ACTION PLAN TOWARDS THE IMPROVEMENT OF THE CRITICAL MASS IN WATER TECHNOLOGY SECTOR IN LATVIA

INTERREG EUROPE Project: iWatermap

ABOUT THE ACTION PLAN

Produced by each iWatermap project region, the **action plan** is a document providing details on **how** the lessons learnt from the cooperation will be exploited in order to improve the policy instrument tackled within that region. It specifies the nature of the actions to be implemented, their timeframe, the players involved, the costs and funding sources.

Disclaimer: The insights composing the arguments for the development of different facets of the action plan are mainly based on the information provided by the Riga Technical University, Ministry of Education and Science and public sources. The specific research topics and directions are used as an example that can be transferred and applied to an overarching water sector development.

2021

GENERAL INFORMATION

Project: iWATERMAP

Partner organisations:

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Ministry of Education and Science of Republic of Latvia (MoES)

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POLICY CONTEXT

The Action Plan aims to impact:

- Investment for Growth and Jobs programme;
- European Territorial Cooperation programme;
- Other regional development policy instrument.

Name of the policy instrument addressed:

Operational Programme Latvia "Growth and Employment" (OP); Thematic objective No 1 "Strengthening research, technology development and innovations " (TO 1).

Identified challenge in the policy context:

Latvia is a country with a small and open economy, and its business structure consists mostly of micro, small and medium enterprises that do not have sufficient capacity to invest in water technology research and development.

Latvia performs well below the EU average for most dimensions, particularly for Linkages and entrepreneurship, Open, excellent and attractive research systems, and Innovators. The innovation capacity and collaboration with different stakeholders using different political instruments should be strengthened in various sectors, including the water sector.

Furthermore, the industry continuously adopts open platforms to create and maintain ecosystem innovation. According to global observations and research, the government's role has changed from regulation control toward facilitation. Universities have become proactively engaged in multiple areas, from technology transfer to knowledge co-creation. Societies and customers have started to form new concepts, R&D, and commercialisation, resulting in a shared economy.[1]

The work in the project has strongly considered the principles of the open innovation system and the micro and macro dynamics of the system. In addition, the dynamic roles of industry, government, university, and society are taken into account and conceptualised according to the quadruple helix model.

The solutions considered in the Roadmap and Action plan towards an increased critical mass of the sector have considered the natural gravitation towards the Quintuple helix innovation model[2] , which is even more comprehensive by contextualising the Quadruple Helix and by additionally adding the helix (and perspective) of the 'natural environments of society[3]. The fifth dimension is especially important considering the heavy focus on the overall urgency and efforts to fight climate change.

[1] Micro- and Macro-Dynamics of Open Innovation with a Quadruple-Helix Model, JinHyo Joseph Yun and Zheng Liu; 2019.
[2] The Quintuple Helix innovation model: global warming as a challenge and driver for innovation: https://innovation-entrepreneurship.springeropen.com/articles/10.1186/2192-5372-1-2
[3] Social ecology focuses on the interaction, codevelopment and coevolution of society, and nature.

For a new, innovative water technology to be considered for implementation, it must have advantages over traditional methodologies. The feasibility can be proved with lower capital investments requirements, reduced operations and maintenance costs, higher efficiency, more straightforward operation, better water quality, and lower waste production.

Moving towards a micro level, understanding the identification and implementation of new technologies is necessary to properly plan and introduce a new technology in any area, especially in water management. Such know-how is needed on the practical and policy level. Having such knowledge allows analysing the existing solutions and working on the frontier research together with the companies, regional authorities, and universities.

On the Baltic Sea Region macro-region level, improvements in water technology, especially in the wastewater treatment area, are important to positively impact the Baltic Sea environment, as in 2007-2011, almost the entire open Baltic Sea was assessed as being eutrophied (HELCOM).

Proposed self-defined performance indicator (in relation to the policy instrument addressed):

1. 30 % increase of implemented projects in the innovative water technology field

Policy instruments or documents that constitute the legal basis of the action plan:

- Smart Specialisation Strategy (RIS3);
- National Development Plan;
- Law on Scientific Activity (ZDL);
- Guidelines for Science, Technology Development and Innovation 2014-2020. (ZTAIP);
- National Roadmap for the Implementation of the European Research Area Roadmap 2016-2020 in Latvia;
- Priority directions in science 2018-2021;
- International evaluation of scientific institutions.

Approach to Funding instruments in the planning period of 2021-2027

The support programme which was the target of the iWatermap project partners in Latvia is the «Growth and jobs» specific objective 1.2 «Research, technological development and innovation». The same programme with the new specific objective sub-programmes that support the development of all three roadmaps are in the center of the attention also for the action plan. A broader overview of the potential sources of funding to accelerate the development of the water sector within the scope of Human resources, Internationalisation and overall Critical Mass are described in the Annex 1: Expected National Funding Instruments.

Taking into account the National development plan 2027 context, these specific directions ought to have the available funding available: (1) Overall business development, (2) Business digitalisation, (3) System digitalisation, (4) Infrastructure development, (5) Environmental education, (6) Digital infrastructure, (7) Water education), (8) Mobility, (9) European Partnerships, (10) Excellence inflow & Centres, (11) R&D projects, (12) Pre-school equipment, (13) Curriculum development, (14) VET-Industry, (15) Lifelong learning, (16) Higher education.

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STAKEHOLDERS ENGAGED IN THE LATVIAN WATER TECHNOLOGY SECTOR

Public Education Institutions

- Riga Technical University;
- The University of Latvia;
- Latvia University of Life Sciences and Technologies;
- RTU agency Olaine Technology college.

Non-profit research organisations

- Institute for Environmental Solutions;
- Latvian Institute of Aquatic Ecology;
- Latvian State Forest Research Institute Silava.

Specific institutes granted by the government

- Bior - Institute of Food Safety, Animal Health and Environment;
- LVĢMC - Latvian Environment, Geology and Meteorology Centre.

Cluster organisations

- Cleantech Latvia Cluster: 45 companies, 5 research & educational institutions;
- Life Science Cluster of Latvia;
- Green Tech Cluster;
- Smart City Cluster of Latvia;
- Latvian Association of Water Supply and Sewerage Companies;
- Latvian Association of Heat, Gas and Water Technology Engineers.

Regional Authorities

- Ministry of Education and Science – education, research funding;
- Ministry of Economics, Investment and Development Agency (LIAA) – innovation funding;
- Ministry of Environmental Protection and Regional Development – legislation related with infrastructure;
- Ministry of Agriculture – drinking water legislation;
- Health Inspectorate, Ministry of Health – supervising water quality.

LATVIAN WATER TECHNOLOGY SECTOR IN A NUTSHELL

During the first phase of the project, important information regarding the **private sector involvement** was gathered. In Latvia, more than 70 companies are involved in the water technology sector. Companies are organised into three groups:

1. distributors of services/technologies ("Simple re-sellers") - approx. 43%,
2. Engineering design ("Pick up guy") - approx. 32%,
3. Original equipment manufacturer - approx. 26%.

32% of companies operate in the wastewater field, 13% in the drinking water field, 11% are exclusively working with pumps and pump systems, 6% in the automatization field, and 6% with piped distribution/production.

Lead Interviews and workgroup meetings with the **Academia and Industry stakeholders** have provided valuable insights:

1. the role of R&D in the companies is relatively limited, and understanding of available funds is fairly limited;
2. there are missing competencies for personnel in water sector companies and specifically in the operators of water and wastewater treatment plants;
3. the level of readiness of companies to be engaged in a lifelong learning process is low;
4. the potential research topics from the regional market demand and product development perspective are related to the sewage sludge treatment and disposal;
5. cooperation and interaction between Academia and Industry is happening in fairly limited scope.

The identified problems in Latvia are categorised in terms of the interaction of each triple helix stakeholder group.

Academia-Industry interaction

Academia:

- A limited number of successful collaboration projects with industry;
- Research projects (Bachelor, Master and PhD) has no establishment in real Industry need and problem-solving;
- Research results are not regularly presented to the industry, lack of dialogue;
- Week/ limited relationships with industry stakeholders.

Industry:

- The industry is not actively involved in research projects, lack basic information;
- Has no clear idea, how to access and collaborate with academia;
- Has limited knowledge and capacity to run research projects with academia;
- Clusters do not prioritise research and development projects with academia;
- Lack of perspective and knowledge on how to transfer innovation into successful business models.

Academia - Government interactions

Academia:

- New developments, promoting entrepreneurship at a university;
- There is no single strategy, many non-synchronised initiatives;
- Integration and synchronisation among different educational programs are needed;
- Passive in policymaking.

Government:

- Lack of policy and stewardship to facilitate Academia and Industry discussion;
- Needs an accountable and traceable process to follow academia supported research and development projects;
- No targeted, evidence-based information provided to the government for specific policy action or funding;
- Not immersed in University real needs.

Government - Industry interactions

Government:

- Project-based industry supporting initiatives lacks long term strategy;
- Needs an accountable and traceable process to follow industry-supported projects;
- "Closer to industry" Real Industry needs grounded initiatives are required – improved dialogue with stakeholders;
- Lack of perspective and strategy from the Government and Municipal companies regarding the needs and applicability of R&D.

Industry:

- Is not informed about initiatives and opportunities offered by the government;
- Focussing on the infrastructure projects, instead of research and development;
- Local market-focused needs and wants to be defined by Latvia industry mainly;
- There is insufficient evidence-based information or/and specific requests from the water sector to the government to formulate a particular action or funding reallocation;
- No dedicated contact point for the industry to search for information and support.

ACHIEVEMENTS TO REACH AN IMPROVED INNOVATION ECOSYSTEM

Goal-oriented achievements were identified in the research process to create roadmaps for the water sector development regarding the overall critical mass, human resources and international cooperation. The stages represent a certain level of maturity of the sector, including the achievements that characterise them.

THE CRITICAL MASS

The Roadmap foresees that these achievements ought to be reached regarding the critical mass development:

Stage 1: Getting started: Joining up in the region

1. The cultivated right mindset in the stakeholders for success (right mindset in this stage, even more important than additional funding).

Stage 2: Joining up outside the region

2. Well-developed Industry-Academia cooperation;
3. Established Public-Private Partnerships (PPP);
4. Increased participation in science, innovation and demonstration projects (ESIF and Interreg);
5. Concentrated funding on the specific economic sector or sectors societal challenge to enhance critical mass.

Stage 3: Enhanced collaboration (more business involvement and expanding national and European cooperation)

6. An increasing amount of start-up's active in RIS3 topic;
7. Region and member state concentrate funding on a specific societal challenge within the region, enhancing critical mass and creating attractive conditions for international cooperation;
8. Coordinating science, innovation and demonstration projects (ESIF and Interreg);
9. Establishing a Centre of Excellence (PPP in which industry is committed long-term and pays at least 25% in cash for pre-competitive research projects).

Stage 3: Advanced achievements

10. Increased interest in scale-ups from the developing enterprises;
11. Dedicated research programme and high amount of PhDs active in RIS3 topic.

Considering the approach and the theoretical base driving the sector development, building the critical mass should focus on specific sector areas and connected policies and not attempt to solve everything simultaneously. The development of the innovation ecosystem critical mass consists of two main directions – developing unique strengths and achieving and maintaining parity with the peers. The answers to these two directions create the national and regional value proposition. The priorities and sequencing are fundamental to successful economic development. Thus, general activities that were identified in the self-assessment can be summarised as:

- Creation of a robust stakeholder group to purposely work with the policy developers to ensure the recognition of water's paramount importance to the society as a whole and proper funding allocation to

develop the sector according to the action plan. A regular stakeholder group engagement is required to continue in reaching **Stage 1 Achievement 1;**

- Creation of project preparation toolkit for the partners to better compete on the local and international R&D market. Improving the project consortium formation and writing skills is expected to advance **Stage 2 Achievement 2, 3 and 4 and Stage 3 Achievement 8;**
- Critical Mass Development is recommended to be led by the industry cluster organisation or an NGO type organisation (think tank) modelled after the example of WETSUS. The main task of such an organisation is to create and drive the water sector development strategy, accelerate knowledge exchange that leads to a better understanding of the sector challenges, and help identify new opportunities for various project development. The potential funding model of emerging water cluster organisation and strategy development and implementation driver should be created. The creation of the Centre of Excellence aims for **Stage 3 achievement 9**. Nevertheless, it directly supports the development of the ecosystem to excel at the previous stages**.**;
- Circular economy principles and the role of water is an essential aspect to be emphasised in all five RIS3 investment priorities and defined specialisation areas. Such an approach would facilitate cross-sectoral collaboration and the identification of opportunities for international collaboration. Choosing a specific focus is required to reach **Stage 2 Achievement 5 and Stage 3 Achievement 7;**
- It is expected that with achieved results in the previous activities the **Stage 3 Achievement 6** will be reached consequently.

HUMAN CAPITAL

The Roadmap foresees that these achievements ought to be reached regarding the human capital development:

Stage 2: Joining up outside the region

1. Well-developed Industry-Academia cooperation;

Stage 3: Enhanced collaboration (more business involvement and expanding national and European cooperation)

2. Developed special training programmes for post-graduates, which include skills training for entrepreneurship and industry-academia cooperation;
3. Increased (high) interest of BSc and MSc students to perform thesis or traineeship in the local RIS3 region;
4. Forecasting the skills needs within the sector. Established strategic cooperation between Vocational Education and Training (VET) Schools and companies active in the RIS3 sector. Education profiles and traineeships optimised; Developed dedicated Master education track in line with RIS3 topic with focus to attract foreign talent to participate in excellent 2-year master education programmes;

Stage 3: Advanced achievements

5. Regional, national & European awards are won;

Especially in small countries, human development is not a luxury. On the contrary, it is needed, and with the ageing workforce in the water technology sector, the need for freshly educated minds that can contribute to the solution to the sector's challenges becomes more pressing.

The activities below are expected to advance the **Stage 2 Achievement 1:**

- The business education that facilitates skills development to enable better solutions to the water sector's challenges is necessary. RTU has started a 2.4 million project connected with the international innovation challenge platform "Demola Latvia". This call is dedicated to (a) development of leadership, innovation, and entrepreneurship for students; (b) development of innovative ideas; (c) for attraction of private investments and (d) for collaboration of higher education institutions with companies. The continuation of such initiatives ought to be considered to facilitate the development of the students' entrepreneurial mindset;
- Incentives to address all or a combination of the eight critical characteristics that define high-quality learning that fits the Fourth Industrial Revolution—"Education 4.0" (according to the report Schools of the Future by the World Economic Forum) ought to be facilitated on all levels of education. The people involved in the EQF 4-8 would be well suited in different formats to start tinkering with prototypes to the grand challenges in the water sector.

Certain jobs-to-do are identified for each education level that could help steer talent acquisition for the water technology sector. These activities are expected to advance the **Stage 3 Achievement 2, 3 and 4:**

Level of Education	Potential activities
ECEC	- Designing and validating water topic popularisation events and other activities for pre-school and primary school kids in cooperation with Science & curiosity centres (e.g. ZINOO[4]) or with existing RTU initiative – RTU Children and Youth University (BJU)
EQF 1-4	- Identification of criteria and assessing total numbers of school kids, potential students for Engineering Bachelor Studies. This includes identifying possible schools with STEM traditions sorting by schools with good results in centralised exams, good experience in scientific research work realisation at country level, dedicated teachers to popularise STEM. - Designing and validating motivation programs for secondary schools' teachers (e.g., in cooperation with RTU Development Fund, in cooperation with already existing tradition in Faculty of Materials Science and Applied Chemistry). - Evaluation, design and development of a program for the training of secondary school teachers on topics scientific methodology and engineering design. These competences will strengthen the practical outcome of the Scientific Research Works. Appropriate funding source ought to be identified, e.g., financial support from the Ministry of Education and Science.

[4] https://www.zinoo.lv/tjd/

	- An additional aspect to consider for inclusion regarding the calculation of the basic research funding (support mechanism) is the number of Scientific Research Works developed in secondary schools. - Expanding the cooperation among the VET schools and higher education institutions, e.g., developing a joint study track between RTU and Olaine VET (ISCED 3, EQF 3-4). That would include synchronisation of study programs among professional education, bachelor and master degrees studies for Environment technologist and Biotechnologist programs.
EQF 5	- Vocational education program, supporting the needs of regional SMEs towards specialists in the water sector and change in professional qualification (in line with the idea of lifelong learning).
EQF 6-7	- Development of RTU Engineering Bachelor Studies, 20+20 hour (full time) program in English language (ISCED 6-7, EQF 6-7[5]) and international double degree Engineering Master Studies program in English language (ISCED 7, EQF 7) to support growing needs of water technology educated engineers.
EQF 8	– Development of the industrial/cotutelle PhD that will contribute to the "New financing model for PhD" promoted in Latvia starting from autumn 2021 and will support and encourage cooperation with EU partners.

A programme where academic personnel can raise their academic qualification through an internship in industrial enterprises in areas of strategic specialisation ought to be created (In 2019, such activity was piloted). In addition, a better understanding of the academia-industry cooperation particularities and opportunities also have the potential to advance the overall system innovation thinking.

The activities mentioned above for all education levels and teachers are expected to increase the excellence and an overall critical mass of knowledgeable and capable students, hence advancing the **Stage 3 Achievement 5.**

INTERNATIONAL COLLABORATION

Networks and hierarchies are the mechanisms governing human interaction and influence in almost all domains of life. Therefore, international collaboration is such an important aspect that depending on its stage of development, can be a tremendous boost in scaling up the sector's success. Having a solid value proposition and the right connections can unlock almost all the opportunities that exist. However, to stay relevant, the stakeholders should constantly develop the areas where the level of excellence is naturally the highest in the sector while rapidly introducing emerging areas and technologies.

Being a part of a strong network or hierarchy can help access the funding for the activities needed in the sector. For example, over 70% of all published research work and results from the University of Cambridge are rated as either world-leading or internationally excellent, positioning it second in overall UK university rankings. Such

[5] European Qualifications Framework – EQF, The International Standard Classification of Education - ISCED

a recognition gives a head start in negotiating any terms in a future collaboration or in proving the level of excellence of the solution.

The Roadmap foresees that these achievements ought to be reached regarding the international collaboration:

Stage 2: Joining up outside the region

1. Branching out beyond the regional domain by participating in initiatives and networks where interregional relationships among other ecosystem stakeholders can be formed to develop joint R&D projects;

Stage 3: Enhanced collaboration (more business involvement and expanding national and European cooperation)

2. Cooperation with knowledge institutes, universities and companies, from other regions and other member states to adopt innovation practices from a wider scope of stakeholders;
3. Connecting with other clusters, regionally, nationally, and European wide;

Stage 3: Advanced achievements

4. Coordinating Research and Innovation Action projects on the EU level (e.g. Framework programme projects).

The approach in a nutshell to reach the achievements mentioned above are:

- Increasing the scientific capacity to participate in international projects in the most relevant water sectors for Latvia (e.g., resource recovery, sludge valorisation and energy efficiency and production) by:
  - Attracting foreign researchers to joint research projects to exchange experience and involve Latvian top and new researchers in international projects;
  - Participating in the most influential EU research and innovation networks. It is expected that in the coming years, partners from Latvia could join more often such partnerships as Water4All and Driving Urban Transitions, which will allow for systemic improvements and promotion of cooperation in the field of water research. The implementation of this activity is expected to advance **Stage 2 Achievement 1**;
  - Involving the regional cluster organisations to develop interregional water industry partnerships with cluster networks or industry-related consortiums as Smart Water Territories, focusing on solving specific regional problems (e.g., prioritising wastewater sludge and biogas digestate treatment) challenges for the water industry. The implementation of this activity is expected to advance **Stage 3 Achievement 2 and 3.**
- Increasing the interaction among the strongest quadruple-helix stakeholders to create islands of excellence within the water technology sector could be positioned from a unified branding concept perspective. Thus, shifting the focus from local competition towards European or global. The implementation of this activity is expected to advance **Stage 3 Achievement 4:**
  - Creating international Summer schools and programmes in the English language to facilitate the enrolment of top international students. The implementation of this activity is expected to advance **Stage 3 Achievement 2.**

ACTIONS ENVISAGED ADVANCING THE INNOVATION ECOSYSTEM

The Regional and iWatermap context

Water is the world's most precious resource. It connects all of us and is essential in everything we do across the globe. Globally and on the EU level, the dominant, overarching thematic relating to the water sector is the water security, circularity and management. These thematic areas are also expressed in the concept of OneWater.[6] The OneWater concept consists of six primary goals (See Figure 1). Stakeholders—whether public or private—must keep these six goals in mind when addressing issues of water that affect them and the communities in which they are located.

Furthermore, the innovation chain in the water business is rather complex due to the considerable public interest in water supply and environmental protection. Due to the significant population increase, increased wealth, groundwater depletion, and climate change, more and more countries experience a water crisis. The demand side for business opportunities is, therefore, with very high potential. Consumers all over the world have become more aware of consumer products that contribute to the short-term health (bacteria and viruses), long term health (toxic compounds and medicine rests) and aesthetic (taste, colour, particular physical aspects) characteristics of water. Industries realise the importance of water due to water shortage and groundwater depletion, leading to increased interest in water reuse technologies. In addition, biodiversity in water bodies is threatened by water pollution, urging governments to install more strict discharge standards worldwide, leading to demand purification technologies.[7]

FIGURE 1 ONE WATER, ONE FUTURE.
SOURCE:HTTPS://WWW.WWDMAG.COM/ONE-WATER/ONE-WATER-ONE-FUTURE

The self-assessment carried out in the scope of the iWatermap project, and the review of the regional ecosystem done by an expert Miranda Ebbekink[8] highlighted the core elements missing in building an innovation ecosystem that can respond to the global, regional water challenges. Putting aside all the scattered achievements in the areas of enhanced critical mass, **Latvian stakeholders have not achieved the most foundational achievement: "Joining together within the region". There is no unifying organisation that would be well-positioned to drive the strategy development and implementation and cultivate the right mindset in the stakeholders and provide support to the policymakers in making better future-oriented policy decisions.**

[6] One Water: An integrated approach to managing local water resources: https://elmontgomery.com/one-water-integrated-approach-managing-local-water-resources/
[7] WETSUS Business Plan 2016-2020 (April 2016); https://wetsus.jcda.nl/app/uploads/2020/06/businessplan2016-web.pdf
[8]Joined iWATERMAP assessment methodology: https://www.interregeurope.eu/iwatermap/library/#folder=1573

National Context

During the iWatermap project, the project team attempted to align all the stakeholders in Latvia towards one shared vision. However, in Latvia, there is no organisation with a mandate to continue the overall coordination of the sector development beyond the scope and time of the project. Hence, it is improbable to arrive at an implementable water innovation ecosystem strategy aligned with the OneWater concept without organisation in the driver's seat.

Moreover, from the policymaking perspective, with the growing complexity of the world we live in, more and more investment ought to be set aside for expert advisory bodies that can translate the findings of fundamental research into policy options and enable politicians to foresee the effects of their decisions. This is where so-called think tanks – which one common UN definition describes as a "bridge between knowledge and power" – come in. The water technology sector is especially highly technical, and it demands a certain level of expertise to have the capacity to lead the discussion.

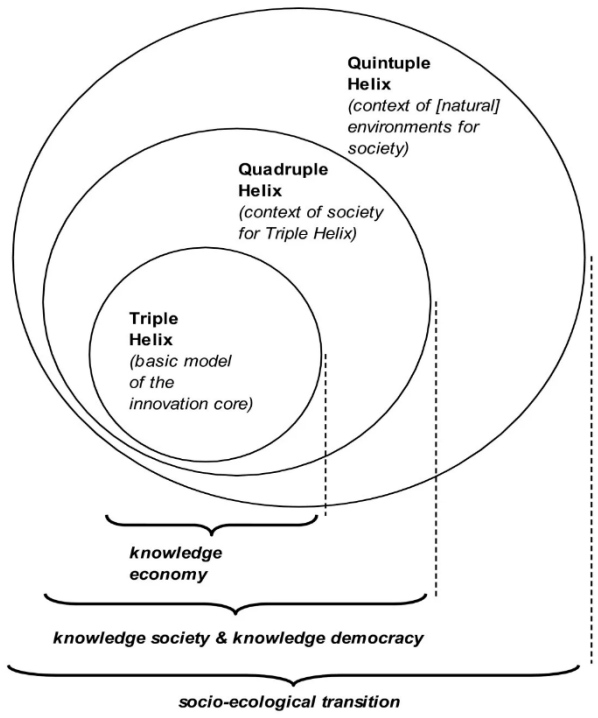


FIGURE 2: KNOWLEDGE PRODUCTION AND INNOVATION. MODIFIED FROM CARAYANNIS AND CAMPBELL ([2012], P. 18), ETZKOWITZ AND LEYDESDORFF ([2000], P. 112) AND DANILDA ET AL. ([2009]).

Hence, there is a threat that without developing a think tank type of organisation that eventually could become a centre of water excellence, the sector development might continue to stall or move too slowly to solve the challenges posed by climate change and other community disasters. Moreover, the lack of a coordinated approach will most likely continue to create silos between all levels of the quadruple helix actors. Moreover, the impact ought to be felt mainly on the industry and society in the influence of policymaking.

Analysis in the iWatermap project reveals that an orchestrator that performs well beyond the baseline cooperation facilitation and holds a research capacity can broaden the knowledge and understanding of the innovation creation of the involved stakeholders. Furthermore, such an organisation can help advance the sector from knowledge economy in the triple helix model towards a knowledge society & knowledge democracy and eventually to a much-needed socio-ecological transition in the Quintuple Helix innovation model (see figure 1).

Good example identified in the iWatermap project

THE EXCELLENCE PARTNER – WETSUS – SOURCE FOR THE LEARNING[9]

Wetsus is the European Centre of Excellence for Sustainable Water Technology. It is a facilitating intermediary for research and know-how development in water technology. Within the Wetsus network, companies and universities are cooperating in a multidisciplinary scientific water treatment research program. The collaboration in the Wetsus programme aims to innovations that contribute to global water problems as, amongst others, formulated in the UN Strategic Development Goal on water.[10] The aim is also to contribute to business opportunities and start-ups in the water technology industry.

The Dutch government innovation policy focuses on nine top sectors of which Water & Maritime is one on a national level.[11] In addition, the Dutch Government has created so-called *Topconsortia voor Kennis en Innovatie* (TKI's) for every top sector to stimulate innovation. Wetsus is one of the key participants in the *TKI Watertechnologie*.[12]

WETSUS is the coordinator of an industry-driven research programme in which over 106 European and global companies actively participate. These companies provide cash contributions to be at the forefront of breakthrough research in the fields of interest.

At a regional level, the northern provinces of the Netherlands have defined a regional economic policy based on innovation and knowledge and centred around a number of economic themes, including water technology. Water technology is one of the key topics in the Northern Netherlands RIS-3 strategy, next to energy, sensor technology, healthy ageing and dairy. The municipality of Leeuwarden and the province of Fryslân also regard water technology as one of the main fields for economic growth.[13] Furthermore, the water technology sector is expected to contribute to regional economic policy goals in the spin-off, economic diversification, internationalisation, and regional employment for highly skilled workers.

WaterCampus Leeuwarden

WaterCampus Leeuwarden, with the Wetsus building at its centre, is the physical core of the activities on water technology innovation in the Netherlands and, increasingly, in Europe. The organisations and institutes that make up the WaterCampus stimulate cooperation between (inter)national businesses, knowledge institutes and

[9] Wetsus Evaluation 2016-2019; Leeuwarden, May 2020
[10] The global goal "Clean Water & Sanitation" is to "ensure availability and sustainable management of water and sanitation for all". See www.globalgoals.org.
[11] See: www.topsectoren.nl (March 2020).
[12] See: www.tkiwatertechnologie.nl/over-ons/ (March 2020).
[13] The economic growth, innovation and sustainability strategy of the municipality of Leeuwarden is set out in the policy programme Volhoudbaar.

governments within the Dutch and international water technology sector. CEW, Water Alliance and Wetsus are the managing partners of WaterCampus. CEW coordinates BSc education and applied research (for SMEs and start-ups), and the Water Alliance focuses on clustering and international marketing.[14]

In 2020 65 PhD candidates linked to 20 universities and research centres in 9 EU countries worked on research projects in the WETSUS laboratory. These breakthrough research projects have already resulted in 700 highly cited research papers, 80 high-value patents and 36 spin-off companies. Also, the participating companies have improved their technologies and solutions, which are exported on the global market and integrated into various value chains.

INSTITUTIONAL KNOWLEDGE AND PRACTICE TRANSFER

WETSUS is one of the best examples in Europe on how to grow an organisation into a centre of research excellence and establish a firm footing as an influential voice in the water technology sector in Europe and globally. The most prevailing aspect important within the context of the Latvian water innovation sector is the solid and significant position of the WETSUS organisation within the Dutch innovation ecosystem.

In the long term, the Latvian innovation ecosystem would benefit significantly if a similar scale centre of research excellence were created. However, this action is beyond the scope of the iWatermap project. Therefore, the iWatermap project action plan will focus on the role of WETSUS as the facilitator and a policy support organisation within the Dutch innovation ecosystem. WETSUS is a facilitating intermediary for trend-setting know-how development. Wetsus creates a unique environment and strategic cooperation to develop a profitable and sustainable state of the art water treatment technology and has a clear role in the innovation ecosystem.

In Latvia, RTU has had previous cooperation with WETSUS in the exchange of master students. Since 2012 several students from RTU started and finished the master programme Water Technology. Meanwhile, one of the students continued PhD studies at Wageningen University, one of the three universities cooperating with WETSUS in joint Masters level education.

Proposed Actions

In the pilot action, Riga Technical University (RTU) and the Ministry of Education and Science of Latvia (MoES) would like to lay down the foundation for a Centre of Water research excellence in Latvia that incorporates the best practice WETSUS and the principles of an independent Think tank. **The Think tank's mission is to provide independent, research-based evidence to improve public awareness about the importance of the OneWater approach, assist the government in better policymaking in response to the climate change challenges, and support the development of the critical mass the water technology sector in Latvia**. The exhibited influence on the policy making decisions primarily ought to be directed to the whole sector coordination and the area that helps to facilitate the creation of applied breakthrough science in the cooperation nexus Academia-Industry.
According to the OneWater approach, the common resource on the Macro-regional level in the Baltic Sea; hence, potentially, the Think tank operations could be scaled to the level of a Macroregion. The Thinktank, in the context

[14] See: www.watercampus.nl/about-watercampus/ (March 2020).

of improving the critical mass, would aim to develop a clear sector development strategy that allows incorporating the necessary steps for talent development, career path development and international collaboration. Furthermore, according to the Quintuple Helix innovation model, the strategy ought to provide a clear roadmap to solve the associated climate change challenges.

MAIN ACTIVITY

Designing and validating the organisational model of an independent Think Tank in Latvia's context incorporating the best practice of WETSUS and the principles of independent Think tanks. Testing an overarching coordination body for the water sector development (in line with the OneWater approach), supporting the ecosystem stakeholders and the policymaking process in the context of specific policy instruments with a precise and transparent system to measure the generated policy impact.

Challenge

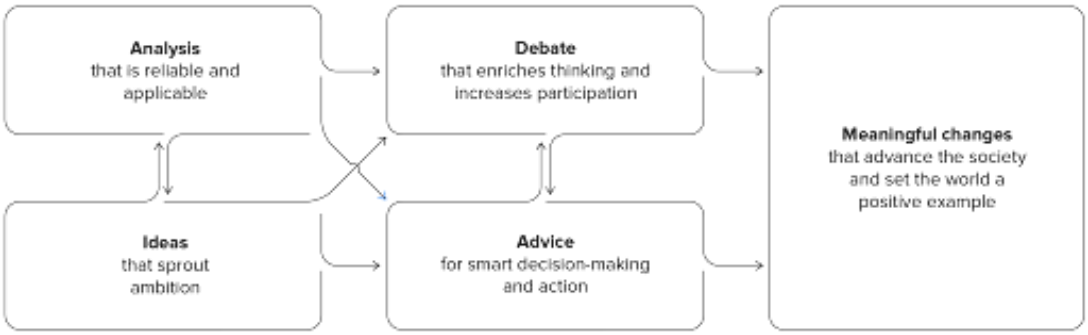
Absence of coordinated advocacy and strategy for the water sector development on the country level that aligns with the OneWater approach. And lack of a support system to ensure comprehensive support in implementing the development of the critical mass.

Solution

"Baltic centre of excellence for sustainable water technology" (possible title of the Think tank) tailored to the regional context. The organisational model for the think tank developed and tested during the iWatermap project lifetime.

Value proposition

FIGURE 3: PRAXIS THINK TANK INTERLINK OF CORE ACTIVITIES



For the Government: Research-based evidence for the policymaking and support to the respective RIS3 industries with better orchestrated Entrepreneurial Discovery Process

For the industry: Playing the role of the innovation catalyst to align the industry interests and needs with the other quadruple helix innovation model stakeholder groups

For the Society: Ensuring access to the key thought leaders for different sides of the argument while maintaining an appropriate distance to any of them with an overarching mission to raise awareness about the importance of OneWater approach and how that can improve the lives of communities

For the universities: Translating the fundamental science revelations to the rest of the water ecosystem to stimulate the innovation uptake and citizen science

Revenue model

Public / Private funding sources for in-depth insights and capabilities to deliver on the value proposition. In-kind contributions from the members to ensure the baseline functions of the organisation.

Potential impact

Increasing the overall critical mass of the water innovation system and removing the silos among the stakeholder groups to facilitate better understanding and engagement of the stakeholders towards the implementation of the sector development strategy

Impact delivered through regular *stakeholder meetings* on the most pressing matters in the sector and regular *newsletters* to members; writing *working papers and shorter issue papers* to cover the background to key issues; writing *Policy briefs* to provide diagnosis and forecast current developments.

ADDITIONAL ACTIVITIES BY THE STAKEHOLDERS

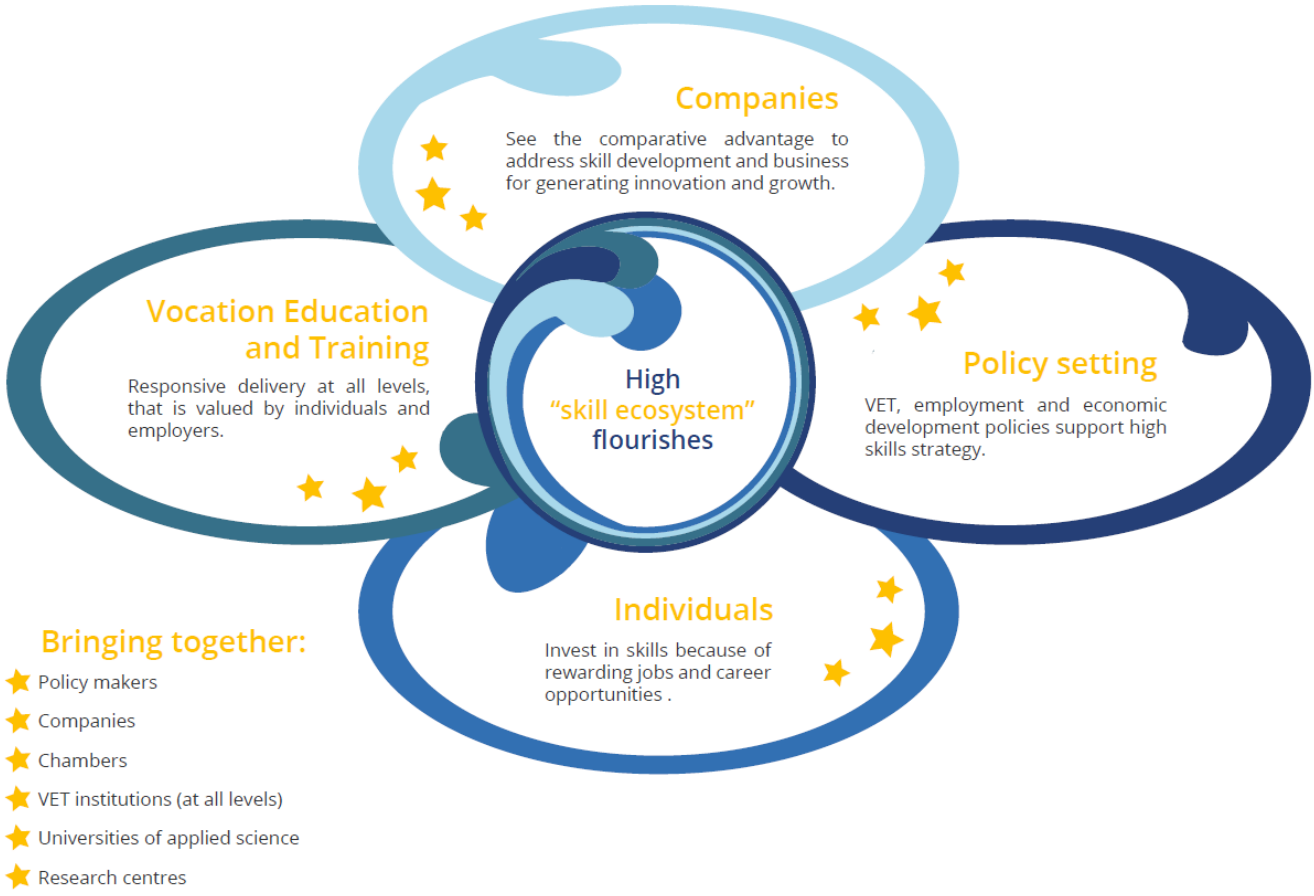
The development of the innovation ecosystem is a complex set of interlinked activities. The desired outcomes have been mapped in the previous section, where specific achievements have been defined. The main activity that is also the key subject of the iWatermap project addresses the overall development of the critical mass. The Roadmap for human capital development and development of international collaboration have other activities that are expected to take place on their timeline not tied to the results of the iWatermap project. They, nevertheless, are very important, and the two support activities that the stakeholders of the ecosystem plan are addressing the Industry-Academia nexus on different levels of education.

(1) Testing and validating the Industrial/cotutelle PhD pilot in water technologies from RTU jointly with WETSUS or UMinho. Cotutelle pilot will be a precursor in the latter stage to establishing a joint PhD. The joint industrial PhD strengthens the advancement of the excellence and internationalisation dimension of the people involved in the sector, thus developing the critical mass of the sector.

(2) Fostering Vocational Excellence through Centres of Vocational Excellence Water (CoVE Water)[15] operating at regional and/or national level embedding Vocational Education closely in the regional innovation ecosystems around water, working with water technology businesses, chambers of industry and commerce, tertiary education, research institutions, public authorities, companies etc. The local, regional, and national partners develop services and actions that improve VET curricula and teaching and learning methods. In a CoVE Water, knowledge of market needs (demand side) push for relevant VET curricula and qualifications (supply-side). CoVE Water actively involve actors of the national/regional 'knowledge triangle' concerning water technology.

Creating the infrastructure necessary to embed vocational excellence in the water sector in Europe, thus laying the grounds for vocational curriculum development and consequently competence development of VET students. (See Figure 4)

[15] PoVE Water: https://www.povewater.eu/



Credits: European Commission Platform of Vocational Excellence – Explanatory note, 23-08-2018

FIGURE 4: HIGH SKILL ECOSYSTEM

THE INTERRELATION BETWEEN THE ACTIVITIES

The group of stakeholders that are planned to be involved in the Think tank operations ought to be well-positioned to support the implementation and information exchange of the other activities mentioned as planned by the ecosystem stakeholders.

The potential role of the Think tank is to not only ensure coordination and support actions for the upcoming and ongoing activity in the sector but also generate proof-of-concept research to support the decision making. Therefore, the emphasis of the Action Plan and the monitoring phase will be on the manifestation of the Main activity.

As discussed in the analysis of the dynamics of different stakeholder groups, a single point of contact for everyone is expected to significantly improve the overall micro-dynamics of the innovation system.

The key areas where the operations of the Think Tank influence and interlink with the other stakeholders are expected:

- OneWater strategy for the country, looking at water usage and treatment with a view of the complete water cycle and how people and aquatic ecosystems are impacted downstream;
- Advocacy of the challenges arising in the OneWater strategy to mediate with the governmental and regulatory bodies on a national and international scale;
- Involvement of the industry representatives that impact source water quality, such as agriculture, and develop plans to handle runoff and stormwater flows to achieve major reductions in contaminant loads to our waters. Agree on the industry standard for water quality management;
- Developing financial mechanisms to better link the delivery on the industry demands with the offer of the knowledge institutions;
- Develop a plan to educate the public on the "value of water" and how we must price it to meet the industry's operational and capital investment needs. Lack of financial resources should not lead to, e.g., result in unsafe drinking water, contaminated source waters.

RISKS

The main risk regarding developing the critical mass and implementing the activities is associated with the inability to establish an organisation that ensures the coordination of the sector development beyond the scope of project "iWatermap". The risks and associated success factors on establishing an organisation that is a think tank are:

Board members

The organisation (formal or informal in the initial steps) ought to consist of not just subject matter experts; also, people who know about think tanks and the various aspects of their work: management, communications, fundraising, etc., should be on board. Furthermore, the people assigned ought to be able to dedicate enough time to support the think tank and its mission.

Researchers

To generate evidence-based opinion, a pool of possible research associates who are available to contribute and support with, e.g., fundraising, contacts writing, ought to be available on the reach of arm's length.

Funders

Securing funding is a critical aspect of the sustainability of any organisation. Although it is planned that the initial investment from the members ought to be made in-kind, to scale the operations of the Think tank, private/public funding will be needed (ideally domestic). The Funders shall be committed to the values of the centre.

MAIN ACTION: ORGANISATIONAL MODEL OF THE "BALTIC CENTRE OF EXCELLENCE FOR SUSTAINABLE WATER TECHNOLOGIES" TAILORED TO THE REGIONAL CONTEXT

Measures for durability and generalisation

While policymakers may often lack the tools to respond to a critical environmental and policy problem quickly, they often suffer not from a lack of information but from an "avalanche of information" that gets in the way of effective decision-making. Hence, the point with creating a think tank is not to search for one perfect proxy for the impact of the action for one specific problem or policy initiative; instead, the idea is to build a dashboard with quantifiable and trackable KPIs relevant for the OneWater. Further, outfit it with a wide variety of variables because think tanks need to develop proxy impact measures by searching for where their supply curve intersects with competitive demand in the marketplace of ideas needed for the water sector's development.

MEASURES FOR DURABILITY

M1.1: Monthly engagement from all the relevant stakeholders in the scope of specific policy challenges relevant to all the stakeholders and linked to specific policy initiatives in the "Jobs and Growth" policy axis.
M1.2: Documented support from the relevant industry leaders and public institutions for the continuation and implementation of this pilot action and future advancement of the water ecosystem.
M1.3: Letter of intent to consider the creation of a state research programme with an interdisciplinary call specific to the research on the challenges that the water sector stakeholders are best positioned to solve.

DELIVERABLES

D1.1: Proof-of-concept study for the functional organisational model of the Baltic Centre of Excellence for Sustainable Water Technologies (if additional funding for the activity is secured).
D1.2: Dashboard to monitor and measure the policy impact of the organisation's activities (if additional funding for the activity is secured).
D1.3: Letters of expression of support for the cause and the organisation from the relevant stakeholders (Ministry of Economics, Ministry of Education and Science, Ministry of Environmental Protection and Regional Development, Ministry of Agriculture, Latvian water and wastewater works association, Cleantech Cluster Latvia, Latvian Employers Confederation).

Key steps in the monitoring

There are also recurring activities that are identified as important to be executed and followed upon in the implementation of the Main activity:

1. Finalising the compilation and analysis of funded academia latest and running research projects from all research institutions in Latvia. (**Direct link to the iWatermap project KPI**: 30 % increase of implemented projects in the innovative water technology field);
2. Organising industry and academia meetings to initiate a discussion about potential partnerships and public funding opportunities;

3. Creating links between companies and Research & Development projects run by academia to facilitate innovation uptake;
4. Facilitation of a discussion with the involved stakeholders to secure the support of the establishment of a Think tank.

Funding needs and sources

The funding requirements highly depend on the scope and the depth of the Main action. In the base scenario, the stakeholder meetings ought to be organised on an in-kind basis. However, external funding is required to achieve high-quality deliverables (D.1.1. and D 1.2.). The conceptualisation of and in-depth research on creating the think tank is expected to cost approximately 30 thousand euros.
The potential funding sources are national funding for the advancement of industrial competitiveness and international open calls for ecosystem development by linking the experience of EU-13 and EU-15 (including the United Kingdom) stakeholders. Some synergies might also be found in the Horizon Europe Pillar2 Global Challenges and Industrial Competitiveness Clusters (1) Climate, Energy and Mobility and (2) Food, Bioeconomy, Natural Resources, Agriculture and Environment. As well as Open calls for Widening participation and spreading excellence.

Possible next steps

A1: Organisational model of the "Baltic Centre of Excellence for Sustainable Water Technologies" tailored to the regional context

A1.1: Setting up the framework for stakeholder engagement. The project team will engage and establish the group of people who will be involved in the testing and validation of the pilot action, create an attentive schedule, set-up the tools for engagement (e.g., Miro boards, Zoom licences), synchronise the agenda for the stakeholder meetings in terms of more concrete thematic areas with the policymakers involved.

A1.2: Organising the first stakeholder meetings with a continued recurrence up to 2x a month.

[If additional funding is secured] A1.3: Designing the tender technical specification for the procurement of the service for the D1.1 Proof-of-concept study for the functional organisational model of the Baltic Centre of Excellence for Sustainable Water Technologies and D1.2: Dashboard to measure the policy impact.

[If additional funding is secured] A1.4: In the scope of D1.1, at least two review meetings with the external expert team are expected. It is expected to discuss the research on the conceptual model that includes analysing the organisation ecosystem of WaterCampus Leeuwarden (iWatermap partner) and/or DRIKS (Chalmers, Lund and SLU in Sweden). Furthermore, the desk research is expected to cover in more detail how to transfer the best practice examples from WETSUS and European Think tanks to Latvia, incl., the main obstacles, challenges, resources, and options for the development of the main obstacles, challenges, and options Baltic Centre of Excellence for Sustainable Water Technologies.

[If additional funding is secured] A1.5: In the scope of D1.2, at least two review meetings with the external expert team are expected. It is expected to discuss the requirements of the policy impact dashboard that would be an integral part of the Baltic Centre of Excellence for Sustainable Water Technologies. Along with the project

development, it is expected to adjust the stakeholder engagement strategy geared towards the findings and metrics of the policy impact dashboard.

A1.6: Stakeholder group meetings are expected to take place 1-2x a month. Among the topics in specific policy instruments, the findings from A1.4 and A1.5 will be discussed, e.g., the organisational/business model for Baltic Centre of Excellence for Sustainable Water Technologies and role definitions (e.g., RTU, Latvian water and wastewater works association and Cleantech Cluster Latvia).

A1.7: The project team will start working on the support letters together with the key stakeholders. This activity aims to have the commitment from the key stakeholders in terms of the specific persons to be dedicated to participation in the stakeholder meetings also beyond the scope of the pilot activity and other potential commitments (e.g., future funding, non-financial investments).

[If additional funding is secured] A1.8: The results of the D1.1 and D.1.2 will be validated in the stakeholder group meetings to ensure the congruency among the key stakeholders of the set target and the means to reach it regarding establishing the Baltic Centre of Excellence for Sustainable Water Technologies.

[If additional funding is secured] A1.9: The review meetings with the service providers of D1.1 and D.1.2 will be organised to align the feedback from all the involved parties.

Additional activities by the ecosystem stakeholders

1. Unification of water sector profession standards and consolidation in one Roadmap in cooperation of water sector players and "Latvian Employers Confederation"/LDDK;
2. Creation of coherent national strategy in education in the field of water management;
3. Awareness-raising campaigns about challenges in the water sector for youngsters;
4. Promotion of Water technology heroes and elevate the importance of water professionals at home, in school, and in the media.

CAPACITY BUILDING FOR INTERREGIONAL COOPERATION

1. Orchestration of the local stakeholders to develop very specific project concept notes and apply for national and international funding;
2. Industry stakeholder workshop, defining the role of Cluster organisation within the water industry for improved interregional collaboration. The workshop should address questions about water industry jobs, related needs and consequent problems that can be addressed via improvements within the interregional collaboration;
3. Informative sessions via stakeholder meetings and social media posts regarding the up-to-date development in the water technology sector;
4. Informative sessions regarding potential funding opportunities, e.g. Water smart territories, Water4All;
5. Informative sessions on the international conferences and other engagements to network or publish the recent breakthroughs in the region regarding water technologies.

ENABLING THE INTERREGIONAL COOPERATION

1. Finding the information and representation agents and ensuring proper resources for the lobbying of the national stakeholder interests on an international scale.

OVERALL CAPACITY BUILDING FOR THE TALENT DEVELOPMENT

1. Awareness-raising for youngsters about challenges in the water sector;
2. Sharing for a wider audience the opportunities in the water technology field, e.g. vacancies for PhD training positions.

ALIGNMENT OF THE CURRICULUM ACROSS EDUCATIONAL LEVELS

1. Predefinition of Industry needs related with education in the level of Vocational Educational & Training (VET). The development of the VET study program "Technician of Environmental Equipment" (EQF 5) is dedicated to lifelong learning purposes for operators already working in companies and young people in RTU agency Olaine Technology college, Daugavpils, Vidzemes Design and Technology College, Smiltenes vocational school;
2. Application of modular-based study principles in the study program "Technician of Environmental Equipment" in cooperation with the National Centre for Education of the Republic of Latvia;
3. Synchronisation of study programmes of Olaine Technology college (EQF 4-5) and RTU (EQF 6) in wastewater treatment and biotechnology. Cooperation between both institutions in the study process - exchange of teachers and infrastructure;
4. Involvement of Olaine Technology college students in RTU study course "Vertically Integrated Projects" dedicated for the development of ideas/methods/prototypes in multidisciplinary and different levels (EQF 4-8) teams;
5. Engaging the secondary school teachers in the process of mentoring the children interested in the water sector to pursue a career of an engineer.

INTERREGIONAL COLLABORATION ON HIGHER EDUCATION

1. Experience exchange for students (EQF 4-6) in summer schools among Latvia, Netherlands, Czech Republic, Malta, Scotland;
2. Involving the global citizenship and environmental awareness education already from EQF 1-2;
3. Development of Vocational education and training program, supporting the needs of regional SMEs and municipal companies towards specialists in the water sector and change in professional qualification (in line with lifelong learning);
4. Vocational education (EQF 3-4) for the water industry includes a lifelong learning process for older people. Lifelong learning can be addressed through funding call 1.2.2.1. "Support for the training of employees";
5. Support the development of and engagement in fun, interactive recreational water awareness and STEM activities;
6. Develop public education initiatives that break down stereotypes about technical and vocational training;
7. Invest in STEM and water challenge awareness teaching, so it becomes a more attractive career path;
8. Attract diverse demographics into STEM and solve water challenges through mentorship and redefining what it means to work in companies representing the water sector.

CONCLUDING REMARKS

The critical mass for a sustainable water technology ecosystem can be built if a symbiotic relationship across multiple factors is ensured. The exposure to the impact and importance of water management in a sustainable future for our planet is crucial, starting from the pre-school level where values are being established up to the PhD level where technical knowledge is applied to solve the most significant challenges in the sector is facing. International collaboration intertwined through all levels of education is a prerequisite for establishing a collaborative and open-minded approach in building the critical mass. Furthermore, the ability of the sector to grow and emerge as internationally competitive lies in the ability to discover and act upon the unique value proposition that the sector can provide. Nevertheless, to create systematic and sustainable growth, the quality of the national business and research environment is paramount. It influences the degree of sophistication of company operations and strategy at scale.

It is essential to understand the niche competencies of the sector to find the right fit of the Latvian Water technology sector in the scope of the European and global market and policymakers to clear the path for the sector stakeholders to develop and scale. The framework for the challenges that have to be solved globally is no different in Latvia. Although Latvia is rich in water resources, water technology plays an essential role in the social challenges that Latvia and many other countries face, e.g. in Agriculture, Water & Food, Key Technologies, Energy Transition and Sustainability.

A real success can be achieved if all the critical elements are aligned - both overarching and targeted policy instruments, critical funding synergies, education pipeline for talent development, enabling environment with research infrastructure and an application centre and demonstration site for fast-paced innovation development.

An important aspect that needs to be improved in all regions is communication among the stakeholders—both in terms of the policy development and the overall status quo of the sector. The sector leaders in each region should improve the information flow regarding the technological possibilities of industry 4.0. The latest advancements in the technological possibilities for the sector should be linked to real benefits for the companies. An improved understanding for the stakeholders is needed to highlight the importance of international collaboration in creating the global value chains that can significantly fast-track the implementation of Industry 4.0 solutions.

Latvia as well the other two regions, believe that the ERDF can support interregional cooperation by

1. supporting better communication channels (and communicators) and practices that lead to better policy creation that fits the development trajectory of the water technology sector;
2. supporting the development of the education system with the curriculum that includes the elements of Education 4.0 and the awareness of global citizenship;
3. supporting the creation of islands of excellence and, among many projects, funding projects that are aligned with the strategy of sector development and include international stakeholders;
4. developing the scope and conditions for the projects that facilitate increased competitiveness, growth and jobs of the participants (requires companies to grow, adopt new technologies in the field, and facilitate the partnership between companies in the sector);
5. supporting the advancement of the capacity to prepare excellent international research projects (as the funding is mainly project-based).

ANNEX 1: EXPECTED NATIONAL FUNDING INSTRUMENTS

National development plan 2027 context	Roadmap	Specific Aspect	Specific Objective
Balancing the funding structure throughout the research and innovation cycle, matching research and innovation capacity with business needs for new opportunities and market development	Critical mass	Business development	1.2.3.SAM
Promotion of digital transformation (digitisation, automation, robotisation, artificial intelligence, etc.) in business, incl. Manufacturing	Critical mass	Business Digitalisation	1.2.2.SAM
Increasing the availability and accessibility of the physical and digital environment in the state and municipal infrastructure, as well as promoting the use of digital solutions by increasing the digital skills of the population, improving the electronic identification and secure electronic signature system and ensuring the accessibility of quality services	Critical mass	System Digitalisation	4.2.4.SAM
Creation of public infrastructure promoting entrepreneurship, based on the specialisation of territories defined in territorial development planning documents and current demand of private investors to motivate regions to create new products and services, increase productivity, diversify business, use innovation and competence transfer opportunities and attract qualified workforce	Critical mass	Infrastructure development	5.1.1.SAM
Reducing the economy's greenhouse gas emissions through climate change mitigation solutions and climate technology breakthroughs, and ensuring increasing carbon sequestration towards climate-sustainable economic development through targeted energy efficiency and decarbonisation of the transport system.	Critical mass	Infrastructure development	2.1.3.SAM
Achieving an increase in the proportion of high and good quality surface and groundwater bodies, as well as improving the condition of inland water bodies and the marine environment and protecting groundwater resources by reducing anthropogenic pressures, incl. the harmful effects of sewage on natural resources and the environment, ensuring the establishment of the necessary infrastructure and promoting the treatment of sewage sludge.	Critical mass	Infrastructure development	2.2.1.SAM

More efficient use of local resources, incl. the application of ecodesign principles and the introduction of a circular economy in the various sectors of the economy, in particular the achievement of higher standards and the use of innovation in the food chain and animal health in accordance with the "one health" principle;	Critical mass	Business process development	2.2.2.SAM
Promoting the change of public behavior patterns and habits, raising awareness of the environment and sustainable management of natural resources.	Human Resources	Envionmental education	2.2.3.SAM
Promoting the change of public behavior patterns and habits, raising awareness of the environment and sustainable management of natural resources.	Human Resources	Envionmental education	2.2.3.SAM
Promoting the change of public behavior patterns and habits, raising awareness of the environment and sustainable management of natural resources.	Critical mass	Digital infrastructure	2.2.3.SAM
Achieving an increase in the proportion of high and good quality surface and groundwater bodies, as well as improving the condition of inland water bodies and the marine environment and protecting groundwater resources by reducing anthropogenic pressures, incl. the harmful effects of sewage on natural resources and the environment, ensuring the establishment of the necessary infrastructure and promoting the treatment of sewage sludge.	Human Resources	Water education	2.2.3.SAM
Attracting research human resources and capacity building by allocating financial resources to significantly increase the number of doctoral students and funding for one doctoral student, implementing a postdoctoral funding program, attracting foreign researchers, especially diaspora professors and young researchers, funding Latvian talent studies at the best foreign universities and providing conditions for such investment national development through greater involvement in international cooperation, in particular through research in the priority areas of science and the achievement of the objectives of the Smart Specialization Strategy	Internationalisation	Mobility	1.1.1.SAM

Attracting research human resources and capacity building by allocating financial resources to significantly increase the number of doctoral students and funding for one doctoral student, implementing a postdoctoral funding program, attracting foreign researchers, especially diaspora professors and young researchers, funding Latvian talent studies at the best foreign universities and providing conditions for such investment national development through greater involvement in international cooperation, in particular through research in the priority areas of science and the achievement of the objectives of the Smart Specialization Strategy	Internationalisation	European Partnerships	1.1.1.SAM
Attracting research human resources and capacity building by allocating financial resources to significantly increase the number of doctoral students and funding for one doctoral student, implementing a postdoctoral funding program, attracting foreign researchers, especially diaspora professors and young researchers, funding Latvian talent studies at the best foreign universities and providing conditions for such investment national development through greater involvement in international cooperation, in particular through research in the priority areas of science and the achievement of the objectives of the Smart Specialization Strategy	Human Resources	Excellence inflow	1.1.1.SAM
Effective implementation of a three-pillar funding model with performance and innovation incentives in higher education and science through the establishment of public research programs and market-oriented research programs for joint R&D between the public and private sectors necessary for long-term strategic development of sectors, especially in smart specialisation strategies	Critical mass	R&D projects	1.1.1.SAM
Strengthening scientific excellence to address societal challenges through the development and sharing of national research infrastructures, strategic engagement, including diaspora researchers, (co-financing, refinancing, complementary actions) in European and global research and innovation initiatives and activities strengthening R&D competitiveness and international openness	Critical mass	Excellence centers	1.1.1.SAM
Ensuring the quality of pre-school education for all children of the respective age, renewal and arrangement of work environment and infrastructure.	Human Resources	Pre-school equipment	4.2.1.SAM

Ensuring the quality of pre-school education for all children of the respective age, renewal and arrangement of work environment and infrastructure.	Human Resources	Pre-school equipment	4.2.2.SAM
Qualitative implementation of new curricula and approaches in general education and dissemination of good practice in learning approaches, with particular emphasis on entrepreneurship and digital skills, education for sustainable development and future skills development (creativity, flexibility, adaptability), STEM / STEAM skills (including interest education), improvements in the learning environment, incl. introducing digital solutions, individualisation of the educational process and talent development initiatives, high-quality and comprehensive interest education activities (including in the school environment), effective career education and strengthening the school's cooperation with parents and other relevant partners	Human Resources	Curriculum development	4.2.2.SAM
Ensure a full-fledged higher education quality assessment process to guarantee the quality of higher education and promote the internal quality culture of higher education institutions, including by reviewing the possibility of introducing cyclical accreditation in 2024, achieving an optimal number of high quality study programs student-centered offer for qualification acquisition and retraining, establishing doctoral studies in accordance with international standards, introducing a tenure system for academic staff, strengthening the introduction of new technologies, as well as developing digital skills and STEM / STEAM competencies in the study process	Human Resources	Curriculum equipment	4.2.1.SAM
Implementation of modern and effective higher education management, involving business organisations more in strategic decision-making, strengthening specialisation and excellence, digitalisation of studies, ensuring implementation of education quality monitoring system, development and improvement of student-centered educational skills for university teachers, especially in STEM / STEAM sectors, remuneration and achieving a higher proportion of highly qualified foreign teachers	Human Resources	Digitalisation	4.2.2.SAM

Ensure a full-fledged higher education quality assessment process to guarantee the quality of higher education and promote the internal quality culture of higher education institutions, including by reviewing the possibility of introducing cyclical accreditation in 2024, achieving an optimal number of high quality study programs student-centered offer for qualification acquisition and retraining, establishing doctoral studies in accordance with international standards, introducing a tenure system for academic staff, strengthening the introduction of new technologies, as well as developing digital skills and STEM / STEAM competencies in the study process	Human Resources	Excellence	4.2.2.SAM
Strengthening vocational education institutions as centers of sectoral excellence and innovation, especially in the areas of smart specialisation, by creating a flexible learning and adult education offer adapted to the development of sectors, promoting inter-institutional and international cooperation and introduction of new technologies	Human Resources	VET-industry	4.2.2.SAM
Strengthening vocational education institutions as centers of sectoral excellence and innovation, especially in the areas of smart specialisation, by creating a flexible learning and adult education offer adapted to the development of sectors, promoting inter-institutional and international cooperation and introduction of new technologies	Human Resources	VET-industry	4.2.2.SAM
Promoting adult interest and involvement in lifelong learning by strengthening high-quality and flexible adult education provision and expanding access, making effective use of the resources of educational institutions and adult education centers, building skills funds, promoting employer and sectoral investment and employee motivation, ensuring so-called second chance education, in line with labor market trends	Human Resources	Lifelong learning	4.2.4.SAM
Implementation of smart specialisation strategy in 5 specialisation areas: knowledge-intensive bioeconomy; biomedicine, medical technology, biopharmaceuticals and biotechnology; smart materials, technologies and engineering systems; smart energy; information and communication technologies	Human Resources	Excellence	1.1.2.SAM

Increasing the availability and accessibility of the physical and digital environment in the state and municipal infrastructure, as well as promoting the use of digital solutions by increasing the digital skills of the population, improving the electronic identification and secure electronic signature system and ensuring the accessibility of quality services	Critical mass	Digitalisation	1.3.1.SAM
Strengthening universities as innovation centers for world-class knowledge creation, transfer and smart growth, including the implementation of doctoral studies in line with international standards and training of public sector specialists, improving links with companies and the labor market with a focus on knowledge-intensive products and services, supporting research-based studies and learning excellence by modernising the learning environment, international cooperation and internationalisation, strengthening national regional and sectoral knowledge partnerships	Human Resources	PhD and Msc grants	1.1.1.SAM
Considering that Measure 4.1.7 of the NDP is not directly aimed at energy efficiency measures, but mainly complex investments in modernisation of infrastructure and educational programs of vocational education institutions and colleges are envisaged, request to transfer the investments marked in NDP measure 417 from PO2 to PO4 in charge 4.2. Priority title “Education, skills and lifelong learning” 4.2.1. SAM Improve access to inclusive and quality services in education, training and lifelong learning by developing infrastructure.	Human Resources	VET infrastructure	4.2.1.SAM
Promoting adult interest and involvement in lifelong learning by strengthening high-quality and flexible adult education provision and expanding access, making effective use of the resources of educational institutions and adult education centers, building skills funds, promoting employer and sectoral investment and employee motivation, ensuring so-called second chance education, in line with labor market trends	Human Resources	Lifelong learning	4.2.4.SAM