

# New Policy Recommendations for R&I Widening countries Agendas

Politecnico di Torino

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# 1 INTRODUCTION

The first objective of WP2 in the UNITE!WIDENING project is to identify the Science, Research and Innovation key areas that the Alliance could potentially focus on, in particular in the process of transferring knowledge to widening partners and in developing future activities. To determine these areas, policy considerations need to be made on the one hand, as well as scientific considerations on the other, evaluating the collaboration potential in the Alliance in terms of fundamental and applied research, starting from the outputs of the previous <u>UNITE.H2020 project</u> (GA n 101017408). In that project scientific priority areas were identified in the domains of Energy and Green Deal, Industry 4.0, Artificial Intelligence.



This report aims to help update these scientific priority areas, in light of the boundary conditions in terms of strategic indications at European and national level. Therefore, the report briefly summarizes current strengths in terms of research domains in the Alliance, by analysing cumulative data using the *Scival* platform on publications and funded research projects, and collaboration potential, by analysing data from the first two rounds of the Unite! "Seed Fund", where research priorities were established "bottom-up". Next, a number of strategic documents (Research and Innovation Strategy 2020-2024, the 5 EU Missions Horizon 2030, the ERA policy agenda) is evaluated, to establish priorities at EU level; finally, research priorities at national level (in Portugal and Poland) are established by analysing policy documents (e.g. current policy agendas on green transition) and their alignment with EU strategies, as well as research gaps and priorities in the widening partners. The aim is to identify the strengths and needs of the Widening countries in the green transition by matching policies at EU and at national level, enhancing the analysis by identifying S&R&I areas of interest for common research projects. This analysis should provide the basis for future steps in the project, including the definition of PL/PT Strategic Areas in Milestone 2.2, and future matchmaking and collaborations for common EU proposals.

# 2 | BACKGROUND: UNITE.H2020 OUTPUTS

# 2.1 | Unite! R&I Agenda

The 2030 R&I Agenda and action plan developed by UNITE.H2020 were aimed at articulating a common strategy to establish tighter links among alliance members and facilitate synergistic actions. The UNITE.H2020 R&I agenda aimed at enabling tangible progress of the partner universities and the alliance as a whole in line with the European Commission's priorities, such as the European Green Deal and the UN agenda 2030, as well as seamlessly integrating the education agenda which is being developed in the complementary UNITE! ERASMUS+ project, from which the European University Alliance Unite! was born. This gave rise to a series of pilot transformation actions consistent with the policy of each partner, relying on the open science principles and coordinated through the different WPs. The pilots of UNITE.H2020 were the first seeds of the action plan, in the longer time horizon of 2030, connected to the following Unite! Research and innovation objectives identified in the Unite! R&I Agenda:



#### 2.1.1. | Guidelines for the further development of the Unite! R&I Agenda

The progress made in the various identified transformational areas was documented in the Guidelines for the further development of the Unite! R&I Agenda. Some strategic indications emerged in each of the considered pilots for future implementation. These included:

- Initiation and fostering of <u>Research communities</u> through regular thematic workshops and matchmaking events aimed at preparing common projects for funding requests.
- Research collaboration activities supported by <u>seed funding</u> initiatives within the alliance, based on co-funding by the participant institutions.
- Support by the IRIS group to the R&I Alliance sustainability
- Accessibility to <u>research infrastructures</u> of the alliance.
- An <u>Open Science</u> and innovation strategic roadmap

In general, it was found that collaboration within the Alliance can provide added value in R&I through concrete initiatives such as:

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- Pooling Resources and Expertise, both human and infrastructural, on a larger scale.
- Sharing of large-Scale Research Infrastructures.
- Creation of <u>stable research communities</u> on key topics (e.g. energy transition, green transition, climate change) to enable multidisciplinary expertise and holistic solutions to complex scientific challenges.
- Standardization and Harmonization of research practices and protocols.
- Mobility Programs on a Larger Scale for researchers, faculty, and students.
- Improved access to EU Funding Programs
- Creating research-based, policy-oriented communities of scholars and professionals on open science management.

#### 2.1.2 | UNITE.H2020 policy brief

In this second policy brief, the European Universities Pilot I Alliances are asked to report on the progress made through cooperation in selected R&I areas and provide a last set of recommendations to the European Commission for further policy development.



According to the Document, Alliances can bring significant added value to excellent science since they allow more systematic relationships, allowing to amplify collaboration, streamline processes, and offer a more comprehensive approach to advancing scientific excellence. Concrete examples are:

Pooling Resources and Expertise, both human and infrastructural, on a larger scale.

Sharing of large-Scale Research Infrastructures: Alliances can provide improved information about availability of resources and systematic access to them, helping to overcome bureaucratic and administrative barriers.

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- Creation of stable research communities on key topics (e.g. energy transition, green transition, climate change to enable multidisciplinary expertise and holistic solutions to complex scientific challenges. This can allow simplifications in creating competitive consortia for EU calls through standardized matchmaking procedures, and potentially increased competitiveness compared to standard procedures.
- Standardization and Harmonization of research practices and protocols, e.g. data collection, reporting standards, including Open access and Open Data practices. Standardization enhances reliability and comparability of research outcomes.
- Mobility Programs on a Larger Scale for researchers, faculty, and students, with related benefits for individuals and the scientific community.
- Improved access to EU Funding Programs: systematic collaboration has allowed UNITE! participants to gain access to funding over various types of programs: aUPaEU, Unite!Energy, Unite!Widening, Green Chips...

The identified prioritized collaboration areas are:



### 2.2 | Unite! Alliance collaboration potential

#### 2.2.1 | Analysis of Unite! Alliance performance indicators

Based on available data on the platform *Scival*, it is possible to highlight the strengths in the Alliance in terms of scientific production and funding acquisition in the period 2019-2024.



The visualization in Fig. 1 helps to convey how research output in terms of publications is distributed across different academic disciplines overall. As expected, there is a focus on the fields of Engineering (34%), Computer Science (24%), and Physics (20%), which dominate in terms of publication volume.



Figure 1 – Research outcomes in the UNITE! Alliance

To go more in detail, the next image image visualizes scholarly output across various specific research topics, indicated by bubbles whose sizes reflect the volume of publications for each topic. Each bubble is associated with a dominant subject area (denoted by the abbreviations listed in the legend, e.g., COMP for Computer Science, MATH for Mathematics, etc.), while the colored ring surrounding the bubbles shows the spectrum of subject areas. Bubble size represents the amount of research in a particular topic, while bubble position is determined by the dominant category.

Some major topics include:

Image analysis using Deep Neural Networks (related to COMP and ENG), Language Processing and Machine Learning (dominant in COMP), 3D printing in MAT, Quantum Optics and theoretical physics in PHYS, and COVID-19-related research in MEDI.

The visual breakdown shown in Fig. 2 highlights that research fields like Computer Science, Physics, Engineering, and Medicine are driving significant academic publications. The cross-disciplinary nature of many research topics is highlighted, such as the blend of Computer Science with Machine Learning or Physics with Quantum Optics.





Figure 2 – Breakdown of the research fields of relevance in the Unite! Framework



#### 2.2.2 | Collaborations between Unite! partners

Figure 3 illustrates a collaboration network diagram showing co-authored publications between collaborating institutions within the Unite! Alliance. Each institution is represented by a section on the circular boundary, with connections between them represented by curved lines. The colour-coded sections represent different universities, and the lines indicate the extent of collaboration. The width of the lines connecting different institutions represents the volume or strength of collaboration, with thicker lines indicating more co-authored publications between the connected universities.



Figure 3: Collaboration within the UNITE! Alliance

From Fig. 3, it appears that the University of Lisbon (blue section) and KTH Royal Institute of Technology (purple section) have strong collaborations networks, with many connections to other institutions, and other universities with significant connections include Aalto University (yellow), INP Grenoble (red), and Graz University of Technology (green), showing active co-authorship with multiple partners. This demonstrates that widening and non-widening countries already established strong ties in key research areas.



#### 2.2.3 | Funding by scientific area for Unite! as a whole

The pie chart in Fig.4 illustrates the amount of funding for research, mainly in EU projects, obtained by the Unite! Alliance as a whole, divided by scientific area. Again, the main area is Engineering (14,6%) and Computer Science (12,6%), but also Energy (12,7%). Areas like Physics or Materials Science, which are strong in terms of publications, have a marginal share of the total funding (3,2% and 2,8%, respectively).



Figure 4: Funding areas within the UNITE! Alliance

#### 2.2.4 | Review of Seed Fund applications for R&I

The Seed Fund is Unite!'s flagship initiative for the promotion of education, research and student activities. The fund provides financial support to innovative, co-creative and collaborative ideas from teachers, researchers and students across the Unite! alliance. One of its three funding lines, "Research and PhD", is specifically designed to stimulate new research projects and forge new research consortia within the alliance. The Unite! Seed Fund significantly boosted researchers' engagement with the Unite! alliance. Between spring 2023 and spring 2024, there was a total 131 applications (all funding lines), 45 of which were successful. For R&I, there was Seed funding for two kinds of collaborative activities: a "Research and PhD" Programme option "Exploring" (up to €10,000 per project), and a Programme option "Developing" (up to €80,000 per project).

The past results (between spring 2023 and spring 2024) can be summarized as follows:



The main research areas on which the applications focus is indicatively:

- ✓ Materials Science/Additive Manufacturing 13 projects
- ✓ <u>ICT/Computer science</u> 11 projects
- <u>Energy</u> 10 projects



- ✓ <u>Urban planning/Mobility</u> 8 projects
- <u>Chemistry/Green Chemistry</u> 5 projects
   <u>Physics//Quantum optics</u> 3 projects
- ✓ <u>Robotics</u> 3 projects
- ✓ <u>Neuroscience/Biotechnology</u> 2 projects
- ✓ <u>Business</u> studies 1 project
- ✓ <u>Maths</u> 1 project

The research areas of the funded "Research & PhD" Seed Fund projects are:

Energy storage & production	Artificial intelligence (3)	Innovation & entrepreneurship
(4)	Materials science (1)	(2)
Water treatment (2)	Urban planning (1)	Finance (1)
Cognitive science (1)	Transport (1)	Robotics (1)
Neuroscience (1)		Biotechnology (1)

The main research areas of the proposals, reflecting the collaboration interest among the Unite! partners, are thus mainly in the field of Materials Science, ICT and Energy.



# 3 | REVIEW OF MAIN EU POLICY DOCUMENTS

There follows a brief review of the main strategic documents at EU level on Research priorities

# 3.1 | ERA Policy Agenda

The European Research Area Policy Agenda sets out 20 voluntary ERA actions for the period 2022-2024 to contribute to the four priority areas defined in the Council Recommendation on a Pact for Research and Innovation in Europe (Pact for R&I).

The ERA actions are related to different priority areas:

- 'Deepening a truly functioning internal market for knowledge' (actions 1 to 9): The ERA shall provide attractive career opportunities and conditions for researchers, encompass world-class research and technology infrastructures, open science practices, and gender equality.
- 'Meeting the challenges of green and digital transformation and strengthening society's participation in the ERA' (actions 10 to 14): This includes encouraging increased business investments in research and development, supporting innovative small and medium-sized enterprises, and actively involving citizens in the research and innovation processes.
- 'Amplifying access to research and innovation excellence across the union' (actions 15 to 17): The goal is to achieve balanced excellence across Europe and promote the circulation of researchers to elevate the overall level of excellence.
- 'Advancing concerted research and innovation investments and reforms' (actions 18 to 20): This involves closing the investment gap with other global regions and fostering coherence among national and regional research systems.

Reference: European Commission Directorate-General for Research and Innovation. "European Research Area Policy Agenda – Overview of actions for the period 2022-2024". Luxembourg: Publications Office of the European Union, 2021. doi:10.2777/52110



### 3.2. | Strategic plan 2020-2024

The "Strategic Plan 2020-2024" for the Directorate-General for Research and Innovation (DG Research and Innovation) outlines the European Union's (EU) vision and strategy for research and innovation over a five-year period. It aims to address significant societal challenges, drive economic recovery, promote environmental sustainability, and enhance the EU's competitiveness on a global scale. The plan aligns with the overarching priorities of the European Commission, integrating research and innovation into broader policy frameworks and objectives.



The strategic plan is centered around several key objectives and priorities, each targeting specific impacts:

	<b>OBJECTIVE</b>	<b>IMPACT</b>
A European Green Deal:	Achieve climate neutrality by 2050 through research and innovation in green technologies and sustainable practices.	Significant reduction in greenhouse gas emissions, advancement in renewable energy, and sustainable resource management.
A Europe Fit for the Digital Age:	Promote digital transformation by enhancing digital skills, infrastructure, and the development of emerging technologies.	Increased digital literacy, robust digital infrastructure, and leadership in digital technologies.
An Economy that Works for People:	Foster innovation to boost economic resilience, create jobs, and support inclusive growth.	Strengthened economic stability, job creation, and enhanced competitiveness of European industries



A Stronger Europe in the World:	Enhance the EU's global leadership in research and innovation.	Increased international collaborations, influence in global research agendas, and enhanced global competitiveness.
Promoting Our European Way of Life:	Address societal challenges such as health, security, and quality of life through innovative solutions.	Improved public health, enhanced security measures, and a higher quality of life for European citizens.
A New Push for European Democracy:	Engage citizens and stakeholders in the innovation process to ensure democratic and inclusive policymaking.	Increased public participation, transparency in decision- making, and policies that reflect the needs and values of citizens.
A Modern, High Performing and Sustainable European Commission:	Ensure efficient, effective, and sustainable delivery of policies and programs	Improved organizational performance, sustainability in operations, and greater accountability.

To achieve these strategic objectives, the plan details several linked actions and activities:

- Horizon Europe Program: This flagship program, succeeding Horizon 2020, aims to fund research and innovation projects aligned with the EU's strategic priorities. It focuses on fostering scientific excellence and addressing global challenges through collaborative projects.
- Green Deal Call (now closed): A EUR 1 billion call under Horizon 2020 to fund research and innovation projects supporting the European Green Deal. This initiative targeted areas such as clean energy, circular economy, and biodiversity.
- Private Investment Promotion: Encouraging private sector investment in research and innovation is key to achieving economic growth and technological advancement. The plan outlines mechanisms to incentivize and support private investment.
- Stakeholder Engagement: Engaging citizens, industries, academia, and member states in the policy-making process ensures inclusiveness and broad support. This is achieved through public consultations, workshops, and partnerships.
- European Research & Innovation Days: Annual events designed to facilitate discussions on research and innovation policies, foster networking among stakeholders, and promote the EU's strategic initiatives.
- Mission-Oriented Approach: Implementing a mission-oriented approach to tackle societal challenges, focusing on impact-driven research and innovation activities.

The identified <u>prioritized thematic areas</u> are:

- Climate Action and Green Recovery: Developing sustainable solutions to combat climate change and promote a green recovery. This includes investments in renewable energy, sustainable agriculture, and resource-efficient technologies.
- Digital Transformation: Advancing digital technologies and infrastructure to support a digital economy. This involves fostering digital skills, enhancing cybersecurity, and promoting digital innovation.

 Economic Resilience: Strengthening the EU's economic stability and growth through innovation. This includes supporting SMEs, promoting industrial competitiveness, and enhancing the EU's innovation ecosystem.

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- Global Leadership: Positioning the EU as a leader in global research and innovation through international collaborations, partnerships, and strategic initiatives.
- Health and Security: Addressing health challenges and ensuring security through innovative research. This involves supporting medical research, enhancing public health systems, and developing security technologies.
- <u>Democratic Engagement</u>: Promoting democratic processes and citizen involvement in research and innovation. This includes fostering transparency, accountability, and public participation in decision-making.

The strategic plan highlights the importance of collaboration and partnerships with member states, international organizations, and various stakeholders to achieve its goals. It includes a robust framework for monitoring and evaluating progress through specific performance indicators, such as climate-related spending and reductions in greenhouse gas emissions. Ethical practices, transparency, and efficiency are emphasized as essential elements for the successful implementation of the strategic objectives.

Additionally, the plan outlines measures for sound financial management, fraud prevention, digital transformation within the organization, and sustainable environmental practices. The commitment to attracting and retaining skilled personnel is also a key focus to ensure the effective delivery of policies and programs.

Overall, The "Strategic Plan 2020-2024" for DG Research and Innovation provides a comprehensive roadmap for advancing the EU's research and innovation agenda over this five years period. By focusing on critical areas such as climate action, digital transformation, economic resilience, and global leadership, the plan aims to address major societal challenges and position the EU as a leader in research and innovation. The strategic objectives, supported by targeted actions and thematic areas, reflect the EU's commitment to fostering a resilient, inclusive, and sustainable future. This plan is instrumental in driving the EU's long-term goals of economic growth, climate neutrality, and global competitiveness, ensuring that research and innovation remain at the forefront of the EU's policy agenda.

# *Reference: European Commission Directorate-General for Research and Innovation. "Strategic Plan 2020-2024". Luxembourg: Publications Office of the European Union, 2020.*

The Horizon Europe Strategic Plan for 2025-2027 outlines the European Union's funding strategy for research and innovation. It details how the plan will address global challenges like climate change, pollution, biodiversity loss, the digital transition, and an aging population. The plan emphasizes three key strategic orientations: the green transition, the digital transition, and building a more resilient, competitive, inclusive, and democratic Europe. It lays out expected impacts, intervention areas, partnerships, and synergies with other EU programs across different sectors. The plan also highlights the importance of cross-cluster complementarities and the need for international cooperation while safeguarding research security.



### 3.3 | Horizon Europe Missions Work Programme 2023-2025

The document outlines the framework and funding allocations for various research and innovation missions aimed at tackling some of the major challenges facing the EU, such as climate change, cancer, and ocean restoration. It specifies calls for proposals, eligibility conditions, and expected impacts for these missions. This detailed analysis provides insights into the scope, objectives, and strategic orientations of the EU's upcoming research and innovation initiatives as outlined in the Horizon Europe Work Programme for 2023-2025.



The five missions are:

- <u>Adaptation to Climate Change</u>: Enhance climate resilience across European regions, local authorities, and communities.
- <u>Cancer</u>: Improve the lives of over 3 million people affected by cancer through better prevention, treatment, and care.
- <u>Restore our Ocean and Waters by 2030</u>: Protect and restore marine and freshwater ecosystems and biodiversity.
- <u>100 Climate-Neutral and Smart Cities by 2030</u>: Support cities in becoming climate-neutral and smart through innovative and sustainable solutions.
- <u>A Soil Deal for Europe</u>: Promote healthy soils across Europe through 100 living labs and lighthouses.





The document has several strategic priorities that focus on the green transition, with specific emphasis on widening countries. These countries can benefit from targeted support and collaboration opportunities provided by the programme. The strategic priorities on Green transition for Widening countries involves:

Strategic Priorities on Green Transition for Widening Countries

- Enhanced Involvement in Missions: The programme encourages active participation of widening countries in various missions. These missions address global challenges like climate change, ecosystem restoration, and sustainable agriculture—all pivotal for the green transition. This inclusion aims to enhance their capacities through research and innovation.
- <u>Specific Calls to Support Transition</u>: Calls that specifically encourage or require participation from widening countries in projects related to the green transition. These might include projects focusing on climate resilience, renewable energy, and sustainable agricultural practices, which are key areas under the EU's Green Deal.
- <u>Capacity Building and Networking</u>: The programme promotes capacity building in widening countries through networking activities, training, and access to new technologies. This facilitates knowledge transfer and collaboration in green technologies and sustainable practices.
- Focus on Innovation and Technology Transfer: Emphasis on innovation actions that support the deployment of new technologies in energy efficiency, clean energy, and resource management. These actions are designed to help widening countries leapfrog to advanced sustainable technologies.



The related thematic areas involve:

• <u>Climate Resilience:</u> Focusing on innovative solutions for agriculture, forestry, and critical infrastructure protection against climate change.

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- <u>Cancer Research</u>: Enhancements in prevention, diagnostics, and patient care.
- <u>Ocean and Water Restoration</u>: Protection and sustainable management of marine and freshwater environments.
- <u>Smart Cities</u>: Development of technologies and systems for climate-neutral urban living.
- Soil Health: Innovations for soil protection and sustainable agricultural practices

For widening countries, these areas offer opportunities to engage in high-impact research and innovation collaborations that align with their developmental goals and the broader EU policy frameworks such as the European Green Deal. Partnering with projects that address specific regional challenges, such as water scarcity, energy efficiency, and urban resilience can provide tangible benefits and foster sustainable growth.

These strategic priorities and calls within the Horizon Europe Missions Work Programme 2023-2025 create a framework for widening countries to enhance their research capabilities and actively contribute to the green transition through international cooperation and innovative solutions.

Thus, for widening countries, the Horizon Europe Missions Work Programme 2023-2025 offers opportunities to leverage their unique strengths and address specific needs through collaborative research projects. By focusing on areas such as climate resilience, health, sustainable development, and digital transformation, these countries can enhance their research and innovation landscape and contribute significantly to Europe's broader scientific goals.

A list of past Horizon Europe calls on Green Transition topics is listed in *Appendix 1* and possible research areas in *Appendix 2* 

*Reference: Horizon Europe Work Programme 2023-2024; 12. Missions (European Commission Decision C(2023) 2178 of 31 March 2023)* 

# 3.4 | EU Missions 2 years on: assessment of progress and way forward

On 19 July 2024, the European Commission published its Communication on EU Missions under Horizon Europe. The Communication provides an assessment of progress so far, as required by the Horizon Europe regulation, after their first two years of operation. It highlights the main achievements of the current five individual Missions, while also identifying challenges they have encountered, and proposing a set of actions to address these.

According to the assessment of EU Missions highlights their potential to accelerate change, leveraging Horizon Europe funding to connect and support policies across the EU, while engaging local communities. The Missions are recognized as timely and inspirational, aligning EU, national, regional, and local policy efforts towards common goals.





Improvements can be made in several areas, including streamlining the governance structure, enhancing leverage of non-Horizon Europe funding, improving synergies with other EU instruments, increasing private sector involvement, and strengthening communication and outreach to stakeholders and citizens.

- Improve the governance and political steer (high level representatives for the mission, yearly debates within relevant parts the Council and Parliament)
- Secure more and better co-investment, including from the private sector (e.g mobilise a broader portfolio of instruments, including public-private partnerships and the public procurement of innovation
- Enhance citizen and stakeholder engagement (propose series of communication efforts)

Expansion of the Missions portfolio:

- Launching the New European Bauhaus Facility previously announced as potential new EU Mission
- Reaffirming political and financial support (propose a Horizon Europe budget for EU Missions of 11% of Pillar 2 until 2027)

Reference: Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions. EU Missions Two Years On: Assessment Of Progress And Way Forward {SWD(2023) 260 Final}

### 3.5 | Agreement on reforming research assessment

The Agreement on Reforming Research Assessment, ratified on 20 July 2022, outlines a comprehensive framework for overhauling research assessment practices. It emphasizes recognizing diverse outputs and practices to enhance research quality and impact. The Agreement delineates the scope of research

assessment, encompassing organizations, projects, and individual researchers. It aims to allocate funding effectively, ensure public investment accountability, inform research priorities, and promote professional development. Through a global coalition of stakeholders, the Agreement fosters collaboration, information exchange, and mutual learning to improve assessment practices worldwide. It signifies a commitment to reforming research assessment while respecting organizational autonomy and promoting equitable evaluation criteria.

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The Action Plan is related to ERA Action 3 of the ERA Policy Agenda which aims to advance towards a reform of the research assessment system, with the goal of assessing the quality, performance, and impact of research and researchers using more suitable criteria and procedures.

The Objectives are:

- <u>Revamping Research Assessment</u>: The primary goal is to reform the existing system of assessing research, moving away from metrics that can lead to bias or undue pressure on researchers.
- <u>Promotion of Quality and Integrity</u>: Ensure that research assessment methods prioritize the quality and integrity of research over quantitative metrics like journal impact factor or citation counts.
- <u>Encouragement of Diverse Research Practices</u>: Promote diversity in research practices and outputs, acknowledging and valuing various forms of scholarly contributions beyond traditional metrics.

The Priorities are:

- <u>To develop Alternative Assessment Criteria</u>: Focus on creating and implementing alternative methods for evaluating research outputs that reflect the diverse nature of scholarly activities
- <u>Promotion of Open Science</u>: Encourage transparency, reproducibility, and openness in research practices, fostering collaboration and innovation.
- <u>Engagement with Stakeholders</u>: Collaborate with various stakeholders including researchers, institutions, funding agencies, and publishers to implement and endorse the agreement.



Targeted Impacts are:

- <u>Cultural Shift in Research Assessment</u>: Fundamental shift in how research is evaluated. By promoting alternative assessment methods and prioritizing quality and integrity over quantitative metrics, it sets the stage for a cultural transformation in the academic community.
- <u>Increased Diversity and Inclusivity</u>: Greater recognition of diverse research outputs and contributions, leading to a more inclusive research environment.



• <u>Improved Research Practices</u>: Encouragement of open science practices, leading to increased transparency, reproducibility, and collaboration within the research community.

*Reference: Directorate-General for Research and Innovation. Agreement on Reforming Research Assessment (2022)* 

# 4 | IDENTIFICATION OF STRENGTHS AND NEEDS OF WIDENING COUNTRIES AND S&R&I AREAS OF INTEREST FOR COMMON RESEARCH PROJECTS

To identify the strengths, needs, and Science, Research, and Innovation (S&R&I) areas of interest for widening countries from the Horizon Europe Work Programme 2023-2025 and beyond, it is necessary to consider the thematic priorities, goals, and specific call actions that are relevant to these countries. Widening countries often have untapped potential in certain research areas due to historical underinvestment, limited access to funding, or infrastructural constraints. In general, the following observations can be made:

#### Strengths of Widening Countries

1. Diverse Ecological Environments: Many widening countries possess rich biodiversity and diverse ecological systems. This can be a strength in research areas related to environmental science, agriculture, and climate adaptation.
2. Historical and Cultural Heritage: These countries often have unique cultural and historical assets that can be leveraged in projects related to social sciences, humanities, and cultural heritage preservation.
3. Emerging Technological Sectors: Some widening countries are developing strong niches in technologies such as IT and digital innovation, which can be integrated into various R&I initiatives.
4. Clean energy sources: some widening countries, in particular Portugal, are leaders in the energetic transition and fully implementation of clean renewable energies and its storage and smart distribution.

#### Needs of Widening Countries

Some of the major challenges faced by the R&D and Innovation ecosystem in widening countries have been related to some key aspects as detailed below.



Ś	1. Infrastructure Development: There is a critical need for improving research infrastructure to enable effective participation in high-quality research and innovation projects.
$\mathbf{i}$	2. Capacity Building and talent retention: Enhancing the skills and capabilities of researchers and institutions is necessary to increase competitiveness and participation in EU research programmes.
	3. Networking and Collaboration: Needs include better integration into wider European research networks to facilitate knowledge transfer, talent circulation and build stable partnerships.

### 4.1 | S&R&I Areas of potential Interest for Common Research Projects

#### 1. Climate Resilience and Environmental Sustainability

**Relevant Calls:** Projects that focus on climate resilience, sustainable agriculture, and environmental protection are crucial. Calls like **HORIZON-MISS-2023-CLIMA** for climate resilience in agriculture and forestry or **HORIZON-MISS-2023-OCEAN** for ocean and water restoration can be areas of high interest.

Strengths to Leverage: Utilize local biodiversity and ecological knowledge.

Needs Addressed: Build capacity for climate adaptation technologies and practices.

#### 2. Health and Well-being

**Relevant Calls:** Health-related research, especially in areas impacted by climate change or focusing on innovative healthcare solutions.

Strengths to Leverage: Apply historical and cultural knowledge to health and well-being projects.

Needs Addressed: Improve health infrastructure and research capabilities.

#### 3. Energy Transition and Sustainable Urban Development

Relevant Calls: Initiatives under calls like HORIZON-MISS-2023-CIT for smart cities can support the development of sustainable urban areas.

Strengths to Leverage: Emerging strengths in technological innovation, particularly digital technologies.

Needs Addressed: Development of smart infrastructure and sustainable urban planning methodologies.



#### 4. Digital Transformation and ICT

**Relevant Calls:** Engage in digital transformation projects that enhance public services, governance, and accessibility.

Strengths to Leverage: Growing IT sectors and digital innovation hubs.

Needs Addressed: Enhance digital skills and infrastructure.

#### 5. Cultural Heritage and Social Sciences

**Relevant Calls:** Research in social sciences that integrates cultural heritage preservation, which is vital for many widening countries with rich histories.

Strengths to Leverage: Unique cultural assets and historical contexts.

**Needs Addressed:** Support for the preservation of cultural heritage and integration of social sciences in broader research agendas.

# 5 | POLISH PERSPECTIVE

# 5.1 | Analysis of key policy documents at country level (Poland) with focus on Green Transition

#### 1 | Long-term National Development Strategy (DSRK - Długookresowa Strategia Rozwoju Kraju)

It is the broadest and most general element of the new system of managing the country's development. It is a document of the Polish government of an analytical and recommendatory nature - it is a description of a new civilization project oriented towards the future, in the perspective of 2030. The main objective of the DSRK is to improve the quality of life of Poles measured both by qualitative indicators and the value and rate of GDP growth in Poland. The DSRK is the basis of the SSRK (National Development Strategy 2020) and nine strategies, including (discussed below):

- Strategy for Innovation and Efficiency of the Economy
- Transport Development Strategy
- Energy Security and the Environment (currently the Energy Policy of Poland 2040)
- National Regional Development Strategy 2010-2020: Regions, Cities, Rural Areas

Key priorities with focus on Green Transition:

- Ensuring energy security and protecting and improving the environment
- Modernizing infrastructure and energy security
- Modernizing power and heating networks
- Increasing energy security by diversifying gas acquisition directions
- Implementing the smart grid program in the power industry
- Integrating the Polish power, gas and fuel markets with regional markets
- Strengthening the role of end users in managing energy consumption
- Creating incentives to accelerate the development of the green economy
- Increasing the level of environmental protection

# 2 | National Development Strategy 2020 with perspective to 2030 (ŚSRK - Strategia Rozwoju Kraju 2020 z pers. do roku 2030)

It is a binding, key document of the Polish state in the area of medium- and long-term economic policy. The strategy defines the basic conditions, goals and directions of the country's development in the social, economic, regional and spatial dimensions in the perspective of 2020 and 2030.

- Rational resource management
- Improving energy efficiency
- Increasing the diversification of fuel and energy supplies
- Improving the state of the environment



#### • Adapting to climate change

3 | SOR 2030 - Strategy for Responsible Development (SOR 2030 - Strategia na rzecz Odpowiedzialnego Rozwoju)

SOR is an update of the country's medium-term development strategy, i.e. the National Development Strategy 2020. It is a binding, key document of the Polish state in the area of medium- and long-term economic policy.

Key priorities with focus on Green Transition:

- Improving the country's energy security
- Improving energy efficiency
- Developing technology
- Restructuring the hard coal mining sector

4 | SIEG - Strategy for Innovation and Efficiency of the Economy "Dynamic Poland 2030" (SIEG - Strategia Innowacyjności i Efektywności Gospodarki "Dynamiczna Polska 2030")

The Strategy for Innovation and Efficiency of the Economy Dynamic Poland 2030 (SIEG) is one of nine integrated strategies implementing the provisions of the medium-term National Development Strategy 2020. The thematic scope includes the following issues: stable macroeconomic foundations for development, financial market, friendly environment for entrepreneurship, development of services, development of industrial and construction sectors, innovation, information society, export and promotion of the economy.

Key priorities with focus on Green Transition:

• Transforming the socio-economic system to a greener path, especially reducing the energy and material intensity of the economy. Supporting the development of sustainable construction at the planning, design, construction and management stages throughout the entire life cycle.

# 5 | PEP 2040 - Poland's Energy Policy until 2040 (PEP 2040 - Polityka Energetyczna Polski do 2040)

The Polish Energy Policy until 2040 (PEP 2040) is a strategic document of the Polish government, which defines the directions of the country's energy transformation in the coming years. The main goals of PEP 2040 are to ensure energy security, develop renewable energy sources, improve energy efficiency and reduce greenhouse gas emissions.

- Optimal use of own energy resources
- Expansion of electricity generation and network infrastructure
- Diversification of supplies and expansion of network infrastructure for natural gas, crude oil and liquid fuels
- Development of energy markets



- Implementation of nuclear energy
- Development of renewable energy sources
- Development of heating and cogeneration
- Improvement of energy efficiency

# 6 | KSRR - National Regional Development Strategy 2030 (KSRR - Krajowa Strategia Rozwoju Regionalnego 2030)

The main objective of the National Strategy for Regional Development 2030 is to effectively use the internal potential of territories and their specializations to achieve sustainable development of the country. The document presents the objectives of regional policy and the actions and tasks that should be undertaken by the government, local governments: voivodeships, districts and municipalities, and other entities participating in the implementation of this policy in the perspective of 2030.

Key priorities with focus on Green Transition:

- Adaptation to climate change and mitigation of environmental threats
- Increasing the productivity and innovation of regional economies
- Increasing the efficiency of development management (including financing development activities) and cooperation between local governments and between sectors

#### 7 | PEP 2030 - State Environmental Policy (PEP 2030 - Polityka Ekologiczna Państwa)

The role of PEP2030 is to ensure Poland's ecological security and a high quality of life for all residents. PEP2030 strengthens the government's actions to build an innovative economy while maintaining the principles of sustainable development.

- sustainable water management, including ensuring access to clean water for society and the economy and achieving good water status,
- eliminating sources of air pollution emissions or significantly reducing their impact,
- protection of the earth's surface, including soils,
- counteracting environmental threats and ensuring biological, nuclear and radiological safety,
- management of natural and cultural heritage resources, including protection and improvement of the state of biodiversity and landscape,
- supporting multifunctional and permanently sustainable forest management,
- waste management towards a circular economy,
- management of geological resources through the development and implementation of the state's raw materials policy,
- supporting the implementation of eco-innovations and dissemination of the best available BAT techniques (which consist in determining emission limits for larger industrial plants),
- counteracting climate change,
- adaptation to climate change and management of the risk of natural disasters,
- environmental education, including shaping sustainable consumption patterns, improving the environmental protection control and management system and improving the financing system.

#### 8 | SPA 2020 - Strategic Adaptation Plan (SPA 2020 - Strategiczny Plan Adaptacji)

SPA 2020 (with a perspective to 2030) indicates the goals and directions of adaptation actions to be undertaken in the most sensitive sectors and areas in the period to 2020: water management, agriculture, forestry, biodiversity and legally protected areas, health, energy, construction, transport.

Key priorities with focus on Green Transition:

- Ensuring energy security and good environmental condition
- Effective adaptation to climate change in rural areas
- Development of transport in climate change conditions
- Ensuring sustainable regional and local development taking into account climate change
- Stimulating innovations that support adaptation to climate change
- Shaping social attitudes that support adaptation to climate change

9 | KPEiK - National Energy and Climate Plan for 2021-2030 (KPEiK - Krajowy plan na rzecz energii i klimatu na lata 2021-2030)

The KPEiK presents the assumptions and objectives as well as policies and actions for the implementation of 5 dimensions of the Energy Union: energy security, internal energy market, energy efficiency, reduction of emissions, and research, innovation and competitiveness.

- 1. Reducing emissions
- 2. Energy efficiency
- 3. Energy security
- 4. Internal energy market
- 5. Scientific research, innovation and competitiveness
- 6. Acquiring European funds by national research units and enterprises priorities:
- Energy storage, including cells and batteries for electric vehicles
- Support for the construction or expansion of infrastructure for the distribution or sale of alternative fuels used in transport
- Implementation of Power-to-Gas technologies
- Construction of small-scale regasification stations with a cooling energy recovery module
- Support for research and implementation related to the introduction of autonomous or partially autonomous vehicles powered by alternative fuels into service
- Support for recycling batteries from vehicles powered by electricity
- Management of post-mining waste and combustion by-products
- Creation of investment areas in post-mining areas
- Support for manufacturers of means of transport using alternative fuels
- Support for national research on so-called clean coal technologies (CTW)
- New directions in the use of hydrogen

The National Research and Development Programme defines Priority Research Areas and, within these areas, proposes Priority Research Directions. It is the basis for formulating Strategic Research and Development Programmes.

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Key priorities with focus on Green Transition:

- Resources and Biodiversity
- Food and Bioeconomy
- Energy and Climate

11 | DSRB - Long-Term Building Renovation Strategy (DSRB - Długoterminowa Strategia Renowacji Budynków)

The strategy therefore defines the necessary actions to achieve high energy efficiency and low emission of buildings in Poland by 2050.

Key priorities with focus on Green Transition:

- Supporting smart technologies and buildings
- Smart and energy-efficient construction
- Skills and education in the construction and energy efficiency sector

#### 12 | KIS - National Smart Specializations (KIS - Krajowe Inteligentne Specjalizacje)

The National Smart Specialization (KIS) indicates preferences in providing support for the development of research, development and innovation (R+D+I).

Key priorities with focus on Green Transition:

- Sustainable (bio)products, (bio)processes and the environment
- Sustainable energy
- Smart zero-emission buildings
- Environmentally friendly transport
- Circular economy

13 | KPO - National Reconstruction and Resilience Programme (KPO - Krajowy Program Odbudowy i Zwiększania Odporności)

The strategic goal of the National Recovery and Resilience Plan (KPO) is to rebuild the development potential of the economy, lost as a result of the pandemic, and to support the sustainable competitiveness of the economy and increase the standard of living of society in the longer term.

- Clean air and energy efficiency
- Facilitating energy companies to meet their energy savings obligations



- Improving conditions for the development of hydrogen technologies and other decarbonized gases
- Support for offshore wind farm investments
- Legal framework for the development of energy storage facilities
- Support for environmental remediation and protection against hazardous substances
- Improving conditions for the development of renewable energy sources
- Increasing the use of environmentally friendly transport
- Increasing the share of zero and low-emission transport and counteracting and reducing the negative impact of transport on the environment
- Regulatory solutions for the accelerated integration of renewable energy sources with distribution networks
- Removing barriers to the integration of renewable energy sources with power grids
- Improving the process of issuing permits for renewable energy sources
- Increasing energy efficiency and accelerating the withdrawal of fossil fuels from heating

#### 14 | SRT2030 - Sustainable Transport Development Strategy until 2030 (SRT2030 - Strategia Zrównoważonego Rozwoju Transportu do 2030 r.)

The main objective of the Sustainable Transport Development Strategy until 2030 is to increase transport accessibility and improve the safety of road users and the efficiency of the transport sector by creating a coherent, sustainable, innovative and user-friendly transport system at the national, European and global level.

Key priorities with focus on Green Transition:

- changes in individual and collective mobility;
- reducing the negative impact of transport on the environment

#### 15 | PRE - Electromobility Development Plan (PRE - Plan Rozwoju Elektromobilności)

The plan defines the benefits associated with the widespread use of electric vehicles in our country and identifies the economic and industrial potential of this area.

Key priorities with focus on Green Transition:

- Promoting electric vehicles as a means of transport in cities of the future
- Vehicle market development (user benefits)

# 16 | PSW - Polish Hydrogen Strategy until 2030 (PSW - Polska Strategia Wodorowa do roku 2030)

The Polish Hydrogen Strategy until 2030 with a perspective until 2040 (PSW) is a strategic document that defines the main goals of the development of the hydrogen economy in Poland and the directions of actions necessary to achieve them. The document is part of global, European and national actions aimed at building a low-emission economy.



Key priorities with focus on Green Transition:

- implementation of hydrogen technologies in the energy and heating sectors
- use of hydrogen as an alternative fuel in transport
- support for decarbonisation of industry
- production of hydrogen in new installations
- efficient and safe transmission, distribution and storage of hydrogen;
- creation of a stable regulatory environment.

#### 17 | Road map of circular economy (Mapa drogowa GOZ)

The Circular Economy Roadmap is a document containing a set of tools, not only legislative ones, which aim to create conditions for implementing a new economic model in Poland.

Key priorities with focus on Green Transition:

- Sustainable industrial production
- Sustainable consumption
- Bioeconomy
- New business models

#### 18 | KPM - National Urban Policy (KPM - Krajowa Polityka Miejska)

The document diagnoses the most important development challenges of cities and their functional areas. KPM 2030 formulates solutions and determines planned actions of the government administration in the legal, financial and organizational scope for the sustainable development of cities and urban functional areas. At the same time, the document is useful to local government authorities and local communities - it equips them with tools and opportunities for effective action.

- Mitigating the negative effects of climate change in cities
- Improving the quality of the natural environment in cities
- Ensuring a sustainable and integrated urban mobility system in urban functional areas

# 5.2 | Common research priorities identified in the key policy documents at the widening country level (Poland) and inscribed in the Unite! Strategy

List of identified research priorities critical for the	Ensuring energy security and protecting and improving the environment
green transition in Poland:	Rational resource management
	Improving energy efficiency
	Improving the environment
-	Technology development
	Transforming the socio-economic system to a so-called greener path, especially reducing the energy and material intensity of the economy
	Supporting the development of sustainable construction at the stage of planning, designing,
-	constructing buildings and managing them throughout their entire life cycle.
	Implementation of nuclear energy
-	Development of renewable energy sources
-	Development of heating and cogeneration
-	Adaptation to climate change and reduction of environmental threats
-	Increased productivity and innovation of regional economies
-	Sustainable water management, including ensuring access to clean water for society and the economy and achieving good water status
-	Elimination of sources of air pollution emissions or significant reduction of their impact,
-	Protection of the earth's surface, including soils,
-	Waste management towards a circular economy,
-	Counteracting climate change,
-	Environmental education, including shaping sustainable consumption patterns,
	Development of transport in climate change conditions
-	Shaping social attitudes conducive to adaptation to climate change
	Reducing emissions
-	Scientific research, innovation and competitiveness
	Acquiring European funds by national scientific units and enterprises - priorities:
-	Support for intelligent technologies and buildings: Intelligent and energy-efficient construction:
	Skills and education in the construction and energy efficiency sector
-	Sustainable (bio)products, (bio)processes) and the environment
	Sustainable energy
	Smart zero-emission construction
-	Reducing the negative impact of transport on the environment
-	Implementation of hydrogen technologies in the energy and heating sectors
-	Mitigating the negative effects of climate change in cities
-	Improving the quality of the natural environment in cities



### 5.3 | Strategic areas of Wrocław University of Science and Technology (based on the WUST Strategy 2023-2030) - Research areas important from the green transition perspective

#### 1. Innovative materials and advanced manufacturing technologies

• green technologies using renewable raw material base and waste valorization,

• sustainable and energy-saving technologies,

#### 2. Sustainable living environment

- raw material economy,
- energy sources (conventional, renewable and nuclear energy),
- transformation of the energy system,
- technologies friendly to humans and the environment (e.g. electromobility),
- climate protection and natural and cultural environment,
- water management,
- identification of environmental threats and response to natural disasters,
- as well as all aspects of sustainable development,
- circular economy
- social acceptance of the changes taking place.

#### 3. Smart cities and the society of the future

- holistic design and construction of human-friendly buildings, housing estates and cities
- using modern technologies,
- application of innovative and safe materials,
- broadly understood communication and mobility including intelligent and autonomous transport systems,
- universal design,
- prevention and counteracting social, energy and digital exclusion,
- research on human-machine interaction,
- analysis, prediction and management of social and economic processes

# 5.4 | Approach to green transition in Poland

In terms of adaptation and mitigation activities, the *modus operandi* should probably be changed. Actions should be initiated by regions and cities defining their problems and critical points requiring corrective action. Then, local governments, in cooperation with universities and research institutions, should develop joint action strategies and seek co-financing for them in EU framework programs. In the absence of appropriately tailored calls, representatives of the regions, in close cooperation with scientists, should submit to the European Commission proposals for new calls for proposals dedicated to needs defined through bottom-up approach.

Some possible common focus areas important from the green transition perspective are:

- green technologies using renewable raw material base and waste valorization, bioprocess engineering, ecosystem services; forest products, bioenergy and biorefineries
- sustainable and energy-saving technologies
- raw material management, resources and raw materials



- energy sources (conventional, renewable and nuclear energy)
- transformation of the energy system
- technologies friendly to humans and the environment (e.g. electromobility),
- climate protection and natural and cultural environment, biodiversity, landscape ecology and planning, global change, climate and global changes, climate change awareness, management & adaptation, environmental risk management & strategic planning, biodiversity & ecosystem based management
- water management, environment and water resources; systems and management; transportation systems
- identification of environmental threats and response to natural disasters
- all aspects of sustainable development
- circular economy
- social acceptance of ongoing changes
- holistic design and construction of human-friendly buildings, housing estates and cities using modern technologies, architecture, urban planning, design, ergonomics
- broadly understood communication and mobility including intelligent and autonomous transport systems
- > prevention and counteracting social, energy and digital exclusion, accessibility and ageing
- processes and systems modelling, analysis, prediction and management of social and economic processes

An analysis of the studies at the national level (Poland) indicated above was carried out in three perspectives: the scope of the study, the period of validity of the study and the fulfillment of the indicated green transition points. The output data is shown in Table 1.

NB	PROGRAM	RELEVANCE	TIME FRAME	GREEN TRANSITION POINTS
1.1	DSRK	national	2020-2030 (longterm)	9
1.2	ŚSRK	national	2020-2030 (midterm)	5
1.3	SOR 2030	national	2020-2030 (midterm update)	4
1.4	SIEG	national	2020-2030	1(2)
1.5	PEP 2040	national	2040	8
1.6	KSRR	national to regional	2030	3
1.7	PEP 2030	national	2030	12
1.8	SPA 2020	national	2030	6
1.9	КРЕіК	national	2021-2030	6
1.10	PNP	national	no data	3
1.11	DSRB	national	2050	3
1.12	KIS	national	no data	5
1.13	КРО	national	no data	13
1.14	SRT 2030	national / european	2030	2
1.15	PRE	national	no data	2

Tab. 1: Key policy documents at country level (Poland) with focus on Green Transition.



1.16	PSW 2023	national	2030	6
1.17	GOZ	national	no data	4
1.18	КРМ	local	no data	3

The analysis revealed 15 documents of national importance (Poland), one of international importance, one of regional importance and one of local importance. There is a noticeable disproportion between the number of plans of national importance in relation to the others and a negligible number of plans of regional and local importance. This confirms the need to implement the above-mentioned bottom-up perspective, where the starting point will be local plans (municipal, district) so that they can be part of provincial and national plans.

It is necessary to differentiate the plans in terms of time to responsibly and long-term plan the strategy for sustainable development, of which green transition is a part. Most of the indicated documents were developed in the perspective of 2030. One document was developed in the perspective of 2050. Some documents (1.1 - 1.3) have a supplementary structure. It seems reasonable to develop a general road plan on a national scale with a long-term perspective, which can be detailed with plans with a shorter (e.g. 10-year) perspective at the regional level. Political consensus is also important here, which should lead to the continuation of established long-term actions so that the change of legislative power does not negatively affect the established and accepted substantive scope (as was the case with the nuclear energy road plan in Poland that had been postponed for about a decade).

Both at the level of national documents, S&R&I areas and recommended common focus areas important from the green transition perspective, the definition of the subject and subject of activities is important. At the general level, the indication e.g. circular economy or transformation of the energy system remains so general that it is not possible to define the results of the activities performed. At least the definition of S&R&I research fields would be justified. However, the application of Circular Transition Indicators (CTI) developed by World Business Council for Sustainable Development (WBCSD) can be considered<sup>1</sup>.

<sup>&</sup>lt;sup>1</sup> <u>Circular Transition Indicators (CTI) – WBCSD</u> (access 14 Sept 2024)

# 6 | PORTUGUESE PERSPECTIVE

# 6.1 | National Strategy for Research and Innovation (R&I) Ecosystems in the Energy Sector in Portugal: Alignment with European Policies

The global transition towards sustainable energy systems, driven by European policy frameworks like the Green Deal and Horizon Europe, emphasizes the critical role of Research and Innovation (R&I) in achieving energy efficiency, decarbonization, and technological breakthroughs. Portugal 2030 program signed with EU defines strategic goals for 2021 to 2027, including 4 national thematic programs dedicated to:



and several regional programs covering all the Portuguese territory with specific goals according to the particular regional development. The overarching objective is the transition to a sustainable and carbon neutral economy.



Regarding research and innovation, Portugal, in alignment with the European Union's (EU) strategies, has created its national framework program, ENEI 2030 (Estratégia Nacional de Investigação e Inovação para uma Especialização Inteligente), to foster the development of sustainable R&I ecosystems within the green energy transition sector. Below, we outline the key components of Portugal's strategy for R&I within the green energy transition sector, its integration into European initiatives, and the roles of public and private actors in driving innovation. This document also defines the key pillars of the Portuguese public policies.

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Portugal, as an EU member, aligns its national strategies with these directives, to contribute to the EU targets and ambitions and to harness European funding and foster cross-border collaboration on related activities and projects.

The green Transition is, concurrently, a core part of the Portugal Smart Specialization Strategy -"Estratégia Nacional para uma Especialização Inteligente 2030" (ENEI 2030). This specialization strategy is addressed in a key document that represents Portugal's comprehensive strategy to enhance its innovation capacity. It integrates national goals with the European Union's vision for smart specialization, promoting sustainable growth and competitiveness.

#### 6.1.1 | The National Strategy for R&I Ecosystems in Energy (ENEI 2030)

#### Overview of ENEI 2030

ENEI 2030 is Portugal's national smart specialization strategy, focusing on innovation as a driver for economic growth and sustainability. The purpose of ENEI 2030 is to create a coordinated approach to innovation, ensuring that resources are effectively utilized, and strategic priorities are addressed. It aims to position Portugal as a leader in innovation by fostering a culture of creativity and collaboration, contribution to meet the EU ambition goals for the Green deal. The vision of ENEI 2030 is to transform Portugal into a hub of innovation, characterized by a high quality of life, a vibrant and creative environment, and a robust scientific and technological foundation.

Green transition is explicitly one of 5 objectives of the strategy, but finds support in most of the other objectives as well:

Main objectives:

#### Digital and Green Transitions

- Digital Transformation: Enhance digital infrastructure, promote digital literacy, and support the development of digital technologies.
- Green Transition: Promote sustainable practices, invest in renewable energy production and storage, and reduce carbon emissions.

#### Advanced Materials and Technologies

- Materials Science: Foster research in advanced materials such as nanomaterials, architectural materials and composites, including their recycling.
- Production Technologies: Encourage the adoption of smart manufacturing and Industry 4.0 solutions.

#### **Cultural and Creative Industries**

- Cultural Heritage: Preserve and promote Portugal's cultural heritage using innovative technologies.
- Creative Industries: Support the growth of creative sectors, including arts, media, and design.

#### Health, Biotechnology, and Food

- ▶ Health Sciences: Invest in biomedical research and healthcare innovations.
- Biotechnology: Support biotech startups and research centers.
- **Sustainable Food:** Promote sustainable agricultural practices and food technologies.

#### Natural Assets

- **Forests:** Promote sustainable forest management and biodiversity conservation.
- Maritime and water Resources: Advance maritime research and technologies and preserve waters.
- **Space Capabilities:** Invest in space exploration and technology.

The implementation of Green and sustainable transitions is also present and supported by the developments of other objectives. For instance, the development of the appropriate production technologies is essential for this purpose. On the other hand, advanced materials can be designed to support recyclability and substitute raw or scarce materials. Creative reuse of locally sourced, through recycling, of critical materials paves the way to mitigate external dependence of the European Union in critical raw materials. Sustainable food production is also central for green transition. The smart and sustainable exploitation of natural assets is also central to this objective.

Within the energy sector, ENEI 2030 promotes strategic research areas that align with the broader European policy framework. Table 1 (in Appendix 3) summarises the smart specialization strategy in Portugal for the key sectors addressed, and Table 2 (also in Appendix 3) summarises the smart specialization strategy for the region of Lisboa. Most of these priorities are directly concerned with energy issues that are the object of R&I at Universidade de Lisboa and its ecosystem of Research Units.

This specialization is determined by the local development of different regions. Thus, the next two tables depicted the national specialization strategy and also the Lisbon area strategy that is considered relevant for this document.

The main priorities within ENEI 2030 for energy R&I include:

**Energy Efficiency**: R&D in energy-efficient technologies for industry, transport, and residential sectors.

**Renewable Energy**: Promoting research in solar, wind, marine, and biomass energy, as well as innovative technologies like hydrogen.

**Energy Storage & Grids**: Innovation in energy storage systems and smart grid technologies to enhance energy distribution and integration of renewable sources.

**Sustainable Mobility**: Supporting the development of electric mobility technologies and infrastructure.

**Circular Economy in Energy**: Fostering innovation in resource recovery, reuse, and waste reduction within energy systems.



#### Strategic R&I Objectives in the Energy Sector

This strategy is anchored on a set of clear objectives:



**Decarbonization**: ENEI 2030 focuses on advancing carbon-neutral technologies to support Portugal's ambition to achieve net-zero emissions by 2050, in line with the European Green Deal.



**Technological Innovation**: ENEI 2030 emphasizes investment in cutting-edge technologies such as hydrogen energy, offshore wind, and smart energy systems that integrate digitalization, automation, and artificial intelligence.



**Energy Sovereignty**: By promoting research in renewable energy technologies, Portugal aims to reduce its dependence on imported energy and increase energy self-sufficiency.



**Collaboration and Knowledge Transfer**: The strategy fosters collaboration between universities, research institutes, and industry to ensure that research outcomes are quickly translated into market-ready innovations.

#### 6.1.2 | Key Initiatives and Projects in Portugal's Energy R&I Ecosystem

Several key initiatives can be identified to attain these objectives:

- Hydrogen as a Strategic Area
  - Hydrogen has emerged as a focal point in Portugal's energy strategy. Several projects, such as the Hydrogen Valley in Sines, are pivotal for establishing the country as a hub for hydrogen production and distribution. These initiatives align with both national objectives and European policies under the Clean Hydrogen Alliance.
- Offshore Wind and Marine Energy
  - Portugal's extensive coastline offers vast potential for offshore wind energy. Research and pilot projects in floating wind platforms, such as WindFloat Atlantic, contribute to European goals for offshore renewable energy capacity.
- Energy Storage and Smart Grids
  - Projects focusing on energy storage and materials for energy, such as Baterias 2030 and new Gereration storage, and investments in smart grid infrastructure are crucial for integrating variable renewable energy sources into the grid. These innovations are



supported by EU funding and strategic national policies to ensure grid resilience, autonomy for clean energy and energy efficiency.

#### 6.1.3 | Stakeholders in the Energy R&I Ecosystem

Portugal's energy R&I ecosystem involves a wide range of stakeholders:

PUBLIC SECTOR AND RESEARCH INSTITUTIONS		
AGÊNCIA NACIONAL DE INOVAÇÃO	<b>Agência Nacional de Inovação (ANI)</b> : Facilitates partnerships and access to funding for innovation projects in the energy sector.	
Fundação para a Ciência e a Tecnologia	Fundação para a Ciência e a Tecnologia (FCT): Funds research projects in energy and related fields.	
<b>IAPMEI</b> Parcerias para o Crescimento	IAPMEI: promotes competitiveness and business growth through the management of instruments and programs aimed at strengthening SME innovation, entrepreneurship and business investment. In Portugal the recovery and resilience plan is managed by IAPMEI and has a strong focus on the green transition.	
PORTUGALclusters	<b>Competitiveness and Technology Clusters</b> : aim to promote links between supply and demand for R&D and innovative solutions that can be incorporated into processes or products, specifically in sectors in which Portugal has or can build competitive advantages in the international economic context in which it operates.	
CoLAB Laboratórios Colaborativos	<b>COLABS</b> : Collaborative Laboratory (CoLAB) are a private non-profit associations or companies, whose main objective is the collaboration of its members in the pursuit of common research and innovation agendas in the short and medium term, oriented towards the creation of skilled jobs and economic and social value.	







#### Portugal is actively involved in European and international energy R&I programs. Crossborder partnerships with other EU countries, and involvement in Horizon Europe projects, strengthen Portugal's capacity to innovate and scale up solutions



#### 6.1.4 | Challenges and Opportunities



**OPPORTUNITIES** 

Renewable Energy Leadership: With its abundant natural resources, Portugal is becoming a global leader in renewable energy technologies. Moreover, the long-standing investment in renewable energy production places Portugal already in a good competitive position for global leadership.

European Integration: Portugal can leverage European partnerships and funding to accelerate its R&I progress in green energy and drive impactful innovation.



# 6.2 | Synergies between digital transition and green transition

#### Smart Energy Systems

- Smart Grids: One of the primary intersections of the green and digital transitions is in the development of smart grids. These grids rely on digital
  technologies such as IoT (Internet of Things), AI (Artificial Intelligence), and big data analytics to efficiently manage energy supply and demand.
  Smart grids allow for real-time monitoring of energy usage and facilitate the integration of renewable energy sources like solar and wind into
  the energy system.
- Decentralized Energy Management: Digital platforms enable decentralized energy systems, allowing consumers to become "prosumers" by generating, storing, and selling renewable energy back to the grid. Blockchain technology can be applied here to create transparent and secure peer-to-peer energy trading systems.

#### Energy Efficiency Through Digital Technologies

- Al and Machine Learning: Al plays a crucial role in optimizing energy use. By analyzing data from various sources (e.g., industrial processes, buildings, transportation), Al can optimize energy efficiency, reducing wastage and improving sustainability.
- Smart Buildings: Digital sensors and smart meters can be integrated into buildings to monitor and control energy consumption in real-time. Smart building functionalities can reduce energy demand through automated heating, cooling, and lighting based on occupancy and external conditions.

#### Electrification and Digitalization of Mobility

- Electric Vehicles (EVs) and Charging Infrastructure: The digital transition supports the green transition in the transport sector by enabling smart EV charging networks. Digital platforms allow for efficient management of charging stations, real-time vehicle-to-grid communication, and energy storage. Data analytics help optimize charging patterns, reducing grid strain and maximizing the use of renewable energy for EVs.
- Autonomous Vehicles: The development of autonomous electric vehicles relies heavily on digital technologies such as AI, sensors, and data analytics, which will revolutionize sustainable urban mobility by reducing traffic, optimizing routes, and minimizing fuel consumption.

#### <u>Energy Storage and Smart Grids</u>

- Digital Management of Energy Storage: Effective energy storage is vital for a sustainable energy system, particularly for managing intermittent renewable energy sources (like solar and wind). Digital solutions help manage storage systems, ensuring efficient distribution and usage of stored energy. Al-powered systems can predict energy needs and optimize the charging and discharging of batteries.
- Predictive Maintenance and Monitoring: Digital tools such as AI and IoT devices can predict equipment failures in energy infrastructure, reducing downtime and increasing the efficiency of renewable energy systems like wind turbines and solar farms. This improves the reliability and lifespan of energy systems.

#### Data-Driven Energy Policies

- Big Data for Decision Making: National and European energy policies are increasingly relying on big data and advanced analytics to make informed decisions. Data-driven insights help governments and companies track emissions, monitor energy usage patterns, and optimize resource allocation, aligning both energy and digital strategies.
- Digital Twins: In large energy projects, digital twins (virtual replicas of physical energy assets) are being used to simulate and optimize processes, test scenarios, and improve decision-making in real time. These models allow for more precise planning and optimization of energy systems, reducing costs and enhancing efficiency.

#### Cybersecurity in Energy Systems

• Protection of Critical Infrastructure: As energy systems become more digitalized, they become more vulnerable to cyberattacks. The integration of advanced cybersecurity measures is critical to protecting smart grids, renewable energy infrastructure, and storage systems from potential threats. Digital strategies must include robust cybersecurity frameworks to ensure the security and resilience of green energy infrastructure.

#### Digital Innovation in Circular Economy for Energy

- Resource Optimization: Digital technologies help track and optimize the use of raw materials in energy production, contributing to a circular economy. Digital platforms support recycling, reuse, and the reduction of waste in renewable energy projects, such as repurposing materials from decommissioned wind turbines or solar panels.
- Al in Waste Reduction: Al and data analytics can streamline energy production and consumption by identifying inefficiencies and reducing waste. This supports the circular economy by ensuring that energy production is cleaner and resources are used more sustainably.

#### Hydrogen Production and Digital Monitoring

Digital Tools for Hydrogen Energy: Digital technologies are critical in optimizing hydrogen production, especially for green hydrogen, which is
produced using renewable energy. Al can improve the efficiency of electrolyzers (which split water into hydrogen and oxygen) and predict when
to ramp up production based on renewable energy availability and grid demand.

#### <u>Research and Innovation Synergies</u>

 Digital Innovation Hubs and Green R&D: Research programs like Horizon Europe are integrating digital innovation with green energy projects. These synergies drive breakthroughs in areas like energy efficiency, renewable integration, and smart city development. Portugal, through programs like ENEI 2030, is fostering these interactions by promoting collaboration between digital and energy R&I ecosystems.



## 6.3 | Alignment of ULisboa priorities with the European Bauhaus

The New European Bauhaus (NEB) aims to promote a movement that realizes the European Green Deal, based on sustainability, inclusion, and a new relational aesthetic. The Lisbon NEB Lab, led by IST-ID, will be a catalyst for Lisbon's green transition, combining technology, art, and culture to create a sustainable and inclusive future. This project aims to engage the local community and various sectors of the economy, transforming them to contribute to climate goals and improve citizens' quality of life. Centered on the redevelopment of the "Old Flour Silos" building in the Unicorn Factory – Beato Innovation District, the Lisbon NEB Lab will be a meeting space for designing future ways of living and developing solutions that regenerate ecosystems, crucial in combating climate change. The infrastructures being gathered to implement this project will foster a profound social transformation, aligned with NEB's goals, promoting a sustainable, aesthetically appealing, and inclusive future.

Bauhaus defined the role of design in the 20th century by combining art and architecture with industry and construction within a political/economic/social vision of the world. The New European Bauhaus (NEB) seeks to promote a movement aligned with implementing the European Green Deal, based on sustainability, inclusion, and a new aesthetic. This movement involves regenerative approaches inspired by nature, enriching our experiences by combining architecture, engineering, creativity, art, and culture, embracing diversity to promote inclusive and accessible spaces where dialogue between different cultures, disciplines, genders, ethnicities, and ages becomes an opportunity to imagine a better future for all.

IST-ID, the Association of the Instituto Superior Técnico for Research and Development, gathers 20 research units (recognized as Excellent by the Foundation for Science and Technology), representing over 650 integrated Ph.D. researchers and a multi-annual budget of €24.8 million allocated by the FCT. Through ITI/LARSyS, IST-ID has been coordinating and developing projects within the NEB framework, including the flagship project Bauhaus of the Seas Sails (http://bahaus-sea.eu). Bauhaus of the Seas is one of six European projects approved for funding and the only one coordinated by a Southern European country, aiming to contribute to climate neutrality, with a particular emphasis on coastal cities. In the context of the NEB, the project promotes community participation in an environmentally sustainable and socially just transition, focusing on climate neutrality, especially in coastal cities. The Lisbon NEB Lab brings together several interdisciplinary projects to: i) Use participatory design methods and tools and leverage interdisciplinary skills; ii) Create or replicate aesthetically pleasing, sustainable, and inclusive places, products, or experiences, or enable initiatives in that direction; iii) Provide practical, replicable results based on international and intersectoral partnerships; iv) Promote processes of change that benefit communities and ecosystems; v) Inform policy-making processes with its output, results, and lessons learned; vi) Offer open-source learning opportunities to community members where it operates.

In this context, the Lisbon NEB Lab outlined in the current project foresees the following activities:

<u>Research</u> – primarily interdisciplinary and experimental in nature, aligned with the principles of the NEB, and developed in an international context involving both the community and the academic sphere. As a result, it is socially and economically relevant and has a strong focus on sustainable, clean and nature based products and eco-friendly technologies.

**Innovation** – to create a unique space that meets the needs of companies and various social sectors, aiming to generate value and propose creative and disruptive solutions to contemporary challenges.



These solutions, guided by NEB values, should be sustainable, economically viable, aesthetically pleasing, and socially inclusive.

<u>Education</u> – implementation of study modules integrated into various undergraduate, master's, and PhD programs, as well as short-term executive training courses aimed at companies, professionals from diverse fields, and even the general public (including national and international citizens, without forgetting the Beato community, where the NEB Lab is located). In this regard, the Lisbon NEB Lab, which is a unique and strategic initiative for Portugal, and the most strategic EU goals, is fully aligned with the smart specialization strategy of the Lisbon region, contributing to and impacting various thematic and cross-cutting areas of specialization in distinct ways:

#### Strategic Axes tackling the Thematic Specialization Domains referred above:



<u>Agri-food sector</u>: Promotion of sustainable cultural practices (e.g., regenerative diets based on local ecosystems), integration of new sensor technologies and digital twins in production and supply chains, use of biomaterials as alternatives to materials currently used in different applications, and the involvement of communities in agri-food production and consumption systems. Relevance: Increase the value of the agri-food industry, reduce environmental impact, and promote eco-efficiency.



<u>Blue Economy</u>: Apply NEB principles to the challenges of coastal cities, promoting ecosystem services in the Tagus estuary, identifying invasive species for local diets, developing Industry 4.0 technologies for maritime and port uses, and improving communities' relationship with nearby aquatic ecosystems. Relevance: Contribute to circular logistics chains and new gastronomic and relational experiences, taking into account the specificities of the coastal environment of the region.



<u>Creative and Cultural Industries</u>: Integration of new technologies to enhance creative entrepreneurship, promote Design Thinking, and develop innovative, sustainable experiences. Relevance: Foster internationalization and eco-efficiency in creative industries, while promoting inclusion and equal opportunities.



<u>Mobility and Transportation</u>: Co-governance and co-creation models, use of AI, blockchain, digital twins to develop and test public policies, optimize traffic management, and improve the interaction between transportation and territory. Experimentation in robotics, autonomous vehicles, and bio-derived materials for energy conversion and storage. Relevance: Contribute to decarbonization, promote the circular economy, and enhance the efficiency of flows in the mobility of people and goods, while promoting advanced, sustainable technological solutions and competitive, efficient logistics chains.



<u>Tourism and Hospitality</u>: Focus on the inclusivity and sustainability dimensions of tourism, interconnecting with other domains (creative industries, blue economy, agri-food systems). Relevance: Enrich tourism content, improve mobility conditions, and elevate innovation and digitalization in the sector.



# 6.4 | Strategic Axes of Cross-cutting Specialization Domains:

**Digital Transition**: Bring together various research units from IST-ID working in digital technologies, with a special focus on Industry 4.0 (robotics, data, virtual/augmented reality, blockchain, IoT, digital chemistry, safer and smarter energy solutions and biobased technologies). Relevance: Strengthen open innovation, develop talent in digital skills, and apply these in the specialization domains.

<u>Higher Education</u>: Interdisciplinary concentration of laboratories and advanced training activities for the Beato innovation district, increasing competition and coordination between institutions and companies. Relevance: Attract, develop, and retain talent in the region, promoting an international network of researchers grounded locally and with strong connections to the business, entrepreneurship, and social sectors.

The Lisbon NEB Lab's contribution is particularly highlighted in disseminating the New European Bauhaus by creating a set of distinctive resources and capabilities to offer businesses and the community at large the ability to fulfill the goals of the European Green Deal.

With the creation of the Lisbon NEB Lab, the research units involved will help accelerate highly qualified talent and energize research and experimentation within the framework of the New European Bauhaus. The priorities will focus on leveraging infrastructures and to invest, among various initiatives, in the creation of experimental laboratories in areas such as digital manufacturing, experimentation with natural materials, circular economy, and autonomous robotics. This will foster a close connection between the academic and economic sectors, facilitating the exploration of specific applications for market introduction. As a result, this will create a significant impact on the local and national economy and enhance society's capacity for transitioning to new sustainability standards.

# 6.5 | SWOT Analysis relative to the PT research & innovation policy

# Strengths:

- Long term investment in energy production from renewable sources
- Well established and strong R&I capability and knowhow. Técnico and UL have a strong R&I capability in key areas for the development of this strategy, including energy storage and services, AI and environmental sciences.
- Strong alignment of the ULisboa RD&I priorities and existing national networks with the Portuguese priorities and regional specialization strategy
- Ongoing research and innovation projects with key industrial partners
- Strong corporate partnerships open to innovation projects tackling the green transition and decarbonization priorities.
- Excellent alignment with EU initiatives, namely the New European Bauhaus

#### Weaknesses:

- Cooperation processes between Academia and Industry still hampered by non-technical issues
- R&I capability in some areas would need more
- Lack of corporate / industry partnerships in some of th
   identified priorities (a.g., materials and regulation)
- Funding calendars and long-term strategic calls require
   long term planning and more stability

#### <u>Opportunities</u>:

- Funding available from the EU Recovery and Resilience Plan (RRP)
- Highly skilled personnel available. Técnico currently trains over 11000 engineering students among the best in the Country.
- Growing interest of corporate partners and openness to new innovation projects
- Good alignment of the research unit's strategy in ULisboa with the National and EU priorities

#### Threats:

- Short time available for use of RR
- Skilled personnel leaving the Country due to low salaries paid
- R&I funding often not stable over time or limited to pre-defined caps
- Difficulties on attracting talented researchers to tackle new research priorities that require stable funding

# 7 | CONCLUSIONS AND RECOMMENDATIONS

The goal of the present document is to gather all relevant information at EU and national level for the widening countries of PL and PT for the definition of strategic areas to invest in future activities within the Unite! Alliance. However, the definition of these areas and research topics should be based on an evidence-based, data-driven approach, which requires further analysis of the research capabilities and resources available at the participating institutions, and the potential for interaction and collaboration among them. This analysis will be performed in the remainder of activities in Work Package 2 in the Unite! Widening project. Some general remarks and preliminary conclusions can however be drawn, based on the presented data, documents and ensuing discussions, as detailed below.

# 7.1 | Conclusions from the Polish analysis

Some identified strategic areas for green transformation in the field of adaptation to climate change, requiring joint actions between scientists and the region (emerging from the roundtable debate "Science – Region, 26 June 2024 (Wrocław)):

- holistic thermal modernization based on interdisciplinary approach, combined with effective use of renewable energy sources
- improving the quality of space and strengthening the cultural context in activities from smaller to larger scale
- extended research showing the impact on the environment and savings (environmental and economic) for beneficiaries
- protection of rainwater and blue infrastructure
- expansion of green infrastructure, interdisciplinary activities related to parks and greenery in the city (Zero-waste urban parks), treating city parks as available model experimental spaces (Living-Labs)
- raising social awareness and social support for green transformation, joint applications for financing civic events (e.g. as part of the MI4ADAPT Climate Change Adaptation Mission project)
- ensuring that local development plans correctly take into account the availability of greenery, model green development
- scientific consulting for large businesses as part of the Excellence Hub

Problems and gaps in regulations and financing programmes that may hinder activities in the area of green transformation, especially in relation to regulations and programmes directly related to Poland as a country expanding its participation in research and development works ("widening country"), are:

- lack of a model enabling and supporting co-financing of adaptation activities by the private sector (such a model should be based on a properly conducted analysis of environmental benefits and effects)
- lack of hydrodynamic models (or fragmentary models available in selected cities) supporting cities and regions in the decision-making process regarding the location of green and blue infrastructure (e.g. issuing permits for rainwater basins)

 lengthy project preparation process resulting from, among others, the need to obtain building consent, long procedure for issuing building permits, burdensome and time-consuming procedures for obtaining environmental decisions

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• lack of support for startups developing innovations important for combating climate change and mitigating its effects, exclusion of startups from many activities due to the need to demonstrate previous experience resulting from the Public Procurement Act.

Policy recommendations resulting from identified problems and gaps regarding actions in the area of selected strategic priorities are:

- ✓ development and implementation of a model enabling and supporting co-financing of adaptation activities by the private sector (such a model should be based on a properly conducted analysis of environmental benefits and effects) – from the central level (ministry)
- ✓ launching a government program (as part of the KPO?) enabling the development of hydrodynamic models supporting cities and regions in the decision-making process regarding the location of green and blue infrastructure (e.g. issuing permits for rainwater basins)
- ✓ shortening and simplifying the project preparation process suggesting a special path for adaptation projects enabling, among other things, the implementation of projects without prior construction consent, accelerated procedure for issuing construction permits, exemption from the procedures for obtaining environmental decisions or significant acceleration of these procedures under the "climate adaptation fast track" path
- ✓ effective support for start-ups developing innovations that are important for combating climate change and mitigating its effects (e.g. by repealing the requirement resulting from the Public Procurement Act to demonstrate previous experience by start-ups applying for the opportunity to test their innovative solutions in cities).

Some identified gaps in research framework programmes are:

- A shortage of strategic programmes that would allow the alliance to fully respond to the key societal challenges expressed through the 5 EU Missions and the New European Bauhaus Facility, especially in the widening countries.
- The need to build synergies between the 5 EU Missions and the New European Bauhaus Facility, while creating strong cooperation between researchers, European university networks (such as UNITE!), regions, central and local governments and the European Commission.
- Joint actions should accelerate and streamline the implementation of the EU Missions and the overall transformation of the built environment in line with the values of the New European Bauhaus.
- Priorities such as combating climate change and mitigating its effects, preserving key resources such as clean oceans and inland waters, fertile soil, a healthy ecosystem, healthy and inclusive European society, living in safe and beautiful natural and cultural environment, require coherent actions supported by adequate financial instruments.

Currently developed Horizon Europe Work Programmes and the initiatives undertaken by the European Commission, such as the New European Bauhaus, clearly indicate the need to ensure synergy in addressing the EU society priorities. These priorities are expressed by the 5 EU Missions and their objectives. The research carried out during the implementation of the task has shown that there is a need to extend the knowledge about the 5 EU Missions and the NEB Facility, especially in the Widening



Countries. The UNITE! university network can and should support deepening of this knowledge and take advantage of the new opportunities for applying for projects under the NEB and Mission calls. For the Widening Countries, expanding participation in Research and Innovation programmes requires joint, interdisciplinary action, connecting in a transformative way the priorities of the EU Missions. A holistic perception of human health and well-being combined with environmental safety, climate change mitigation and adaption to this change will bring invaluable benefits to European society, but it requires synergetic actions in the area of the built environment, healthy soil and clean water. The role and task of universities is to provide support in these areas. To pave the way for these actions, the first European hub of 5 EU Missions and the NEB Facility in the UNITE! Network could be created. The hub should be prepared to contribute to Coordination and Support Action at the EU level by connecting researchers, municipalities, regional and local governments, SMEs, industries and other relevant actors. UNITE! has already developed instruments to support researchers and IRIS network can offer the know-how and experience in this field. WrocławTECH has taken the first steps towards such 5 EU Missions hub starting from such initiatives as Smart City hub, New European Bauhaus Pioneering hub, River Research Center acting together in strong cooperation with Wrocław Municipality, Polish Ministry of Climate and Environment and the European Commission (DG Clima). This fruitful cooperation resulted in joint organization of the 4th Forum of the EU Mission Adaptation to climate change in May 2025 in WrocławTECH, during the Polish presidency of the EU. Such a cooperation model can become exemplary to other widening countries and could likely result in multiple research proposals and further successful projects.

# 7.2 | Conclusions from the Portuguese analysis

Portugal's strategy for fostering R&I ecosystems in the energy and digital transition sectors is wellaligned with European policy frameworks, particularly through ENEI 2030. The national strategy emphasizes decarbonization, technological innovation, digital solutions and collaboration across public and private sectors. By continuing to align its policies with European goals and leveraging international funding opportunities, Portugal is well-positioned to be a key player in the EU energy transition. The future of national research and innovation in the green transition demands a long-term, systemic, and multidisciplinary approach at various scales—local, regional, and national. This approach should incorporate living labs to simulate diverse scenarios, along with pilot projects designed to foster crosssectoral collaboration and generate wide-reaching impacts.

Key challenges for national R&I in this domain include:

- Strengthening cross-sectoral cooperation in key sectors spanning from clean energy to digital transition and sustainable and ecologically conscious technologies to combat climate changes, to preserve oceans and water, to meet the decarbonization goals and accelerate innovation;
- Ensuring coordination between multiple governmental bodies and fostering partnerships between public and private sectors leading to common strategic agendas and more efficient use of funding instruments;
- ✓ Creating innovative forms of interdisciplinary partnerships, promoting closer interactions between different actors in the system and by allocating joint funding to address common research challenges
- ✓ Stimulating new communication and mobilization strategies tailored to different audiences;



- ✓ Increasing investment in education, infrastructure, researcher training, capacity-building and talent retention
- ✓ Developing new governance frameworks for risk management and dissemination that encourage public participation in co-creating adaptation and mitigation strategies;
- ✓ Promote the conditions that allow businesses to enable new opportunities for business and knowledge anchored innovation.

Alongside these challenges, several critical factors have been identified as essential to achieving the vision and goals of the current agendas. These include: a) enhancing scientific network collaborations; b) investing in world-class scientific infrastructures; c) fostering a well-qualified workforce; d) improving management and data-sharing processes; e) ensuring flexible financial mechanisms adapted to R&I needs; f) creating stronger interfaces between academia, industry, and public policy; and g) promoting education and capacity-building across all sectors of society.

The complexity of R&I in the green transition arises not only from the broad range of scientific fields involved but also from the need for interdisciplinary and intersectoral cooperation to deepen theoretical knowledge and refine shared analytical methods. The successful implementation of the green transition agenda will enhance decision-making in international negotiations, strengthening Portugal's position by advancing its R&D objectives and reinforcing its role in the global green transition.

### 7.3 | Overall conclusions

In terms of scientific strategic areas, a preliminary analysis of the main areas of competence and collaboration within the Unite! Alliance have highlighted the possibility of extending the current focus areas to other fields in Computer Science, Physics, Materials science, and Medicine. All of these research fields can contribute to EU priority areas linked to climate resilience and the Green transition and could potentially be supported by existing research infrastructure at Unite! Partner universities. These fields should be defined more in detail in future analysis leading to milestone ML2.2 (Definition of PL/PT Strategic Areas).

In terms of general strategy, conclusions from the analysis of EU and national documents and by both widening partners highlight the importance of regulatory reform, funding models, and partnerships to achieve meaningful progress in climate resilience and the green transition, identified as macro-research areas. These include:

- Holistic and Cross-Sectoral Adaptation Efforts: Effective climate adaptation requires a combined focus on thermal modernization, renewable energy, blue and green infrastructure, and public spaces as living labs to promote resilience and sustainability in urban areas.
- Streamlined Regulations and Private Sector Involvement: Simplifying adaptation project approvals and enabling co-financing models for private sector contributions would support more rapid green transitions.
- Increased Research and Innovation Support: Supporting start-ups and bridging regulatory gaps would accelerate green innovation, while stronger interdisciplinary R&D networks and pilot projects would foster adaptation.



- Enhanced Collaboration Across EU Frameworks: Coordination between EU Missions, national strategies, and programs like the New European Bauhaus is vital for effective climate action, requiring synergies among researchers, universities, governments, and local bodies.
- Investment in Education, Communication, and Talent Development: Fostering public awareness, training, and talent retention is crucial for sustainable R&I ecosystems, helping to build a skilled workforce and enhance public involvement in adaptation efforts.



# **APPENDIXES**

Call Identifier	Call Title	Description	Relevant for Green Transition Areas
HORIZON-MISS-2023-	Testing and	Proiects to increase	Climate Resilience.
CLIMA-01-01	Demonstrating	climate resilience in	Sustainable
	Transformative	agriculture and	Agriculture, Forestry
	Solutions for Climate	forestry, using nature-	<i>, ,</i>
	Resilience in	based and other	
	Agriculture and	innovative solutions.	
	Forestry		
HORIZON-MISS-2023-	Protecting Critical	Focuses on developing	Climate Resilience,
CLIMA-01-02	Infrastructure from	and demonstrating	Infrastructure
	Climate Change	solutions to protect	Protection
		critical infrastructure	
		against climate	
		impacts,	
		mainstreaming	
		nature-based	
	Puilding Posilionco	Solutions.	Dublic Hoalth Climato
	Towards Health Risks	strategies and	Resilience
CLIMA-01-03	Caused by Climate	solutions to address	Resilience
	Change	health risks related to	
	chunge	climate change	
		impacts.	
HORIZON-MISS-2023-	Actions for the	Various calls under	Marine and
OCEAN-01-01 to -01-	Restoration of Marine	this identifier focus on	Freshwater
11	and Freshwater	protecting and	Ecosystems,
	Ecosystems	restoring the health of	Biodiversity
		marine and freshwater	
		ecosystems,	
		promoting biodiversity	
		and sustainable use of	
	Custainable and	marine resources.	
HURIZUN-IVIISS-2024-	Sustainable and	Calls related to	Blue Economy,
OCEAN-01-01 to -01-	Circular Blue Economy	promoting a	Sustainability,
05			CONSELVATION
		includes innovative	
		approaches to marine	
		and maritime activities	
		that ensure	
		conservation and	
		sustainable use of	
		ocean resources	

Appendix 1: List of past calls of interest (2023-2024) for the Topic Green Transition



HORIZON-MISS-2023-	Support for Climate-	Initiatives to develop	Smart Cities, Urban
CIT-01-01 to -01-04	Neutral and Smart	and implement	Sustainability
	Cities by 2030	solutions for	
		sustainable urban	
		development,	
		including zero-	
		emission mobility,	
		positive energy	
		districts, and	
		integrated urban	
		planning.	
HORIZON-MISS-2023-	Innovations for Soil	Focuses on developing	Soil Health,
SOIL-01-01 to -01-09	Health	solutions for	Sustainable Land Use
		sustainable soil	
		management,	
		enhancing soil health,	
		and combating land	
		degradation, which	
		are crucial for	
		sustainable agriculture	
		and ecosystem	
		services.	



#### Appendix 2: Possible research areas to be addressed by projects focusing on green transition

#### Healthy oceans, seas, coastal and inland waters;

#### I. Water Quality Improvement Projects:

develop and implement measures to improve the quality of rivers and freshwater bodies, including:

- 1. reducing pollution from sources such as agriculture, industry, and urban runoff,
- implementing stricter regulations and monitoring mechanisms to prevent pollution and ensure compliance with water quality standards set by the EU's Water Framework Directive.

#### II. Biodiversity Protection Projects:

protect and restore the biodiversity of rivers and freshwater ecosystems by preserving natural habitats, restoring degraded areas, and enhancing connectivity between different river systems; including:

- 1. implementing measures to remove barriers to fish migration,
- 2. restoring riparian vegetation,
- 3. creating protected areas along river corridors.

#### III. Flood Risk Management Projects:

develop strategies and infrastructure to manage flood risks and enhance resilience to climate change impacts in riverine areas, involving:

- 1. implementing nature-based solutions such as restoring wetlands and floodplains,
- 2. developing and implementing flood protection measures such as levees, floodwalls, and stormwater management systems.

#### IV. Sustainable Water Use Projects:

developing and promoting sustainable water use practices to ensure the long-term availability of freshwater resources; including:

- 1. developing and implementing water efficiency measures in industry and urban areas,
- 2. promoting measures to reduce water abstraction and optimize water allocation in river basins.

#### V. Integrated River Basin Management Projects:

developing integrated river basin management approaches to coordinate actions and decision-making across different sectors and administrative levels, involving:

 engaging stakeholders, including local communities, water users, and authorities, in participatory planning processes to develop and implement river basin management plans that address environmental, social, and economic objectives.

#### VI. Circular Economy in Water Management Projects:

promoting circular economy principles in water management to minimize waste and maximize resource efficiency; including:



- 1. implementing measures to promote water reuse and recycling,
- 2. recovering energy and nutrients from wastewater.

#### VII. International Cooperation Projects:

strengthen international cooperation and coordination on river basin management and transboundary water issues; involving:

- 1. collaborating with neighboring countries to address common challenges and promote sustainable use of shared water resources,
- 2. creating shared water management practices.

#### Climate-neutral and smart cities;

#### VIII. Green Building and Infrastructure Projects:

collaborate on projects to design and construct green buildings and sustainable infrastructure that minimize energy consumption, reduce carbon emissions, and enhance environmental performance; this project could include:

- 1. researching and implementing green building standards,
- 2. developing innovative construction materials and technologies,
- 3. retrofitting existing buildings to improve energy efficiency and indoor environmental quality, including upgrading insulation, installing energy-efficient lighting and HVAC systems, and optimizing building management systems to monitor and control energy usage more effectively,
- 4. regeneration of the built environment for the decrease of resource consumption,
- 5. revitalization of buildings and urban spaces:
- 6. energy renovation of buildings;
- 7. post obsolescence repurposing of historic buildings;
- 8. designing and implementing photovoltaic cell use on smart buildings to offset energy consumption from traditional fossil fuel sources,
- 9. increase of biologically active areas in urban and functional areas and limiting soil sealing;
- 10. increasing the energy efficiency of open spaces and non-residential buildings by developing and implementing energy-saving lighting technologies for roads, public buildings and public spaces; (Wydział Elektryczny; Faculty of Electrical Engineering)

11. increase in the use of renewable energy sources in the city,

In accordance with: ERA Action 11; ERA Action 13; ERA Action 14;

#### IX. Sustainable Urban Mobility Projects:

develop and implement sustainable urban mobility solutions to reduce carbon emissions and alleviate traffic congestion; this project could include :

- 1. designing and testing electric vehicles to increase the share of zero-emission public transport,
- developing smart transportation infrastructure (including the application of ICT solutions and electronic services optimization) to enhance traffic flow, improve public transport performance and reduce environmental impacts of urban public transport,



- 3. promoting public transportation systems, (Wydział Inżynierii Środowiska; Faculty of Environmental Engineering)
- implementing bike-sharing programs for university staff and students, including the design of accompanying infrastructure: bike lanes, vehicles, parkings,(Wydział Budownictwa Lądowego i Wodnego; Faculty of Civil Engineering)
- creating safe and green infrastructure for vulnerable road users (e.g. construction of pedestrian streets, expanding bike lanes, woonerfs, reconstruction or change of traffic organization in front of educational institutions, reconstruction of places where accidents often occur); (Wydział Budownictwa Lądowego i Wodnego; Faculty of Civil Engineering)
- 6. development of zero-emission transport infrastructure (pedestrian, bicycle) integrated with public transport through creating preferences for pedestrian and bicycle traffic, including the construction of coherent networks of bicycle paths and lanes in cities and their functional areas, along with bicycle parking lots;(Wydział Budownictwa Lądowego i Wodnego; Faculty of Civil Engineering)

In accordance with: ERA Action 11; ERA Action 13; ERA Action 14;

#### Climate adaptation,

#### X. Climate Change Adaptation and Resilience Projects:

develop projects aimed at enhancing climate change adaptation and resilience in vulnerable communities; this project could include:

- 1. conducting research on climate change impacts,
- developing adaptation strategies and technologies to implement community-based resilience-building initiatives such as green infrastructure development, flood management and disaster preparedness planning,
- 3. urban design for distributed energy systems and energy communities; (energy cooperatives in the form of smart districts)
- 4. education and raising citizens' awareness about the need for green transformation of cities towards climate neutrality in terms of adaptation to climate change,
- 5. educating and raising citizens' awareness about the need to transform cities towards climate neutrality in terms of adaptation to climate change; (Wydział Inżynierii Środowiska; Faculty of Environmental Engineering)

Past Mission calls (launched on 18<sup>th</sup> April 2024):

- HORIZON-MISS-2024-CLIMA-01-01 : Bringing available and actionable solutions for climate adaptation to the knowledge of the regions and local authorities
- HORIZON-MISS-2024-CLIMA-01-02 : Bringing together the national level with the engaged regional and local levels (multi-level governance)
- HORIZON-MISS-2024-CLIMA-01-03 : Develop and refine outcome indicators to measure progress on climate resilience at national, regional and local levels, including knowledge and feedback developed from the Mission

• HORIZON-MISS-2024-CLIMA-01-04 Research the complex interplay between the climate and biodiversity crises towards more systemic approaches and solutions

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- HORIZON-MISS-2024-CLIMA-01-05 : Improve design for transformative approaches and build local capacity for implementation of available solutions focused on climate adaptation
- HORIZON-MISS-2024-CLIMA-01-06: Demonstration of approaches to improve bankability of solutions by design, addressing the co-benefits (mitigation and adaptation) to improve revenues streams
- HORIZON-MISS-2024-CLIMA-01-07 : Demonstration of solutions specifically suited to rural areas and small/ medium size population local communities
- HORIZON-MISS-2024-CLIMA-01-08 : Demonstration of approaches by regions and local authorities focused on increasing climate resilience of the most vulnerable social groups (just climate resilience)
- HORIZON-MISS-2024-CLIMA-01-09 : Systemic and cross-sectoral solutions for climate resilience, tailored to the local needs of regions and local authorities.

The closing date for all calls is 18 September 2024.

The research areas to be considered for joint activities include:

#### - Cross-cutting research on climate adaptation/biodiversity/climate resilience

In accordance with: ERA EOSC Action ; ERA Action 10; ERA Action 11; ERA Action 12; ERA Action 13; ERA Action 14;

#### XI. Circular Economy Projects:

launch a circular economy program, this project could include:

- 1. induction strategies for waste reduction, recycling, and upcycling,
- 2. developing and promoting sustainable product design principles and business models that prioritize longevity and resource conservation.

In accordance with: ERA Action 11; ERA Action 13; ERA Action 14;

#### XII. Biodiversity Conservation and Ecosystem Restoration Projects:

undertake projects to protect and restore natural ecosystems, conserve biodiversity, and promote sustainable land management practices; this project could involve:

- 1. conducting biodiversity surveys,
- 2. restoring degraded habitats,
- 3. implementing sustainable land-use planning initiatives,
- 4. initiating conservation efforts,
- 5. promoting and designing investments using nature-based solutions (NBS) with associated means of boosting vegetation biodiversity,



 sustainable rainwater management systems including green-blue infrastructure and nature-based solutions; (Wydział Inżynierii Środowiska; Faculty of Environmental Engineering)

In accordance with: ERA Action 11; ERA Action 13; ERA Action 14;

#### XIII. Partnerships with Industry and Government:

collaborate with industry partners, government agencies, and non-profit organizations to advance sustainability initiatives both on campus and in the broader academic community; this project could involve:

- 1. participating in joint research projects,
- 2. sharing best practices,
- 3. advocating for policies that support the green transition and sustainable development goals.

In accordance with: ERA Action 7; ERA Action 11; ERA Action 12; ERA Action 16; Soil health and food;

#### XIV. Sustainable Agriculture and Food Systems Projects:

work on projects to promote sustainable agriculture practices and improve food security while minimizing environmental impacts; this project could involve:

- researching and implementing agroecological farming methods and regenerative agriculture: improving soil health, reducing chemical inputs, promoting biodiversity, and enhancing resilience to climate change, supporting the development of innovative fertilizing technologies and practices,
- promoting organic farming practices, supporting smallholder farmers, and developing sustainable food supply chains that prioritize local sourcing and reduce food waste,
- 3. promoting and establishing urban agriculture initiatives,
- 4. facilitating community-supported agriculture (CSA) by designing and promoting partnerships between local farmers and institutions,
- develop educational programs and awareness campaigns to promote nutrition education, healthy and sustainable diets among students, faculty, and in result broader community, (Wydział Medyczny, Wydział Inżynierii Środowiska; Faculty of Medicine, Faculty of Environmental Engineering)

In accordance with: ERA Action 11; ERA Action 13; ERA Action 14;

#### Opening soon: Destination New European Bauhaus calls

With a budget of €20 million, the Destination New European Bauhaus will lay the groundwork for the implementation of the New European Bauhaus Facility 2025-2027. It has been included in the amended Horizon European Work Programme 2023-2025. Three calls have already been published with an opening date of 7 May 2024

- ✓ Exploiting the potential of secondary bio-based products
- ✓ Accelerate digital transition



- ✓ New governance models for the co-design and co-construction of public spaces in neighbourhoods by communities
- ✓ Setting up a New European Bauhaus hub for results and impact

LIFE Calls LIFE - European Commission (europa.eu)

Nature and Biodiversity

Circular Economy and Quality of Life

Climate Change Mitigation and Adaptation

**Clean Energy Transition** 

#### According to Directorate-General for Structural Reform Support brochure<sup>2</sup>:

#### Technical support for implementing the European Green Deal, green transition is:

- Supporting land use and forestry management, including urban planning, SMART cities and forestry accounting and inventory. **SMART CITIES**, **URBAN AGRICULTURE**
- Developing nature-based solutions to address heat waves, drought, flooding and poor air quality in urban areas. **NATURE-BASED SOLUTIONS**
- Enhancing energy efficiency investments in buildings.
- Fostering digital education and skills.

<sup>&</sup>lt;sup>2</sup><u>https://reform-support.ec.europa.eu/document/download/e94ce3c2-f4aa-4e14-bfed-9d3fa06402d5\_en?filename=2020.2329-final-web.pdf</u>

#### Appendix 3: Portuguese strategy tables

Strategic Area	Description	Green Transition Focus	Digital Transition Focus
Renewable Energy	Research and innovation in solar, wind, marine, and biomass energy production technologies.	Decarbonization, energy sovereignty, and increasing renewable capacity.	Digitalization of renewable energy production through smart grid systems.
Energy Efficiency	Development of energy-efficient technologies for buildings, industry, and transport sectors.	Reducing energy consumption and promoting energy savings in key sectors.	AI and IoT to optimize energy usage and improve operational efficiencies.
Energy Storage	Innovations in storage technologies to manage renewable energy supply and demand variability.	Critical for integrating intermittent renewable energy into the grid.	Advanced digital systems for real- time management of energy storage.
Hydrogen Economy	Development of green hydrogen technologies and production infrastructure.	Supports decarbonization of hard-to-abate sectors like heavy industry.	AI-powered optimization of hydrogen production and distribution networks.
Circular Economy	Innovation in the reuse, recycling, and reduction of waste, especially in energy systems.	Reducing environmental impact through resource optimization.	Digital platforms for tracking and optimizing material flows in energy.
Smart Mobility	Electrification of transportation, development of EVs, and smart urban mobility solutions.	Reducing transport emissions and promoting sustainable urban development.	Data analytics, AI, and IoT to optimize EV charging networks and traffic.
Smart Grids	Digitalized grids that integrate renewable	Enabling efficient renewable energy	AI, big data, and IoT for real-time

# Smart Specialization Strategy in Portugal (National Level)



	energy sources and optimize electricity distribution.	integration and reducing emissions.	monitoring and predictive management.
Sustainable Agriculture	Innovative solutions for reducing the environmental impact of agriculture and food production.	Reducing carbon footprint and promoting sustainable practices.	Digital farming solutions (AI, sensors, drones) for precision agriculture.
Industrial Digitalization	Integration of digital tools in industrial processes to improve energy efficiency and reduce waste.	Reducing energy consumption in the industrial sector.	AI, robotics, and automation to optimize industrial processes.

# Smart Specialization Strategy in Lisbon (Regional Level)

Strategic	Description	Green Transition	Digital Transition
Area		Focus	Focus
Urban Mobility & Smart Cities	Development of sustainable urban mobility solutions, including electric vehicles and public transport.	Reducing urban pollution, CO2 emissions, and improving public transport systems.	AI and IoT-driven traffic management systems, smart parking, and EV networks.
Sustainable Tourism	Implementing sustainable practices in the tourism industry, focusing on environmental conservation.	Reducing the carbon footprint of tourism and promoting eco- friendly solutions.	Digital tools for monitoring tourist impact and optimizing resource use.
Energy- Efficient Buildings	Innovations in green construction, energy- saving technologies for buildings, and retrofitting.	Improving energy efficiency in urban development and reducing emissions.	Smart building systems using IoT and AI for energy monitoring and control.
Digital Health	Integration of digital technologies in healthcare to promote	Reducing environmental impacts of healthcare	AI and big data for personalized health



	sustainability and efficiency.	(e.g., waste management).	solutions and efficient services.
Creative and Cultural Industries	Fostering digital innovation in creative sectors while promoting sustainable practices.	Encouraging sustainable production and consumption of cultural content.	Digital platforms and AI tools to expand creative industries sustainably.
Smart Waste Management	Digitalization of waste management systems to optimize recycling, reuse, and resource recovery.	Promoting circular economy and reducing waste in urban environments.	Smart sensors and AI-powered systems for waste collection and recycling.
Energy Innovation Hubs	Development of innovation hubs to foster research and innovation in green and digital technologies.	Supporting green startups and sustainable innovation ecosystems.	Digital innovation hubs for AI, blockchain, and data analytics in energy.