**INVEST FOR EXCELLENCE IN REGIONAL SUSTAINABILITY: TACKLING CLIMATE CHANGE CHALLENGES IN A TRANSDICIPLINARY PERSPECTIVE**

***A project presentation***

Mariana Ivanova1, Ekaterina Arabska1, Nazan Arifolgu Sen1,2, Rik Eweg3, Omiros Iatrellis4, Liisa Timonen5, Drahoslav Lančarič6, Martin Valach6

1 University of agribusiness and rural development, Plovdiv, Bulgaria

2 Çanakkale Onsekiz Mart University, Çanakkale, Turkey

3 Van Hall Larenstein University of Applied Sciences, the Netherlands

4 University of Thessaly, Greece

5 Karelia University of Applied Sciences, Finland

6 Slovak University of Agriculture, Nitra, Slovakia

**Abstract:** INnoVations of REgional Sustainability: European UniversiTy Alliance – INVEST unites partners of different European regions supporting the idea that higher education and science have a leading role in sustainable development. The application of the concept of Living labs by the alliance provides opportunities for establishment of innovative learning environments in combination with a new vision on regional transitions oriented towards diversity of actions focused on transdisciplinary approaches, innovation and knowledge sharing for achieving sustainability in European regions. INVEST Focal points, identified as: 1) Water, energy, food and environment; 2) Quality of life and 3) Entrepreneurship, include sustainability fields addressing the most pressing global challenges linked to and with a special accent on climate change, adaptation and mitigation. These are implied in INVEST Regional Living labs knowledge agendas as the basis for strengthening partnerships and working for synergy in innovation and sustainability. A new model for institutional transformation, European Innovation Ecosystem for Academia-Business and Society, capacity building tools and the I‑EDUC8EU tool for engagement of the main actors in the regions are among the main deliverables of INVEST4EXCELLENCE project funded by European Union’s Horizon 2020 research and innovation programme. The current paper presents the Living lab approach applied in the project paying a special attention on the development and implementation of research and innovation ideas for regional sustainability, capacity building and community development. Outlining the impacts of climate change and shared visions on sustainable societies and economies in European regions, INVEST Regional Living labs are functioning as open innovation platforms for collaboration facilitating quadruple helix partnerships for open innovation and sustainable future benefiting the latest achievements of modern information and communication technology.

**Keywords:** sustainable development, higher education institutions (HEIs), research and innovation (R&I).

**INVEST for Excellence in Regional Sustainability**

INVEST4EXCELLENCE is a project financed by Horizon 2020 (Work Programme 2018 – 2020 Science with and for Society, Action: 33. Support for the Research and Innovation Dimension of European Universities) and it is implemented by the INVEST partner universities:

* Slovak University of Agriculture in Nitra, Slovakia (SUA);
* University of Agribusiness and Rural Development, Bulgaria (UARD);
* University of Thessaly, Greece (UTH);
* Karelia University of Applied Sciences, Finland (Karelia UAS);
* Van Hall Larenstein University of Applied Sciences, Netherlands (VHL).

The thematic focus of INVEST alliance, put on sustainable regional development, considers three focal points[[1]](#footnote-1):

***Focal point A: Water, Energy Food and Environment Nexus***

* Climate proof Regional Development
* Sustainable, smart Agriculture,
* Aquaculture
* Food security
* Food safety
* Water resources management
* Energy transition,
* Green energies
* Natural and cultural heritage

***Focal point B: Quality of Life***

* Education and capacity building
* Urban-rural relationship
* Inter-European citizenship
* Ensuring and quality of public services

***Focal point C: Entrepreneurship***

* Ensuring and quality of public services
* Circular-/ Bio-Based Economy
* Job creation and human capital management
* New business models and smart technologies
* Regional sustainability driven capitalism and bio-based industries

Emphasis in the work methodology of INVEST4EXCELLENCE is put on the preservation of complementarity and coherence between these focal areas and the SDGs determined and selected by the Alliance in the INVEST project. Selection of the SDGs is perceived as the response to the needs and requirements of the new generation of Europeans as the leaders in introducing the sustainable life in regions across Europe. The young generation will carry the burden of actual global challenges, such as ending the hunger, dealing with pandemic threats to food supply chains, ensuring healthy lives and well-being, inclusive and equitable quality education and promoting lifelong learning, sustainable management of water and sanitation, inclusive, safe, resilient and sustainable cities, combat climate change, or sustainable use of ocean and land resources. These challenges are decisive indicators for the Alliance in the selection of the specific SDGs to be addressed – Zero Hunger (SDG02), Good Health and well-Being (SDG03), Quality Education (SDG04), Clean Water and Sanitation (SDG06), Sustainable Cities and Communities (SDG11), Climate Action (SDG13), Life below Water (SDG14), and Life on Land (SDG15)[[2]](#footnote-2).

INVEST strategic priorities are:

* Enhancing the high quality of education including through the use of challenge-based and transdisciplinary approaches, and through innovative pedagogical models in order to develop forward-looking skills and competences, making best use of digital technologies, blended learning and work-based learning;
* Strengthening the links between education and research and/or innovation, including the integration of research results and/or innovation into education;
* Increasing mobility of students, staff and researchers - physical, virtual, blended; short and long term;
* Strengthening engagement with key stakeholders to foster societal engagement of students and staff as well as their entrepreneurial key competences;
* Improving the involvement of local community;
* Ensuring the social diversity of the student body and promoting the access, participation and completion of under-represented and disadvantaged groups.

The main aim of INVEST4EXCELLENCE is to develop an integrated and long-term joint strategy on research and innovation in line with the education strategies from the INVEST EU University Alliance[[3]](#footnote-3).

The specific aims of INVEST4EXCELLENCE are:

* Specific aim 1: To develop and implement the INVEST4EXCELLENCE model for institutional transformation at research and innovation dimension
* Specific aim 2: To develop INVEST4EXCELLENCE European Innovation Ecosystem for Academia-Business & Society
* Specific aim 3: To develop INVEST4EXCELLENCE Capacity Building Tools
* Specific aim 4: To implement and promote the I-EDUC8EU tool
* Specific aim 5: To set up well-functioning group of stakeholders

INVEST4EXCELLENCE will:

* Develop the first international education academic tool (called I-EDUC8EU);
* Stimulate higher education by applying innovative virtual academic advising models;
* Represent a breakthrough framework in the area regional ecological sustainability related to the European urban and rural development;
* Be based on some of the most cutting-edge technology in the area of education, artificial intelligence and human-computer interaction.

INVEST4EXCELLENCE Methodology described in fig. 1 includes four major elements.



Fig. 1. INVEST4EXCELLENCE Methodology

*1. Institutional transformation at Research and Innovation Dimension*

The model for institutional transformation will serve as a long-term tool for integrated, systematic, structural and sustainable impact at the various levels and areas of activities in partner universities based on their strengths and potentials for synergies.

*2. European Innovation Ecosystem*

A set of measures was aimed to connect INVEST Regional Living Labs to the European Innovation Ecosystem focusing on a common approach towards quadruple helix.

*3. Capacity Building*

The project identified key competences and skills for capacity development in sustainable supply chains, is developing training tools to mainstream the open science practices and to provide trainings for various target groups including non-academic (stakeholders).

*4. Dissemination*

INVEST uses strategic communication tools that will deliver the deployment of a large-scale promotion and dissemination campaigns ensuring a widespread of INVEST research and development results and impact.

INVEST4EXCELLENCE is equipped with several key enabling educational and digital technologies (e.g. Living Labs, EDUC8EU-system, machine learning, digital twins’ paradigms and artificial intelligence (AI)) that can optimize all aspects of research and innovation promoted by the INVEST Alliance, especially towards the regional sustainability thematic area.

**Institutional transformation at research and innovation for sustainable development**

Sustainable development appears to be one of the biggest challenges of the 21st century. Sustainability is an issue mostly driven up by the envisioning of the negative effects of natural resources exploitation and negative impacts on global environment. While the concern towards saving environment and sustainability in higher education has started even in early 1970s (Alghamdi et al., 2017), models for sustainable development of higher education institutions have been considered since 1990s (Weenen, 2000). Models for sustainable development of higher educational institutions have been investigated in different regions and from different aspects. Weenen (2000) focused mainly on the importance of university’s mission, research, education and operation activities in order to develop sustainable institutions. On the other hand, Velazquez et al. (2006) developed a sustainability model composed of 4 main phases: defining vision statement; formulating mission statement; establishing a sustainability committee for creating policies, targets and objectives; and developing sustainability strategies at education, research, outreach and partnership and campus sustainability dimensions. Aleixo et al. (2018) investigated the sustainability practices in Portuguese HEIs at economic, social, environmental and institutional dimensions through research mainly including the decision-makers of the institutions. Alghamdi et al. (2017), reviewed 12 assessment tools of HEIs sustainability and concluded that they have similar traits in terms of criteria, sub-criteria and indicators, with the main criteria being management, academia, environment, engagement, innovation. Casarejos et al. (2017) proposed 40 strategic actions at administrative, social and cultural, academic and operational dimensions to achieve sustainability of HEIs. Cheben et al. (2020) focused on the economic sustainability of HEIs and structured the main determinants to be used in the evaluation process. More recently, Medne et al. (2022) analysed the challenges when developing sustainability strategy of university by applying the PESTLE analysis to determine the external factors having impact on the institutions’ decisions. Winkler et al. (2022) mapped the social structure for sustainability transformation, while groups mainly active at the university campus from 6 domains (research, education, administration, operations, connectivity and students) were involved in the survey, but still no stakeholder from outside of the institution was included in the research. A comprehensive analysis of the drivers and barriers to organizational change during integration of sustainability in HEIs in the areas of internal structure of the institution, external factors to the institution, stakeholders, institutional framework and resources, was provided by Blanco-Portela et al. (2017). Nowadays, the emerging need to structure, implement and evaluate the HEIs actions towards sustainability in terms of research and innovation requires a more holistic approach. Not only the decision-makers of the respective institution, but also other stakeholders should have to be involved in the development process of sustainability strategies. Higher education institutions are the drivers of sustainable development at regional, national, international and global levels.

In line with the Sustainable Development Goals (SDGs) of the UN, as well as to become more competitive in the ever changing circumstances, higher education institutions (HEIs) are thriving to transform in research and innovation in order to achieve sustainable development. The ecosystem in which a university is found, as well as the expectations of all stakeholders are changing continuously. Driven by the political, economic, socio-cultural, technological, legal and environmental issues of the 21st century, HEIs have not only to cope with the arising challenges, but they are also obliged to transform and adapt to the new circumstances in a sustainable way.

Based on the need to evaluate all factors affecting the sustainable development of HEIs, a model for institutional transformation at research and innovation will be developed. This model will be used as a long-term tool to evaluate the integrated, systematic, structural and sustainable impact at different levels and areas of the activities of the partner HEIs and will be the basis for the further improvements of the INVEST4EXCELLENCE Alliance members. In the process of transformation at research and innovation towards sustainable development, the current situation of the partner HEIs will be analysed by pointing out the strengths, potentials and opportunities of the Alliance members based on the involvement of all stakeholders via the quadruple helix approach. The needs and reflections of the stakeholders are key factors that will be assessed and further through strategic planning, the sequence of decisions will be evaluated. Accordingly, the major external factors that may have an impact on the HEIs will be analysed. Afterwards, gap analysis / needs assessment methodology will be applied to compare and determine the specific internal deficiencies. The action plan will include cost-benefit analysis that will evaluate the benefits of taking actions towards institutional transformation at research and innovation for sustainable development across the Alliance members. During the implementation phases of the model for institutional transformation, the activities of the partner HEIs will be overviewed through case studies of good practices for analyzing the specific issues concerning the transformation at research and innovation, involving especially research and innovation activities with regards to climate change challenges. The follow-up and continuous assessment of the institutional transformation at research and innovation for sustainable development of the Alliance partners will be assessed by determined key performance indicators.

**INVEST Regional Living labs**

In the INVEST Alliance Living Labs are considered as *‘transition pathways requiring a transdisciplinary positioning and sharing of experiences in an open and collegial manner by involved knowledge institutions, to ensure further insights on the Living Lab approach in the context of regional sustainable development and the role of Higher Education’*.

The position paper on exploring a transdisciplinary view on the INVEST Living Lab approach called “The transition towards regional sustainable futures”[[4]](#footnote-4) accepts the four design principles[[5]](#footnote-5):

* Fostering inclusive quadruple helix participation;
* Creating authentic learning environments that focus on a sustainable future;
* Stimulating reflexivity in learning and innovation for sustainability;
* Facilitating interaction, knowledge sharing and open system management.

Considering the Obama’s statement *“we are the first generation to feel the effect of climate change and the last generation who can do something about”,* this position paper makes it clear that this is not just a slogan in the INVEST project and a kind of motivation, but a societal engagement embedded in sound research and education practices.

This position paper inspires the INVEST project partners and other interested parties to further explore how the shared ambitions for sustainable futures can be optimised in an even more European vision on strong, transdisciplinary and relevant education, research programmes and societal configurations.

The application of the Living Labs’ concept in INVEST universities can be summarized as follows:

* Living lab at SUA is focused on food and agricultural processing. The Slovak University of Agriculture, with its Strategic Plan, is committed to the 2030 Agenda and the fulfilment of global sustainability goals. Furthermore, SUA representatives are participating in the preparation of the new Regional Integrated Spatial Plan for the Nitra Region, in which the issue of sustainability plays an important role. It covers areas of transport, mobility, energy and waste management. At SUA, sustainability and climate change are addressed by study programs, publications and projects.
* The Living Lab established in UARD addresses the issue of the integrated and sustainable regional development in the South-Central Region of Bulgaria in the following main directions: Sustainable production and consumption and bio-based industries; Natural and cultural heritage preservation and management; New business models and smart environmental solutions; Green urban and rural environment and quality infrastructure; New systems of access to public services (social and healthcare services, education and training, culture and sports) and capacity development.
* The Living Lab RES-Q established in UTH acknowledges that the reduction of vulnerability and management of natural hazards that lead to disaster is a major challenge for a sustainable future of the Central Region of Greece. The main directions of the RES-Q Living Lab are: Develop smart and sustainable cities; Prevent new disaster risk, reduce existing disaster risk, and manage residual risk; Improve urban resilience; Manage corresponding information from multiple heterogeneous sources during a natural or man-made disaster; Assist organizations, governments, and public authorities, who are involved in disaster management, in decision making during an emergency.
* Karelia Living Labs foster sustainability in many ways. There are separate working environments, e.g. for sustainable energy solutions, timber and construction engineering, product and process development for plastic and metal industry, and learning and simulation environments for health and social sectors. Karelia also takes actively part in regional Living Labs like Joensuu Photonics Center, ENO Environment Online and North Karelia Biosphere Reserve.
* In the Netherlands, as elsewhere, it is increasingly recognised that contemporary transitions, responding to the impact of climate change, biodiversity loss and resource scarcity, require shared visions on a sustainable future. VHL is experimenting with a Living Lab approach to strengthen the transition towards regional sustainable development in three regions in the Netherlands:
	+ Living Lab peatland area Friesland - The aim of the living lab is to develop new balances between economy (agriculture) and ecology. Or more specific: to find ways for profitable landuse under ‘more wet conditions’ that are needed (a) to reduce soil subsidence, (b) to reduce GHG emissions, (c) to restore biodiversity and (d) to make the area more resilient towards climate change (droughts, flooding). All to improve and maintain liveability.
	+ Living Lab ‘de Achterhoek’ - The aim of the Living Lab ‘de Achterhoek’ is to accelerate the transition towards a regenerative agricultural system, in the Netherlands known as ‘natureinclusive, circular agriculture’. The principles of circular agriculture are based on those of the Circular Economy concept60: contribute to biodiversity, reduce environmental impact and close nutrient cycles.
	+ Living Lab Delta East - Living Lab Delta East provides an arena where complex water related and other issues of the fluvial area link to an array of governance, knowledge and communication challenges and the quest for sustainable futures. The aim of Living Lab Delta East is to enhance participatory and deliberative governance and transdisciplinary learning for sustainable transitions in the riverine landscape.

In the INVEST Regional Living Labs were joined or established at each of the partner universities as platforms for collaboration for applied research and education64[[6]](#footnote-6). These Living Labs rely on active users’ involvement and feedback into the innovation process and the active involvement of end-users in research and innovation life-cycles which is a prerequisite for achieving the envisioned sustainable futures.

With one joint and five dedicated sustainable knowledge agendas (one for each region)[[7]](#footnote-7) the INVEST Living Labs present a next step: based on diverse meetings with civic society and relevant associated partners regional sustainable knowledge agendas have been formulated. In months to come the Living Labs will act accordingly the knowledge agendas and search to strengthen the Living Labs partnerships.

The specific objectives of WP3. INVEST4EXCELLENCE EUROPEAN INNOVATION ECOSYSTEM FOR ACADEMIA-BUSINESS & SOCIETY of INVEST4EXCELLENCE Project are:

* Developing a common approach for the regionally established INVEST Living Labs, based on transdisciplinary methods for connecting applied science, education, governance, business and citizens in learning and innovation.
* Identifying common aspects and criteria for the development and performance of transition pathways in the regional Living Labs.
* Creating synergy on European level between the academic research practices of diverse universities, and regional Living Labs practices and experiences.
* Developing innovative and relevant applied research methods for European higher education inter-university ‘campuses’ to facilitate European Innovation Ecosystems.

The INVEST alliance elaborates on innovation in higher education, so institutions involved will be able to contribute appropriately to regional sustainability transitions, which will strengthen the position of HEIs within regional networks.

**INVEST4EXCELENCE and the World of the Digital transformation**

University of Thessaly, Greece has developed a working prototype platform (EDUC8EU) of a novel integrated IT solution regarding the modelling and the dynamic composition of the Higher Education (HE) procedures of students learning pathways tightly integrated with machine learning and semantic web technologies, aiming at optimizing the quality of the offered services by the Higher Educational Institutions (HEIs). The learning pathway meta-models that is being established by EDUC8EU will facilitate through continuous reasoning the recommendation and execution of personalized learning pathways for each student based on his/her learning state, personality, interests, requirements, available educational options and performance to the academic plan offered to him/her. Moreover, the proposed framework will cover both the technical and the financial dimensions of a learning pathway, thus providing a complete tool for the optimization and calculation of the offered services by the HEIs in combination with the minimization of respective costs[[8]](#footnote-8).

INVEST4EXCELLENCE will uptake and use the I-EDUC8EU (international version of EDUC8EU) online tool whose main advantages are its adaptability, flexibility and maintainability. This tool will be used in any future synergy or consortium of any other university attempts that will incorporate all organizational workflows of initiatives of the kind. I-EDUC8EU will be capable of constructing, organizing and predicting higher education student performance dynamics and be self-configured and applied in any university alliance that promotes the European University. Furthermore, the proposed automation will diminish human advisor subjectivity and partiality in taking final educational decisions. For that reason, INVEST4EXCELLENCE’s primary goal is to provide an open source innovative tool for organizing, monitoring and promoting higher education especially when courses are gathered from heterogeneous awards and program studies. Such open science initiative will coordinate institutional transformation efforts at the research and innovation (R&I) level embedding a strong equal opportunities culture for the European educational system as a whole.

In relation to the implementation and promotion of the I-EDUC8EU tool, INVEST4EXCELLENCE follows a rigorous methodology that first specifies the functional and user requirements of the tool and then follows with its implementation in a spiral-mode software engineering fashion that always proactively implements the new features and retroactively refines the functionalities of the software.

I-EDUC8EU promotes the notion of dynamic personalization of learning pathways in higher education management systems and INVEST4EXCELLENCE’s ambition is to fully implement and provide to EU the open-science I-EDUC8EU system as a “plug-and-play” component to any educational institution. The final release of I-EDUC8EU will be disseminated to all relevant stakeholders.

**Capacity building and Stakeholders involvement**

The aim of the INVEST4EXCELLENCE Work Package 4: Capacity Building Tools is to strengthen the human capital by developing Research, Development and Innovation (RDI) sustainability competences and skills of the INVEST alliance RDI staff and students.

The specific objectives are:

* Identification and description of the key competences and skills that are needed to share research resources within INVEST consortium;
* Development of INVEST4EXCELLENCE Open Science training tool and materials that enable mainstreaming the open science practices within and beyond the consortium;
* Development of INVEST4EXCELLENCE stakeholder tool for systematic involvement of the stakeholders into joint research and innovation;
* Development of INVEST4EXCELLENCE training tool providing online and on-site training camps for re- and up-skilling of the RDI staff, PhD students and stakeholders.

The specific Deliverable 4.1: RDI Competence Matrix summarizes the baseline of the key competences found in a three-step research process: (1) Scoping Review, (2) Case Study, and (3) Focus Group Interviews[[9]](#footnote-9). The main aim of this specific research was to identify the key RDI competences to be developed during the INVEST4EXCELLENCE project (Table 1).

Table 1. RDI Competence Matrix

| **Category** | **Subcategory** |
| --- | --- |
| Sustainable Supply Chain Management (SSCM) (based on scoping review and external interview results) | * Planning; Evaluation & Innovation: General Competences
* Product & Process Design: General
* Product & Process Design: General
* Product & Process Design: Specific Competences
* Supplier Management & Operations: General Competences
* Logistics: General/specific
 |
| Higher Education and Industry interaction | * Competences based on scoping review
* Competences based on external interviews (industry and public sector)
* Competences based on internal interviews (HEI)
 |

Competence is generally defined as a possession of sufficient knowledge, judgment, skill or strength for a particular duty. In organizations, competences can be used to define work roles i.e. knowledge in circular economy.

Task 4.2. Stakeholder Involvement Tool will determine how the INVEST Living Labs are in on-going and productive dialogue with the surrounding society. The main focus is to elaborate explicitly on how the research-to-business approach can be effectively and systematically applied, analyze what kinds of involvement tools are available and, based on those, elaborate relevant tool for the INVEST learning community. The stakeholder involvement tool will describe the process and methods of thematic dialogue and promotion of innovations and will also provide a scheme for a regular impact assessment.

**Conclusion**

INVEST4EXCELLENCE will provide a set of support tools aimed to facilitate the institutional transformation and research and innovation dimension. INVEST4EXCELLENCE will deliver a model for institutional transformation covering multiple levels and areas of activities in partner universities based on their strengths and potentials for synergies. The project will provide strategies for internationalization, research and innovation and handbook of best practices in institutional transformation for policy makers. INVEST4EXCELLENCE will develop the first international education academic tool: I-EDUC8EU as a part of its ambition to introduce advanced IT solutions for education and academic advising systems. The stakeholder involvement tool describes the process and methods of thematic dialogue and promotion of innovations and it also provides a scheme for regular impact assessment.

The change in the focus in research and training towards SDGs, and particularly towards practical training and acquisition of new skills for the future, implies strong partnerships and integrated interdisciplinary interactions, application of innovative approaches and good practices. Four major actors in the innovation system, in terms of science, policy, industry, and society, united in the open-innovation cycle of the INVEST Living Labs could provide the synergy effects needed in the context of sustainability both for training and research practice.

INVEST LLs focus on knowledge and innovation creation in SDGs focal points encouraging involvement of key stakeholders and developing the concept of learning communities. In INVEST LLs co-creation processes are substantiated by the strong relationships between all the parties involved, considering real needs and situation, forecasting future implications and providing innovative solutions to the most pressing challenges to the modern society, as sustainable regional development and the global climate change.

**Acknowledgements**

*The INVEST FOR EXCELLENCE IN REGIONAL SUSTAINABILITY (INVEST4EXCELLENCE) project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101035815. Responsibility for the information and views set out in this paper lies entirely with the authors.*

**References**

Aleixo, A. M., Azeiteiro, U., & Leal, S. (2018). The implementation of sustainability practices in Portuguese higher education institutions. International Journal of Sustainability in Higher Education, 19(1), 146-178.

Alghamdi, N., den Heijer, A., & de Jonge, H. (2017). Assessment tools’ indicators for sustainability in universities: An analytical overview. International Journal of Sustainability in Higher Education, 18(1), 84-115.

Blanco-Portela, N., Benayas, J., Pertierra, L. R., & Lozano, R. (2017). Towards the integration of sustainability in Higher Education Institutions: A review of drivers of and barriers to organisational change and their comparison against those found of companies. Journal of Cleaner Production, 166, 563-578.

Casarejos, F., Frota, M. N., & Gustavson, L. M. (2017). Higher education institutions: a strategy towards sustainability. International Journal of Sustainability in Higher Education, 18(7), 995-1017.

Chebeň, J., Lančarič, D., Munk, M., & Obdržálek, P. (2020). Determinants of economic sustainability in higher education institutions. Amfiteatru Economic, 22(54), 462-479.

Dedicated sustainable knowledge agendas. Innovations of Regional Sustainability: European University Alliance Project No.: 101004073. Deliverable 3.19, 2021.

Establishing a living lab in each of the INVEST Universities. Innovations of Regional Sustainability: European University Alliance Project No.: 101004073. Deliverable 3.17, 2021.

INVEST Cooperation Strategy. Deliverable 2.1. Innovations of Regional Sustainability: European University Alliance. Project No: 101004073, 2021.

Invest for Excellence in Regional Sustainability Project Proposal. H2020-CP-LS-RIA-CSA, 2020.

Medne, A., Lapiņa, I., & Zeps, A. (2022). Challenges of Uncertainty in Sustainable Strategy Development: Reconsidering the Key Performance Indicators. Sustainability, 14(2), 761.

RDI Competence Matrix. INVEST FOR EXCELLENCE IN REGIONAL SUSTAINABILITY (INVEST4EXCELLENCE), Horizon 2020 research and innovation programme, Grant agreement No 101035815. Deliverable 4.1, 2022.

Velazquez, L., Munguia, N., Platt, A., & Taddei, J. (2006). Sustainable university: what can be the matter? Journal of Cleaner Production, 14(9-11), 810-819.

Weenen, V. H. (2000). Towards a vision of a sustainable university. International Journal of Sustainability in Higher Education, 1(1), 20-34.

Winkler, K. J., Bennett, E., & Chestnutt, H. R. (2022). Mapping social structures for sustainability transformation at McGill University, Canada. International Journal of Sustainability in Higher Education, 23(6), 1209-1228.

Witteveen, L., Eweg, R., Smits, T., & Voskamp-Harkema, W. (2016). Design principles for Living Lab’s aiming at sustainable development. The role of higher education in Living Lab’s. Conference: "Competence 2016 Wageningen". Wageningen, The Netherlands.

Witteveen, L., J. Fliervoet, R. Eweg, E. Arabska, P. van de Maas, A. Lazarov,O. Iatrellis, A. Bania, D. Lančarič, H. Puhakka-Tarvainen. 2022. The transition towards regional sustainable futures: a position paper on exploring a transdisciplinary view on the INVEST Living Lab approach. INVEST FOR EXCELLENCE IN REGIONAL SUSTAINABILITY (INVEST4EXCELLENCE), Horizon 2020 research and innovation programme, Grant agreement No 101035815.

1. INVEST Cooperation Strategy. Deliverable 2.1. Innovations of Regional Sustainability: European University Alliance. Project No: 101004073, 2021. [↑](#footnote-ref-1)
2. Invest for Excellence in Regional Sustainability Project Proposal. H2020-CP-LS-RIA-CSA, 2020. [↑](#footnote-ref-2)
3. Invest for Excellence in Regional Sustainability Project Proposal. H2020-CP-LS-RIA-CSA, 2020. [↑](#footnote-ref-3)
4. Witteveen, L., J. Fliervoet, R. Eweg, E. Arabska, P. van de Maas, A. Lazarov,O. Iatrellis, A. Bania, D. Lančarič, H. Puhakka-Tarvainen. 2022. The transition towards regional sustainable futures: a position paper on exploring a transdisciplinary view on the INVEST Living Lab approach. INVEST FOR EXCELLENCE IN REGIONAL SUSTAINABILITY (INVEST4EXCELLENCE), Horizon 2020 research and innovation programme, Grant agreement No 101035815. [↑](#footnote-ref-4)
5. Witteveen, L., Eweg, R., Smits, T., & Voskamp-Harkema, W. (2016). Design principles for Living Lab’s aiming at sustainable development. The role of higher education in Living Lab’s. Conference: "Competence 2016 Wageningen". Wageningen, The Netherlands. [↑](#footnote-ref-5)
6. Establishing a living lab in each of the INVEST Universities. Innovations of Regional Sustainability: European University Alliance Project No.: 101004073. Deliverable 3.17, 2021. [↑](#footnote-ref-6)
7. Dedicated sustainable knowledge agendas. Innovations of Regional Sustainability: European University Alliance Project No.: 101004073. Deliverable 3.19, 2021. [↑](#footnote-ref-7)
8. Invest for Excellence in Regional Sustainability Project Proposal. H2020-CP-LS-RIA-CSA, 2020. [↑](#footnote-ref-8)
9. RDI Competence Matrix. INVEST FOR EXCELLENCE IN REGIONAL SUSTAINABILITY (INVEST4EXCELLENCE), Horizon 2020 research and innovation programme, Grant agreement No 101035815. Deliverable 4.1, 2022. [↑](#footnote-ref-9)