice cases is provided in Chapter 4.

# 4. Good Practices for Green and Digital Transition and Research and Innovation in Higher Education

According to the requirements identified in Chapter 3, this section provides an analysis of good practice cases for Green and Digital Transition and Research and Innovation in Higher Education. They represent existing support structures in the INITIATE institutions as well as capacity-building measures present and those needed in future. These structures need to fulfil a number of criteria. First and foremost, they need to be permanent and pervasive, trusted and responding to the needs of the R&I community.

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ESEIA collected 20 cases which were reviewed according to the monitoring and evaluation framework established by UZagreb (INITIATE T2.1). The analysis of the cases also reflects on whether and to which extent they are transferrable studying the absorption capacity of specific models such as competence centres.

**Sources:** ESEIA investigated relevant EU projects, Website, publication, reports, inputs from project partners, ESEIA membership, and six other European University Alliances, and initiatives.

**Method used**:

1. **Create the list** of existing European University Alliances and networks
2. **Explore websites, publications, and reports** from the European University Alliances and initiatives
3. **Exploit ESEIA network** (include European organizations, national governments, HEIs, Student and academics, industry and society) to address knowledge gaps, bridge the gap between industrial innovation and education, and create network
4. **Establish connection with European University Alliances** to collect information on green transition, digitalization, or higher education innovation to identify gaps and opportunities for improvement align with the overall objectives of the green transition and digitalization of European Universities.
5. **Combine data and analyse the results,** review by experts for insights and recommendations
6. **Create a Report** on Good practices from European University Alliances

**Analysis of Best Practice Cases**

This analysis evaluates 20 use cases included in the best practice overview (Annex 3) **based on their relevance and effectiveness in addressing the green and digital transition challenges, as well as R&I in HEIs in Widening Countries**.

The cases collected from INITIATE partners represent a **large spectrum of R&I, more or less permanent infrastructures**, good educational practices, and projects related to digital and energy transition.

**The cases were rated in terms of their impact and effectiveness**. The primary focus was on identifying permanent structures, that are pervasive, and that are trusted because they respond to the needs of the research and innovation communities and address the twin challenges effectively.

The cases can be categorised in **five groups** of decreasing effectiveness as follows:

1. **University Alliances (High)**
2. **R&I infrastructures (High)**
3. **Innovation hubs (High)**
4. **Entrepreneurial education and training (High), and**
5. **EU funded R&I projects for green and digital transition (High to Moderate).**

1. **University Alliances**

In terms of sustainable structures, European alliances stick out as they can provide a stable breeding ground for peer-to-peer interaction and the international partnerships needed for enhancing R&I performance.

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In analysing the **effectiveness** of different European university alliances— **ARQUS**, **ECIUn+**, **EPICUR-SHAPE-IT**, **Unite**, **EU4DUAL**, and **INGENIUM**—in fostering the **twin transitions** (green and digital) and improving **excellence in higher education**, we can assess each alliance based on its mission, structure, collaboration, and contribution to the twin transition.

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| 1. ESEIA | **European Sustainable Energy Innovation Alliance - ESEIA**<br><br>• **Focus Area**: Cross-sector **Thematic Alliance**, includes businesses, Sustainable energy and capacity building for renewable energy systems.<br>• **Twin Transition Role**: Direct focus on the **green transition** through renewable energy research, innovation, and capacity-building activities. It indirectly supports the **digital transition** by integrating smart energy systems, digital tools, and technological innovations.<br>• **Higher Education Excellence**: ESEIA aims to close the **innovation gap** by building strong local, regional, and international partnerships among 23 members, including higher education institutions, research organizations, and businesses. It enhances **research excellence** in renewable energy systems and builds capacity for both students and faculty.<br>• **Effectiveness**: **High in green transition**, engaging with digital transition. Strong for **research excellence and innovation and entrepreneurial education**. Its impact on local and regional innovation ecosystems is significant. |
| 2. **ARQUS** | **ARQUS, The European University Alliance**<br><br>• **Focus Area**: General collaboration on **research, study, teaching**, and **social engagement**.<br>• **Twin Transition Role**: While ARQUS focuses on **social engagement**, it integrates elements of both the **green** and **digital transitions** through various sustainability and digital literacy initiatives. However, its direct contribution to these transitions is less defined than other alliances.<br>• **Higher Education Excellence**: ARQUS prioritizes improving research and education quality through collaboration between its nine member universities. It promotes **cross-disciplinary** research, joint teaching initiatives, and exchange programs, enhancing overall **education quality**.<br>• **Effectiveness**: **Moderate** in both the green and digital transitions, as its focus is broader. Strong in fostering **excellence in education** through its social engagement and integrated learning approach. |

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| 3. **ECIUn+** | **ECIUn+, The European Consortium of Innovative Universities**<br><br>• **Focus Area**: Innovation in **education, research, and knowledge exchange**.<br>• **Twin Transition Role**: **Highly relevant to the twin transitions**, as ECIUn+ focuses on integrating **digital innovation** (such as smart cities, AI, and digital transition) and **green solutions** (sustainability, circular economy) into education and research. It leads projects directly tackling both transitions.<br>• **Higher Education Excellence**: ECIUn+'s strong **focus on innovation** and **entrepreneurship** enhances its member universities' global competitiveness. It connects research with real-world applications, improving the education quality by emphasizing **hands-on, challenge-based learning**.<br>• **Effectiveness**: High in both **green** and **digital transitions** due to its focus on innovation ecosystems and technology transfer. Strong in **education excellence**, particularly for developing cutting-edge programs that integrate innovation. |
| 4. EPICUR | **EPICUR-Alliance - European Partnership for an Innovative Campus**<br><br>• **Focus Area**: Transformation and integration of European higher education.<br>• **Twin Transition Role**: EPICUR focuses on **sustainable** and **regional innovation** and promotes a digital learning environment. It works on **regional sustainability** and includes efforts to integrate **green technologies** and **digital innovation** across campuses, contributing to both transitions.<br>• **Higher Education Excellence**: By focusing on **European integration**, EPICUR promotes excellence in **curriculum design**, **mobility**, and **cross-disciplinary education**, aligning closely with European Higher Education Area (EHEA) priorities.<br>• **Effectiveness**: High in **higher education transformation**, moderate to high in the twin transitions due to a more regional approach to sustainability and digital learning. |
| 5. Unite! | **Unite! (University Network for Innovation, Technology, and Engineering)**<br><br>• **Focus Area**: Engineering and **technology innovation**.<br>• **Twin Transition Role**: Unite! plays a key role in both transitions by focusing on engineering solutions for the **green transition** (clean technologies, energy efficiency) and **digital innovation** (automation, Industry 4.0, digital infrastructure).<br>• **Higher Education Excellence**: Strong focus on **research excellence** and technological leadership, particularly in engineering. Unite! fosters cross-campus collaboration, developing innovative educational programs in **STEM** that align with industrial needs.<br>• **Effectiveness**: High in **digital transition** due to its technological expertise. Strong in **green transition** due to its focus on energy and sustainability. Significant impact on **education quality** in STEM fields. |

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| 6. EU4DUAL | **EU4DUAL (European Dual Studies University)**<br><br>• **Focus Area**: Dual-study models connecting **higher education** with the **world of work**.<br>• **Twin Transition Role**: **Moderate impact** on the twin transitions, as EU4DUAL's main focus is on **work-based learning**. However, it aligns with both transitions by training students in green technologies and digital tools that are critical for the future workforce.<br>• **Higher Education Excellence**: EU4DUAL improves the **quality of education** by directly connecting it with industry needs through **dual-study programs**, ensuring that students are well-prepared for the evolving labor market.<br>• **Effectiveness**: Moderate in green and digital transitions, as its focus is primarily on **employability**. Strong in improving **education quality** through its hands-on, real-world approach. |
| 7. INGENIUM | **INGENIUM (Alliance for Innovative Higher Education Institutions)**<br><br>• **Focus Area**: Offering high-quality, **digitally enhanced programs** in higher education.<br>• **Twin Transition Role**: INGENIUM has a strong focus on **digital education** and **technological integration**, contributing directly to the **digital transition** by using digital learning platforms and tools. It also addresses **green transition** challenges through curricula that integrate sustainability and energy management.<br>• **Higher Education Excellence**: The alliance focuses on **high-quality, digitally enhanced programs** across its member institutions, promoting **innovation in teaching** and improving access to **digital learning**.<br>• **Effectiveness**: High in the **digital transition**, due to its commitment to digital education technologies. Moderate to high in the **green transition**, depending on the adoption of sustainability-focused curricula. |

**Table 2**

| Alliance | Twin Transition Role | Higher Education Excellence | Overall Effectiveness |
|---|---|---|---|
| **1 ESEIA** | Focus on Renewable Energy innovation with a Focus Group on Advanced Computing | Strong in **research** and **innovation as well as capacity-building for green transition** | High in green innovation using digital capacity, close to innovation ecosystem |
| **2 ARQUS** | Moderate in both transitions, focuses on **engagement** | Strong in **social engagement** and **cross-learning** | Moderate due to broad focus, strong in education |
| **3 ECIUn+** | High in both transitions, focused on **innovation** | Strong in **entrepreneurship** and **real-world** impact | High in both green and digital, strong for excellence |
| **4 EPICUR-Alliance** | Moderate to high, focused on **regional innovation** | Strong in **European integration** and curriculum | High for higher education reform, moderate for transitions |
| **5 Unite!** | High in both, especially in **engineering** | Strong in **STEM** and **technological leadership** | High in both transitions and education innovation |
| **6 EU4DUAL** | Moderate, work-based learning relevant to transitions | Strong in **employability** and **industry alignment** | Moderate for transitions, high for applied education |
| **7INGENIUM** | High in **digital education**, moderate in **green** | Strong in **digital innovation** and **program quality** | High in digital, moderate in green, strong for digital education |

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**Key Takeaways on European Alliances:**

- **ECIUn+**, **Unite!** and **ESEIA** are the most effective alliances for both **twin transitions** and improving **higher education excellence**, particularly in fields related to **technology** and **innovation**. **ESEIA** sticks out as it is the **only cross-sector thematic alliance** including businesses as members.
- **EU4DUAL** excels in **education-employment alignment** and prepares students for both transitions, but its broader impact on the transitions themselves is more limited.
- **INGENIUM** stands out for its **digital learning innovations**, making it highly effective in the **digital transition**, while its green transition impact is moderate.
- **ARQUS** and **EPICUR-SHAPE-IT** focus more on **education quality**, regional integration, and social engagement, showing moderate relevance to the twin transitions but strong contributions to education transformation.

Each alliance offers unique strengths, but the most effective for the **twin transitions** are European thematic Alliances like **ESEIA** with a clear focus on **innovation**, **technology**, and **green solutions**.

**2. R&I infrastructures**

**Permanent Structures fostering R&I:** Initiatives like the cross-sector Alliance **ESEIA** representing the innovation eco-system Europe-wide and **COMET Program** stand out for creating long-lasting partnerships, educational programs, and innovation hubs. These structures **offer consistent and pervasive support to HEIs and other stakeholders, ensuring sustainability in both green and digital transitions.**

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| 8. ESEIA | **European Sustainable Energy Innovation Alliance - ESEIA**<br><br>• Focus Area: Developing collaborative research and innovative education related to sustainable energy. Cross sector alliance bridging the gap between Higher Education and industry.<br>• Challenges Addressed: Difficulty in coordinating energy innovations at the European level, especially in integrating HEIs with the energy sector and with regional and local ecosystem.<br>• Methodology: Five thematic working groups and coordinated innovation hubs.<br>• Target Audience: HEIs, research organizations, and European decision-makers.<br>• **Impact:** The establishment of working groups and innovation hubs ensures a permanent structure for collaboration across Europe, making ESEIA a trusted and pervasive initiative. Its focus on research infrastructure addresses critical gaps in R&I for the green transition, particularly in renewable energy.<br>• **Effectiveness: High.** The initiative is a long-standing organization that continually supports HEIs through strategic partnerships, addressing energy-related R&I needs directly in line with the EU's green transition agenda. |

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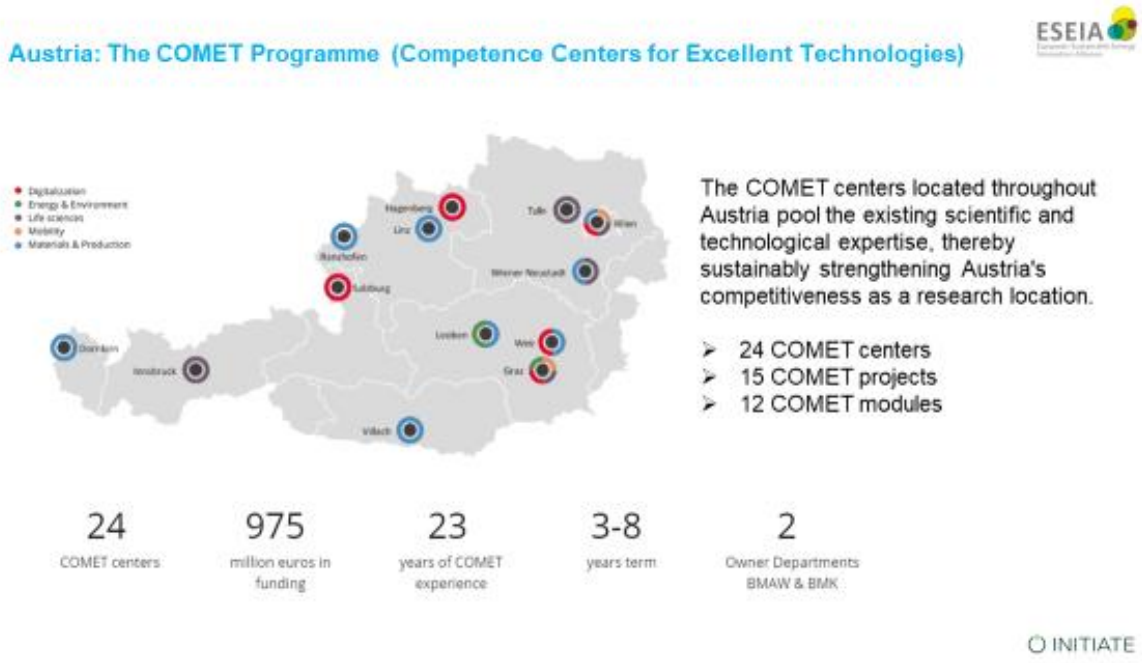
| 9. **Austrian COMET Programme** | Founded in 2006 COMET is a programme funded by the Austrian government designed to foster collaborative R&D between academia, industry, and research organizations.<br><br>• **Focus Area:** Supports R&D in areas like renewable energy, digital technologies, and sustainable manufacturing. Key sectors include Industry 4.0, AI, and cybersecurity, which align with the goals of the green and digital transitions.<br>• **Challenges Addressed:** Fragmented innovation ecosystems: Limited collaboration between academia and industry. Lack of infrastructure for supporting cutting-edge green and digital technologies in Widening Countries.<br>• **Methodology:** Public-private partnerships (PPP): Collaboration between universities, research institutions, and businesses. Establishment of competence centers with long-term funding, providing infrastructure and ongoing support for R&D. Use of staff exchanges, workshops, and knowledge transfer seminars to embed skills and foster innovation.<br>• **Target Audience:** HEIs, research institutions, and industry (particularly SMEs and high-tech sectors). Policy-makers who create frameworks to support innovation.<br>• **Impact:** Creates permanent structures through competence centers, ensuring long-term collaboration with industry. Drives progress in renewable energy and digital technologies, supporting the green and digital transitions. Supports upskilling through continuous education and training programs.<br>• **Effectiveness: High:** COMET provides a sustainable framework for innovation by fostering deep collaborations and delivering impactful R&I. The competence centers serve as trusted and pervasive structures, ensuring ongoing development including in green and digital transitions. |

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### 3. Innovation Hubs

**EU funded Digital innovation hubs** like PTCentroDiH and INNOFEIT have been highly effective in supporting SMEs and start-ups, facilitating both green and digital transitions.

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| 10. PTCentroDIH | **PTCentroDiH (Digital Innovation Hub of Portugal)**<br><br>• Focus Area: Digital and green innovation through education, training, and developing R&I infrastructure.<br>• Challenges Addressed: Lack of innovation structures supporting digital transition and training in digital technologies.<br>• Methodology: Hybrid training models combining online and face-to-face methodologies.<br>• Target Audience: SMEs, digital innovators, and HEIs.<br>• **Impact:** The hub provides support services to enhance digital literacy and innovation capabilities, particularly for SMEs and HEIs. Its hybrid methodology ensures that digital skills can be transferred efficiently, offering a sustainable structure for ongoing digital education and training.<br>• **Effectiveness: High.** By integrating digital innovation with green transition goals and creating a permanent structure (innovation hub), PTCentroDiH is a vital tool for digital upskilling and fostering innovation in a sustainable manner. |
| 11. 4INNOFEIT of Macedonia | **INNOFEIT of Macedonia**<br><br>• Focus Area: INNOFEIT advances sustainable energy and digital innovation by supporting renewable energy technologies and digital solutions like energy efficiency, clean technologies, and AI. It facilitates technology transfer by connecting research with industry needs.<br>• Challenges Addressed: INNOFEIT tackles weak R&D collaboration, lack of innovation infrastructure, and the skills gap in areas like sustainable energy and digital transition, especially in Widening Countries.<br>• Methodology: As a technology transfer hub, INNOFEIT acts as a bridge between universities and industries, focusing on transforming research into market-ready solutions. It also promotes collaborative projects, staff exchanges, and training programs to foster knowledge transfer.<br>• Target Audience: Includes HEIs, research organizations, SMEs, startups, and policy-makers, promoting collaboration, mentorship, and alignment with regional innovation strategies.<br>• Impact: INNOFEIT helps commercialize technologies by turning research into viable products, supporting both green and digital transitions. It fosters startups and SMEs, promoting innovation and entrepreneurship.<br>• Effectiveness: Rated moderate to high, INNOFEIT effectively bridges academia and industry, promoting sustainable and digital technologies. Its potential for long-term impact depends on continued engagement and funding to maintain sustainability and scalability. |

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### 4. Entrepreneurial education and training

Innovative Education and Training Programs such as GET-UP and PTCentroDiH (included also in previous section) highlight the importance of innovative education methodologies, including hybrid learning and digital training.

These approaches are critical in addressing the skills gap in Widening Countries, particularly in green entrepreneurship and digital innovation. Practices like INNOFEIT demonstrate the effectiveness of staff exchanges and collaborative curriculum development. These exchanges foster long-term capacity building by institutionalizing knowledge within HEIs and research organizations.

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| 12. GET-UP from Cyprus | **Green Entrepreneurship Training (GET-UP) from Cyprus**<br><br>• Focus Area: Innovative education and training for green economy development.<br>• Challenges Addressed: Insufficient support for green entrepreneurs and a lack of training for educators in green economy skills.<br>• Methodology: Development of pedagogic practices and training material.<br>• Target Audience: HEIs, green economy practitioners, and educators.<br>• **Impact:** The program developed six intellectual outputs (training programs and educational resources), which are integrated into educational institutions, providing a long-term framework for green economy education.<br>• **Effectiveness: Moderate to High**. The initiative provides sustainable educational resources and programs, effectively contributing to capacity building in green entrepreneurship. However, its impact may depend on broader adoption by HEIs. |

### 5. EU funded R&I projects for green and digital transition

EU funded Energy transition projects like InovGrid, SET_HEAT, GreenH2Atlantic, and TEC4Growth have the highest potential for immediate carbon reductions, addressing critical energy and environmental challenges. Urban regeneration and sector-specific projects like OLGA and COMMUNITAS show high potential in their respective fields, though scaling efforts remain a challenge.

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| 13. InovGrid | **InovGrid: Transformation of Energy Distribution Network**<br><br>• **Focus Area:** InovGrid focuses on smart energy management through the development of an intelligent electricity grid. It supports the integration of renewable energy and promotes energy efficiency by enabling better control and management of energy consumption.<br>• **Challenges Addressed:** Energy transition: The need for a modernized energy grid to handle the increased use of renewable energy. Energy efficiency: Addressing inefficient energy use and distribution.Consumer engagement: Encouraging end-users to adopt energy-efficient practices.<br>• **Methodology:** InovGrid uses smart meters and advanced data analytics to monitor and optimize energy consumption. It leverages real-time monitoring to manage energy distribution and support renewable integration. Engages end-users by providing tools to manage their energy consumption more effectively.<br>• Target Audience: Utility companies: Modernizing their energy infrastructure. End-users and consumers: Encouraging energy-efficient behaviors. Policy-makers: Ensuring regulatory support for smart grid technologies.<br>• **Impact:** InovGrid has improved energy efficiency and reduced carbon emissions by optimizing energy distribution and consumption. It supports the integration of renewable energy, enhancing the reliability of the energy grid. Engages consumers in the green transition by providing better control over energy use.<br>• **Effectiveness:** Rated high, InovGrid has proven effective in creating a smart, flexible energy grid that supports both energy efficiency and renewable integration. Its impact on reducing carbon emissions and engaging consumers makes it a strong contributor to the green transition. |
| 14. GreenH2Atlantic | **GreenH2Atlantic**<br><br>• **Focus Area**: GreenH2Atlantic focuses on producing green hydrogen through renewable energy sources. It aims to demonstrate the feasibility of green hydrogen as a sustainable alternative to fossil fuels, supporting decarbonization in energy-intensive sectors.<br>• **Challenges Addressed:** decarbonization: Reducing reliance on fossil fuels by introducing green hydrogen. Energy storage: Addressing the challenges of storing renewable energy efficiently. Technological scalability: Demonstrating the potential for large-scale green hydrogen production.<br>• **Methodology:** The project uses electrolysis technology powered by renewable energy (such as wind or solar) to produce green hydrogen. It involves collaborative efforts between industry, research organizations, and policy-makers to develop and implement green hydrogen infrastructure. Focuses on integrating green hydrogen into existing energy systems, including industrial applications.<br>• **Target Audience:** Energy companies: Transitioning to green hydrogen solutions. Heavy industries: Using green hydrogen to decarbonize their operations. Policy-makers: Supporting regulatory frameworks for hydrogen production and usage.<br>• **Impact:** GreenH2Atlantic has the potential to significantly reduce carbon emissions by replacing fossil fuels with hydrogen in energy-intensive sectors. The project supports the scaling up of green hydrogen technologies and demonstrates the viability of using hydrogen for large-scale energy storage and industrial use.<br>• **Effectiveness:** Rated high in terms of potential impact, GreenH2Atlantic addresses critical challenges related to decarbonization and energy storage. Its success in producing and integrating green hydrogen can accelerate the green transition across various industries. |

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| 15. OLGA | OLGA (Holistic Green Airport)<br><br>• Focus Area: OLGA focuses on creating green airports by reducing carbon emissions, improving energy efficiency, and integrating sustainable practices in airport operations. The project targets both infrastructure and operational changes to promote environmental sustainability in air transport.<br>• Challenges Addressed: Carbon emissions: Tackling the high emissions generated by airports and air traffic. Energy efficiency: Improving the energy usage of airports through sustainable technologies. Sustainable mobility: Addressing the need for greener transportation options in and around airports.<br>• Methodology: The project incorporates renewable energy technologies, such as solar panels, into airport infrastructure. Implements energy-efficient solutions in airport operations and logistics. Focuses on sustainable mobility by promoting the use of green transport options for passengers and airport services.<br>• Target Audience: Airports and aviation authorities: Focus on adopting green practices and technologies. Passengers: Encouraging the use of sustainable mobility options. Policy-makers: Supporting the development of green regulations for airports.<br>• Impact: OLGA helps to reduce carbon footprints and promote the use of renewable energy in airports. Improves overall energy efficiency in airport operations and introduces greener mobility options for travellers and airport services.<br>• Effectiveness: **Rated moderate to high**, OLGA is effective in addressing environmental challenges in the aviation sector. Its holistic approach to greening airports can make a significant impact on reducing emissions and promoting sustainability, though widespread adoption and further regulatory support are necessary for maximum effect. |
| 16. COMMUNITAS | COMMUNITAS<br><br>• Focus Area: COMMUNITAS focuses on sustainable urban development through community engagement. It promotes green urban spaces, energy-efficient housing, and digital solutions to enhance livability and environmental sustainability in cities.<br>• Challenges Addressed: Urban regeneration: Addressing the need for revitalization of urban areas with a focus on sustainability and inclusivity. Social inclusion: Ensuring that urban development benefits all, particularly marginalized communities. Sustainable living: Promoting environmentally friendly housing and infrastructure in urban settings.<br>• Methodology: Community-driven approach: Involves citizens in decision-making processes related to urban development, ensuring that regeneration efforts meet local needs. Green technologies: Integrates renewable energy, sustainable building practices, and digital technologies to enhance urban sustainability. Collaborative projects: Encourages partnerships between local authorities, community groups, and businesses to foster inclusive urban regeneration.<br>• Target Audience: Local communities: Engaging citizens in urban planning and sustainability initiatives. City planners and local governments: Encouraging sustainable urban development policies. Policy-makers and businesses: Supporting frameworks and innovations for green and inclusive urban spaces.<br>• Impact: COMMUNITAS promotes socially inclusive and sustainable urban regeneration, improving the quality of life in cities while supporting the green and digital transitions. Enhances community participation, leading to more equitable and environmentally friendly urban environments.<br>• Effectiveness: Rated high, COMMUNITAS effectively addresses the challenges of sustainable and inclusive urban development. Its community-centric approach ensures that regeneration projects are both socially beneficial and environmentally sustainable, with the potential for long-term impact in urban areas. |

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| 17. SET_HEAT | **SET_HEAT**<br><br>• **Focus Area:** SET_HEAT is an initiative focused on the decarbonization of heating systems through the promotion of sustainable energy technologies, addressing key challenges in energy transition, particularly in the heating sector. SET_HEAT supports the broader goals of the green transition by decarbonizing one of the largest sources of energy consumption.<br>• **Challenges Addressed:** High carbon emissions from heating: Traditional heating systems heavily rely on fossil fuels, contributing significantly to greenhouse gas emissions. Energy inefficiency: Many existing heating systems are inefficient, leading to excessive energy consumption.<br>• **Methodology:** Deployment of renewable heating technologies: SET_HEAT promotes the adoption of heat pumps, solar thermal systems, and district heating powered by renewable energy sources. Collaborative efforts: The project involves partnerships between policy-makers, energy providers, and local communities to promote sustainable heating solutions.<br>• **Target Audience:** Local governments and policy-makers: Encouraging the implementation of policies that support renewable and energy-efficient heating. Energy providers: Consumers and local communities<br>• **Impact:** Reduction in carbon emissions: By shifting to renewable heating systems, SET_HEAT significantly lowers the carbon footprint of residential and commercial heating. Improved energy efficiency: It enhances energy savings and contributes to the overall sustainability of the energy system in targeted regions.<br>• **Effectiveness:** Rated high, SET_HEAT effectively addresses the decarbonization of heating, a crucial area for reducing greenhouse gas emissions. Its focus on renewable energy solutions and energy efficiency makes a substantial impact on the green transition, with strong potential for scalability across regions needing sustainable heating solutions. |
| 18. EMERGE | **EMERGE**<br><br>• **Focus Area:** The EMERGE Energy System Modelling project, as outlined in the image, focuses on addressing the urgent need for sustainable energy in Africa, specifically targeting the Niger River region, north-western Africa, and Mozambique. It aims to overcome the challenges posed by energy deficits while promoting a balance between technology, culture, and ecology.<br>• **Focus Area:** Sustainable energy solutions for energy-deficient regions in Africa, particularly in areas grappling with complex socio-economic and cultural contexts.<br>• **Challenges Addressed:** Energy deficits: Providing solutions to the current lack of energy infrastructure. Cultural and socio-economic barriers: Balancing sustainable energy adoption with local cultures and economies.<br>• **Methodology:** Co-designing a toolbox: Involving policymakers, academics, investors, and citizens to create tailored sustainable energy solutions. Knowledge base creation: Establishing a foundation of knowledge that empowers stakeholders to implement long-term sustainable energy solutions.<br>• **Target Audience:** Policymakers, academics, investors, and citizens in the target regions are the key beneficiaries, promoting a unified approach to solving energy crises.<br>• **Impact:** By fostering sustainable solutions that transcend borders, the project aims to empower communities and address Africa's energy challenges in a holistic and culturally sensitive manner.<br>• **Effectiveness:** High potential, as it builds a collaborative, inclusive framework for sustainable energy development, leveraging both local knowledge and international expertise to drive change in energy-deficient regions. |

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| 19. MetaBuild | **MetaBuild**<br><br>• Focus Area: MetaBuild concentrates on promoting sustainable construction by incorporating energy-efficient building practices, eco-friendly materials, and digital tools like Building Information Modelling (BIM) to optimize construction processes and outcomes.<br>• Challenges Addressed: Environmental impact of construction: Reducing the significant carbon emissions and waste generated by the construction industry. Lack of digital adoption: Encouraging the use of digital technologies to improve efficiency and sustainability in construction. Energy efficiency: Addressing the need for more energy-efficient building designs and practices.<br>• Methodology: Digital tools for construction: MetaBuild leverages BIM and other digital solutions to streamline building design, reduce resource consumption, and enhance energy efficiency. Sustainable building practices: The project promotes the use of sustainable materials and energy-efficient construction methods, focusing on minimizing environmental impact throughout the building lifecycle. Collaboration and knowledge sharing: Involves stakeholders from construction firms, digital technology providers, and environmental agencies to ensure the widespread adoption of best practices.<br>• Target Audience: Construction companies: Helping them integrate sustainable and digital innovations. Architects and engineers: Providing tools and training to implement green building practices. Policy-makers and regulators: Ensuring policies support the adoption of sustainable and digital solutions in construction.<br>• Impact: MetaBuild contributes to reducing the carbon footprint of the construction industry by promoting eco-friendly building methods and energy-efficient designs. It accelerates the digital transition of the construction sector, leading to more efficient, sustainable building processes and reducing waste.<br>• Effectiveness: Rated moderate to high, MetaBuild is effective in pushing the construction industry toward green and digital transitions. Its emphasis on sustainable practices and digital tools ensures long-term impact, though the widespread adoption of these practices across the industry will be key to its full effectiveness. |
| 20. TEC4Growth | **TEC4Growth**<br><br>• **Focus Area:** Digital transition and Growth: TEC4Growth focuses on advancing digital technologies and integrating them into various sectors, including health, manufacturing, and energy. Its core goal is to leverage emerging technologies such as artificial intelligence (AI), data science, and cyber-physical systems to fuel sustainable growth and innovation. Sustainability and Innovation: The initiative also aligns with the green transition, promoting the use of smart energy systems and resource-efficient technologies to foster environmental sustainability.<br>• Challenges Addressed: Fragmented Innovation Ecosystem; Skills Gap in Emerging Technologies: The program also tackles the skills gap in critical areas such as data science, AI, and digital engineering, Sustainability Pressures: addressing the need for smart energy management and sustainable technologies to reduce carbon footprints across industries.<br>• Methodology: Collaborative Research and Development (R&D): TEC4Growth promotes collaborative R&D between universities, research centers, and industrial partners. Interdisciplinary Projects: The initiative encourages interdisciplinary research by combining expertise in AI, IoT, cyber-physical systems, and sustainable technologies to create holistic solutions. Knowledge Transfer and Technology Adoption:<br>• Target Audience: Academic Researchers, Industry Leaders, Policy-Makers and Public Institutions:<br>• Impact: Advancement of Digital Technologies, Support for the Green Transition Economic Growth<br>• Effectiveness: High in Digital transition: TEC4Growth is highly effective in fostering digital innovation, particularly through its interdisciplinary approach and strong ties to industry. Moderate in Green Transition. |

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# 5. Conclusions

If Higher Education Institutions do not perform at their best they cannot be fully effective in driving our societies through research and innovation, let alone help tackle the energy and digital transitions. This is why the European Excellence initiative (EEI) within Horizon funds projects like INITIATE.

While Widening Countries face **significant internal and external barriers** in their green and digital transitions, they also possess **substantial opportunities** to leap forward thanks to EU support and targeted policy interventions, and institutional reforms that favour **permanent and pervasive structures that are trusted by the R&I community**.

In addition, **HEIs in the Widening countries require the** application of the **best management practices** ensuring alignment of goals and capacities, adequate resources and their efficient use, and appropriate organisational structures, adequate distribution of responsibilities, and strong collegiality (ref. **Preface by Brian Norton**).

HEIs in Widening Countries also need to learn from **good practice** such as from the Austrian COMET programme and innovation hub models like PTCentroDiH and 4INNOFEIT. They need to establish whether and how these cases are adaptable to their context.

By addressing these challenges, higher education institutions in Cyprus, Slovenia, Portugal, Croatia, Serbia, North Macedonia, Romania, Bosnia-Herzegovina, and Ukraine can play a pivotal role in closing the innovation gap within Europe and beyond.

**It is recommended** that HEIs in the Widening Countries, must undergo **significant transformation steps across several key areas**:

**1. Integration of Green Technologies**

- Sustainability in Infrastructure: HEIs need to adopt renewable energy systems such as solar, wind, and energy-efficient building technologies to reduce their carbon footprint. Campuses should serve as models of sustainable operations like the Energy Campus at Transilvania University of Brasov, incorporating green technologies like smart grids and sustainable transportation systems.
- Curriculum Reform: Institutions must revise curricula to include sustainability principles and green technology education across disciplines, especially in engineering, environmental sciences, and economics. This prepares students to tackle real-world sustainability challenges (ref. BioEnergyTrain).

**2. Advancing Digital transition**

- Digital Infrastructure: Universities need to invest in advanced digital infrastructure such as high-speed internet, cloud computing, and digital learning platforms to facilitate online education and research collaboration. Artificial intelligence (AI) and data analytics should be integrated into teaching and research processes.
- Digital Skills Development: Offering courses and training in digital literacy, coding, data science, and cybersecurity is essential for both students and staff. This ensures that institutions are equipped to navigate the digital economy and foster innovation.

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**3. R&I Excellence through Collaboration and Innovation**

- Interdisciplinary Collaboration: HEIs must foster cross-disciplinary R&I that combines green and digital technologies, encouraging collaboration between departments like engineering, computer science, and environmental studies. This will drive innovation in areas such as smart energy management and sustainable urban development.
- Strengthening Industry Partnerships: Universities should build stronger ties with industries, especially in sectors like energy, technology, and transportation, to facilitate technology transfer and commercialization of research outputs. This includes expanding public-private partnerships that support applied research in both green and digital innovations.

**4. Institutional Governance and Policy Reforms**

- Sustainability Goals and Policies: Institutions need to adopt clear sustainability policies and set measurable goals for achieving carbon neutrality and resource efficiency. This includes implementing institutional policies that encourage energy conservation, waste reduction, and green procurement.
- Support for Innovation and Startups: Institutions must promote entrepreneurship by providing resources for startups and spin-offs focused on green and digital technologies. Establishing innovation hubs or incubators on campus can support students and researchers in developing market-ready solutions.

**5. Funding and Resource Allocation**

- Increased Investment in R&I: To enhance excellence in R&I, institutions need to secure adequate funding for research related to green and digital technologies. This includes accessing EU funds and national grants for innovation, as well as fostering partnerships that bring additional private investment into the R&I ecosystem. According to the European Innovation Scoreboard, **Cyprus** has advanced much in recent years. The country has joined the **strong innovators group** while most Widening Countries belong with the **emerging innovators** group with performance well below EU average, except for Slovenia and Portugal which are moderate innovators.
- Resource Sharing and Open Science: Encouraging open access to research data and promoting collaborative research platforms will ensure that findings related to green and digital innovations are widely shared and utilized to their full potential.

**6. Workforce and Leadership Development**

- Capacity Building: Universities must invest in the professional development of management, faculty, and administrative staff, equipping them with the necessary skills to lead in the green and digital transitions. This includes training in sustainable practices, digital pedagogy, and cutting-edge research methodologies.
- Leadership for Sustainability and Innovation: Institutional leadership should be aligned with the goals of sustainability and digital transition. Leaders need to be forward-thinking and innovation-driven, focusing on long-term strategies that align with global sustainability targets and digital advancements.

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7. **Engaging with European Thematic Alliances**

- HEIs in **Widening Countries** should engage in **European Alliances** to close the **innovation gap** and enhance **research excellence**. Especially **European thematic alliances like ESEIA** offer access to **funding**, **cutting-edge technologies**, and **global networks**, enabling institutions to advance the **green** and **digital transitions**.
- By joining alliances, HEIs can improve **education quality**, promote **student and staff mobility**, and foster **capacity building**.
- Collaborations also facilitate **knowledge transfer** and help HEIs align with **EU policy goals**, strengthening their regional and global presence in research and innovation.

To sum up, higher education institutions in the Widening Countries must get on a holistic transformation pathway to fully embrace the green and digital transitions. This requires:

- Adopting sustainable infrastructure and green technologies.
- Expanding digital capabilities and modernizing research approaches.
- Enhancing interdisciplinary collaboration, particularly between academia and industry.
- Reforming institutional policies and leadership to prioritize sustainability and innovation.
- Engaging with European thematic Alliances to enhance impact.

By making these changes, institutions can achieve excellence in R&I, equip their students and staff for the future, and contribute meaningfully to global green and digital transitions.

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# 6. Appendices

1. INITIATE Partnership
2. References (ISCTE)
3. Acronyms
4. ESEIA in a Nutshell
5. Best Practices (Summary)

INITIATE

## 1. INITIATE Partnership

Members of the INITIATE Consortium by Sector (Higher Education Institutions, Research Organisations, Businesses in 10 Widening Countries, namely Bosnia-Herzegovina, Croatia, Cyprus, North Macedonia, Portugal, Romania, Serbia, Slovenia, Ukraine) and one European Alliance ESEIA based in Austria:

| No | Logo | Name of the Organisation | Country | Partner |
|---|---|---|---|---|
| 1 | FSB | **SVEUCILISTE U ZAGREBU, FAKULTET STROJARSTVA I BROD** | HR | Coordinator |
| 2 | ESEIA European Sustainable Energy Innovation Alliance | EUROPEAN SUSTAINABLE ENERGY INNOVATION ALLIANCE | AT | Partner |
| 3 | The Cyprus Institute RESEARCH•TECHNOLOGY•INNOVATION | THE CYPRUS INSTITUTE | CY | Partner |
| 4 | Jožef Stefan Institute | INSTITUT JOZEF STEFAN | SI | Partner |
| 5 | NURE Kharkiv National University of Radio Electronics | KHARKIV NATIONAL UNIVERSITY OF RADIO ELECTRONICS | UA | Partner |
| 6 | brainit | Brain Information Technologies d.o.o | HR | Partner |

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| | | | | |
|---|---|---|---|---|
| **7** | | **B1 Media** | HR | Partner |
| **8** | | **INSTITUT ZA NUKLEARNE NAUKE VINCA INSTITUT OD, NACRS** | SB | Partner |
| **9** | | **Ss. CYRIL AND METHODIUS UNIVERSITY IN SKOPJE** | MK | Partner |
| **10** | | JAVNO PREDUZECE ELEKTROPRIVREDA BOSNE I HERCEGOBA | BA | Partner |
| **11** | | **Iscte - Instituto Universitário de Lisboa** | PT | Partner |
| **12** | | **LVIV POLYTECHNIC NATIONAL UNIVERSITY** | UA | Partner |
| **13** | | **UNIVERSITATEA TRANSILVANIA DIN BRASOV** | RO | Partner |

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## 3. Acronyms

AIRC - Atlantic International Research Center
DT – Digital Transition
EC - European Commission
EDIH - European Digital Innovation Hub
ERA - European Research Area
EV – Electric Vehicle
FITD - Fund for Innovation and Technological Development
GT - Green Transition
HEI - Higher Education Institution
ICT - Information and Communication Technology
IT - Information Technology
PV – Solar Photovoltaic
RES - Renewable Energy Source
R&D - Research and Development
R&I - Research & Innovation
SDG - Sustainable Development Goal
SME - Small and Medium-Sized Enterprise

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## 4. ESEIA in a Nutshell


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ESEIA
European Sustainable Energy Innovation Alliance

*ESEIA is dedicated to advancing research and innovation in sustainable energy across Europe. By bringing together experts from academia, industry, and policy, we foster collaboration and solutions that drive the transition to a sustainable energy future.*

Brian Norton
ESEIA President

## About us

The European Sustainable Energy Innovation Alliance is a recognized European association of leading organizations representing the entire renewable energy innovation landscape. As a cross-sector alliance, ESEIA approaches energy transition from a systemic point of view, from energy provision to energy consumption, in research, teaching, business, and governance.

## Why Join Us?

The cross-sector membership of scientific, business and political partners is dedicated to advancing innovation to implement renewables and sustainable technologies in Europe as well as on a global scale. The members hold wide-spread knowledge and experience which is brought together in ESEIA providing a valuable knowledge pool for almost any sustainable energy innovation challenge from renewable resources to consumption and implementation.

### Our Mission

By 2050 ESEIA will have enabled Europe to reach its renewable energy targets as outlined in the Green Deal by contributing research for innovative solutions, as well as education and training for a climate-neutral sustainable energy system.

### Strategic Challenges

ESEIA addresses three strategic challenges: ' Setting the Agenda for renewables on the European market', 'Capacity Building both for people and institutions' and 'Forging International Partnerships'.

### How do We Work?

The ESEIA Working Groups are the key drivers of the association. They are main forum for codesign and collaboration. The ESEIA WGs coordinate expertise from our members in a number of key innovation areas.

### Who do we represent?

The ESEIA umbrella represents the entire innovation ecosystem of actors from research, academia, industry, and government. In 2024, ESEIA has 23 member organizations from 12 EU countries.

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## 5. Best Practice Cases: Summary Table

- For a comprehensive overview of the provided tables, please refer to the detailed Best Practice Cases available at this link!

**Best Practice Case 1: University Alliances**

| Source | Project name or Good Practice name | Focus Area | Brief Description of the Practice | Outcomes | Ranking |
|---|---|---|---|---|---|
| Project Partner - ESEIA | **ESEIA - European Sustainable Energy Innovation Alliance** | Developing Research Infrastructure<br>Innovative Education and Training<br>Developing Research and Innovation projects<br>Expanding International Partnerships<br>Overcoming Policy Barriers<br>Boosting Research and Innovation impact and nourish local innovation ecosystems | **ESEIA represents a sustainable European R&I and E&T infrastructure** that has been operative for 15 years enabling members to advance in research and innovation as follows: 1. ESEIA promotes advancement in R&I by offering cooperation in five Working Groups. This leads to more knowledge and better performance in Horizon. 2. ESEIA promotes Capacity-Building by Funding its own Education and Training Programme which benefits members and local ecosystems. 3. ESEIA helps overcome policy barriers in the Widening countries by supporting their R&I efforts. 4. ESEIA boost R&I impact by promoting results with local ecosystems and in E&T as well as by raising awareness. 5. ESEIA fosters cooperation with sister Alliances in Europe and worldwide. | Some Outcomes: 1. **Yearly ESEIA Work Programme** enabling members to join forces in R&I 2. Proposals leading to **strong research portfolio** in the areas of the Working groups engaging more than **300 experts**, leading to **qualified Coordinator**s and Partners, leading to **effective high-quality process**, leading to interaction with peers and other actors from innovation ecosystem, leading to **joint publications** 3. **Large partnership** network through project and proposal work in the EU and internationally (success rate considerably higher than EU average) 4. **International Visibility** of the ESEIA experts; **5. Capacity-Building:** high-quality practice-oriented training delivered for 110 participants per year, of which two thirds from academia and one third from industry, two thirds from Eu and one third from Widening countries and international participants. | High |

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| | | | | | |
|---|---|---|---|---|---|
| European University Alliance | **ARQUS, The European University Alliance Arqus** | General collaboration on research, study, teaching, and social engagement.<br>Developing Research Infrastructure<br>Developing Research and Innovation projects<br>Overcoming Policy Barriers<br>Boosting Research and Innovation impact | Through various initiatives and work packages, Arqus aims to foster collaboration, innovation, and inclusivity among its member institutions, ultimately contributing to a more sustainable and cohesive Europe. | The outcomes of the Arqus European University Alliance include the development of innovative and interdisciplinary educational programs that enhance the quality of learning, increased collaboration among member institutions resulting in impactful research initiatives, and improved student mobility that fosters cross-cultural experiences. | Moderate |
| European University Alliance | **ECIUn+, The European Consortium of Innovative Universities** | Innovation in education, research, and knowledge exchange<br><br>Boosting Research and Innovation impact | The ECIU University provides students with the opportunity to gain international experience by studying at various European universities through flexible exchange options, including semester-long programs, short meet-ups, or online participation. Students can earn micro-credentials that are tamper-proof and issued according to European standards, helping to validate their achievements and enhance career prospects. | The outcomes of the ECIU University initiative include enhanced student mobility, allowing participants to study at various European universities and gain diverse international experiences. The implementation of micro-credentials facilitates the recognition of skills and competencies, making qualifications more transparent across borders. Stronger connections with industry and public sectors provide students with practical experiences and expand their professional networks. | High |
| European University Alliance | **EPICUR-SHAPE-IT: European Partnership for an Innovative Campus Unifying Regions** | Transformation and integration of European higher education. | The EPICUR alliance is a collaborative network of nine member universities aimed at transforming education, research, and knowledge transfer to tackle complex societal challenges in Europe. Established in 2019, EPICUR focuses on priority areas such as sustainable transformation, European values, global health, and future intelligence. The alliance promotes innovative learning experiences through initiatives | The outcomes of the EPICUR alliance include enhanced student and faculty mobility through flexible learning pathways and flipped mobilities, leading to a richer educational experience. The establishment of the EPICUR Inter-University Campus fosters interdisciplinary collaboration and innovation in research. Additionally, the emphasis on multilingualism and cultural diversity enhances inclusivity in academic programs. | High |

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| | | | | | |
|---|---|---|---|---|---|
| European University Alliance | **Unite!, University Network for Innovation, Technology and Engineering** | **Developing Research Infrastructure** Innovative Education and Training Developing Research and Innovation projects Expanding International Partnerships **Overcoming Policy Barriers Boosting Research and Innovation impact** | The project will develop a common research and innovation (R&I) 2030 agenda to address major societal challenges, with particular reference to energy, industry 4.0 and artificial intelligence. UNITE will also develop policies to strengthen human capital (such as new career development initiatives) and research infrastructures, reinforce cooperation with non-academic R&I players, mainstream open science practices, involve the public and collaborate with other EU alliances and higher education institutions. | The outcome of the Unite! European University Alliance is a strengthened collaborative network that enhances educational quality, research excellence, and societal impact across its member institutions. By promoting interdisciplinary learning and fostering innovation, Unite! aims to produce skilled graduates equipped to address the challenges of the digital and green transitions | High |
| European University Alliance | **EU4DUAL,The European Dual Studies University** | Dual-study models connecting **higher education** with the **world of work**. | The alliance practices a collaborative Dual Education model that emphasizes strong partnerships between academia, industry, and regional stakeholders. This approach integrates theoretical learning with practical, work-based experiences, enabling students to apply their knowledge in real-world settings. By offering joint courses, research projects, and shared learning opportunities across multiple campuses, the alliance aims to equip students with the skills needed to address pressing societal challenges such as climate change and digitalization | The outcomes of the alliance include enhanced educational quality through integrated Dual Education programs, a skilled workforce equipped to meet industry demands, and increased collaboration between academia and industry | Moderate |
| European University Alliance | **INGENIUM, alliance of ten institutions of higher education** | Offering high-quality, **digitally enhanced programs** in higher education. | INGENIUM promotes collaborative practices among its diverse member institutions by fostering transnational and interdisciplinary partnerships. The alliance emphasizes shared values in education, research, innovation, and social engagement, facilitating joint projects, co-created curricula, and knowledge exchange across various academic disciplines. | The outcomes of the INGENIUM alliance include enhanced educational quality through the development of interdisciplinary curricula, increased collaboration among member institutions resulting in innovative research projects, and improved employability for graduates equipped with diverse skills. The alliance fosters a vibrant academic community that encourages knowledge exchange, leading to the creation of best practices in teaching and research. | High |

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**Best Practice Case 2: R&I infrastructures**

| Source | Project name or Good Practice name | Focus Area | Brief Description of the Practice | Outcomes | Ranking |
|---|---|---|---|---|---|
| Project Partner - ESEIA | **ESEIA - European Sustainable Energy Innovation Alliance** | Developing Research Infrastructure<br>Innovative Education and Training<br>Developing Research and Innovation projects<br>Expanding International Partnerships<br>Overcoming Policy Barriers<br>Boosting Research and Innovation impact and nourish local innovation ecosystems | **ESEIA represents a sustainable European R&I and E&T infrastructure** that has been operative for 15 years enabling members to advance in research and innovation as follows: 1. ESEIA promotes advancement in R&I by offering cooperation in five Working Groups. This leads to more knowledge and better performance in Horizon. 2. ESEIA promotes Capacity-Building by Funding its own Education and Training Programme which benefits members and local ecosystems. 3. ESEIA helps overcome policy barriers in the Widening countries by supporting their R&I efforts. 4. ESEIA boost R&I impact by promoting results with local ecosystems and in E&T as well as by raising awareness. | Some Outcomes: 1. **Yearly ESEIA Work Programme** enabling members to join forces in R&I 2. Proposals leading to **strong research portfolio** in the areas of the Working groups engaging more than **300 experts**, leading to **qualified Coordinator**s and Partners, leading to **effective high quality process**, leading to interaction with peers and other actors from innovation ecosystem, leading to **joint publications** 3. **Large partnership** network through project and proposal work in the EU and internationally (success rate considerably higher than EU average) 4. **International Visibility** of the ESEIA experts; **5. Capacity-Building:** high-quality practice-oriented training delivered for 110 participants per year, of which two thirds from academia and one third from industry, two thirds from Eu and one third from Widening countries and international participants. | High |

This project has received funding from the European Union's Horizon Europe research and Innovation programme under grant agreement **No. 101136775**

| | | | | | |
|---|---|---|---|---|---|
| Project partners-ESEIA, AUSTRIA | **The COMET Programme** | Developing Research Infrastructure<br>Developing Research and Innovation projects<br>Overcoming Policy Barriers<br>Boosting Research and Innovation impact | The Comet is a strategic initiative designed to enhance collaboration between research institutions and industry. It aims to drive innovation and technological advancement by fostering partnerships that leverage academic expertise and industrial needs. | The COMET program has significantly contributed to technological advancements by driving innovation in fields like information technology, materials science, and manufacturing, resulting in new software solutions and improved processes. It has fostered economic growth by bridging the gap between research and industry, enhancing the global competitiveness of Austrian companies and creating jobs in technology and research sectors. Competence centers under the program have produced high-quality research outputs, including publications and patents, addressing specific industrial challenges. Additionally, the program facilitates the transfer of technology from research to industry, leading to successful spin-offs and start-ups. It has also improved research infrastructure, enabled high-quality activities and promoted interdisciplinary collaboration. By strengthening partnerships between academia and industry, the program has created a more integrated innovation ecosystem. Furthermore, it offers training programs that contribute to the professional development of researchers and industry professionals, while insights from COMET inform policy-making and strategic planning in research and technology development at both national and European levels. | High |

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**Best Practice Case 3: Innovation hubs**

| Source | Project name or Good Practice name | Focus Area | Brief Description of the Practice | Outcomes | Ranking |
|---|---|---|---|---|---|
| Project partners-ISCTE, PT | **PTCentroDiH** | Innovative Education and Training<br>Developing Research and Innovation projects<br>Expanding International Partnerships<br>Boosting Research and Innovation impact | As a Hub integrated in Inovcluster atmosphere, one of the best practices adopted by the PTCentroDiH project is the creation of a "**one-stop shop" that integrates several services to support digital transformation.** This approach guarantees easy access to digital technologies, technical support, training and financing opportunities, promoting competitiveness, innovation, and territorial cohesion. The fact that PTCentroDiH is recognized as a European Digital Innovation Hub (EDiH), is financed by Next Generation EU and is part of Portugal's Recovery and Resilience Plan (PRR), facilitates collaboration with regional clusters, universities, and research centers, which guarantees personalized solutions, contributing significantly to the digital transformation of the region. Overall, the text provides a clear and comprehensive overview of the project's impactful practices. | One of the best practices adopted by the PTCentroDiH project is the creation of a "**one-stop shop" that integrates several services to support digital transformation.** This approach guarantees easy access to digital technologies, technical support, training, and financing opportunities, promoting competitiveness, innovation, and territorial cohesion. Recognized as a European Digital Innovation Hub (EDiH), financed by Next Generation EU, and part of Portugal's Recovery and Resilience Plan (PRR), PTCentroDiH facilitates collaboration with regional clusters, universities, and research centers. This ensures personalized solutions with significant contributions to digital transformation, becoming a historic milestone for the central region of Portugal. Overall, the project is providing a clear and comprehensive view of its impactful practices. | High |

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| Project partners- UKIM, North Macedonia | **Center for Technology Transfer and Technologies - INNOFEIT** | Developing Research Infrastructure<br>Innovative Education and Training<br>Developing Research and Innovation projects<br>Expanding International Partnerships<br>Overcoming Policy Barriers<br>Boosting Research and Innovation impact | **INNOFEIT is the sole technology transfer initiative at the Macedonian's largest university** (UKIM) and the country's only fully operational Digital Innovation Hub (DIH) to date. INNOFEIT specializes in the broad areas of Artificial Intelligence-of-Things (AIoT) and Renewable Energy and Energy Efficiency (REEE) providing contract research services for local, regional and international SMEs, prototyping and experimentation facilites as well as support to state initiatives towards increasing the national digital maturity index. INNOFEIT is the only Macedonian research entity mentioned in the country's progress report towards EU accession in 2019 and 2020 and the country's anchor point for S3 in the areas of ICT and energy for the future. Additionally, INNOFEIT is the biggest founding partner of Business Accelerator UKIM (BAU), which shows INNOFEIT's long-term commitment to nurturing and growth of innovative startups and spinoffs towards greater market success in N. Macedonia. | • Developed prototypes for local and international SMEs<br>• Commercialization path development for SMEs<br>• Conducted trainings on renewable energy sources and digitalization for local stakeholders | Moderate to High |

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**Best Practice Case 4: Entrepreneurial education and training**

| Source | Project name or Good Practice name | Focus Area | Brief Description of the Practice | Outcomes | Ranking |
|---|---|---|---|---|---|
| Project partners-CYI, CY | **Green Entrepreneurship Training - Underpinning Prosperity** | Innovative Education and Training | GET-UP - Green Entrepreneurship Training - underpinning prosperity is an ERASMUS + project funded by the European Commission, within the key action 'Cooperation for innovation and the exchange of good practices' in the' Strategic Partnerships' action with the focus on 'Strategic Partnerships for vocational education and training ". It is an internationally oriented project in the EU educational program with a duration of 28 months, completed in 2018.<br>The Department of Business Education II of the University of Paderborn coordinated the project GET-UP and focused on entrepreneurship education in the field of the green economy. 8 partner institutions from 7 countries cooperate in the project: the coordinating institution from Germany (Department of Business Education II, University of Paderborn), the partner from Romania (Universitatea din Pitesti), the partner from the UK (SFEDI Ltd, Darlington), the two partners from Ireland ( Mells Partnership, Kells, FIPL Ltd., Ballyjamesduff Cavan), the partner from Cyprus (European University Cyprus, Nicosia), the partner from Spain (FUERM, Murcia) and the technical partner from Finland (INNOVENTUM OY, Joensuu). | In the GET-UP project, six Intellectual Outputs (IOs) were processed:<br>IO1. Summary Pedagogic Research Report<br>IO2. CPD Training Program for VET Staff<br>**IO3. Green Entrepreneurship Curriculum**<br>IO4. **On-line Observatory of Green Business & E-learning Portal**<br>IO5. Green Entrepreneurship in Europe - A Comparative Perspective<br>IO6. Policy Paper "**Green Entrepreneurship Training** - Underpinning Prosperity in Europe" | Moderate to High |

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**Best Practice Case 5 : EU funded R&I projects for green and digital transition**

| Source | Project name or Good Practice name | Focus Area | Brief Description of the Practice | Outcomes | Ranking |
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| Project partners-ISCTE, PT | **InovGrid** | Developing Research Infrastructure<br>Innovative Education and Training<br>Developing Research and Innovation projects<br>Expanding International Partnerships<br>Boosting Research and Innovation impact | The InovGrid project, driven by the "Smart Grid" initiative and supported by the European Institute of Innovation and Technology (EIT) and EIT InnoEnergy, implements advanced communication and automation technologies to modernize Portugal's electrical infrastructure. This initiative integrates smart monitoring and control devices into the grid, facilitating efficient energy management. The public privet project aims to enhance grid reliability, effectively integrate renewable energy sources, improve service quality, and minimize energy losses, creating a more resilient and sustainable electrical system for modern society. | The InovGrid project yielded significant outcomes, including the **implementation of smart grid technologies for real-time monitoring and control**, leading to improved efficiency and reliability of Portugal's electrical grid. Integration of renewable energy sources was successfully achieved, alongside increased consumer engagement through demand response programs. Data analytics enabled informed decision-making, while optimization of grid operations reduced energy losses. These achievements collectively modernized the grid, fostering a more resilient, efficient, and environmentally sustainable energy system for Portugal. | High |

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| Project partners-ISCTE, PT | **GreenH2Atlantic** | Developing Research Infrastructure<br>Innovative Education and Training<br>Developing Research and Innovation projects<br>Expanding International Partnerships<br>Overcoming Policy Barriers<br>Boosting Research and Innovation impact | The GreenH2Atlantic project is a public-private partnership focused on enhancing green hydrogen production. It's centered around establishing a 100 MW **hydrogen production hub** in Sines, Portugal, equipped with cutting-edge, scalable, and rapid-response 16 MW electrolyze modules. The project integrates practices from several sectors from Portugal and abroad, including energy companies, oil and gas corporations, chemical industry players, construction and engineering firms, and electrical equipment manufacturers, alongside academic and research institutions. This collective effort is dedicated to improving efficiency, system longevity, and flexibility, all while supporting Europe's transition to a low-carbon economy. | The GreenH2Atlantic project has achieved notable outcomes, including a significant reduction in greenhouse gas emissions, estimated at 82.16 kilotons of CO2 equivalent per year. It's also projected to generate over a thousand direct and several thousand indirect jobs by 2030. Additionally, the project has been recognized as a national strategic initiative, with operations expected to commence by the end of 2025. | High |
| Project partners-UNIZAG-FSB, HR | **OLGA – hOListic & Green Airports** | Developing Research Infrastructure<br>Developing Research and Innovation projects<br>Expanding International Partnerships<br>Boosting Research and Innovation impact | Today's aviation community – from the airport and airlines to ground handling services – is facing the challenge of environmental transition. Guided by the ambitions of the European Green Deal in ensuring that transport (including air transport) makes an important contribution to climate neutrality by 2050, the EU-funded OLGA project is part of the bigger plan for aviation decarbonization. The consortium, consisting of airports, airlines, ground handlers, industry, research bodies and SMEs, will integrate sustainable aviation fuels supply chains in conventional jet fuel infrastructure and demonstrate complementary types of low-emission mobilities, electric ground support equipment, hydrogen infrastructure and reduced carbon airside operations. OLGA | To meet its ambition in terms of multimodality and the underlying components of climate goals (energy transition, efficiency improvements, fuel alternatives, reduction of fuel burn and emissions), OLGA proposes a portfolio of innovations deemed necessary to the global airport/aviation industry. The portfolio includes initiatives in different contributing areas and innovation levels at all sizes of airports and implementation levels. | Moderate to High |

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| Project partners-UNIZAG-FSB, HR | **COMMUNITAS – Bound to accelerate the roll-out and expansion of Energy Communities and empower consumers as fully-fledged energy market players** | Innovative Education and Training<br>Developing Research and Innovation<br>Expanding International Partnerships<br>Overcoming Policy Barriers | The European Commission has introduced the concepts of renewable energy communities (RECs) and citizen energy communities (CECs). By doing so, it is promoting a more active role of EU citizens in the energy markets. However, there are several barriers that need to be lifted. In this context, the EU-funded COMMUNITAS project will promote energy citizenship, empowering citizens to take control of the path towards sustainability by becoming active elements of the energy markets. To that end, the project will deliver a knowledge base providing users with technical, administrative and legal information on energy communities as well as set tools that enable citizens to participate in different energy markets. | The project will deliver a Knowledge Base that will provide users with technical, administrative, and legal information on ECs, streamlining the creation and expansion of this concept. COMMUNITAS will also deliver an innovative set of tools - capitalizing on technologies such as IoT, Blockchain and Cloud Computing - to unlock citizens' active participation in energy markets and communities (all integrated into an open, digital "one-stop-shop" COMMUNITAS Core Platform (CCP)), allowing EC members to have an aggregated position in the energy markets or explore ancillary services using different energy assets or load profiles of the community. | High |
| Project partners-UNIZAG-FSB, HR | **SET_HEAT – Supporting Energy Transition and Decarbonisation in District Heating Sector** | Developing Research and Innovation<br>Expanding International Partnerships<br>Overcoming Policy Barriers | The LIFE22-CET-SET_HEAT project focuses on the shift towards cleaner, more sustainable district heating systems in Eastern Europe.<br><br>Its primary goal is integrating renewable energy sources and waste heat into existing high-temperature district heating networks. Implemented by a consortium of 12 partners, the project spans five countries: Poland, Croatia, Romania, Denmark, and Lithuania. LIFE22-CET-SET_HEAT foresees an active involvement of district heating companies and key stakeholders in collaborative planning that will result in tangible, replicable model investment projects. | The project will indirectly support other external companies by delivering outputs such as examples of scalable and replicable solutions, and model investment projects. In particular, the project will focus on a significant reduction in the share of fossil fuel and biomass combustion processes in heat production. It will also assess possibilities for establishing local ecosystems of DH companies in the future energy market. There will be taken into consideration the scenario of supporting by DH companies the development. | High |

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| Project partners-UNIZAG-FSB, HR | **EMERGE - ENERGY SYSTEM MODELLING FOR GREEN DEVELOPMENT OF AFRICA** | Innovative Education and Training<br>Developing Research and Innovation projects<br>Expanding International Partnerships<br>Boosting Research and Innovation impact | In Africa, the urgent need for sustainable energy collides with complex cultural and socio-economic challenges. There is a need to address current energy woes but also pave the way for harmonious coexistence of technology, culture and ecology. As nations grapple with energy deficits, the EU-funded EMERGE project steps in as a catalyst for change. With a focus on north-western Africa, the Niger River region and Mozambique, EMERGE aims to empower policymakers, academics, investors and citizens in overcoming energy crises through a unified effort. This project will co-design a toolbox and establish a knowledge base, fostering sustainable solutions that transcend borders and uplift communities. | Knowledge Base with a collection of initiatives, materials, and knowledge-exchange activities will be created. The North Western Africa (Morocco), Niger river region (Mali/Nigeria), and east Africa (Mozambique) are three African ecosystems where EMERGE will develop knowledge communities through a participatory approach. | High |

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| Project partners-UNIZAG-FSB, HR | **MetaBuild – Powering the METAmorphosis of BUILDings towards a decarbonised and sustainable energy system** | Developing Research and Innovation projects<br>Expanding International Partnerships<br>Overcoming Policy Barriers | As the EU increases efforts to decarbonize its building stock, a pressing dilemma emerges – how to effectively electrify thermal energy demand while maintaining affordability and sustainability. Current challenges span the entire building life cycle, from manufacturing to operation, necessitating a comprehensive solution. In this context, the EU-funded META BUILD project is proposing a cost-effective, replicable solution for these challenges by developing heat pumps coupled with renewable energy and storage systems. META BUILD will address each challenge by adopting a holistic approach involving stakeholders at different levels. | META BUILD will deliver: KPI-driven assessment methodology & LCA analysis on building electrification; Decarbonization as a service decision support tool; sound Business Models combined with energy efficiency and electrification; Advanced HP technologies, PVTs & other RES solutions, thermal & second-life battery storage systems; Interoperable framework for electrified ready buildings; Energy management services for RT-monitoring & performance analytics; Demand response, grid interaction & flexibility planning tools; Pro-active maintenance & controls services; Digital Twins for maintaining/enhancing the buildings' performance; Blueprints & policy recommendations for replication & scalability. | Moderate to High |
| Project partners-ISCTE, PT | **TEC4Growth** | Digital transition and Growth: TEC4Growth focuses on advancing digital technologies and integrating them into various sectors, including health, manufacturing, and energy. | Its core goal is to leverage emerging technologies such as artificial intelligence (AI), data science, and cyber-physical systems to fuel sustainable growth and innovation. Sustainability and Innovation: The initiative also aligns with the green transition, promoting the use of smart energy systems and resource-efficient technologies to foster environmental sustainability. | The TEC4Growth initiative yields several key outcomes, including enhanced digital innovation through the development and implementation of advanced technologies across various sectors. It effectively bridges the skills gap in emerging fields like AI and data science by providing targeted training programs. | High in Digital transition |

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