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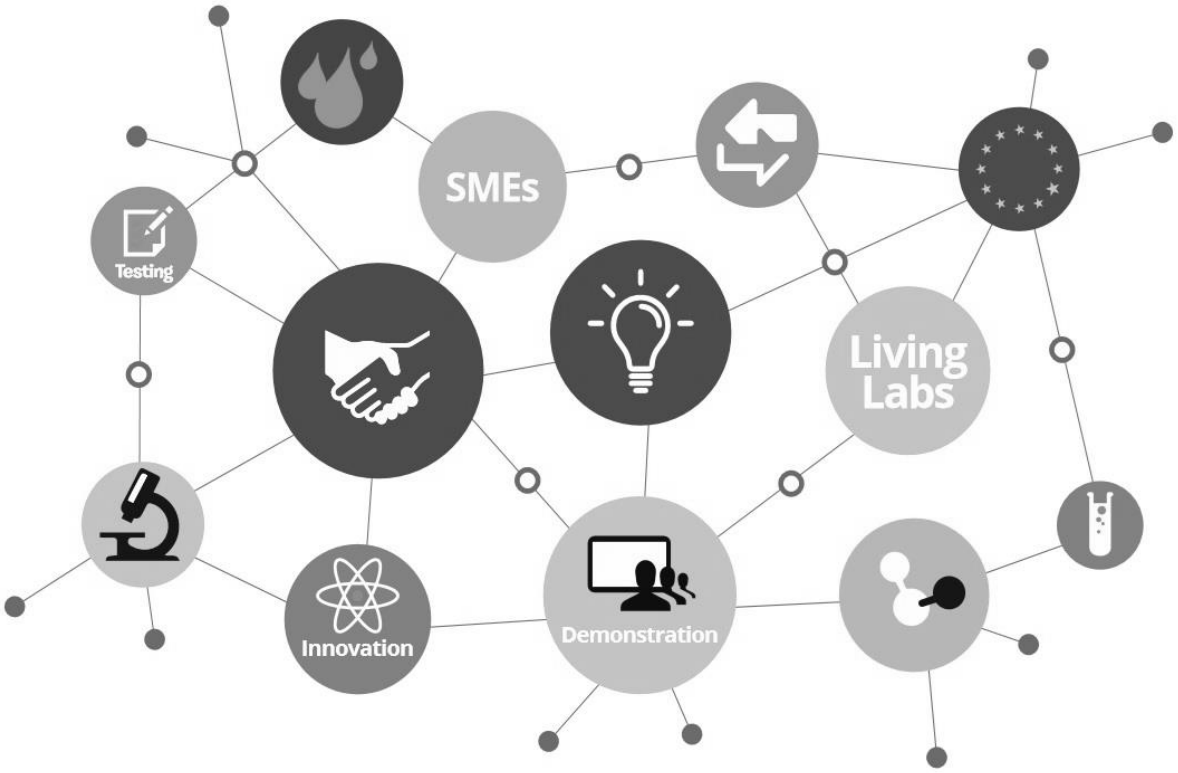

REGIONAL INNOVATION SYSTEMS FOR WATER TECHNOLOGY

REPORT ON MODEL, EXPERIENCES, BEST PRACTICES AND FINANCING REGIONAL ECONOMIC POLICY ON WATER TECHNOLOGY FROM AROUND THE EU. INCLUDING THE ROLE OF REGIONS IN DEVELOPMENT AND THE OPERATION OF DEMO SITES.

T. H. VAN BALEN

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THE WATER TEST NETWORK

PREFACE

At first, doing an internship at the province of Fryslân for mostly desktop research seemed illogical. I was working on a Interreg project called the Water Test Network were the province of Fryslân was involved as a sub-partner. Therefore, almost no one else in the province was involved in the work I did. However, the added value of an internship at the province of Fryslân was immediately apparent in the first month. By this opportunity I had a look behind the scenes. Not only how a province works, but also how Interreg projects are executed and the different political interests' regions and stakeholders have in the same project. So, I worked on a project on my own but I mostly learned lessons due to the conversations I had with colleagues and their experiences with other projects. During this internship, I have become aware of the fact that Interreg projects serve a greater goal and that despite stakeholders having different interests, this project also contributes to improving the quality of liveability in Europe.

Furthermore, I learned a lot at the time writing this thesis. Not only at a scientific level but also on personal level. It was my supervisor Eric Vos who taught me that doing research is more than sitting behind a computer and that personal contact with other partners, especially in Interreg projects, is important as well. I would also like to thank Eric for his recommendations and guidance during my internship. With his years of expertise and critical notes during our conversations he made the concept of water technology understandable in times I was buried under new information. The internship he offered was interesting but also challenging and I advise everyone to accept such an opportunity with both hands.

Furthermore, my thanks go to Stefan Bergsma of Water Alliance. I am not only grateful for the time he spend as my interim supervisor, but also for putting me in contact with the right stakeholders were necessary. Despite his busy schedule Stefan was always willing to offer assistance.

Finally, I would like to thank my supervisor and first assessor of this masters' thesis, dr. Arjen Edzes. His perspective and comments were an added value to put me in the right direction at the time writing this thesis. Sometimes it is necessary to look at a certain topic from a broader perspective and that is exactly what Arjen pointed out to me.

Thomas van Balen
Leeuwarden, 5 Juni, 2020

SUMMARY

Water is a scarce product, only 0,4% of the total water amount is available for human consumptions. With a rising world population and an ongoing climate change the pressure for water consumption will grow in the upcoming decades. To tackle this scarcity, water is one of the key subjects of the European union. Through innovation in water technology and policymaking the EU is aiming at solving future scarcity issues. Therefore, Interreg North-West Europe Water Test Network was launched in 2018. The aim is to establish a transnational network of test facilities which can be used by SMEs in North-West Europe (NWE) to test, demonstrate and develop new products for the water sector. In this way, new innovations will be developed and it will accelerate the time from idea to market.

To reach this goal, stakeholders in the water sector but also policymakers who want to strengthen innovation need to collaborate. However, this collaboration differs per region across Europe. These innovation systems for water technology are abstract and cannot be defined according predetermined rules. Therefore, comparing innovation systems is not doable if one is focused at the output, since the systems do have different purposes. Especially for water technology, a sector which is highly fragmentated and intertwined into other sectors. As a result this report is focused at the input. There are some indispensable characteristics needed for a regional innovation system; an active government, universities / research institutes and an industry. For the water sector, which is fragmentated, cluster organisations are recommended to act as a network among the industry. Yet, a regional innovation system is also influenced by regional characteristics and specific policies which are in place.

To tackle the issues a fragmentated market brings, a mixed method research is conducted to map the characteristics of the regional innovation systems of the regions collaborating in the WTN project. Based on desktop research a top-down approach is applied to water (technology) policies and how they affect the innovation system. Furthermore, Eurostat data is used to compare the regions at NUTS2-level. Due to questionnaires with the (sub)-partners of the WTN, the regional characteristics of the innovation systems are portrayed. Thereupon, small interviews are conducted to derive inter-relationships between the stakeholders of an regional innovation system.

This resulted in 6 different portrayals of innovation systems which are compared according the determinants for regional innovation systems. However, input differs per region and therefore the output varies by region. Main reason for this, are the different scopes water technology can have. In a broad sense, the water sector has 3 main purposes: stimulating the regional economy, solving environmental issues and as enabling industry for other sectors. All purposes do foster innovation in water technology but the aim varies per region. Although, roles of regional authorities differ, there are also similarities. Peripherical regions make use of managing programmes with the intention to benefit the regional economy. European core regions act more as a facilitator. Based on the scope and how specific regions act on water technology, financing gets more complicated as well. In general, water technology and innovation is funded at 3 different institutional levels, European, national and regional. Whereas, the intention for these funding differs in forms of cluster policy, economic policy or environmental policy. Therefore there is not a one-size fits all approach regarding innovation systems in water technology. Regional governments use different methods to achieve different goals, it is rather a matter of perspective. With an unclear definition and different scopes, issues which should be solved first, comparing regional innovation systems for water technology is challenging and open for discussion.

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1. INTRODUCTION

Approximately 97% of water in the world is seawater and 3% is freshwater. Nearly 90% of this freshwater is not readily available, because it is stored in icecaps of the Antarctic. Of the freshwater 13% is accessible, which is only 0.4% of the total amount of water. Worldwide, water is roughly used for three main purposes; agricultural uses (69%), industrial uses (23%) and domestic uses (8%), all being vital activities for communities and economies to survive (Oki & Kanea, 2006; Shiklomanov, 1993). With rapidly growing demand for water, providing the global community with access to freshwater is a major challenge for the coming decades. In addition, providing society with access to sufficient quantities of freshwater assuring and improving its quality also requires serious attention given rapid demographic growth and increasing levels of urbanisation and ongoing industrialisation. Recent decades have shown that human activities caused that many different types of pollutants, like chemicals, minerals, metals and water-born-diseases have found their way in freshwater (eco-)systems. Water quality management systems are increasingly needed to maintain and improve basic health and sanitary requirements, both for communities and industries. Innovation is therefore necessary.

However, there are barely new techniques used within the water sector. Water management as a whole sees few innovations (Krozer, Hophmayer-Tokich, van Meerendonk, Tijsma, & Vos, 2010). Partly, this phenomenon can be explained due the high costs of pre-commercial testing. These new techniques often requires on site test locations and explicit knowledge which is costly at operation scale. On the other hand, investors are reluctant to invest in unproven technology. Being a pioneer in a market is risky and it can absorb many resources. Therefore, companies turn into an imitation strategy; copying others and taking advantage of the innovators (Zheng Zhou, 2006). Due these constraints it could take up to 15-20 years to bring new technologies into the market (Water Test Network, 2018). To foster innovation within the water technology sector in Northwest Europe, an Interreg-project[1] started in 2018 between 7 partners and 5 countries (table 1). The aim is to decrease the time to market for innovative products within the water technology sector. Water Test Network and thereby the partners (onwards WTN) will help and facilitate SME's from across Northwest Europe to test their innovative water technologies at Technology Readiness Level (TRL) 5-8 (Héder, 2017).

Partners of WTN	Sub partners	Country	NUTS2-level: Region
1. Scottish Water: *Lead partner*	None	United kingdom	Eastern Scotland (UKM2)
2. James Hutton Limited	None	United kingdom	North Eastern Scotland (UKM5)
3. DVGW Water Technology Centre (TZW)	None	Germany	Karlsruhe (DE12)
4. VITO NV	1. De Watergroep 2. Ghent University	Belgium	Province of West-Flanders (BE25)
5. Centre of Expertise Water Technology	1. Province of Friesland 2. Water Alliance	The Netherlands	Province of Friesland (NL12)
6. French Geological Survey (BRGM)	None	France	Centre-Val de Loire (FR2)
7. Water board Vallei and Veluwe	1. Cleantech Region	The Netherlands	Province of Gelderland (NL22)

Table 1: The Interreg Partners Water Test Network and their business location.

This will be achieved by creating an international network between the partners, the test facilities and the SME's in the United Kingdom, The Netherlands, Belgium, France and Germany. These test sites can be used by all kinds

[1] Transnational programme to support innovation in Northwest Europe.

of SME's[2] who do want to test new products which are related to water technology. The test facilities all have their own characteristics. By working closely with the SME's, the Water Test Network can provide the right facility to the needs of any company. Because of this network, a wide scope is provided for different tests on various operational levels. Every test location does have its own unique water type which can be used for various research purposes.

Test Sites of the Water Test Network	
1. De Blankaart. Diksmuide, Belgium	8. Wetterskip Fryslân Municipal Wastewater Treatment Technnologies. Leeuwarden, The Netherlands
2. VEG-i-TEC. Kortrijk, Belgium	9. Sentec - Sensor Test Centre. Glimmen, The Netherlands
3. DVGW Water Technology Centre (TZW). Karlsruhe, Germany	10. Waste Water Treatment & Resource Recovery Centre. Apeldoorn, The Netherlands
4. Antonius Hospital. Sneek, The Netherlands	11. Bo'ness Waste Water Development Centre. Bo'ness, United Kingdom
5. Dairy Campus. Leeuwarden, The Netherlands	12. Gorthleck Water Development Centre. Near Inverness, United Kingdom
6. Water Application Centre. Leeuwarden, The Netherlands	13. James Hutton Limited. Aberdeen, United Kingdom
7. Wetsalt Desalination and Blue Energy. Harlingen, The Netherlands	14. Prime. Orleans, France

Table 2: List with (active) test sites of the Water Test Network

Because of the WTN, companies within the water technology sector are offered an integrated package of support which is divided into the following three components:
1. An investigative report which analyses the development and support needs of the SME and their proposed technology.
2. Access to a test facility to allow the SME to test their technology.
3. Support with validation and verification to assist market entry, where necessary.
Source: (Water Test Network, 2018)

This approach could lead to more market efficiency. Its purpose is to shorten the time to market and the increase of proportion reaching the market. This must stimulate the innovation cycle within the water technology sector so it can provide and deliver for future needs. It is not clear though, how local and regional governments do foster these innovation cycles within their region. Therefore, this study is focused on the input from local and regional authorities within the WTN and good practices from around the EU. To provide insight in the role of the active regions who do or do not collaborate with the partners of the WTN. The aim of this research is to draw an image of the model, experiences, best practices, financing and the regional economic policy on water technology to foster innovation. Based on available literature and policy documents, this study compares the different methods, instruments and inputs at various policy scales for the regions involved in the Water Test Network to foster innovation. Specific data is conducted via a mixed method research. Based on the available policy documents, a survey is conducted among the partners of the WTN to gather more insight at specific subjects which are not available in online documents. To broaden the scope and to map the underlying thoughts, interviews are conducted to collect more information about the underlying thoughts behind certain regional policies. With this research, the regions of the WTN can learn from each

[2] an organisation with no more as 250 employees and a turnover of at most €50 million (European Commission, 2016).

other and share their knowledge and policies based on where the different regions stand in the conceptual model (chapter 2.7).

There are different issues which have to be addressed before deriving results from the data. First of all, the water technology sector is an integrated sector with shares in all kinds of sectors. Therefore, the water technology sector in Europe as a whole is hard to define. As a result, definitions differ per country or even per region (Allouche, Finger, & Luís-Manso, 2008). This might have its impacts on results for regional or national economies when the impact of the sector is assessed. Secondly, policy on water technology is made on different institutional levels. Sometimes it is even made at multiple levels simultaneously. Taking this into account, a comparative study between policies from different regions in Europe about water technology does lead to strong results at the regional or national level on economic effects. Therefore, this study is a starting point for regions on how they could provide services for the stimulation and innovation of water technology.

Followed from the implications based on different institutional levels and definitions for water technology this report answers the following main question:

TO WHAT EXTENT DO REGIONAL AND LOCAL GOVERNMENTS INVOLVED IN THE WATER TEST NETWORK DIFFER IN APPROACH TO FOSTER INNOVATION IN THE WATER TECHNOLOGY SECTOR?

Based on the main question above there are four sub questions which gives insight in formulating conclusions about policies and the regional influence. With these conclusions one is capable to answer the main question:

1. WHAT ARE THE CHARACTERISTICS OF THE REGIONAL INNOVATION SYSTEMS OF WATER TECHNOLOGY IN EUROPEAN REGIONS?
2. WHAT IS THE ROLE OF THE REGIONAL GOVERNMENT WITHIN THE ECONOMIC POLICY AND ITS CHARACTERISTICS?
3. AT WHAT INSTITUTIONAL LEVEL DO REGIONS ACT ON WATER TECHNOLOGY INNOVATION?
4. WHICH POLICY INSTRUMENTS DO THE REGIONS USE TO STIMULATE INNOVATION IN THE WATER TECHNOLOGY SECTOR?

Answers to sub-question 1 describe the region and its characteristics. Research is conducted for the regions who are involved in the Water Test Network. To make use of European data, the regions were compared at a NUTS2-level[3]. Main reasons to choose for these territorial units at a level 2 scale are the benefits of these regional levels. Most of the NUTS2-regions are already existing administrative boundaries within the member states. However, the NUTS2-level operates at a regional level which means that the region has a minimum of 800.000 inhabitants and a maximum of 3 million inhabitants. Therefore the data of Eurostat, which is used in this paper, is often used to compare the administrative boundaries. Thus, data at NUTS-level ensures harmonised data at regional level which is comparable between the regions of the WTN. Hereby, it is suitable for socio-economic analyses. Furthermore, a lot of policy interventions are made at NUTS-levels since it corresponds with national administrative boundaries (Eurostat, 2015).

Yet, policy instruments are available at different administrative scales. So to answer sub question 2 and 3, a study to water technology and innovation is conducted via a top-down approach from wide European policy instruments to more specific regional policy instruments for the regions within the WTN. The expectation is that there are differences in policy for the participating regions. Some regions will be influenced from national policy and other regions will have their own policy on water technology. It might be the case that some regions do not have a policy on water technology at all but that water technology is embedded in a broader topic. Or the partners involved in the WTN are not aware that there is policy within their region to stimulate water technology. This must be apparent from survey questions based on the available policy notes. To know more about the

[3] Nomenclature of Territorial Units for Statistics (NUTS) at a regional (2) level.

motives how and why the partners act on the policy, what applies in their regions, interviews are conducted which lead to answers on sub question 4.

Based on socio-economic analyses of the regions participating in the WTN on a NUTS2-level, a study of the different policy notes at different administrative levels and survey questions derived from the policy notes together with in-depth interviews to map the motives behind certain actions an answer is given on the main question. This will result to conclusions for every region involved (chapter 6).

1.1 DEFINITIONS

To demarcate the playing field of this research, the definitions of the following subjects are used within this paper. In literature, such as reports of governmental institutions or consultancy firms various definitions are used to describe the water sector as a whole and the water technology sector (Krozer etal., 2010). Some countries do have numbers about firms who are considered to belong in the water sector. Sometimes, regions did their own research about the water sector. However most studies refer to an exact numbers of companies who are considered as belonging to the water sector (Allouche, Finger, & Luís-Manso, 2008). Yet it is unclear which company or institution belongs to the water technology sector since there is not any data available for statistical purposes to set a clear definition. Most companies who are in the water sector are often intertwined within other sectors . For example soda factories and beer brewers, who do need water as a vital product for their production but who are not considered to be within the water sector. As a result, the water sector can be defined in different ways which leads to different outcomes. Therefore it is necessary to set a clear line to define water technology and the water sector in this report.

WATER TECHNOLOGY SECTOR

The water chain is hard to define since water is used within all kinds of other sectors, therefore the water sector does have a broad scope (Bogardi, et al., 2012). Based on the purpose of the Water Test Network this study describes water technology as below.

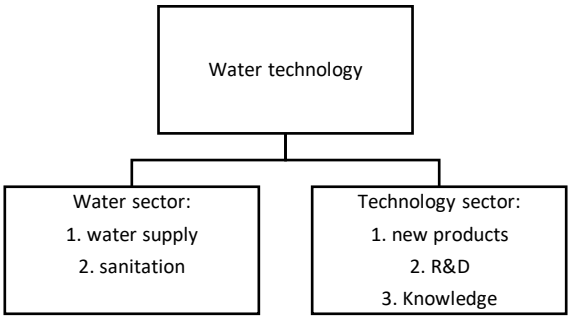


Figure 1: Water technology divided into its different segments

Water technology includes:

Drinking water, process- and industrial water, waste water treatment, reuse of water (for instance recovery of energy or nutrients) and sensor technology. All activities that treat or process water in one way or another with use of technology. all technologies and technics that are being developed and used for treatment of water due the use of R&D from knowledge institutions as seen in figure 1. (Reitsma & van der Hoek, 2015).

It is not defined as:
Delta technology: dikes, dredging, water management and nature and environment protection. Maritime technology: ship building and repair, off shore activities and harbour services.

INNOVATION IN THE WATER TECHNOLOGY SECTOR

The aim of the Interreg-project is to stimulate innovation within the water technology sector. This goal has to be reached with the development of test sites for the use of SME's to shorten the time to market for their innovative products. However innovation is a concept which could be implemented in different ways. In this study innovation is divided into two subjects, technological improvement and improvement in policy and governance (Science for Environment Policy , 2015). Although, innovation is a vague concept over time used in different concepts for various reasons within the water sector. Therefore, a distinction is made for innovation in the water sector based on the work of Moore, et al., (2014).

Innovation includes:

On the one hand, technological improvement. The process to establish new products or a changing manner to produce new products. This is in line with Schumpeter's (1941) view on innovation, 'doing things differently' and his theory of creative destruction (Reinert & Reinert, 2006). In his research, innovation is defined as a paradigm shift. As seen in figure 2, where innovation of the past years is divided into different waves. As soon as new techniques occur, who are more suitable and creative than the methods or products used before, the old technique will come to an end due to 'creative destruction'. This is also related for products established due SME's within the WTN. Their products could have significant impacts which might lead to fundamental changes in the water sector and other sectors as well. It can be argued that the WTN supports the 6th wave to green technology and sustainability. (Schumpeter, 2010).

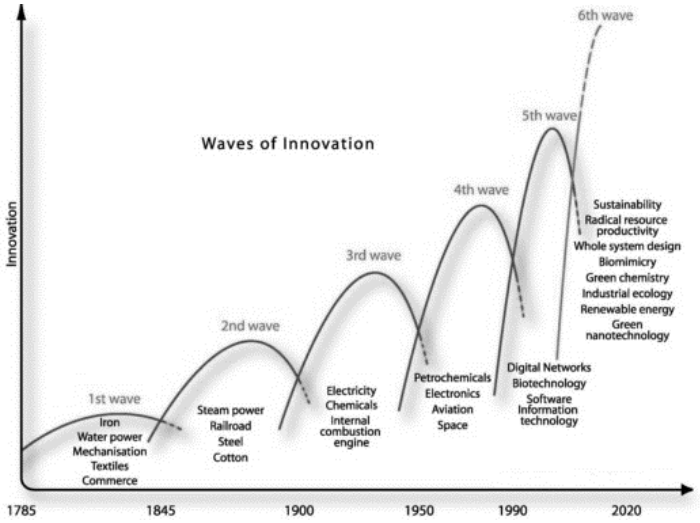


Figure 2: The innovation shifts proposed by Schumpeter (1941). Source: The Natural Edge project (2004).

On the other hand, innovation in the water sector implies fundamental changes in policy within different themes that support water technology. A definition is made, based on the work of Moore, et al., (2014) who conducted research about water-policy-literature in a 5 year time frame from 2009 till 2013. Their findings about definitions for innovation in water policy where very diverse. For policy makers and practitioners there is not a clear definition to maintain. Therefore they divided the used definitions into different themes which will be used in this report (table 3). Thereby, this study compares per region if every theme is present or not.

INVOLVED REGIONS OF THE WATER TEST NETWORK

The regions covered in this report are simultaneous as the regions of the partners within the WTN. However, the involved regions in this case are defined as the regions who facilitate test sites in their area. These 8 regions (NUTS level 2) are considered to be part of the WTN (figure 3). In Scotland there are 3 regions who do collaborate with each other; Highlands and Islands, North Eastern Scotland and Eastern Scotland. In The Netherlands 2 regions are taking part of the WTN; the province of Friesland and the province of Gelderland. Furthermore Germany, France and Belgium are all involved with one region, which are consecutively Karlsruhe, Centre-Val de Loire and the province of West-Flanders. Together they host 14 test sites of which almost half of them are located in the province of Friesland, the Netherlands. All partners (table 1) are supposed to have contact with their relevant local authorities (Interreg North-West Europe, 2018). Therefore it is likely that the partners and test facilities are influenced by policy programs. However, this might differ per region and institutional level. To gather more insight into the policy instruments for regions in the WTN, a top down approach is applied.

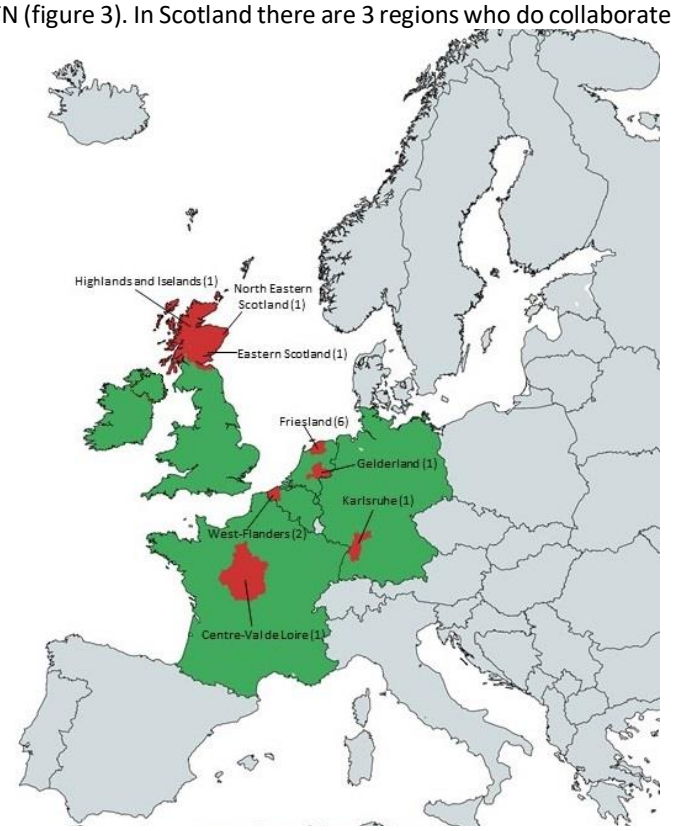


Figure 3: The involved regions based on NUTS level 2 and the test sites within the different regions.

The European policy for water, Water Framework Directive and EIP Water [4] is embedded into national policies (European Commission, 2012). What might differ is how specific water technology is incorporated into policy notes and at what institutional level or programme.

Therefore this report distinguishes 3 different institutional programme levels:

1. National programme
2. RIS3 programme
3. Region specific programme

Nevertheless, this definition is not as clear as it seems since European regions do have the possibility to collaborate for their RIS3 strategies. In Scotland for example, the 3 regions defined in the WTN are subject to the same policy programmes (Hydronation; Scotland Can Do). On the other hand, sometimes the region specific programme is equivalent to the RIS3 strategy. For example, the French region Centre-Val de Loire. And for the region of Karlsruhe most policy is made at province (Länder) NUTS1-level. Nonetheless, with the use of a top-down approach of the policy programs it is mapped to what institutional level water technology and its innovation is implied. There could be possibilities where water technology does have its own policy or (in most cases) where water technology is embedded in other themes as circular economy or green technology.

Another influence which could have an impact on the level of innovation in the water sector are the regional characteristics and the quality of the government (Rodríguez-Pose & Di Cataldo, 2015). Therefore regional socio-

[4] Policy instruments of the European Commission to address water related issues

economic conditions are taken into account to control for these regional differences. Due to the use of NUTS2 level data for the regions in the WTN.

1.2 SOCIETAL RELEVANCE

The aim of the Water Test Network is to boost society as a whole. Due to stimulate SME's in the water technology sector to foster innovation. This must lead to a decrease in time of development for new products and an increase of innovative products reaching the market. Since the water sector is intertwined within other sectors, new products will not only serve the water sector but it could also bring prosperity in other sectors as well (Water Test Network, 2018).

This report will map the policy instruments used in the different regions involved in the WTN. Therefore, this research can be used as a starting point to learn from other regions and there best practices concerning policy on water technology and innovation. At the end of the Interreg project in 2021, the Water Test Network aims to be a self-contained network for water related problems. A platform is established where SME's can come together for specific water related issues. Because of the platform, every test facility or region does have its own expertise. In this way, specific issues can be solved at the right place where the knowledge and facilities suits the specific problem.

Governmental institutions and policy makers do see the importance of innovation in the water sector (Science for Environment Policy , 2015), yet it is unclear how to act as a region to support these trends. With this research, policy makers and other practitioners can learn, compare and apply from different policy instruments used to stimulate the smart specialisation within the water sector to foster the region to a more circular economy. At the end of the project, 6th December 2021, the purpose is to have brought 30 new technologies to the market, at least 90 innovative ideas tested and 120 SME's supported with help from the WTN.

1.3 SCIENTIFIC RELEVANCE

It is obvious that the WTN serves a societal relevance. Since the project is partly funded due the European Union in the form of ERDF funding it has to strengthen regional cohesion (Anderson, 1990). Due to this report the different stakeholders can learn from each other. In addition, the platform will be used to share knowledge which will benefit society as a whole. Furthermore, there is a scientific relevance due the fact that collaboration will lead to an increase in knowledge and innovation. For scientists within the water technology sector this might open doors to enhance research problems.

Internationalisation of scientific research in the water technology leads to a wider audience as well. Therefore it will be easier for scientists to reach policy makers and other researchers. This way, the gained knowledge is more likely to be transferred to other practitioners who benefit from the conducted research. Overall, this study closes the research gap for policy with the purpose of water technology and innovation.

2. THEORETICAL FRAMEWORK

This chapter sets out the academic research of innovation and its driving factors in European regions. At first, the difference in quality between regions in Europe is described. These different aspects lead to different interactions between determinants of innovation systems. Secondly, the triple helix model is discussed. This model and its evolution is widely used across European innovation policies for the development of a competitive knowledge-based society, yet there is some criticism on the effectiveness of the model. Thirdly, the importance of clusters in today's innovation is taken into account. A concept brought to attention by Michael Porter and Paul Krugman. Cluster development has since become a focus for many government programs. Fourthly, the determinants of regional innovation systems (RIS) are identified and analysed. These factors form the basis of an innovation system yet a measurement method is hard to conduct. Therefore understanding of the whole system is necessary. At last, innovation in water policy and its determinants are outlined. These factors together with the components available in a RIS form the basis of Regional Innovation Systems for water technology which are portrayed into a conceptual model.

2.1 GOVERNANCE QUALITY

Innovation is one of the key concepts of the European Union's 2020 strategy. The aim is to foster economic growth by stimulating high quality research, technological development and innovation. To reach the goal of a smart sustainable and inclusive economy for Europe as a whole (European Commission, 2012). To achieve these standards different instruments have been used such as the Regional Innovation Strategies (RIS3) and ERDF funding programmes. However, Europe's innovative policies have had limited success in improving the innovation potential of the in particularly peripherical regions of the European Union (Rodríguez-Pose A. , 2001). Most commonly reasons for these failures are issues such as the distance to the technological frontier (Greunz, 2003), shortages in human capital (Sterlacchini, 2008) and geographical distances to the main economic and innovative areas (Moreno, Paci, & Usai, 2005). Yet, several studies have shown that institutions do have a significant role in innovation (Asheim & Coenen, 2005). Their results showed that government institutions have an impact on organisational mechanisms and collaborative institutional structures. Most of these analyses, however, are conducted at a national level. But in the European Union (EU) strategic interventions and political programmes to stimulate innovation are set out at a sub-national level or at EU-NUTS2 level as well. This trend is reinforced due to decentralisation which leads to an increase of innovation policy domains (OECD, 2011). But at the same time more pressure and responsibilities are transferred to the local regions, who might or might not being capable to implement and design an innovation strategy based on the capacity of the subnational government institutions.

However, research of Rodríguez-Pose and Di Cataldo to the quality of public institutions of European regions based on the growth rate of patents applications has shown that there is a positive impact on governance quality and regional innovation. Yet, the results also show that a good regional authority does not influence European regional innovation systems in the same way. Policy making capacity and the level of corruption are the main factors which determine the effectiveness of innovation policies in the regions of the European Union. In core regions with high innovation potential, improvements in government quality have a small effect on patent applications but in more peripherical regions an improvement in quality of governance may have substantial benefits (Rodríguez-Pose & Di Cataldo, 2015). Based on their conclusions there is not a simple single approach to innovation policies. The same innovation strategy might lead to different results in different regions. This raises the question which factors determinate the effectiveness of regional innovation systems if a good government is in place.

2.2 THE TRIPLE HELIX MODEL

A knowledge based economy is defined as production and services based on knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advance, as well as rapid obsolescence (Powell & Snellman, 2004). However, knowledge is a concept that is tricky to define. This leads to the fact that there are no unambiguous methods to measure the effectiveness of a knowledge based economy. Henry Etzkowitz and Loet Leydesdorff in the 1990s were the first researches who theorised a framework for economic and social development. Their model is based on 3 different elements; university, industry, the government and the interactions between them (seen in figure 4). Where the government has a controlling function in the market. The Industry is responsible for the production of goods and services and the university's main objective is the generation of knowledge (Etzkowitz & Leydesdorff, 1995).

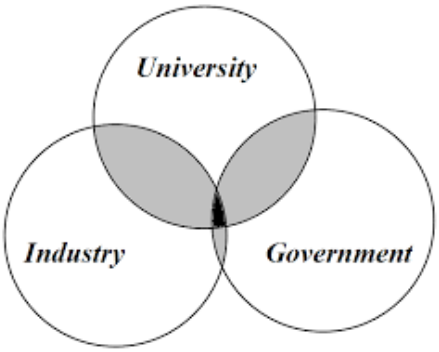


Figure 4: Triple Helix model based on the insights of Etzkowitz and Leydesdorff (1995).

Over time, interactions increase within this framework. Where each component can evolve to adopt characteristics of the other institutions. This will result in the rise of hybrid institutions. However, differences may arise and the model may develop in several ways. According the researchers, this depends on the strength of interactions between university, industry and government. In a statist model, the government is the driving force where interactions are being made by a top-down implementation. Although in a Laissez-faire model[5], the market is regulating itself. Based on the stance of the market it differs which institution is the leading force. Therefore a triple helix model differs per region. In a knowledge-based economy it is argued that universities will play a major role since education is the basis within the system (Leydesdorff, 2012)

Building on to the model of the triple helix, it was first suggested in 2009 by Elias G. Carayannis and David F.J. Campbell to add an extra component to the model; civil society. The transformation to this quadruple helix model must close the gap between innovation and civil society. Within this framework, the researchers claim that there could be a mismatch between the emerging technologies and the needs of the society. Therefore, the potential impact could be limited (Carayannis & Campbell, Mode 3 and 'Quadruple Helix': toward a 21st century fractal innovation ecosystem , 2009). A year later they even added another helix into the model; The environment (figure 5). This helix views the society and economy as drivers for knowledge production and innovation in a region (Carayannis, Barth, & Campbell, 2012). However, there is still a debate of how to define these helices. Some researchers see them as additional helices while others see them as overarching helices which influence the whole system (Höglund & Linton, 2018).

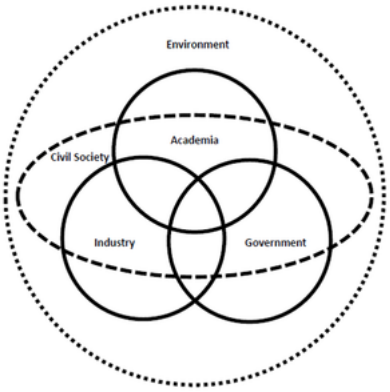


Figure 5: Quintuple helix as suggested by Carayannis and Campbell (2010)

In this thesis a distinction is made between the institutes and the environment and society. The environment and society is split up in social-, economical- and geographical factors (chapter 4). Data which can be obtained by Eurostat. The presence of a triple helix and its interaction is obtained due questionnaires and desktop research.

[5] French: laissez faire, lit. 'let do' is an economic system in which transactions between private parties are free from any form of government intervention such as regulation, privileges, imperialism, tariffs and subsidies.

2.3 CLUSTERS, A COMPETITIVE ADVANTAGE

Another important aspect of a good functional innovation system are geographical clusters. Brought under attention by Michael Porter and Paul Krugman. One would conclude that increasing globalisation, diminishing transport costs and corporate networks should lead to an decrease of importance of locations. However, it was Porter who concluded the opposite effect happened. This paradox of location in a global market is what Porter describes as a competitive advantage (Porter, 1998). So, locations do matter in today's economy. Yet, the function differs. In the past, some geographic locations such as harbours or other strategic places along trade routes did have comparative advantages. Nowadays transport costs are just one of the many inputs which determinate the location. Other aspects such as access to skills, suppliers, customers, specialised information and complementary products and services do get a raise of attention. Therefore Porter described clusters as geographic concentrations of a critical mass of interconnected companies and institutions in a particular field whereby proximity leads to shared advantages through the aggregation of expertise and specialized resources.

Paul Krugman noticed similarities in his researches. Based on his work which is now converged to 'new economic geography' he analyses the effect of economies of scale (Krugman, 1991). Due to scale up the manufacturing of products and services in a particular sector, a region can provide from lower transportation costs which creates increasing returns of scales. Krugman states that these regions with economies of scales will establish in places with high demand. However, due to concentrated nearby production demand will rise in the same places. This is where agglomerations occur, the same hotspots as what Porter calls clusters. Since then, cluster development is a focus for many policy programs in the Western world (World Bank, 2009).

Working forward on the ideas of Krugman and Porter, other researchers added the concept of innovation to the clusters. These new clusters of innovation (COI) are defined as: global economic hot spots where new technologies germinate at an astounding rate and where pools of capital, expertise, and talent foster the development of new industries and new ways of doing business (Engel, 2015). The business clusters explained how areas specialised in a particular sector gain competitive advantage due economy of scales and decreasing transportation costs. However, it did not explain why highly innovative clusters were able to support innovative growth firms who diverge from the original business cluster, an effect which raised a lot of awareness due to the success stories as Silicon Valley (Saxenian, 1994).

A cluster in the form of a hub, campus or valley can play an important role to foster innovation. Not only due the reasons mentioned before but also due the transfer of knowledge. According to Engel, There are 3 key components in an innovation-centred business cluster; Government, Universities and Entrepreneurs. These components form the basis of the cluster and are present in every region (figure 6). Yet, there roles might differ per region. This concept is almost complementary to the triple helix theory. However, a physical location or place where these institutions can transfer knowledge is sometimes not taken into account. Yet, it is at these locations where tacit knowledge[6] finds a way to transfer itself. Therefore it is argued that a physical place fosters innovation by transferring knowledge between the institutions (O'connor, 2004).

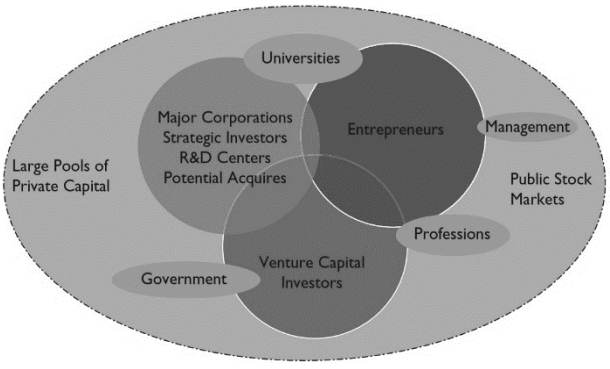


Figure 6: The cluster of innovation model (Engel, 1995)

[6] Tacit knowledge (as opposed to formal, codified or explicit knowledge) is the kind of knowledge that is difficult to transfer to another person by means of writing it down or verbalizing it.

2.4 THE DETERMINANTS OF REGIONAL INNOVATION SYSTEMS

In earlier researches, the determinants of regional innovation systems have been studied. It was de Oliveira et al., who conducted a qualitative literature review about these factors which have its impacts on RISs. Based on their findings, they suggest different factors which have its impact on regional innovation. Those factors are respectively: proximity and close relationship with Higher Education Institutions (HEI), a government system to intermediate relationships with knowledge actors outside the regional system, mechanisms of relationship network and knowledge absorptive capacity of the firms within the innovation system and public support such as incentives, funding and capable of the right infrastructure (de Oliveira, Echeveste, Cortimiglia, & Gonçalves, 2017). Based on these results the researchers came up with the conceptual model for RISs seen in figure 7. In this study, the triple helix is present as well. Although, the authors go more in depth about interrelationships between the different institutions. Furthermore, they do add extra determinants which the authors consider as public support. In their study, the writers also acknowledge the geographical distance between the institutions yet they do not mention the need of a physical location.

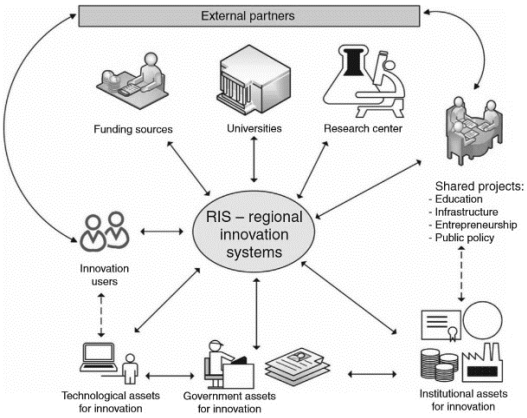


Figure 7: Components of RIS (de Oliveira, Echeveste, Cortimiglia, & Gonçalves, 2017)

In the work of Pino and Ortega (2018) *Regional innovation systems: Systematic literature review and recommendations for future research*, who conducted a systematic literature review about the evolution of RISs between 1997 and 2017, the need of this physical location becomes more clear. Due to interaction and relationships between RISs and other ISs companies and knowledge institutions increasingly interact across sectors. Therefore clusters became part of the same system. Yet, one should take into account the specificity for clusters and the sector orientation of RIS can differ (Asheim & Coenen, 2005). Clusters that rely on tacit knowledge and not so much on scientific knowledge do favour a central place where knowledge transfer is applicable.

Thereafter, the writers discuss the different methods regarding measuring effectiveness of RISs. In their study, they make a distinction between 4 different approaches: the organisational approach (1), institutional approach (2), capability approach (3) and the assessment approach (4). All methods do have their pros and cons (Pino & Ortega, 2018). However, water technology does have many cross-overs. The scope can vary between the different Regional Innovation Systems. Therefore, it is complicated to compare the RISs of the regions in the Water Test Network. As a consequence, this study examines the organisations, the institutions and the interrelationships and not their capabilities and their functionality.

2.5 NATIONAL INNOVATION SYSTEMS, AN OVERVIEW OF THE FRAMEWORK

This study is focussing on Regional Innovation Systems. However, one should take into account that stakeholders in an innovation system within a regional or constitutional boundary are often part of a wider system of National Innovation Systems. Within this research, national characteristics are not taken into account. However, these characteristics and frameworks always play a role in shaping the regional innovation systems (OECD, 1999). The OECD theorised their findings into a framework (figure 8). Based on their findings, the authors did include the triple helix system as core element. The differences between the regional system and the national system can be seen in the size of the market. Macroeconomics (e.g., product conditions, education, infrastructure and country performance). Although, the OECD acknowledge the country specific factors, corporate governance and financial systems vary per country.

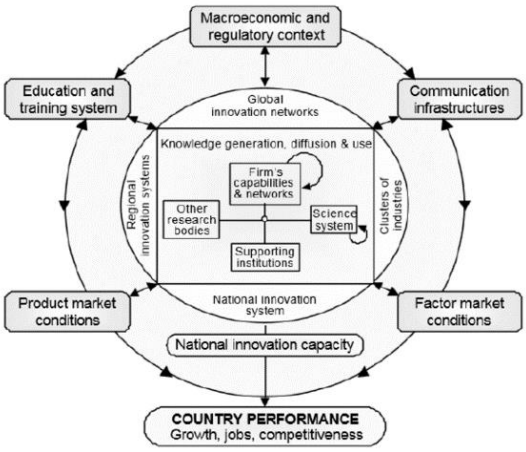


Figure 8: OECD framework of national innovation systems (OECD, 1999).

In this research, the focus lies in comparing regional systems of innovation. Therefore different problems occur. At first, the RISs are located in different countries which differ a lot in size and market factors. Comparing there macroeconomic factors is therefore hard to conduct. Secondly, due to different government systems every RIS has its own framework which is affected by national and regional policy programmes. As a result, standardisation is needed to compare RISs in different national innovation systems. To tackle this issue, data at NUTS2-level from Eurostat is used to compare economic- and social factors of the regions where the RIS is located (chapter 4). However, governance systems and policy programmes are made and implemented at different levels. Thus, comparing at NUTS2-level would result in a mismatch from policy programmes. It would even lead to a benefit for countries who are more decentralised than others. As a consequence, top down implementation for policy programmes with the focus on water technology is conducted per RIS. By doing so, the different governance systems are taken into account (chapter 5). However, an innovation system is often affected by other policy programmes as well (e.g., circular economy-, ecology- or innovation programmes).

2.6 FACTORS FOR INNOVATION IN WATER POLICY

Every regional innovation system does have the same actors. However, the scope and market often differs since the focus is not always on the same products and services. For innovation in water technology the scope is hard to define. This is not only because definitional problems but also due the fragmentated market water technology is embedded (Krozer et al., 2010). For many sectors water technology is important, it could be a subject on its own to stimulate the regional economy. Although, water technology is also a cross-over for a lot of other sectors and end-users such as the food industry, ecology and circular economy.

Therefore, it is unclear how policy makers should stimulate innovation in water technology. Moore et. Al., recognises these problems, therefore they conducted a systematic literature review in a five-year time frame between 2009 and 2013. The authors came to the conclusion that innovation is used in different terms. So, they made a typology for innovation in water policy. Based on six different themes, innovation in water policies are described (table 4). The researchers concluded that water policy is a transformative change process within complex systems.

Themes for innovation in water policy	Description
Legal and political reforms	Decentralisation of national water governance (Petit & Baron, 2009).
Policy entrepreneurs and change agents	Individuals who promote and influence policy changes.
Networks and collaborative approaches	Organisations collaborating in a network are more likely to be innovative.
Social learning	Due learning in interregional multilevel cooperation, sharing experiences and pooling the related science, new innovative solutions should be achieved (Martins, et al., 2013).
Adaptive, integrated approaches	An adaptive integrative approach underpinned water technology and innovation.
Niche experiments	The need of safe spaces for policy experiments in order to support innovation and change.

Table 3: Themes that enable innovation for water policy (Moore, von der Porten, Plummer, Brandes, & Baird, 2014).

Policy programmes are hardly to place in one theme. However, policies should stimulate and contribute to innovation defined as the table above. According the authors, innovation in water policy includes decentralisation and change agents. Since specific problems ask for customised solutions. They also recognises the importance of network collaboration to transfer knowledge and to stimulate social learning. It is argued that an adaptive and integrated approach must encourage these steps. At last, they see the importance of niche experiments. Policy makers should be able to test innovative policies at small scales to allow flexibility (Moore et. Al., 2014).

2.7 CONCEPTUAL MODEL

Based on scientific literature of regional economic factors, determinants in RISs, the working of the triple helix, clusters and themes that stimulate innovation in water policy the following conceptual model is made (figure 9). This model can be seen as a collection of different economic and innovative models which together form the factors of creating a regional innovation system in water technology.

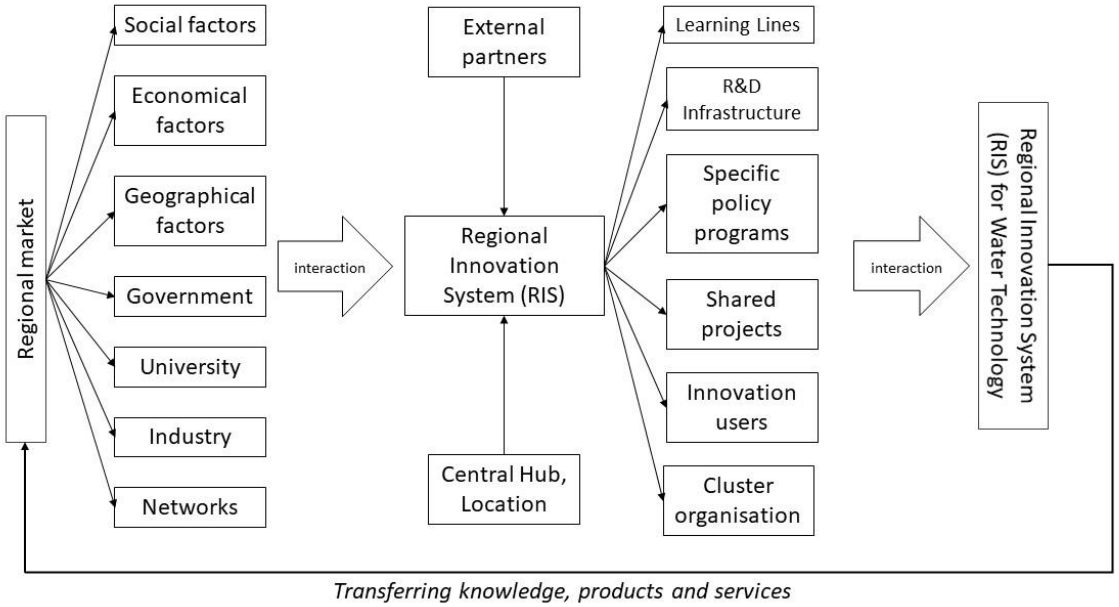


Figure 9: conceptual Model for RISs in water technology based on the triple helix (Etzkowitz & Leydesdorff, 1995), the determinants for RISs (Pino & Ortega, 2018) and factors for innovation in water policy (Moore, von der Porten, Plummer, Brandes, & Baird, 2014).

The following explanation is applicable to the model: Every region has its weaknesses and its strengths. Yet, innovation should be a priority for all regions in Europe. Therefore every region in the European Union (EU) has made a regional innovation strategy (RIS3). In this strategy, every region sets out their knowledge specialisations that best fit their innovation potential, based on their assets and capabilities. Smart specialisation involves businesses, research centres and universities working together to identify a regions most promising areas of specialisation (European Commission, 2014). However, this triple helix does not function in the same way between European regions. Social factors, such as the presence of human capital, the level of education and the drive for entrepreneurship differ between European regions. Therefore, economic factors vary per region. Some regions do have a higher GDP which often leads to more expendables in R&D and a rise in human capital. Of course, geographical factors do influence these aspects as well. Peripheral regions in particular, are affected by negative economic factors. Within these regions, the educational level and R&D expendables are often lower than European core regions.

These regional factors do influence the triple helix system of Government-Industry-University and their interrelationships. A functional innovation system consists of interactions between Government-Industry-University. Yet, the strength of the interaction differs per region. Based on the stance of the market it is not always clear which party is the driving force in this framework. Moreover, other factors are important as well. Clusters and there drive for innovation are comprehensively discussed. A physical location, such as a campus, valley or hub is seen as an added value for technology transfer and the tacit knowledge from external partners and partners within the region.

However, the water sector is a fragmented market with a lot of cross-sectors. Therefore specific policy programs can vary from water specific, economy to ecology. To understand this whole picture, cluster organisations,

specialised R&D infrastructure and subsequent learning lines are necessary to promote regional innovation systems in water technology. Furthermore, innovation users are necessary to ensure the sustainability of the innovation system. Active SME's who work together in shared projects (such as the Water Test Network) are being stimulated more to share their knowledge.

2.8 HYPOTHESES

Based on the scientific literature, the following hypotheses are formulated to give an answer on the research question:

TO WHAT EXTENT DO REGIONAL AND LOCAL GOVERNMENTS INVOLVED IN THE WATER TEST NETWORK DIFFER IN APPROACH TO FOSTER INNOVATION IN THE WATER TECHNOLOGY SECTOR?

H0: There are no differences between the policy instruments of the regional and local governments involved in the Water Test Network to foster innovation in water technology.
H1: There are differences between policy instruments of the regional and local governments involved in the Water Test Network.

The expectation in this research is based on economical and geographical factors which might differ per region. Based on the market stance some regions need an active government and some do not. Therefore the approach to foster innovation in water technology differs per region.

3. RESEARCH DESIGN

This chapter describes which methodology is used to answer the main questions of this report. How the data analysis is conducted and the validity and reliability of the data used in this research. Furthermore, an explanation for the research process is given. This report used qualitative and quantitative research. A desktop study to regional economic characteristics is conducted. As well as questionnaires and small interviews with stakeholders and partners of the institutions involved in the WTN project. Based on the theoretical framework, determinants of RISs in water technology are outlined. Thereupon, a desktop study is carried out to map all determinants within the different RISs of the partners in the WTN project. Subsequently, personal implemented questionnaires are set out between the actors of the triple helix (Government-University-Industry) in every region. Based on this survey, the RIS of every region and there interactions is drawn. Short interviews conducted at the Aquatech[7] in Amsterdam did provide the last information about any uncertainties. All information together, gives an comprehensive overview of the RISs for water technology.

3.1 DATA COLLECTION

For this study, the data is collected in 3 different ways. At first, a desktop research has been conducted. The data of Eurostat[8] is used to gather info about regional economics and demographics (chapter 4). Due the use of Eurostat based on European regions at a NUTS2-level comparisons between the regions of the WTN are possible. This is because Eurostat harmonises the definitions, classifications and methods for European official statistics, together with the national statistical institutes. Furthermore, a desktop research was also carried out into the various political programmes on water technology. Yet a clear definition for water technology can differ per region as well as the different perspectives towards innovation in water technology. Therefore, a top-down research is applied. Based on European legislation from the Water Framework Directive (WFD). The issues addressed in this directive form the basis of the regional policies which are linked to water technology. However, the water sector is a fragmentated market. Therefore, other policy programmes could be applicable as well. Within this research, those programmes are not taken into account because of the different scopes of all regions in the WTN-project. Based on these programmes the different actors involved in the RIS are portrayed.

Subsequently, questionnaires were conducted with all the partners in the WTN-project. The questions per region are based on the conceptual model to gather information about all determinants which are available in the region. However, the role of the partners within the triple helix differs. Thus, per region 3 surveys were established to cover the whole triple helix within every region. Based on their answers about the interaction with each other and their role within the RIS, the entire model of the triple helix and partners is outlined. Further questions which derived from the questionnaires were answered at the Aquatech trade fair. Disadvantages for these semi-structured interviews at trade shows are the open conversations which often ends up in quick answers. Moreover, policymakers and other stakeholders at these trade fairs present themselves at their best which could lead to exaggerated responses .

[7] Aquatech Amsterdam is a trade show for water technology. It is intended for visitors from the agriculture, energy industry, the automotive industry, metal industry and the pharmaceutical industry.

[8] Eurostat (European Statistical Office) is a Directorate-General of the European Commission located in Luxembourg. Its main responsibilities are to provide statistical information to the institutions of the European Union (EU) and to promote the harmonisation of statistical methods across its member states and candidates for accession as well as EFTA countries.

3.2 RESEARCH PROGRESS

The progress of this thesis was diverse. The WTN-project was already up and running at the time this research was conducted. Therefore, starting with desktop researches to regional characteristics and policy programmes went fluently. Most contact persons were already in place because of the Interreg-programme however, this was also the key problem. To compare regional innovation systems, one should need an overview of the triple helix and the stakeholders within the RIS. Although, the partners of the WTN-project are all classified as different institutions placed in various helixes. Therefore, a one-size-fits-all questionnaire is not possible. Every region and stakeholders do have their own scope. To understand how these systems differ, specialised questionnaires are necessary. This resulted in 12 different questionnaires: to cover a stakeholder in every helix within 6 different regions of France, Belgium, Germany, Scotland and the Netherlands. However, partners of the WTN-project did indicate that it is challenging to map all forms of subsidy and which function the funding has. In addition, regional governments who are not part of the WTN-project are not obligated to fill in the questionnaire. This has led to zero response from the regional governments of Gelderland, West-Flanders and Karlsruhe. The government of Baden-Württemberg did not receive a questionnaire since TZW is not in contact with this institution.

	University	Government	Industry
Friesland	✓	✓	✓
Gelderland	✗	✗	✓
Karlsruhe	✗	✗	✓
West-Flanders	✓	✗	✓
Centre-Val de Loire	✗	✓	✓
Scotland	✓	✓	✓

Table 4: The triple helix per region and their response on the questionnaire.

3.3 VALIDITY AND RELIABLITY

This research outlined the different RISs in water technology of the regions collaborating in the WTN-project. Because of the small group (6 regions) only qualitative measurements have been used to gather information about the interaction and interrelationships in the triple helix. This information derived from survey's and interviews is based on the conceptual model (figure 9) and could be interpret as an overview of determinants necessary in a RIS. The fact that all the parties concerned are surveyed makes it possible to make statements about the interactions in the RIS. However, there are also downsides at these qualitative data. At first, policymakers and stakeholders in the WTN-project do promote their own business and therefore the regional innovation system they are located in. As a consequence, this research can rather conclude if all determinants are available in the RIS and not about the individual functionality of the system as such.

4. REGIONAL CHARACTERISTICS

This chapter describes the regional characteristics of the areas involved in the WTN at a NUTS2-level. To give an overview of relevant social-, economical- and geographical factors which have an influence on the interaction within the triple helix system. Because of these differences, actors in regional innovation systems do have arguably other roles and interrelationships. Furthermore, it influences the quality of innovation capabilities and therefore has its effects on the RIS. By comparing these variables per region, this study tries to control for these differences in innovation quality and therefore the interaction in the regional innovation systems. The data used in this chapter is retrieved from the database of Eurostat and can be found in the appendix.

4.1 DEMOGRAPHY AND LANDAREA

The regions of the WTN differ a lot in size and thus in population. Comparing land areas therefore results in enormous differences. Where West-Flanders is the smallest area (3,144km2) and Highlands and Islands the largest area (41,974km2). However, these figures are in contrast with population size. Conversely, Highlands and Island has the smallest population (470.743) and Karlsruhe has the biggest population (2.795.783). So, to analyse these statistics the population density is compared. The regions with the most densely populations are respectively West-Flanders, Karlsruhe and Gelderland. According Krugman's theory, economies of scale are more likely to occur within these regions than others, since the demand in these areas is higher as well. Therefore cluster development will suit these regions more (Krugman, 1991). For Friesland and the Scottish areas, population density is beneath average. Therefore the opposite effects can occur. These regions face less demand and do have a smaller workforce to pool from.

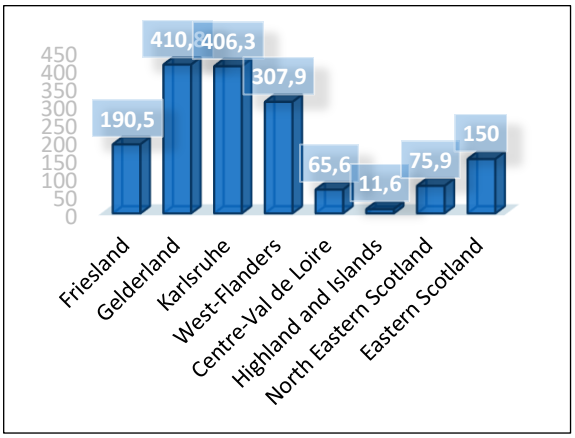


Figure 10: Population density in km2 (2017) of the regions in the Water Test Network at NUTS2-level.

4.2 THE EU REGIONAL COMPETITIVENESS INDEX

Another factor to take into account is the regional competitiveness index (RCI) of the European Union. This index is a combination of eleven pillars which are adopted from the World Economic Forum and its global development index (GDI). These pillars consist of different groups which vary from social to economic factors. Together they determinate the score of competitiveness for European regions at NUTS2-level. Based on this index, the following score is measured for the regions in the WTN seen in figure 11.

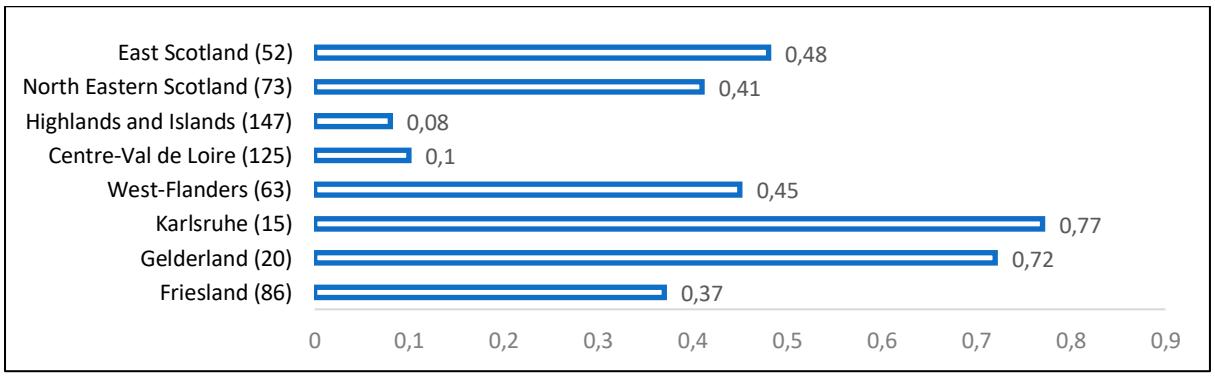


Figure 11: Regional Competitive Index (RCI) and the regions overall score between the parentheses.

According the RCI, European core regions score better than peripheral regions. Karlsruhe has the highest score and is at a 15th place of all European regions. Highlands and Islands, one of Europe's most peripherical regions has the lowest score and is at a 125th place of the total 268 regions in Europe. Concluding the RCI, densely populated places in European core regions score the most points. Therefore it is no surprise that Karlsruhe and Gelderland have the highest overall scores.

4.3 GDP, R&D AND THE WORKFORCE

Other indicators to reflect on are the Gross Domestic Product and the regional labour force. Regions with a high GDP per capita do have more resources and therefore more assets to invest. However, the biggest areas do have often the highest GDP since there are more inhabitants within these regions. To compare the different regions of the WTN, the GDP per capita is used (figure 12). As seen in the figure, the European core regions have a higher GDP than other regions. However, North Eastern Scotland is an exception. With a GDP per capita of 42.000 Euros it is even higher than the region of Karlsruhe. Although, this score is mainly caused due oil and gas revenues. Therefore it is questionable if the region itself has profits from these high numbers. Furthermore, R&D investments do give an overview about the regional strength in innovative power. In figure 12, the R&D investments as percentage of the GDP is pictured. For Scotland, research and development is measured for all regions combined. Based on these insights, Karlsruhe is the region with the highest amount of investments in R&D. The province of Friesland does have the smallest result with under 1% spend on R&D.

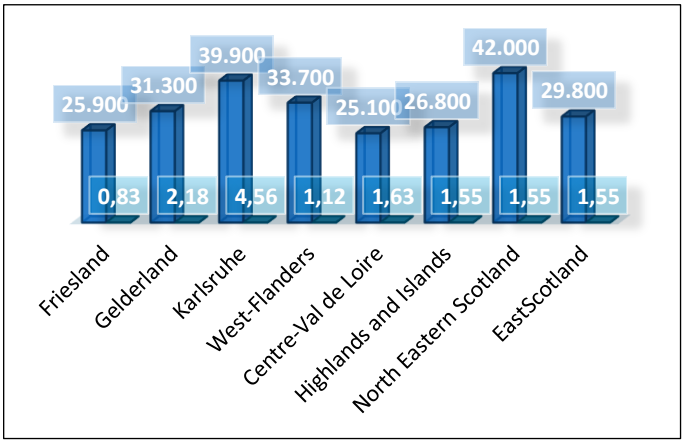


Figure 12: GDP per capita (2017) per NUTS2 region and the percentage of GDP spend on R&D investments (2016).

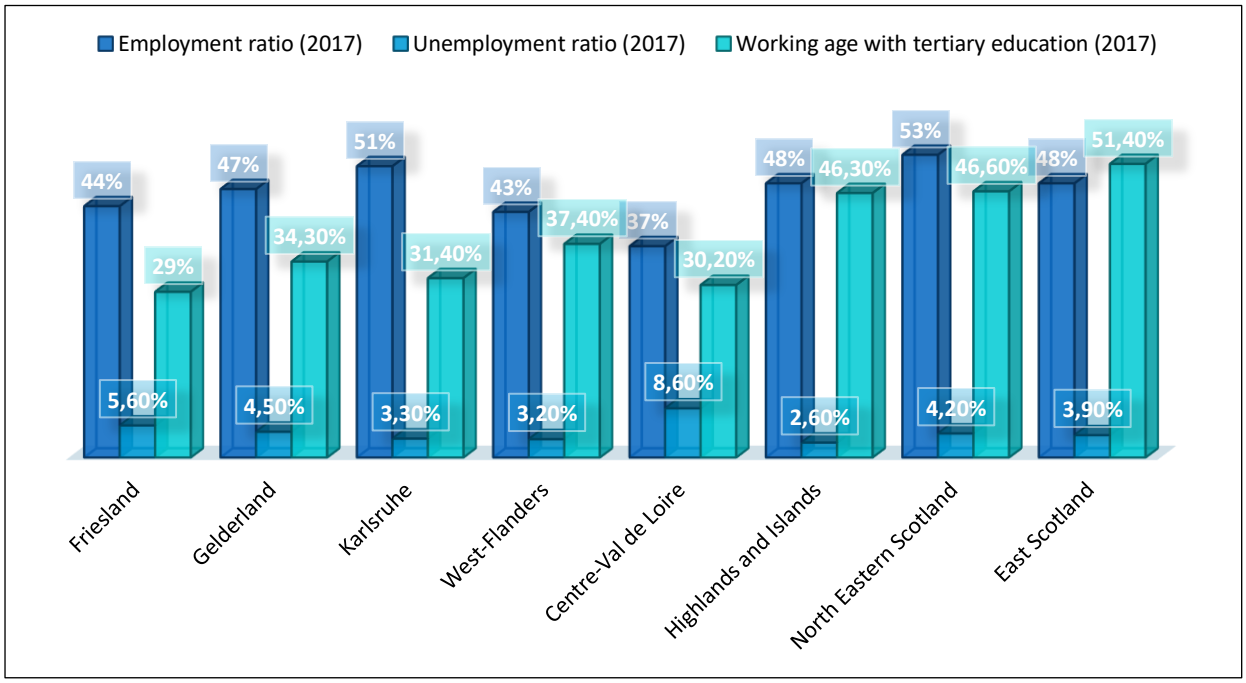


Figure 13: Labour market statistics, employment ratio, unemployment rate and educational level per region in 2017.

Furthermore, general labour market statistics are compared per region (figure 13). A highly active and skilled workforce is beneficial to stimulate innovation. Looking at the graph, most regions score around the 50% comparing the employment ratio (the number of people with a job divided by all population). It is Centre-Val de Loire with the lowest score of 37%. This statistic is also seen in the unemployment rate where the French region scores 8,6% almost exactly the score as the national score of France (8,5%) yet still 2% higher than the EU-28 average. Most differences can be seen in the tertiary educational level. The gross of the regions score around the 30% where Friesland has the lowest score of 29%. Outliers are the Scottish regions, who do score 15 to 20 percent higher. Most common reason could be the policy of free university tuition.

However, these results are not explicitly applicable for innovation in water technology, it is an overview of strengths and weaknesses per region for innovation as a whole. Furthermore, there are other factors which stimulates innovation and due ongoing globalisation people work all across Europe. Therefore, this data should be critically discussed by comparing European regions.

5. REGIONAL INSTITUTIONS AND THE POLICY PROGRAMMES

The water sector is a diverse sector with spin-offs in many other sectors. Therefore, water policy involves a combination of chemical, biological, physical, social and economic factors who do act at different levels and are exposed to change over time (Grey, et al., 2013). The complexity of these issues in a rapidly changing world will lead to a complicated interplay of climatic and demographic change together with developments in economic activities, industries and land-use which all have its impact on our water management (European Commission, 2012). To address all these challenges the EU established the Water Framework Directive (WFD) in the early 2000's. The WFD gives an overview of all water related issues in the European Union together with related stakeholders at different geographical scales. The aim is to safeguard Europe's fresh water and to integrate other relevant sectors into the new water policy. For example, to make progress on water related issues in the EU, the water policy should be embedded in agricultural, renewable energy, transport and industrial policies (Giakoumis & Voulvoulis, 2018). However, to tackle the upcoming challenges for Europe's water sector innovation and forward thinking is necessary. To stimulate this innovation into a green and circular economy the European Innovation Partnership (EIP) Water was launched in 2012. The purpose of EIP Water is to foster innovative solutions to tackle the water problems at a European and global level, while supporting sustainable economic growth and job creation. EIP Water is therefore an intermediate for collaboration in the public- and private sector, non-governmental organisations and the general public (EIPWater, 2017).

Yet it is unclear how these water related issues are embedded into different policy programmes and how specific countries and/or regions in the WTN are concerning water technology and innovation. Therefore a top down approach is applied per country of the WTN-project. Starting at the top, national policy programmes (1) to RIS3 strategies per region (2) and at the bottom, region specific policy (3). However, these policies are different per region and sometimes overarching with other policy notes at other levels. the results of the questionnaires and interviews are combined to give a descriptive overview per region of the innovation system in water technology. Based on the results from the questionnaire, the scope of water technology, the most important stakeholders and the networks becomes clear. Interviews derived at the Aquatech give extra information about linkages between the stakeholders and other important players in water technology who are based within the region.

5.1 PROVINCE OF FRIESLAND, THE NETHERLANDS

The Netherlands have a lot affiliated with water. A large part of their history has taken place on or near the water. On the one hand, water was seen as a blessing. Due to rivers and oceans the Dutch could go globally. Therefore, the Dutch maritime sector founds it origin. However, through increased global trade the whole economy had a boost. It was due to the water that the Dutch national economy found its prosperity. On the other hand, water is one of the biggest challenges for the Netherlands. 55% of the country is vulnerable for flooding and 26% percent of the land surface is beneath NAP[9] (sea-level). As seen in figure 14, more than half of the country and almost the whole province of Friesland is vulnerable for water flooding. Therefore, the delta technology is predominantly present in the Netherlands. The oldest dikes date from the 11th century and do fail current standards. Yet from now on till 2031 there is 7,9 billion euros available to improve 1100 kilometres of

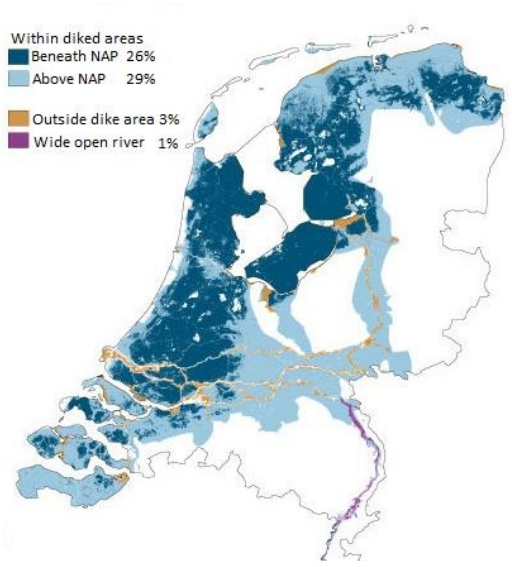


Figure 14: flood-sensitive areas in the Netherlands (Pieterse, Knoop, Nabielek, Pols, & Tennekes, 2009)

[9] Normaal Amsterdams Peil or Amsterdam Ordnance Datum, used as vertical datum in Europe which led to the European Vertical Reference System (EVRS).

dikes (Programmaplan Hoogwaterbeschermingsprogramma, 2019). Because of climate change and a rising sea-level (Morris, Sundareshwar, Nietch, Kjerfve, & Cahoon, 2002), the dikes need to comply with new standards. Furthermore, the Dutch government recognises upcoming water issues due to changing economy, industries and land use. Therefore the water sector is one of the nine so called 'top sectors' of the Netherlands. The top sectors policy is a Dutch business policy to stimulate the knowledge-based economy. The nine sectors are areas in which Dutch industry and research centres worldwide excel. (Ministerie van Economische Zaken, 2017). These sectors are of economic importance after the economic crisis. As seen in figure 15, top sectors do provide more export and do have a large amount of R&D expenditures.

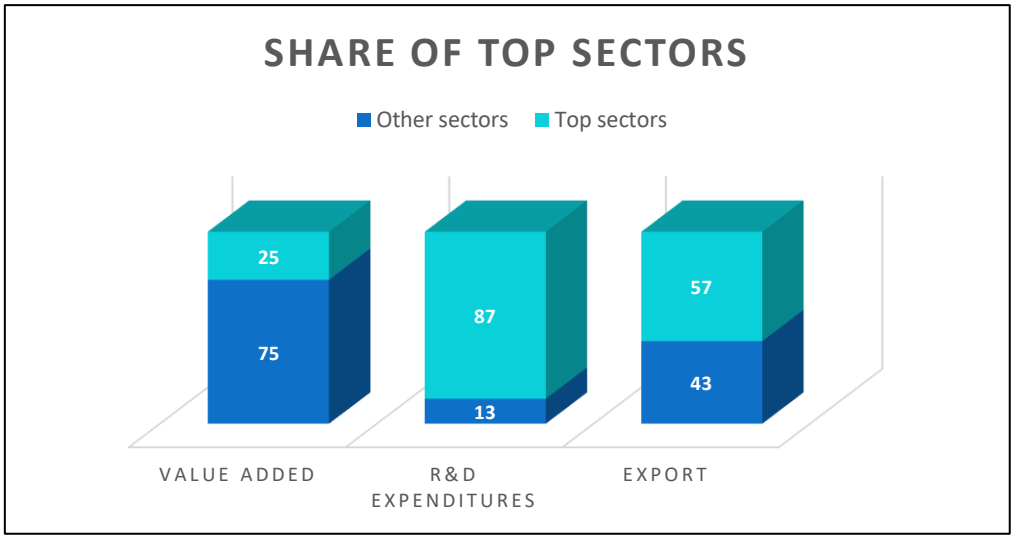


Figure 15: The top sectors in the Netherlands do have significant more influence than other sectors within the national economy. Measured after the crisis in 2012 (van der Wiel, 2016).

NATIONAL POLICY

The national government has established the top sector water policy. The water sector of the Netherlands is therefore divided into 3 sectors: delta technology (1), maritime technology (2) and water technology (3). The water technology sector is responsible for the produce of drinking and industrial water of the highest quality, while keeping the pressure on the living environment as low as possible. The sector also specialise in the purification and reuse of waste water.

To establish these goals and to support innovation, every sector has got its own Top Consortia for Knowledge and Innovation (TKI). These TKIs stimulate public-private partnership projects. In the TKIs, entrepreneurs and scientists from the nine top sectors work together to find ways to bring innovative products and services to the market. TKI-water technology works closely with SME's, knowledge institutions and public organisations to support innovative ideas. Furthermore is TKI the binding factor to establish a national partnership in the water sector, Netherlands Water Partnership (NWP). In addition to this, the TKI can submit an application for a PPP programme[10] supplement. The basic principle of the PPP supplement works as follows, for every euro of private cash R&D contribution from a company to a research organisation, the Ministry of Economic Affairs and Climate adds € 0.30 to the PPP bonus. The TKIs use this programme supplement for research and development with the business community or for innovation activities. Another programme SME's can apply for is the MIT-arrangement[11]. With the MIT regulation Top Sector Water & Maritime, the Ministry of Economic Affairs and Climate encourages SME entrepreneurs to cooperate and innovate within the top sector. The goal is to double

[10] Public Private Partnership programme to stimulate innovation.

[11] MKB Innovatiestimulering Topsectoren (MIT), a policy instrument to support SME's within the top sectors.

its added value and export by 2020 by working on many international challenges in the field of water safety, water scarcity, cleaner transport and energy scarcity. The MIT-regulation consists of different instruments where SME's are supported to contact knowledge institutions, apply for network activities and collaborating in R&D cooperation projects (Rijksdienst voor Ondernemend Nederland, 2016). However, these policies are not explicit for SME's in the water technology sector. All companies within the 9 top sectors who do match the prerequisites are able to apply for these instruments.

RIS3 STRATEGY NORTHERN NETHERLANDS

To stimulate the regional innovation and to boost the local knowledge-based economy the 3 northern provinces of the Netherlands, Friesland, Groningen and Drenthe have conducted their Research and Innovation Strategy for Smart Specialization (RIS3) together as a Northern Netherlands Alliance (SNN). In this report at NUTS1-level, the key points of the northern economy are clustered. The SNN can furthermore subsidise projects who do match to these key points. Overall, these sectors are contributing both to the competitive strength of the Northern Netherlands, and to solving major societal challenges. SNN mapped the region's well-developed industries and industrial niches that demonstrate potential for further growth (SNN, 2013).

Figure 16: The RIS3 strategy for Friesland is conducted by SNN at NUTS1-level.

According the report of SNN the Northern Netherlands does have its main focus on 7 industry sectors who are highly active in the region:

Northern Netherlands main economic sectors	
1. Agri-food	2. Healthy Ageing
3. Energy	4. Water Technology
5. Sensor Systems	6. Chemistry
7. Tourism & Recreation	

Table 5: The main economic sectors in the North of the Netherlands, Water Technology is most active in the province of Friesland.

The Northern Netherlands distinguished these 7 sectors on the basis of three different criteria. The first criterion SNN examined was evidence based. Utilising the life cycle approach[12], combined with statistical evidence and qualitative information obtained from interviews and desk research. The second criterion was policy based and utilised the already existing initiatives within the industry sectors. The final criterion concerned the innovation potential of the industry sectors under investigation, meaning the contribution the sectors or clusters could provide in order to tackle the major societal challenges.

Water Technology is actively taken into account for the innovation strategy of the SNN since the sector has experienced strong growth over the last 10 years. Furthermore is the industry deeply rooted in the province of Friesland. The sector is early in its life cycle, in terms of activity and potential and has a very sizeable R&D investment and cash contributions to the Water Campus located in Leeuwarden, the capital of Friesland.

[12] implies that everyone in the whole chain of a product's life cycle, from cradle to grave, has a responsibility and a role to play, taking into account all the relevant impacts on the economy.

REGIONAL POLICY FRIESLAND

Historically, the water sector is well represented in the province of Friesland. However the water technology sector was fragmentated and consisted of companies around the food and cardboard industry who specialised in the construction of wastewater treatment equipment. In the period between 1995-2000, several market studies have shown that the Northern Netherlands insufficiently exploited its knowledge position and potential in the growing international water market (BBO / Grontmij, 2012). To respond to this issue, the Frisian Water Alliance was founded in 1999. This organisation consisted of representatives of the province of Friesland, the municipality of Leeuwarden and representatives of schools and companies affiliated with the water sector. However, a knowledge institute for water technology was still missing. That is why Wetsus was built, a cooperation between (inter)national businesses, knowledge institutes and governments within the water technology sector to become the European Centre of Excellence in the field of water. In order to make this ambition a reality, various bodies have been set up over the years. Wetsus is the research institute, the Frisian water alliance which is now called Water alliance is responsible for business development and CEW leads the fundamental research. Together, these bodies operate under the name Watercampus Leeuwarden.

Figure 17: The Watercampus Leeuwarden, Collaboration between government, industry and university.

To stimulate the ongoing development in water technology, the province of Friesland made an operational framework water technology 2013-2020. This framework has to stimulate the water technology cluster to grow further and to tackle future uncertainties. With this framework water technology is one out of five pillars highlighted in the Frisian economy. The province is there to provide funding, operate as business networker and to governance subsidies and prestation (Provincie Friesland, 2013).

The Frisian region has a clear economic focus on water technology. From political perspective, water technology is a focus point. Nationally, the water sector is seen as a driving sector and regionally water technology is the innovative niche Friesland is focusing on to establish a European hub for water technology. Therefore, the local authorities work closely together with all regional stakeholders in water technology. Located in Leeuwarden, the capital of Friesland, the Watercampus is the physical center for water technology. As part of the development of the European Water Technology Hub, an 'eco-innovation system' has been set up around Wetsus and the Water Alliance in recent years with the aim of accelerating the innovation cycle from knowledge to product. These include research, laboratories, a complete water technology learning line (from secondary vocational education to PhD), demo sites for technology scaling up, showcase projects, business accommodation on the water campus, facilities for venture capital, and support for innovation projects, export and the development of entrepreneurship.

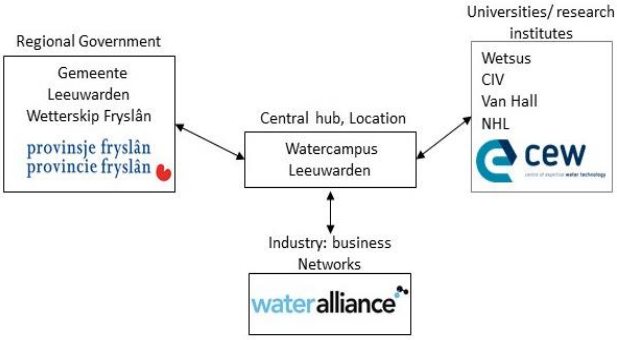


Figure 18: The most important stakeholders for water technology in Friesland.

Based on desktop research and interviews, figure 18 portrays the regional innovation system. Within this region, the regional government supports the Watercampus. Therefore, there is a cluster organisation focused on the water sector and there are several knowledge institutions where water technology is an item.

5.2 PROVINCE OF GELDERLAND, THE NETHERLANDS

The province of Gelderland, located in the east of the Netherlands does have the same applications as the province of Friesland concerning national policies. All SME's within Gelderland can apply for the 'top sector policy' which consists of a Public Private Partnership programme (PPP) and an MIT-arrangement. All water technology related SME's are able to retrieve these policy instruments which should help the level of innovation within the sector. Since the policy on a national level is equivalent as the province of Friesland the national policy will not be re-explained. However, the province of Gelderland does have its differences. Gelderland is located in the east of the Netherlands and has therefore another RIS3 strategy with other economic focuses. Furthermore, the regional policies do differ significantly from other regions. Friesland does have its focus especially on water technology, where Gelderland has its main focus on the Clean Tech Region (sub partner of Water board Vallei and Veluwe). This partnership between 3 cities is aiming for an energy neutral and sustainable future where economy and ecology goes hand in hand. Water technology is embedded into these arrangements. Yet, the policies therefore differ on a regional level.

RIS3 STRATEGY EASTERN NETHERLANDS

The Eastern Netherlands consists of 2 provinces, Gelderland (1) and Overijssel (2). The regional governments of the 2 regions did write a regional innovation strategy based on policy framework of the 2 regions together. As seen in the Northern Netherlands (SNN), the eastern part of the country does have its own managing authority (OPOost). The main focus in their report relies on a strong triple helix model between universities, government and companies dealt within the theoretical framework. The east of the Netherlands has different knowledge expertise because of the presence of various large knowledge institutions. Technology, health and Agro & Food, the orientation of these knowledge institutions fits in with the orientation of the business community (OPOost, 2013).

Figure 19: OPOost is the operational programme for the Eastern Netherlands at NUTS1-level.

Based on a SWOT-analysis[13] and the regional economic policy agendas, the Eastern Netherlands opts for smart specialisation in the following four sectors and its crossovers:

Eastern Netherlands main economic sectors	
1. Agro & Food	2. High Tech Systems and Materials (HTSM)
3. Health	4. Energy and environmental technology / bio based economy

Table 6: The most present sectors of the Eastern Netherlands, water technology is not specifically appointed but is embedded within the HTSM sector.

The region explicitly chooses four sectors as its priorities. Added value is created by the presence of regionally strong companies and industries, which have the potential to make use of the available knowledge from the top sectors. The available innovation infrastructure that has been developed within the top sectors can largely support this and thus accelerate development. The choices made by the East Netherlands are in line with the objectives set by the European Commission in its Europe2020 policy to contribute to smart, sustainable and inclusive growth. Furthermore, the four East Dutch sectors are in line with the top sector policy of the Ministry of Economic Affairs in the Netherlands.

Within the regional innovation strategy of the Eastern Netherlands there is not an explicit reference to water technology as sector. In their report, water technology is anchored within the HTSM sector. The following

[13] planning technique used to help a person or organization identify strengths, weaknesses, opportunities, and threats related to business competition or project planning.

technology fields of the HTSM sector are important for the East Netherlands:

1. Micro- and nanotechnology
2. Sensor technology
3. (Bio)medical technology
4. ICT Mechatronics/robotics
5. Materials science Plastics
6. Bio-organic hybrid materials
7. Water technology.

The HTSM sector and therefore water technology is supported by the eastern region. SME's do have the possibility for subsidising and to make use of different network activities for the region specific. Moreover, start-ups and other innovative companies can apply for a participation fund. Managing authority East will become stakeholder in return for investments up to 5 million euros (Oost-NL, 2019).

REGIONAL POLICY GELDERLAND

The province of Gelderland has the ambition to become the most successful circular economy of Europe. To achieve this, several municipalities and the province are collaborating in a network organisation: The Cleantech region. Within this network the triple helix (governance, companies and education) are working closely together. The Cleantech Region stimulates business development and innovation in the greater Apeldoorn area. It is a partnership between entrepreneurs, educational and research institutions and governments. Their aim is to stimulate innovation and roll out the red carpet for current and new cleantech entrepreneurs, providing business development and field labs for testing. Within WTN they will play a role in facilitating the demonstration site of Apeldoorn with market scans, business developers and revenue models. They must be a connection between the market and the SME's who do use the test site (Cleantech Regio, 2018).

Within Gelderland, circular economy is an important topic. The local authorities do have the ambition to become one of Europe's first completely circular economies. The authorities therefore stimulate all projects which contributes to reach this goal, including investments in water technology. The cleantech region is responsible for reaching this goal. This organisation follows the principles of the triple helix system, where regional governments, educational institutions and companies work together. The Waterboard Vallei en Veluwe has their own resources to invest in R&D, but they do work together with the Cleantech region to attract SME's at the available test sites. However, this process is still in development at the moment of writing this report. Based on the partners of Vallei en Veluwe and the Cleantech region the regional innovation system for water technology is portrayed in figure 20.

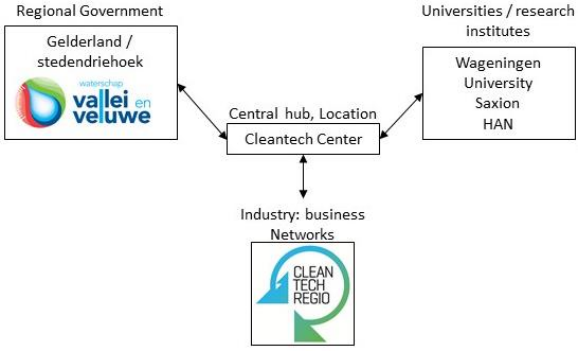


Figure 20: Regional innovation system of Gelderland, circular economy is the main subject and water technology is embedded at the cleantech center.

5.3 SCOTLAND, UNITED KINGDOM

The landscape of Scotland is widespread with lochs and lochans. Therefore, Scotland is one of the world's most fresh water containing areas. Many individuals, companies and communities rely on groundwater for drinking water, agriculture and industry. Groundwater also feeds wetlands and river flows during dry spells and is vital to the maintenance of their rich ecology and biodiversity (Scotland's environment, 2016). Furthermore is water essential for the economy as well. Water is used by industry (e.g., distilling whisky and supporting fisheries), for producing energy (hydropower), and for recreational activities such as bird-watching, angling and water sports. Yet water is not embedded in the national economic strategy of Scotland.

Concerning administrative areas, Scotland can be seen as an exception. It is a nation of people living in an internal division of the United Kingdom of Great Britain. Yet, Scotland does have its own government, legal system, health service, education system and interior affairs department. Therefore this study sees the policy from Scottish government as a national policy. Although it does have its implications, the Scottish regions involved in WTN do all collaborate on a national level. Their RIS3 strategy is therefore conducted on a national level as well as their policies on water technology; Scotland a Hydro Nation. Thus, this study aims at 3 policy interventions in Scottish government: the national economic strategy (1), Scotland can do RIS3 strategy (2) and the Hydro Nation Strategy (3).

NATIONAL POLICY

The Scottish national economic strategy has its aim on four broad priority areas: investment, innovation, inclusive growth and internationalisation. The economic strategy builds on the vision and framework set out in Scotland can do, which is co-created with public, private and third sector partners, with the purpose to make Scotland a world-leading entrepreneurial and innovative nation (The Scottish Government, 2015). In their strategy based on 4 pillars, the government sets out their vision. Where investment needs to stimulate sustainable growth in people, infrastructure and other assets. At the same time innovation is seen as important. The Scottish economy has to be open for new ideas and doing things differently. Additionally, the whole of Scotland needs to benefit. Inclusive growth needs to be in the whole society creating opportunity through a fair and inclusive jobs market and regional cohesion to provide economic opportunities across all of Scotland. Furthermore, internationalisation is seen as relevant. Scotland must have an outlook on new ideas, open for trade and collaboration and migration (figure 21). This strategy is comprehensive since all economic aspects are divided into those 4 pillars. Although, at the same time it does have a lack in depth.

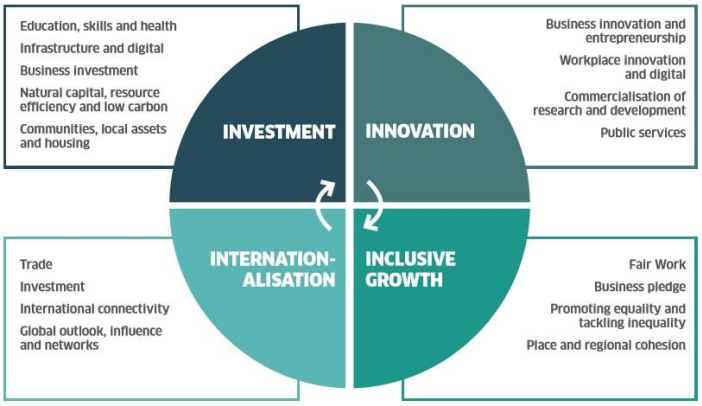


Figure 21: The Scottish economic strategy divided into 4 areas (The Scottish Government, 2015).

RIS3 STRATEGY SCOTLAND CAN DO

The implementation of the economic strategy is embodied in the Scotland can do report. Which can be seen as the regional innovation strategy of Scotland. In this report, another perspective is being used. Where innovation is seen as the key to development. According their RIS-strategy the Scottish economy has 8 main economic sectors for innovation (Scotland Can Do, 2017).

Scotland's main economic sectors	
1. Food & beverages	2. Tourism
3. Energy	4. Life Science
5. Universities	6. Creative Industries
7. Marine Energy	8. Financial & Business service

Table 7: The most innovative sectors of Scotland, Marine Energy is present but water technology is not appointed in their regional innovation strategy.

However, their innovation strategy is more an overview how innovative businesses and start-ups from key sectors could scale up their investments in R&D. With a comprehensive action plan where public and private parties from all kinds of sectors are working together. Therefore, the Scottish government is focused on 4 issues which must help the Scottish economy to foster innovation.

To support innovation the Scottish government wants to directly encourage more business innovation by the increase of companies and to scale up existing high growth potential start-ups into a collaborative scale-up programme. Where more companies are receiving innovation support due to streamlining partnerships across all relevant agencies (1). Secondly, The Scottish Government's Procurement should act as a catalyst for business innovation. By using the public sector needs to stimulate innovation. To do so, the government wants to start a public challenge fund. The public can bring their own innovative ideas to solve issues with help from this fund (2). Furthermore, enhance innovation across sectors and places all over Scotland with investments in manufacturing, product design and supply chains to create high-value and highly skilled jobs (3). Moreover, make best use of university knowledge and talent to drive growth. To increase the conversion of academic research and knowledge into business (4). With these steps the Scottish government tries to foster innovation and inclusive growth all over Scotland. Although, these measures are not sector specific but more a comprehensive plan to tackle issues derived from the Scottish economic strategy (Scotland Can Do, 2017).

HYDRO NATION PROGRAMME

Within the Scottish economic strategy and their action plan to stimulate innovation, water technology is not included or specially named as driving sector. The Scottish economic water activities do come back in their annual reports of Hydro Nation. An initiative established by the Scottish government through Scottish Enterprise and Highlands and Islands Enterprise. The Scottish government launched the Hydro Nation Strategy in 2012. With this strategy, the ministers want to fulfil their duty to take reasonable steps as they consider appropriate for the purpose of ensuring the development of the value of Scotland's water resources. Which is outlined in the Water Resources (Scotland) Act 2013.

Based on this policy, water technology is stimulated in various ways for Scottish economy. The Hydronation strategy covers the whole water sector. Which covers, according their definition, also cross sectors such as food and drinks, oil and gas and the public sector (Scottish Government, 2019). The establishment of Hydro Nation Water Innovation Service (HNWIS) by the Scottish government should stimulate the work with innovative

Scottish companies, particularly Small and Medium Enterprises (SMEs) and supports them along the innovation path to commercialisation. Not only for the UK but also to promote the Scottish water sector worldwide.

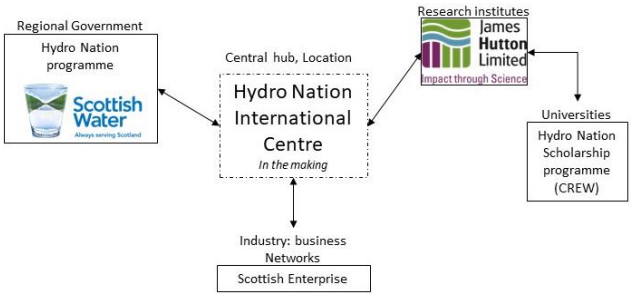


Figure 22: Scotland is aiming for innovation in its entire water sector. Due to administrative issues is Scotland's innovation system classified as national system.

Scotland is not seen as an independent country or state. However, Scotland is a nation of people living in an internal division of the United Kingdom of Great Britain. Because of these political structures it is hard to define regions according classifications of the European Union (NUTS2-level). Scotland has its own parliament and are therefore operating as a country. Although, the regional innovation strategy (RIS3) is conducted for Scotland as a whole. So, here Scotland is classified as a region. However, there is no regional innovation system for water technology. This is mainly due to the fact that most of the influence comes from the Scottish government. With the launch of the Hydro Nation programme the government of Scotland wants to boast its water sector. The scope of the Scottish government is to promote the water sector in a broad sense. Within this programme, innovation is a part that is carried out by the Hydro Nation Water Innovation Service (HNWIS). Their aim is to provide support and opportunities for innovative businesses in Scotland to create and grow sustainable solutions for the global water and wastewater sector. To reach this goal, HNWIS works according the simplified innovation system seen in figure 22. The Scottish government is directly involved with the launch of the programme and the Scottish enterprise who acts as business network to support SME's in water technology. The James Hutton institute, a non-profit organisation with expertise in agricultural research, soils and land use, is responsible for CREW[14]. A scholarship programme to involve Scottish universities into water issues.

5.4 PROVINCE OF WEST FLANDERS, BELGIUM

Both the quality and the availability of fresh water are under increasing pressure in Flanders. In Flanders, every inhabitant has around 1700 cubic meters of water, which is very little compared to other countries. Only three other countries in the Organisation for Economic Cooperation and Development (OECD) score worse: Italy, Korea and the Czech Republic (OECD, 2017). In this research Flanders is seen as the national and the regional government for legislation in water (technology). This is because of the non-hierarchical political system in Belgium, where legislation is divided for the federal government, regions (Gewesten) and communities (Gemeenschappen). However, it is unclear who is in charge for which subject since more governmental bodies are involved in the same themes. The water sector, an already fragmentated market is therefore influenced by several agencies but not on a national level for Belgium in its entirety (Belgium.be, 2019).

FLEMISH POLICY

The government of Flanders do understand that water is an important subject. In their Integral Water Policy they notice that recent water scarcity and droughts have shown that freshwater resources in Flanders are scarce. Therefore Flanders is investing in water purification. In their report, they state that a functional water management system is the basis for public health and economy. Therefore not only the government, but also the industries should reuse water (CIW, 2017). These statements also comeback in the Flemish Reform Programme of 2019 where the government state to invest 260 million in wastewater treatment infrastructure.

[14] Centre of expertise for waters: CREW established user groups around themes focussed on the main policy areas to help identify, prioritise and coordinate research and other activity between policy makers, their implementation partners and researchers.

Partly because Vlakwa carried out research into the socio-economic importance of water in Flanders. The largest water consumers are companies in the food, chemical, petrol and energy sectors (Flemish Government, 2019).

RIS3 STRATEGY FLANDERS

The regional innovation strategy for the provinces of Flanders is conducted as one identity for all Flemish provinces. So, the Flemish government sets out the smart specialisation strategy where they want to transform Flanders for a better allocation of investments for innovation. As the writers reported, Flanders has several advantages but also disadvantages. At first their central geographical location in Europe offers scope for R&D and service based activities for the global value chain. However these activities should pick up more value-added attractors for the innovation system. Therefore it is needed to transform the industry by innovation and to modernise the education and training. Disadvantages to these transformations are the ongoing pressure of increasing competitiveness position. To tackle these issues, Flanders aimed at a targeted approach. A SWOT-analyses identified 10 themes that would be prioritised for further innovation investments.

Flanders main economic sectors for innovation	
1. Smart systems	2. Sustainable Chemistry
3. Specialised manufacturing	4. Sustainable living
5. Responsible entrepreneurship	6. Value-added logistics
7. Personalised cure and care	8. Agro-food
9. Industrial design and creative industries	10. Smart services

Table 8: The most important economic sectors in Flanders, water technology is not taken into account however the top 3 water consuming sectors are present.

The water sector or water technology is not mentioned, However the manufacturing-, chemistry- and agro-food sectors are dependent on water. For Flanders, the water technology is an enabling sector.

REGIONAL POLICY WEST-FLANDERS

The province of West-Flanders has set out their economic strategy in the report called 'West Deal'. In this paper most attention goes to entrepreneurship and SME's. Whereby West-Flanders should invest in sustainability, social economy and human capital. The POM West-Flanders has the responsibility to fulfil these tasks and therefore has the focus on innovation, entrepreneurship, logistics and the labour market (Provincie West-Vlaanderen, 2013). However, this strategy is very common and most projects could be placed in one of the subjects above. Therefore this rapport is more a general overview how the province fosters the regional economy by bringing several parties together. At the same time, policy interventions are not described in depth. The water sector or water technology is never mentioned but it could be placed in several themes.

The food-industry is well presented in West-Flanders. Within this type of industry, water plays a dominant role. Water technology is therefore closely related with this sector. Main difference here, is the vision of the role the water sector has. Politically, the economic focus is aimed at the agro-food- and chemical sector. Both sectors are major water users, therefore new technologies in reuse of water should help these sectors to become more sustainable. The importance of the water sector is therefore acknowledged as enabling sector.

To achieve this goal, Vlakwa is operating as interconnecting player to foster innovation for water technology and to reduce fragmentation in the water sector. The regional innovation system in West-Flanders is therefore a combination of institutions who are involved in the water sector but do not have their main focus in this sector in particular. The regional government supports the process to become more sustainable but there is not a clear aim at a certain subject. De Watergroep, water authority in Flanders, does have its own projects for research and development and Ghent university is focused on food- and environmental technologies. Their test site: veg-i-tec, which is part of the WTN, is aimed at the disinfection of food and the reuse of water which is used in the food sector. Watercircle is operating as business network for all water related companies and knowledge institutions. Based on these findings the regional innovation system for water technology for Flanders is portrayed in figure 23.

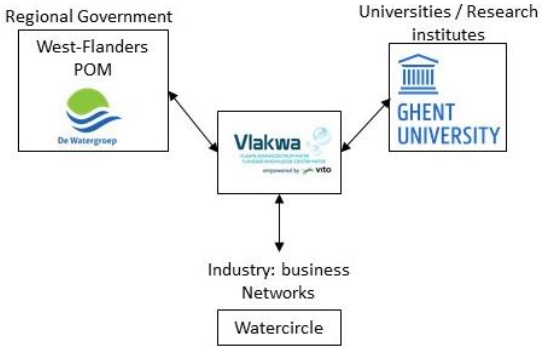


Figure 23: The regional innovation system in Flanders is aimed at other sectors, water technology is seen as enabling sector and recognised as important.

5.5 BADEN-WÜRTTEMBERG, GERMANY

Germany is a federal state with a federal structure: The tasks of the state are divided between the federal government, the provinces (Länder) and the municipalities. After reunification, the Federal Government, based in Berlin, is responsible for the framework legislation and national tasks of water management. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety is responsible for water protection, the Federal Ministry of Economics and Technology for water supply and the water industry, the Federal Ministry of Education, Science, Research and Technology for the development of new technologies, and the Federal Ministry of Health for determining drinking water quality. International cooperation is the responsibility of the Federal Ministry for Economic Cooperation and Development. The ministries have specialised authorities such as the Federal Environment Agency, the Federal Institute of Hydrology as well as private agencies such as the Project Management Agency for Water Technology or the Society for Technical Cooperation (BMU, 2001). Within the framework of federal legislation, the governments of the 16 Länder are responsible for regulating water supply and wastewater disposal in their territories. However, water legislation in Germany is thus fragmentated in a lot of agencies. Therefore, this report is focusing on the legislation for new technologies in water treatment.

NATIONAL POLICY

At the national level, new technologies and therefore water technologies is embedded in the Research Agenda Green Economy by the Federal Ministry of Education, Science, Research and Technology (BMBF). Green Economy unites economics and ecology: an economy must be internationally competitive, but must also be environmentally friendly and socially acceptable. A Green Economy enhances social welfare, combats poverty, and strives for social justice. The Agenda is focused on several priority areas:

1. Production and Resources: Raw Materials, Water, and Land
2.Sustainability and Financial Services
3. Sustainable Consumption
4. Sustainable Supply and Use of Energy in the Economy
5. Sustainable Mobility Systems
6. Infrastructures and Intelligent Supply Systems for the City of the Future

The BMBF is providing 350 million euros of funding into research of green economy (BMBF, 2015). It is unknown how much of this budget is invested in water technology. The priority is broader and not especially for the water sector, however the water sector is seen as one of the priority areas who can apply for these funding's.

OPERATIONAL PROGRAMME BADEN WÜRTTEMBERG (RIS3)

The authority of Baden-Württemberg did not write a regional innovation strategy, however their policies do come back in the operational programme. This programme is a comprehensive overview of the policies for the European Regional Development Fund (ERDF). Baden-Württemberg is stimulating clusters and inclusive growth. Within these strategies, the government intends to build on the good facilities already available in the region. There are more than 100 colleges and universities and Baden-Württemberg has a central location in the global innovation network. To maintain this position, the state has continued its innovation strategy in the sense of intelligent specialisation on the basis of the 2011 coalition agreement, focusing its economic and innovation policy on four future fields, existing innovative cores and nine key technologies. The four future fields are:

Baden-Württemberg main economic sectors for innovation	
1. Sustainable mobility	2. Environmental Technologies, Renewable Energies and Resource Efficiency
3. Health and Care	4. Information and Communication Technologies, Green IT and Intelligent Products

Table 9: The main innovative sectors in Baden-Württemberg. Water technology and the water sector are not included but the region does focus on Environmental technologies as a whole.

Intelligent specialisation provides orientation for the entire innovation system, from knowledge development, especially in public research institutions, through transfer to companies, with the focus on SMEs, to the application and market launch of innovative products. Important components of the state's innovation system are the provision of public research and innovation infrastructure, knowledge development, knowledge and technology transfer, networking, start-ups and the development of the potential for technology leadership (Baden-Württemberg, 2013).

REGIONAL POLICY BADEN WÜRTTEMBERG

Within the region of Baden-Württemberg, the regional government stimulates cluster initiatives. Therefore, the ministry of economic affairs and housing of B-W yearly presents the Cluster Atlas B-W. This atlas is an overview of cluster related networks and initiatives across B-W. For the Karlsruhe region (Mittlerer Oberrhein) several clusters are identified. These key industries are the automotive-, energy-, information and corporate software-, creative economy-, and the nanotechnology cluster. Many of these clusters work across state and national borders and are orientated at the global market (Baden-Württemberg, 2019).

Water technology and the water sector is for the regional government not seen as priority sector. However a study from the Helmholtz Water Network to the water research community in Germany sees Karlsruhe Institute of Technology (KIT) and the University of Stuttgart as major institutions for the German water sector (figure 24).

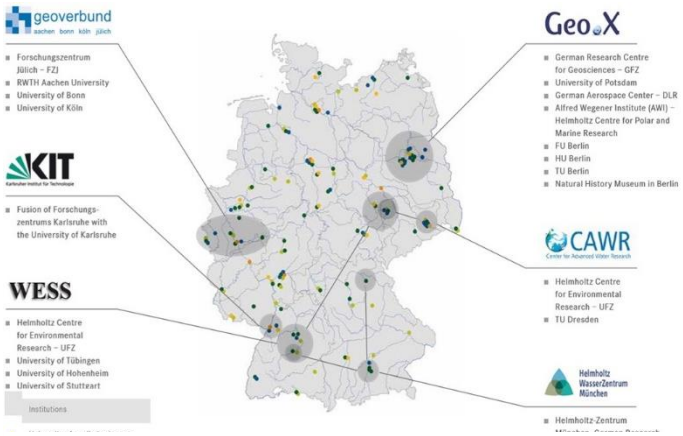


Figure 24: An overview of all publicly funded water research institutions in Germany

According their research B-W has several institutions in the water (technology) sector (Helmholtz Water Network, 2015).

Baden-Württemberg is a highly innovative region, however the focus point is not at water technology. TZW (project-partner) has its main focus on water technology, however their daily business are mainly market driven. TZW (Water Technology Centre) is the center of applied research of the German Waterworks Association (DVGW). TZW is a non-profit organisation and provides scientific consulting to waterworks and to governmental bodies and offices. The DVGW bundles the competence of utilities, gas and water companies, public authorities, institutions, organisations and individuals.

Because of the national and international market DVGW and TZW are operating on, a regional innovation system is not in place here. The regional government does not provide funding for water technology specific but they do support innovation in environmental technologies. Umwelttechnik BW is tasked with fostering environmental technology and resource efficiency in Baden-Württemberg. This organisation market and advertise the local industries, thus making environmental technologies and resource efficiency from Baden-Württemberg more visible. The main target group are small and medium enterprises mainly in industry and construction. Umwelttechnik B-W is therefore operating as business network but it is not specifically for water technology. Furthermore, TZW is collaborating with other research institutes such as the Karlsruhe institute of technology, who do have a department for water technology, and the LUBW (State Institute for the Environment, Measurements and Nature Conservation Baden-Württemberg). However, these cooperation's do have educational purposes. Based on these findings the regional innovation system can be portrayed according figure 25.

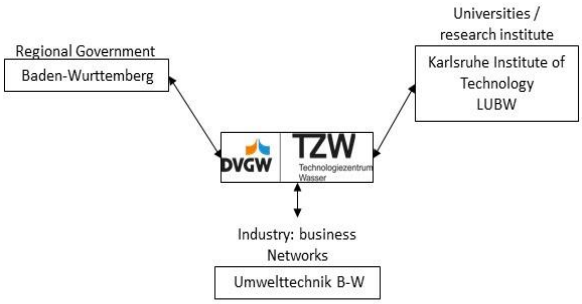


Figure 25: In Baden-Württemberg water technology is market driven. TZW is part of a national organisation (DVGW), therefore a regional innovation system is not in place.

5.6 CENTRE-VAL DE LOIRE, FRANCE

In France the Ministère de la Transition écologique et solidaire (Ministry of Ecological and Solidarity Transition) is responsible for water related issues. Therefore, they have the task to control the sanitation for wastewater and the treatment of sludge deriving from the wastewater. The French ministry describes sanitation and their treatments as follow: there are two main types of sanitation collective sanitation (collection network and wastewater treatment plant) and non-collective (or individual or autonomous) sanitation. The choice between these two solutions is a matter for the municipality and depends in particular on the density of the habitat. The ministry sets out the regulation for water quality and do control if all municipalities comply to the standards set out for France as a whole. However, the municipalities are free to decide how water is treated in their region (Ministère de la Transition écologique et solidaire , 2019).

NATIONAL POLICY

At the national level, French water policy is also managed by the ministry of Ecology, Energy, Sustainable Development and the Sea. Where other institutions are responsible for wastewater treatment, this ministry is in control of managing water and aquatic environments. Hereby, they made distinguishes in qualitative issues such as water quality and quantitative issues such as extreme events as floods and drought. The aim of this policy is to restore water of good ecological quality for industrial, agricultural and public usage. The institutional organisation is divided into 3 main players; the state (ministry of Ecology, Water and Biodiversity Department), basin organisations, who set out water policy and local authorities who deliver water and sanitation services (Mignaux, 2011).

Figure 26: The French National water cluster. A collaboration between 3 already existing clusters.

For water technology, the economic focus can be found in the French national cluster policy. Le Pôle de Compétitivité de la Filière de l'Eau (Competitiveness Cluster of the Water Sector certified by the State Cluster directory), by creating this national cluster, 3 already existing structures will jointly work together under the name: France Water Team. This national cluster is a collaboration between Hydreos, Aqua Valley and DREAM cluster (figure 26). The ambition of the Water Sector Competitiveness Cluster is to identify and develop solutions that meet the major water challenges for the future: resource resilience to climate change (including water re-use and controlled groundwater recharge) and management, with infrastructure and ecosystem adaptation and responses and the fight against emerging pollution, with the use of new analysis and treatment techniques (Pôle de Compétitivité de la Filière de l'Eau France Water Team, 2019).

RIS3 STRATEGY CENTRE-VAL DE LOIRE

The regional innovation strategy for Centre-Val de Loire is set out to identify regional strengths and areas of growth potential for economic development and employment in the region so that the innovation actions and investments are better targeted. Therefore the region is focused to encourage all types of innovation within companies by strengthening the territory's research and innovation capacities. Thereby, Centre-Val de Loire is investing in human capital; to raise the skills and qualifications in the region. And the region is aiming to strengthen their financial capacity. Investing in technology and innovation does have a high level of risk. Therefore, Centre is focusing on 5 themes and projects likely to have recognised and quantified impacts on the regional territory (Centre-Val de Loire, 2013).

Centre-Val de Loire's main economic sectors for innovation	
1. Environmental engineering and metrology	2. Biotechnology and health & cosmetics
3. Energy storage systems	4. Energy efficiency technologies
5. ICT services for heritage tourism	

Table 10: The main innovative sectors in Centre-Val de Loire. Water technology or the water sector is not involved. However, the environment and biotechnology do play a role.

As recognised by the region, environmental engineering and metrology is one of the main innovative sectors in Centre-Val de Loire. Water technology is not named explicitly but is it likely to have cross-overs with the environment and metrology.

REGIONAL POLICY CENTRE-VAL-DE LOIRE

Water technology does come back in the regional policy of Centre-Val de Loire called the Pivots programme. This programme funded by the region of Centre is focused on monitoring the quality of the environment. Its goal is to preserve natural resources (soils, subsoil, surface water, groundwater, air) at a time when they are doubly threatened by human activities and climate change (Plateformes PIVOTS, 2016). The aim of the PIVOTS programme is to integrate academic actors and companies from basic research to the validation of products and services. This interaction between actors will therefore support the emergence and development of an economic sector.

Figure 27: Pivots programme to tackle environmental issues.

From these 7 platforms, the PRIME platform is taking part in the Interreg Water Test Network. This platform is managed by BRGM (partner of WTN) and has the purpose to study water-related issues. The other platforms, seen in figure 27, have their focus on other environmental issues such as air quality and soil & subsurface measures. The programme as a whole is a collaboration between the government of Centre-Val de Loire, BRGM, DREAM cluster and other relevant companies and research institutes.

Centre-Val de Loire has a clear aim on ecology. At the national level, the French government is stimulating cluster policy to promote innovation through increased collaborations between firms, private research centers and universities, and to strengthen the competitiveness of French products on international markets (Fontagné, Koenig, Mayneris, & Poncet, 2013). Therefore a water cluster is established between DREAM and 2 other partners in France. At the regional level, Centre-Val de Loire is stimulating various environmental test locations: the PIVOTS programme.

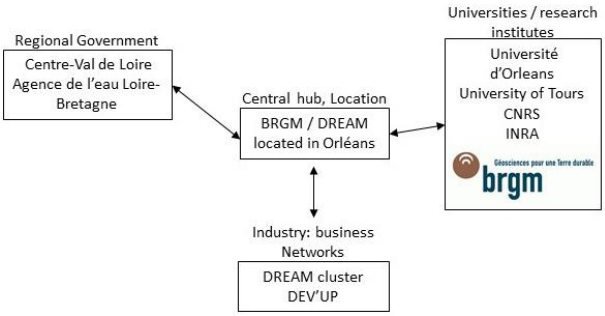


Figure 28:The regional innovation system in Centre-Val de Loire is aimed at environmental technologies. However, a water cluster is established in the region.

Water and water technology is one of the items within the programme. The regional government, together with universities and several research institutes are involved in the 7 platforms of PIVOTS. There is not a central location or campus however, all institutions are located in Orléans which is the capital of Centre-Val de Loire. The test sites are located across the province as is seen Friesland, Scotland and Flanders as well. The main difference in Centre-Val de Loire is the scope. Environmental metrology is the main topic, water technology (as defined in this research) is part of the programme with 1 platform; PRIME. Therefore the regional innovation system for water technology in Centre-Val de Loire is portrayed according figure 28.

6. RESEARCH RESULTS: AN ANALYSIS PER DETERMINANT

In this chapter, Taking both interviews and questionnaires into account, an analysis per region is conducted. In chapter 2, the determinants for a regional innovation system in water technology are set out into a conceptual model. This model is an overview of factors which should be present in a regional innovation system for water technology. Through the outcome of the surveys and interviews every determinant is assessed per region. This chapter discusses the outcome of the analyses to make clear where the regions differ between each other.

6.1 INTERPRETATION OF THE RESULTS

Giving a score to certain values which are not easy to interpret could lead to randomness and subjectivity. It is to the writer how he or she values the data that is obtained. With qualitative data this might lead to some bias and therefore to misleading results. To control for this, the determinants are valued according the legend in table 11 based if they are available for water technology or not.

Social factors	Social factors such as the presence of human capital, the level of education and the drive for entrepreneurship derived from the EU regional competitiveness index valued in chapter 4.	A +++ is awarded if all social factors are highly present. A -- is awarded if none of these factors is present. Based on the differences in the EU competitiveness index and the number of people working in the tertiary sector the regions have been ranked.
Economic and geographic factors	Economic factors is measured by GDP per capita, R&D investments and the EU regional competitiveness index. Geographic factors are measured by population density.	A +++ is awarded if GDP per capita, R&D investments and the population density is above average. If one of these variables is less present a ++ is awarded and so on.
Government	The Government is assessed according the questionnaires to the engagement of the water sector and if they play a managing role or more a facilitating role.	If the local government (NUTS 2) is highly involved with the water sector and does have a managing role a +++ is awarded. If the government is involved but the scope is not explicit on water (technology) the score is less high. If the government only facilitates the score is at lowest.
University	Universities are assessed per region on the availability of education for the water sector and the focus the university has on water related topics derived from the survey and desktop research.	A university with explicit study tracks for the water sector receives +++. If a university does have study track who do touch upon the water sector a ++ is given. If there is a university with no relevant study tracks a + is given.
Industry	Some regions lack in having a report about the water sector and its influence on the industry. Therefore industry is assessed by standardised data of Eurostat in chapter 4.	The industry is assessed on the level of employment and the number of people working in the tertiary sector. If these numbers where above average a +++ is awarded, if one of those variables is less high a ++ or + is given.

Networks	Networks are assessed by the surveys only and is based on the collaboration of the government, university and industry.	The networks are assessed according the collaboration of the triple helix. If all parties do fulfil a role for the water sector a +++ is given. If one party is not active participating the score will be less high.
External partners	External partners are partners outside the own region, in this research the Water Test Network is one of those examples where external partners are created.	A ++ is awarded if the region does have several (important) partners outside their own region. If the Water Test Network is the only external project a + is given.
Central location, hub	A physical location, such as a campus or hub is seen as an added value for technology transfer and the tacit knowledge from external partners and partners within the region based on the questionnaire there is assessed if a hub is in place or not.	If there is a clear central location and the region does profile themselves as a hub or campus a +++ is awarded. If there is a central location but the parties do not operate actively together a ++ is given. If only a part of the members collaborate at the same place a + is awarded.
Learning lines	Subsequent learning lines are necessary to promote regional innovation systems in water technology. Learning lines are assessed based on the amount of learning lines for all educational levels.	The learning lines for water the water do receive +++ if all learning lines are covered for water specific education tracks. If all learning lines are covered but not specific for the water sector a ++ is awarded. And if a part of the learning line is missing a + is given.
R&D infra for water sector	Specialised R&D infrastructure is necessary to promote regional innovation systems in water technology. The infra is assessed on the technological readiness level (TRL) and if they are in place.	Based on the TRL a +++ is awarded if all levels are available. If one of the levels is missing a ++ is awarded. If there is only one operation site which covers only a part of the TRL, a + is awarded.
Specific policy programmes	Specific policy programmes for water technology are available in different regions. The assessment of this determinant is based on the availability of specific- or in a broad context policy programmes.	A +++ is awarded if a region does have specific policy for the water sector. A ++ is awarded if this policy is available for water and other environmental purposes as well. If there is not a specific policy programme at a regional level a – is given.
Shared projects	Active SME's who work together in shared projects (such as the Water Test Network) are being stimulated more to share their knowledge. Do regions participate in other projects as well.	If a region does participate in other projects for the water sector a +++ is given. If this project is not explicitly for the water sector a ++ is awarded. A + is given if the Water Test Network is the only shared project within the region.

Innovation users	Innovation users are necessary to ensure the sustainability of the innovation system and are measured as the amount of SME's who make use of the WTN-project.	If there are more than 15 innovation users a +++ is awarded. Between 10-15 users a ++ is given. 5-10 receives a + . 1-5 is awarded a -. And 0 users is --.
Cluster organisation for Water sector	Cluster organisations are necessary to promote regional innovation systems in water technology. A cluster organisation can be water technological specific or broader. And therefore assessed based on its function.	If the cluster organisation is specific for the water sector a +++ is awarded. If the organisation is available for the water sector but is not actively involved a ++ is awarded. A + is given if there is a cluster organisation in the region which is not sector specific.

Table 11: legend of the score system for the determinants of a Regional Innovation System in Water technology.

6.2 SOCIAL AND ECONOMIC FACTORS

This paragraph is based on data retrieved from Eurostat as is described in chapter 4. A weakness in this dataset is that the available data per region covers standardised data such as demography, GDP, R&D expenditures and employment rates rather than data explicit for the water (technology) sector. Furthermore the EU regional competitiveness index is taken into account. However, this data could be explained as an overall score for regions and therefore for a regional innovation system. A better solution would be numbers about the water sector specific for those regions. Friesland and Scotland conducted such a study, however the other regions have not. Moreover, it is arguable what should be counted as the water sector and what not. Because of this lack of information, general data is used to assess the social and economic characteristics of the regions. What stands out is that European physical core regions, Karlsruhe, Gelderland and Flanders score higher on all general data than the peripheral regions. The social factors are assessed according the working force in the tertiary sector and the R&D investments as percentage of the GDP. As seen in table 11 social factors are hardly available in the regions of Friesland and Centre-Val de Loire. This is because of a lack in R&D investments in Friesland and a relatively low workforce in the tertiary sector in Centre. The economic factors are based on population density, the competitiveness index and the GDP. Based on this information Karlsruhe stands out with a high GDP and the best score on the regional competitiveness index. It becomes clear that there is a distinction between the economic power of European core regions and the peripheral regions.

6.3 THE TRIPPLE HELIX AND THE NETWORKS

This part describes the focus of the triple helix: government, industry, university on the water sector and their underlaying networks which each other. The 3 core regions score the lowest points for engagement in the water sector. The regional authorities here do not have a managing role and they rather operate as facilitator. An explanation could be that the market is more in balance with the industry as managing role. For the peripheral regions it is the government with a managing function. This could be water sector specific as seen as in Friesland and Scotland. But it could also contains larger interests such as in Centre, where the main subject is ecology as a whole. This interaction changes between the industry and the government. Therefore core regions do score better on industry and lower on government and the opposite interaction is seen for the peripheral areas. Extra study about the water sector and its impacts per region is needed here to make in depth statements.

For universities it is easier to assess the physical availability per region because this determinant relies on available study tracks for water technology. However there is also a contradiction here. The province of Friesland does not have its own university in the region but Wetsus, a multidisciplinary collaboration between companies and research institutes from all over Europe for water technology is located in the province. So, despite the fact

that Friesland is the only region without a university it is assessed with the highest score. All other regions have several universities and high education institutions who do touch several playing fields for the water sector and water technology. Nevertheless, it is about how these 3 parties work together in their networks. Again, the distinction between core and peripheral regions gets visible. If the government is in a managing role, tasks are divided between the helixes. If the industry is in a leading role, networks are smaller and tasks often stay at the industry side. Therefore, networks between the triple helix are lower estimated for core regions than for the peripheral regions. However, in potential there is no wrong and right here. Input differs but this does not say anything about the output.

6.4 INFRASTRUCTURE, LEARNING LINES, PARTNERS AND THE LOCATION

All regions do have infrastructure for water technology or the water sector in the form of test facilities, research laboratories and companies who might use these facilities. This infrastructure is assessed according the amount of test facilities and laboratories in the region and how mature this infrastructure is. Friesland has the best score because the infrastructure in this region is complete from demand to product. Followed by the Scottish regions who are establishing the same infrastructure but they are still in an earlier phase compared to Friesland. Therefore, the infrastructure is less mature which lead to a lower score. Centre-Val de Loire does have its own system which does have a broad infrastructure connected to their local universities and the regional authority. However, this PIVOTS programme is a broader topic than water sector specific. The other regions do not have a full infrastructure but are rather dependent on one test facility or laboratory in the area.

Learning lines are another concept in sharing knowledge for the water sector. This determinant is assessed based on the availability of specific learning lines for different educational levels. Most regions do have universities with study tracks who do touch upon water or water technology. However most of these studies are focused on other fields as well. Therefore all regions have the same score except Friesland where a complete learning line is developed at all educational levels. Of course, a complete learning line is almost only possible to bundle the specific study tracks at a certain location: Watercampus Leeuwarden. Because of the availability of a central location a geographical cluster can be established. This is seen in other regions as well, Centre does have all the available resources closely located together in Orléans. However, the stakeholders do not profile themselves as a cluster, hub or campus. The Scottish regions are again in an earlier phase but they are currently developing the Hydronation International Centre in Aberdeen. For the European core regions a central location is not in place. This also interacts with the amount of partners the regions have. A well functional cluster does have more interaction with other stakeholders than in other regions who do not operate as a cluster. Although according the survey, every region did say that they have interaction with important stakeholders for the water sector outside their own region. Therefore a distinction is made between the amount of important stakeholders a region was aware of. However, it is open for discussion if a stakeholder is seen as important or not. Further research is needed to map these uncertainties out.

6.5 SPECIFIC POLICY PROGRAMMES AND SHARED PROJECTS

This paragraph is based on the Ris3 strategies and specific regional programmes for the water sector. In the regional innovation strategies, the local authority sets out the important sectors which are seen as focus point for the area. However, there are only 2 regions who do mention the water sector or water technology as a spear point; Friesland and Gelderland. Where Gelderland does mention it as part of the HTSM sector. The other regions do acknowledge the importance of innovation but their focus points are not with the water sector. Or their strategies are rather a holistic overview of every aspect of innovation. Looking at specific regional policy programmes there are 3 regions who do set out a programme where the water sector is noticeable present:

Centre, Scotland and Friesland. Therefore they score higher than other regions. Furthermore a difference is noticeable between Centre and the other 2 peripheral regions because the French region has its focus on a broader topic of ecology.

Another determinant is the number of shared projects. Which is to some extent related to the external partners. These shared projects are available in every region. A major reason for this is the Water Test Network itself, which is a shared project. However, some regions are involved in other projects as well. If they are involved in other water related projects regions received the highest score. If the Water Test Network is the only project noticeable, the score is lower. Which is the case for the region of Karlsruhe.

6.6 CLUSTER ORGANISATIONS AND INNOVATION USERS

In a fragmentated market such as the water sector, cluster organisations do have an important guiding role. They connect the market to university and vice versa. However, not every region does have such an organisation. Gelderland and Karlsruhe are lacking in a cluster organisation for this sector. In Scotland, the national government in the form of Scottish Enterprise does fulfil this role but this is not water sector specific. The other regions do have cluster organisations to establish networks at international level. Water Alliance in Friesland, DREAM cluster in Centre-Val de Loire and Watercircle in Flanders. However West-Flanders scores less high because the cluster here is not (yet) involved in the policy programmes of Flanders.

Furthermore, a functional innovation system needs users to make the mechanisms work. For the Water Test Network these users are defined as the amount of companies who make use of the test sites. Therefore Scotland and Friesland do score well with both have respectively 25 and 18 innovation users. Gelderland follows with 6 users and the other regions do have 3 (Karlsruhe) 2 (Centre-Val de Loire) and 1 (West-Flanders) innovation users at the time this report was written (figure 29).

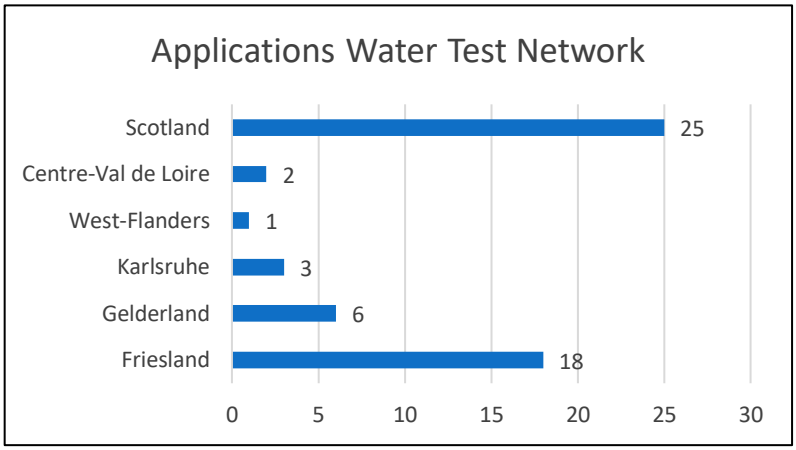


Figure 29: Active applications per region at 28 November, 2019.

6.7 RESULTS PER DETERMINANT

In table 12 the determinants for a regional innovation system are assessed according the definitions applied and described in table 11. This table gives an overview per available factor and to what extent these factors are available within the region. It is rather an overview per region which describes the input but it does not say anything about the quality of the water sector if one is speaking about the output per region. Partly, this is because the regional innovation systems differ in purposes and therefore pursue different goals.

	FRIESLAND	GELDERLAND	KARLSRUHE	FLANDERS	CENTRE-VAL DE LOIRE	SCOTLAND
SOCIAL FACTORS*	-	+++	+++	++	-	++
ECONOMIC AND GEOGRAPHIC FACTORS*	-	++	+++	++	-	-
GOVERNMENT	+++	+	+	+	++	+++
UNIVERSITY	+++	++	++	++	++	++
INDUSTRY*	+	++	+++	++	+	+
NETWORKS	+++	+	+	+	+++	+++
EXTERNAL PARTNERS	++	+	++	+	++	++
CENTRAL LOCATION, HUB	+++	--	--	--	++	+
LEARNING LINES	+++	++	++	+	++	++
R&D INFRA FOR WATER SECTOR	+++	+	+	+	++	++
SPECIFIC POLICY PROGRAMMES	+++	--	--	--	++	+++
SHARED PROJECTS	+++	+	+	++	+++	+++
INNOVATION USERS	+++	+	-	-	-	+++
CLUSTER ORGANISATION FOR WATER SECTOR	+++	--	--	++	+++	+

Table 12: Analyses per determinant for the regions if they are available or not. -- is not present, – hardly available, + available, ++ available for broader topic, +++ available specific for water (technology).

*** These determinants are assessed based on aggregated data of Eurostat and do not rely on the availability for water technology but do tell something about the overall strength of the region.**

7. CONCLUSIONS AND RECOMMENDATIONS

Regional innovation systems are abstract to define. At first, regions could be classified according existing jurisdictional boundaries. However, an innovation system and the stakeholders within these systems are often overarching these borders. Moreover, stakeholders within the regional system such as cluster organisations could have their focus on national economies. Therefore, a regional innovation system could not be described according to predetermined rules. It is rather a descriptive overview of characteristics which every innovation system favours to perform. Secondly, the water sector is a complicated market. Partly, the water sector is driven by legislation at different political levels. These regulations create a forced market for stakeholders in the water sector. On the other hand, the water sector is fragmented within the public sector. For many other sectors, water and its technology is an enabling sector for other economic fields. Therefore, this chapter sets out an overview between the regional innovation systems in water technology for the regions collaborating in the Water Test Network. Based on the results, derived from desktop research, questionnaires and interviews, a comparison is made based on RIS characteristics, specific policy programmes and the financing of water technology. By comparing these determinants the following question is answered:

TO WHAT EXTENT DO REGIONAL AND LOCAL GOVERNMENTS INVOLVED IN THE WATER TEST NETWORK DIFFER IN APPROACH TO FOSTER INNOVATION IN THE WATER TECHNOLOGY SECTOR?

The results are translated into recommendations for policy makers and researchers interested in regional innovation systems and in particular water technology. Every paragraph answers one of the sub questions.

7.1 CHARACTERISTCS OF INNOVATION SYSTEMS IN WATER TECHNOLOGY

Regional innovation systems in water technology are not defined by size of the region, a region is rather a legislative boundary which provides guidance for mapping an abstract system. Although, for water technology, it is also the scope the region has that determines from which angle water technology is being studied. This could be specific, with the focus on water technology or the water sector. Or from a broader perspective such as environmental technology or circular economy. Subsequently, it differs which role the water sector has between regions. Water can be a subject on its own, or relevant as enabling sector for other economic fields such as the chemistry or agro-food sector. Furthermore, political visions vary between regions. For a fragmentated market, as the water sector, with a lot of overlapping areas in other sectors the purposes for water technology differ. For some regions it might have economic reasons, where other regions focus on solving environmental issues.

However, there are also similarities looking at the characteristics of a regional innovation system. First, governments, industries and educational institutions are coming together. Because of the fragmentation of the water sector a cluster organisation or a business network seems necessary to involve the industry into these processes. Main difference between the regional innovation systems are the organisations who act like business networks. In most cases these are hybrid institutions who are funded by regional authorities. Their aim could be water specific, such as the water alliance (NL), DREAM (FR) and watercircle (BE). But it could also be an overarching network as seen by Cleantech region (NL), Umwelttechnik B-W (DE) and Scottish enterprise (UK). Secondly, a central location in the form of a hub, valley or campus might help in creating and maintaining these networks. Although, a central location goes together with a strong focus at a certain topic; water or water technology. Thirdly, if the scope is broader, the involved stakeholders are not clustered anymore which makes it harder to define the regional innovation system and therefore a geographical location. At last, there is need for acknowledgement for national innovation systems. As seen as in Germany, TZW (partner) is part of a larger institution (DVGW) which has a strong national focus. The institutions who are operating under the name of DVGW are located all across Germany. Even TZW, which has several locations in Germany. Because of these structures the innovation system could rather be described as a national system driven by market demand.

7.2 THE INSTITUTIONAL LEVEL AND ROLE OF THE REGIONAL OR LOCAL GOVERNMENT

Institutional levels are very diverse, in contradiction to innovation systems, and often bounded to legislative areas. However, the regional or local government could be defined in several ways depending on the perspective of the respondents about the region. In Europe, these definitions do vary a lot. Therefore the European commission made their own classification based on NUTS levels. For comparing regional characteristics these classifications are often used by scientists because of their standardisation of measurements and data collections. However, regional authorities are not always bound to these classifications and in reality, it is hard to compare regions based on their legislative authority, especially for water technology and the regions collaborating in the WTN project.

Based on the limitations of defining the regional boundaries, a top-down approach in water (technology) policies is conducted. Starting at EU broad water policies towards region specific policy. By doing so, regional authorities are classified as the bottom layer of policymaking for water technology. Although, governmental structures are different across Europe. For the Netherlands, France and Germany a top-down implementation leads to a hierarchical categorisation. For Scotland and Belgium other policy structures are in place. The institutional level is therefore different among the regions of the WTN project and because of this, the legislative regional or local government for water policy is not equal to the NUTS2-level of the European Union.

Furthermore, the role of these governments differs. The water sector and its technology have in broad meaning 3 functionalities: strengthen the regional economy (1), improving environmental issues (2) or as enabling industry (3) for other economical fields. However, all scopes foster innovation in water technology, it is the vision of policymakers that decides which purpose this innovation should have. This also implies that the role of a regional government changes regarding which aim the water technology sector should fulfil. In peripheral regions, strengthen the economy is often seen as a task for the government, this is mostly done by governmental programmes such as Hydro nation (Scotland), Pivots programme (Centre-Val de Loire) and the policy framework water technology (Friesland). In European core areas, the government has a facilitating role rather than a managing role. As seen in Flanders, where the water sector is facilitating other sectors such as the agro-food- and chemistry sector. Gelderland, where water technology is embedded in a broader theme of circular economy and Baden-Württemberg, where water technology is market driven at a national level.

However, regions are not focused on one functionality of the water sector. Because of political interference it is rather a mixture of all functionalities depending which viewpoint is taken. Although, it is at this point where regions do not set a clear focus. A reason for this might be that local and regional authorities do not want to exclude themes in their policies, however, this also leads to vagueness. As seen back in the innovation strategies, every region wants to innovate in a sustainable way with the aim of inclusive growth for the whole region. These principles are in line with the European vision but it also leads to strategies with a lack of depth and focus. Every region wants to improve the environment and the sustainability, but it is unclear how these strategies are implemented. Water technology is therefore intertwined in a lot of cross sectors fulfilling different roles in various sectors.

7.3 FINANCING INNOVATION IN WATER TECHNOLOGY

Depending on how specific regional governments act on water technology their funding changes as well. However, it is challenging to identify how the different governments fund water technology in the region. This is because of the fact that every region has another vision or they want to fulfil more functionalities of the water sector in once. Therefore, stakeholders in the regions are not able to identify which policies or funding programmes could apply for water technology. They rather describe which funding is available for them. Since the water sector is fragmentated, it remains unclear how specific water technology is financed between the regions.

For funding programmes, stakeholders do have 3 institutional layers to pool from. European level, in the form of Interreg or ERDF, national level and regional level. However, there are considerable differences in the specification of these subsidy programmes. This in itself, is related to the vision and scope of water technology in the region. The more attention there is to water technology or the water sector, the more detailed the programmes are. This leads to differences in the purposes of the subsidy programmes which could have general themes such as cluster politics or stimulating innovation and technology. But it could also serve water technology, which can be divided into several layers: ecology, circular economy, water sector broad and water technology specific. Furthermore, if water technology is seen as an enabling sector, there might be other programmes as well to fund innovation in water related topics. In reality, it is often a mix of several programmes whereby it remains unclear in terms of money how much a region is investing in water technology. The resources are available, but because of different views water technology is funded from different perspectives in a direct and indirect manner. These differences demonstrate that the scope and funding is diverse. Therefore, fostering innovation for water technology is not structured according a fixed pattern. Input in every region is different and therefore one is not able to compare the output for the regional innovation systems in water technology.

However, Some guidance can be found in the number of active applications per region as seen in figure 29. Scotland and Friesland do perform significantly better than the other regions. At the same time, these 2 regions are the only one who have a clear focus for the water sector. One might argue that a clear vision and therefore specific policies could have greater influence on a regional innovation system. However, these findings should be commented upon. Friesland is already longer active in water technology and Scotland started the Interreg project. this could mean that these regions already had a head start at the beginning of the project.

7.4 DISCUSSION & RECOMMENDATIONS

As described above, regional innovation systems are abstract systems. Taken into account the various scopes on water technology within these abstract systems will result in multiple solutions to foster innovation for (at a certain extent) water technology. And none of them is right nor wrong. This depends on the vision of policymakers and their purposes for water technology in their region.

For policymakers and further research in regional innovation systems and water technology, one should be aware of comparing apples with oranges. There is not a single one-size fits all approach, simultaneously more input from stakeholders and regional authorities is not a guarantee for more output. There are other regional factors as well which should be taken into account such as the economic and social characteristics of a region. To make statements regarding this topic it is necessary to collect standardised data for the water sector and its technology. However, a general definition of the water sector should first be established. This is the most effective way of comparing the output of regions. Without any data an innovation system can only be analysed on its inputs which is, for the water sector, hardly doable if the purpose and goals differ in the same sector.

The added value of this report is to map the strategies of regional innovation systems in the field of water technology in different European regions. In the societal field, policymakers are given an insight into how other regions operate. The regions can also learn from each other in this way. For the WTN project, this report serves as a comparative study so that knowledge and ideas can be shared. In the scientific field, this study shows a manner how to compare regional innovation systems with different social and economic characteristics. Furthermore, this research might be interesting for scientists and policymakers who are interested in the operation of innovation systems for water technology and the possible impact on regions.

However, there are a few important lessons learned during this research. I would like to describe my point of view during the time writing this thesis. An internship at the province of Fryslân was an opportunity I could not resist. However, my point of view during this research was therefore focused on water technology as seen as in the province of Friesland. When doing research to regional innovation systems I was focused on how these regions did stimulate the water sector or its technology. Looking back at this point of view, I would reconsider this perspective. For scientists, policymakers or students I would advise to start with a fresh and open mind rather than focusing on a subject which is most important valued for one of the regions. Now I only found out a few months later that regional innovation systems for the water sector serve different interests. This will of course affect the type of questionnaires or interviews I conducted. Secondly, doing questionnaires and interviews with respondents who have different views or goals concerning the water sector will lead automatically to different understandings. I noticed that the respondents had trouble filling in the questionnaires. Fortunately, I was able to clarify many issues in interviews conducted at the Aquatech in Amsterdam. However, I could not record this interviews because the space was not suitable since it was at an exhibition stent at a fair. Therefore I conducted one on one conversations with my respondents to retrieve answers on all questions asked in the questionnaire and follow-up questions derived from the answers of the respondent. nevertheless, I am very pleased with the results but I would like to emphasize that these answers were not obtained in the original way as planned. The most important lesson that I would therefore like to give is to be open minded

REFERENCE LIST

Allouche, J., Finger, M., & Luís-Manso, P. (2008). Water sector evolution scenarios: the case of Europe . *Water Policy*, 221-238.

Anderson, J. J. (1990). Skeptical Reflections on a Europe of Regions: Britain, Germany, and the ERDF. *Journal of Public Policy*, 417-447.

Asheim, B., & Coenen, L. (2005). Knowledge bases and regional innovation systems: Comparing Nordic clusters. *Research Policy*, 1173-1190.

Baden-Württemberg. (2013). *Operationelles Programm : des Europäischen Fonds für regionale Entwicklung (EFRE) in Baden-Württemberg 2014-2020 .* Stuttgart: Ministerium für Ländlichen Raum und Verbraucherschutz Baden-Württemberg.

Baden-Württemberg. (2019). *Regional Cluster Atlas Baden-Württemberg.* Stuttgart: Ministerium für Wirtschaft, Arbeit und Wohnungsbau Baden-Württemberg .

BBO / Grontmij. (2012). *Water technologie Noord-Nederland: Groeiende sector met grote toegevoegde waarde.* Leeuwarden / Assen: BBO.

Belgium.be. (2019, November 19). *België, een federale staat*. Retrieved from Belgium.be: https://www.belgium.be/nl/over_belgie/overheid/federale_staat

BMBF. (2015). *Nachhaltigkeitsbericht des Bundesministeriums für Bildung und Forschung.* Berlin: Bundesministerium für Bildung und Forschung.

BMU. (2001). *der wassersektor in deutschland - methoden und erfahrungen .* Berlin: bundesministerium für umwelt naturschutz und reaktorsicherheit.

Bogardi, J. J., Dudgeon, D., Lawford, R., Flinkerbusch, E., Meyn, A., Pahl-Wostl, C., . . . Vörösmarty, C. (2012). Water security for a planet under pressure: interconnected challenges of a changing world call for sustainable solutions. *Environmental Sustainability*, 35-43.

Carayannis, E. G., & Campbell, D. F. (2009). Mode 3 and 'Quadruple Helix': toward a 21st century fractal innovation ecosystem . *International Journal of Technology Management*, 201-234.

Carayannis, E. G., Barth, T. D., & Campbell, D. F. (2012). The Quintuple Helix innovation model: global warming as a challenge and driver for innovation. *Journal of Innovation and Entrepreneurship*, 1-12.

Centre-Val de Loire. (2013). *vers une strategie regionale de l'innovation pour une specialisation intelligente en region centre .* Orléans: Région Centre.

CIW. (2017). *Integraal Waterbeleid: Samen werken aan water .* Aalst: Coördinatiecommissie Integraal Waterbeleid.

Cleantech Regio. (2018). *Agenda Cleantech Regio.* Apeldoorn: Cleantech Regio.

de Oliveira, L. S., Echeveste, M. E., Cortimiglia, M. N., & Gonçalves, C. G. (2017). Analysis of determinants for Open Innovation implementation in Regional Innovation Systems . *RAI Revista de Administração e Inovação*, 119-129.

EIPWater. (2017, May 15). *Basics*. Retrieved from EIPWater: https://www.eip-water.eu/about/basics

Engel, J. S. (2015). Global Clusters of Innovation: lessons from Silicon Valley. *California Management Review*, 36-35.

Etzkowitz, H., & Leydesdorff, L. (1995). The Triple Helix: University-Industry-Government Relations: A Laboratory for Knowledge Based Economic Development. *EASST Review*, 14-19.

European Commission. (2012). *European Innovation Partnership Water Strategic Implementation Plan.* Brussel: European Commission.

European Commission. (2012). *Regional innovation monitor: governance, policies, and perspectives in European regions.* Brussels: European Commission.

European Commission. (2014). *national/regional innovation strategies for smart specialisation (ris3).* Brussels: European Commission.

European Commission. (2016). *User guide to the SME Definition.* Brussels: European Commission.

Eurostat. (2015). *Regions in the European Union: Nomenclature of territorial units for statistics NUTS 2013/EU-28 .* Luxembourg: Publications Office of the European Union.

Flemish Government. (2019). *vlaams hervormingsprogramma 2019 .* Brussels: Flemish Government.

Fontagné, L., Koenig, P., Mayneris, F., & Poncet, S. (2013). cluster policies and firm selection: evidence from france. *Journal of Regional Science*, 1-26.

Giakoumis, T., & Voulvoulis, N. (2018). The Transition of EU Water Policy Towards the Water Framework Directive's Integrated River Basin Management Paradigm. *Environmental Management*, 819-831.

Greunz, L. (2003). Geographically and technologically mediated knowledge spillovers between European regions. *Annals of Regional Science*, 657-680.

Grey, D., Garrick, D., Blackmore, D., Kelman, J., Muller, M., & Sadoff, C. (2013). Water security in one blue planet: twenty-first century policy challenges for science. *Philosophical Transactions of the Royal Sciety*, 1-10.

Héder, M. (2017). From NASA to EU: the evolution of the TRL scale in Public Sector Innovation. *Innovation Journal* , 1-23.

Helmholtz Water Network. (2015). *Integrated research for addressing global water challenges.* Leipzig: Helmholtz wassernetzwerk.

Höglund, L., & Linton, G. (2018). Smart specialization in regional innovation systems: a quadruple helix perspective. *R&D Management*, 60-72.

Interreg North-West Europe. (2018). *INTERREG VB NWE Application Form .* Brussels: European Commission.

Krozer, Y., Hophmayer-Tokich, S., van Meerendonk, H., Tijsma, S., & Vos, E. (2010). Innovations in the water chain - experiences in the Netherlands. *Journal of cleaner production*, 439-446.

Krugman, P. (1991). Increasing Returns and Economic Geography. *The Journal of Political Economy*, 483-499.

Leydesdorff, L. (2012). *The Knowledge-Based Economy and the Triple Helix Model.* Amsterdam: University of Amsterdam.

Martins, G., Brito, A., Nogueira, R., Urena, M., D., F., Luque, F., & Alcácer, C. (2013). Water resources management in southern Europe: Clues for a research and innovation based regional hypercluster. *Journal of Environmental Management*, 76-84.

Mignaux, L. (2011). *French Water Policy.* Paris: Ministère de l'environnement de l'energie et de la mer.

Ministère de la Transition écologique et solidaire . (2019, November 26). *L'assainissement collectif (réseau de collecte et station de traitement des eaux usées)*. Retrieved from Ecologique Solidaire: https://www.ecologique-solidaire.gouv.fr/assainissement

Ministerie van Economische Zaken. (2017). *Navigeren met wind in de zeilen: Voortgangsrapportage Bedrijvenbeleid 2017.* Den Haag: Ministerie van Economische Zaken.

Moore, M.-L., von der Porten, S., Plummer, R., Brandes, O., & Baird, J. (2014). Water Policy Reform and Innovation: A systematic Review. *Environmental Science & Policy*, 263-271.

Moreno, R., Paci, R., & Usai, S. (2005). Geographical and sectoral clusters of innovation in Europe. *Annals of Regional Science*, 715-739.

Morris, J. T., Sundareshwar, P. V., Nietch, C. T., Kjerfve, B., & Cahoon, D. R. (2002). Responses of Coastal Wetlands to Rising Sea level. *Ecology*, 2869-2877.

O'connor, J. (2004). A Special Kind of City Knowledge': Innovative Clusters, Tacit Knowledge and the 'Creative City. *Media International Australia*, 131-149.

OECD. (1999). *Managing National Innovation System.* Paris: OECD.

OECD. (2011). *Regions and innovation policy. OECD Reviews of Regional Innovation.* Paris: OECD.

OECD. (2017). *Groundwater Allocation: Managing Growing Pressures on Quantity and Quality.* Paris: OECD Studies on Water.

Oki, T., & Kanea, S. (2006). Global Hydrological Cycles and World Water Resources. *Science*, 1068-1072.

Oost-NL. (2019, August 7). *Participatiefonds Oost NL*. Retrieved from OostNL: https://oostnl.nl/nl/participatiefonds-oost-nl

OPOost. (2013). *Slimme specialisatiestrategie Oost-Nederland .* Arnhem: Managementautoriteit Oost-Nederland.

Petit, O., & Baron, C. (2009). ntegrated Water Resources Management: From general principles to its implementation by the state. The case of Burkina Faso. *Natural Resources Forum*, 49-59.

Pieterse, N., Knoop, J., Nabielek, K., Pols, L., & Tennekes, J. (2009). *Overstromingsrisicozonering in Nederland.* Den Haag: Planbureau voor de Leefomgeving.

Pino, R. M., & Ortega, A. M. (2018). Regional innovation systems: Systematic literature review and recommendations for future research . *Cogent Business & Management*, 1-17.

Plateformes PIVOTS. (2016, May 16). *7 Innovation Platforms to Respond to Environmental Issues*. Retrieved from Plateformes Pivots: https://plateformes-pivots.eu/pivots-program/?lang=en

Pôle de Compétitivité de la Filière de l'Eau France Water Team. (2019, November 26). Retrieved from Pôle de compétitivité: https://competitivite.gouv.fr/les-56-poles/annuaire-des-poles-192/pole-de-

competitivite-de-la-filiere-de-leau-france-water-team-276.html?cHash=2757d32bd1a4a1edd187b2381ff9be3c

Porter, M. E. (1998). Clusters and the New Economics of Competition. *Harvard Business Review*, 77-90.

Powell, W. W., & Snellman, K. (2004). The Knowledge Economy. *Annual Review of Sociology*, 199-220.

Programmaplan Hoogwaterbeschermingsprogramma. (2019). *Een sterke alliantie voor sterke dijken.* Utrecht: Hoogwaterbeschermingsprogramma.

Provincie Friesland. (2013). *Uitvoeringskader Watertechnologie 2014-2020.* Leeuwarden: Provincie Friesland.

Provincie West-Vlaanderen. (2013). *West Deal: Strategisch plan gericht op de economische transformatie in West-Vlaanderen.* Brugge: Provincie West-Vlaanderen.

Reinert, H., & Reinert, E. (2006). Creative Destruction in Economics: Nietzsche, Sombart, Schumpeter. *The European Heritage in Economics and the Social Sciences*, 55-85.

Reitsma, A., & van der Hoek, J. P. (2015). *Kennis- en Innovatieagenda 2016-2019 TKI Watertechnologie.* Den Haag: Ministerie van Economische Zaken.

Rijksdienst voor Ondernemend Nederland. (2016). *MKB Innoveert .* Utrecht: Ministerie van Economische Zaken. Retrieved from TKI Watertechnologie.

Rodríguez-Pose, A. (2001). Is R&D investment in lagging areas of Europe worthwhile? Theory and empirical evidence. *Papers in Regional Science*, 275-295.

Rodríguez-Pose, A., & Di Cataldo, M. (2015). Quality of government and innovative performance in the regions of Europe. *Journal of Economic Geography*, 673-706.

Saxenian, A. (1994). *Regional Advantage: Culture and Competition in Silicon Valley and Route 128.* Cambridge: Harvard University Press.

Schumpeter, J. (2010). *Capitalism, Socialism and Democracy.* London: Routledge.

Science for Environment Policy . (2015). *Future Brief: Innovation in the European water sector.* Bristol: European Commission.

Scotland Can Do. (2017). *Scotland Can Do.* EdinBurgh: The Scottish Government.

Scotland's environment. (2016, October 3). *Scotland's fresh water*. Retrieved from Scotland's environment: https://www.environment.gov.scot/our-environment/water/scotland-s-freshwater/

Scottish Government. (2019). *Scotland: The Hydro Nation Annual Report 2019 .* Edinburgh: Scottish Government.

Shiklomanov, I. (1993). World fresh water resources. In P. H. Gleick, *Water in crisis: A Guide to the world's Fresh Water resources* (pp. 34-58). Oxford: Oxford University Press.

SNN. (2013). *Research and Innovation Strategy for Smart Specialization (RIS3) Northern Netherlands.* Groningen: SNN.

Sterlacchini, A. (2008). R&D, higher education and regional growth: Uneven linkages among European regions. *Research Policy*, 1096-1107.

The Scottish Government. (2015). *Scotland's Economic Strategy.* Edinburgh: y APS Group Scotland.

van der Wiel, H. (2016). *Dutch Enterprise Policy.* Ministry of Economic Affairs. Den Haag: Ministry of Economic Affairs.

Water Test Network. (2018, December 19). *Innovation Support Vouchers .* Retrieved from Water Test Network: http://www.nweurope.eu/projects/project-search/water-test-network/undefined

Water Test Network. (2018, December 12). *Project Summary*. Retrieved from Water Test Network: http://www.nweurope.eu/projects/project-search/water-test-network/undefined

World Bank. (2009). *Clusters for Competitiveness: A Practical Guide & Policy Implications for Developing Cluster Initiatives.* Washington: World Bank.

Zheng Zhou, K. (2006). Innovation, imitation, and new product performance: The case of China. *Industrial Marketing Management*, 394-402.

APPENDIX

QUESTIONNAIRES

Vlakwa – Charlotte Boeckaert

Beste Charlotte,

Zoals bij u bekend is de provincie Fryslân verantwoordelijk voor één van de deliverables in het Interregproject Water Test Network (WTN): een rapport over regionale informatie systemen op het gebied van watertechnologie.

Dit rapport bleek een interessant onderwerp te zijn voor de master thesis van Thomas van Balen ter afronding van zijn studie Economische Geografie aan de Rijksuniversiteit Groningen. Thomas heeft al diverse data verzameld. Via vragenlijsten en interviews dienen nu de openstaande vragen te worden beantwoord. De vragenlijst voor de Provinciale Ontwikkelingsmaatschappij West Vlaanderen is gereed.

Van de (sub)partners in het WTN-project willen we graag weten van welke beleidsinstrumenten van de regionale autoriteiten zij gebruik maken en welke positie zij hebben in het regionale innovatiesysteem op het gebied van watertechnologie. Voor VLAKWA hebben we enkele vragen toegevoegd, omdat wij denken dat u een goed beel hebt van het innovatiesysteem voor watertechnologie in West-Vlaanderen.

We vragen u de onderstaande vragenlijst in te vullen. Voeg alsublieft opmerkingen en aanvullende informatie toe als dit uw antwoord kan verduidelijken. Dit kan ook in het Nederlands/Vlaams.

We verzoeken u vriendelijk om de ingevulde vragenlijst binnen twee weken te retourneren.

Kind regards,

Eric Vos

Explanation of the questionnaire

The survey is divided into 3 parts. In the first part we ask which policy instruments are available for stakeholders in the water technology sector in (West-)Vlaanderen. The WTN-project will help SMEs to test their innovative water technologies at operational scale demonstrator sites. Its main aim is to speed up market uptake of innovative water technologies. However these test sites are just one stage in the innovation cycle from idea to successful export products as is symbolised in the innovation eco-system for water technology in the province of Fryslân.

This innovation eco-system is not a scientific model. It is rather a best practice consisting out of a combination of a number of instruments in the different stages of the innovation cycle. We will use it as a reference to map the support for water technology innovations in each region. We have broken down the innovation eco-system in a number of policy instruments. We ask you if your organization makes use of specific instruments and to indicate if you know whether the specific policy instrument exists in (West-)Vlaanderen or not.

The second part of the survey outlines the factors within the regional innovation system and the interaction between the triple helix: Government-Industry-University. Every system or region does have these determinants such as an active government, involved universities and an industry producing the goods. By

means of networks, clusters or shared projects these parties are collaborating in different cases. However, the interactions and roles differ per region. We ask you a number of questions to clarify the place of your organization in the triple helix framework in (West-)Vlaanderen.

In the last part of the questionnaire we ask you to give an example of good practice of stimulating water technology in (West-)Vlaanderen. The Interreg programme aims to disseminate examples of good practices to help other regions to improve their policy instruments. You can use the template to promote a project that VLAKWA is involved in.

Questionnaire WTN (sub)partners

Name: Charlotte Boeckaert……..

Organisation: Flanders Knowledge Center Water (Vlakwa/VITO)……..

Function: project coordinator…….

Email cb@vlakwa.be:……

Telephone: +32 14 33 50 06……

In this questionnaire water technology is defined as follows:.

Definition water technology sector

Water technology includes: drinking water, process- and industrial water, waste water treatment, reuse of water (for instance recovery of energy or nutrients) and sensoring.

All activities that treat or process water in one way or another with use of technology.

All technologies and technics that are being developed and used for treatment of water.

It is NOT

- delta technology: dikes, dredging, water management and nature and environment protection

- maritime technology: ship building and repair, off shore activities and harbour services.

Questionnaire part 1: policy instruments in (West-)Vlaanderen

In this part we ask which policy instruments are available in (West-)Vlaanderen. In the table we have distinguished a number of policy instruments in the different stages of the innovation cycle. The bottom three instruments refer specifically to water technology test sites.

We ask you:
- whether your organisation (VLAKWA) makes use of these specific instruments or not.
- to indicate whether you know if the specific policy instrument exists in (West-) Vlaanderen or not.

Notice: I consider 'Flanders' as the region. Vlakwa is a part of VITO but is independent. Answers in black are Vlakwa, answers in black (highlighted in yellow) are VITO.

	ancial pport own anisation by onal horities				Financial Support For other organisations by regional authorities		
	Yes	No	Don't know		Yes	No	Don't know
	Instruments innovation cycle						
1.Scientific R&D (e.g Phd projects)	X	X			X		
2.Applied R&D	X	X			X		
3.Research infrastructure (labs and equipment)	X	X			X		
4. Innovation projects of SME's	X - X				X		
5. Demonstration projects / pilot projects (limited scale)	X - X				X		
6. Launching customer projects (full scale)		X - X			X		
7. Incubator facilities (e.g. offices for start ups)			X				X
8. Cluster organizations	X	X			X		

9. Venture capital		X - X			X		
10. Education (e.g. study tracks etc)		X - X			X		
11. Export preparation (e.g. trade fairs)			X - X		X		
12. Export (grants)			X - X				X
13. Housing / real estate			X - X				X
14. Co-funding EU-projects (ERDF, Interreg, other ….)	X - X				X		
	Financial support for water technology test sites						
15. Construction of the site			X - X		X		
16. Operation and maintenance (exploitation)			X - X				X
17.Support of users (direct or indirect via site owner)			X - X				X

The questions and answers in the table are rather straight forward. If you want to make a remark or give more explanation please use the table at this page.
Put in the number of the instrument in the first column and put your remark or explanation in the second column.

Number of the instrument	**Comments, remarks and nuances**

Questionnaire part 2: Regional innovation system water technology

A functional innovation system consists of interactions between Government-Industry-University. Yet the strength of the interaction differs per region. With the questions in this part we try to picture the triple helix framework for water technology in (West-)Vlaanderen.

1. Who are the important players/stakeholders for water technology among the regional authorities ?

Vlaamse gewest **Yes**/No
Provincie West-Vlaanderen **Yes**/No
POM West-Vlaanderen Yes/**No**
Others:

All provinces in general (bevoegd over 3de categorie waterlopen, kan captatieverbod instellen).

2. Who are the important players/stakeholders for water technology among the universities/research institutes ?

- **Ghent University (see CAPTURE initiatieve)**

- KU Leuven

- Antwerp University

- VITO

- Agricultural research centres

3. Who are the important players/stakeholders for water technology among the companies / business organisations ?

- watercircle.be

- federations of end users (food, chemistry, textile, tank cleaning): fevia, essenscia, fedustria, CTC.

- Aquafin

- drinking water companies

4. Are you member of a cluster organisation in the field of water technology ? **Yes** / No

- if so what is the name

B-IWA (Belgian branch of the International Water Association -> is research oriented)

5. Is there a physical location, hub or campus where all partners in water technology can meet each other and cooperate together ? Yes / **No** / don't know

if so which location? ……

6. To which category of the Triple Helix for water technology would you reckon VLAKWA ?

Government Yes/No
Company/business organisation Yes/No
University/research organisation Yes/No
Cluster organisation **Yes**/No
Combination of: we unite and interlink water stakeholders from government, industry and research.

7. What kind of contacts does VLAKWA have with universities ?

- we give universities assignments to do research Yes / No
- we work together with universities in (subsidised) projects: **Yes** / No
- Other type of contact: **they are member of our 'resonance group'**

- Most important universities: **UG, KUL, UA**

8. What kind of contacts does VLAKWA have with regional authorities ?

- Regional authorities give us yearly funding for our basic activities **Yes** / No
- Regional authorities give us assignments to do (technical or economic) studies Yes / **No**
- Occasionally we get grants from regional authorities for special projects **Yes** / No
- Did you inform a regional authority about the WTN-project ? **Yes** / No
- Does a regional authority co-fund the WTN-project ? **Yes** / No
- We have regular meetings with an economic department Yes / **No**
- We have regular meetings with an environmental department **Yes** / No
- We have regular meetings with a water policy department **Yes** / No
- We have regular meetings with POM W-VL Yes / **No**

9. What kind of contacts does VLAKWA have with companies ?

- companies give us assignments to do (technical or economic) studies Yes / **No**
- we assist companies in innovation projects **Yes** / No
- we work together with companies in (subsidized) projects: **Yes** / No
- Other type of contact: **bilateral contact with companies in view of specific water problems.**

- The number of companies we cooperate with is ca. **30**

10. Are there external partners (partners outside Vlaanderen) who are important for water technology innovations in (West-)Vlaanderen ?
Yes / No
(if yes, please mention these)

- Water Europe

11. How are SMEs involved in the activities for water technology and which organisations have a role in this ?

Water technology provider companies are often SME's.

For reseach & development they can get funding from VLAIO.

They also want to get their technology on 'the limitative list for ecology bonus'. Once the technology is on the list, end users buying the technology can get a % reduction.

In case they want to demonstrate their innovation, they can apply for funding at 'Vlaanderen Circulair' (demonstrating circular economy) or for the VITO/Vlakwa open call (demonstrate innovation at the end user).

Water technology providers have a federation called 'watercircle.be'. This organization might also apply for funding e.g. VIS Blauwe Cirkel, KO Water, Intelsens are projects from the past.

12. Are there specific study tracks for water technology in West-Vlaanderen?

1. PHD education	**Yes** / No / Do not know
2. University education	**Yes** / No / Do not know
3. College level	Yes / **No** / Do not know
4. Vocational education	Yes / **No** / **Do not know**
5. High school education	**Yes** / No / Do not know

13. Below we have mentioned drivers for establishing test sites at Ghent University and the Watergroep. Which is the most important ? Could you please rank them 1 to 4 (1 = most important)

For De Watergroep

1. Stimulating economic activities in water technology
2. Improve environmental quality in West-Vlaanderen
3. Stimulating economic activities in the food industry
4. Improve education for our students

For Ghent University

1. Stimulating economic activities in the food industry
2. Stimulating economic activities in water technology
3. Improve education for our students
4. Improve environmental quality in West-Vlaanderen

TZW – Beate Hambsch & Josef Klinger

Name:…Beate Hambsch……(Josef Klinger)……..
Organisation TZW: DVGW-Technologiezentrum Wasser……..
Function:Head of section drinking water microbiology (CEO)
Email:…beate.hambsch@tzw.de (josef.klinger@tzw.de)
Telephone:…0049 721 9678 220…(0049 721 9678 110)…….

In this questionnaire water technology is defined as follows:.

Definition water technology sector

Water technology includes: drinking water, process- and industrial water, waste water treatment, reuse of water (for instance recovery of energy or nutrients) and censoring. All activities that treat or process water in one way or another with use of technology. All technologies and technics that are being developed and used for treatment of water.

It is NOT

- delta technology: dikes, dredging, water management and nature and environment protection
- maritime technology: ship building and repair, off shore activities and harbour services.

Questionnaire part 1: policy instruments in das Bundesland Baden-Württemberg

In this part we ask which policy instruments are available in das Bundesland Baden-Württemberg. In the table we have distinguished a number of policy instruments in the different stages of the innovation cycle. The bottom three instruments refer specifically to water technology test sites.

We ask you:
- whether your organisation (TZW) makes use of these specific instruments or not.
- to indicate whether you know if the specific policy instrument exists in Baden-Württemberg or not.

	ancial port own anisation by onal authority			**Financial Support** For other organisations by regional authority		
	Yes	No		Yes	No	Don't know
Instruments innovation cycle						
1.Scientific R&D (e.g Phd projects)	X			X		
2.Applied R&D	X			X		
3.Research infrastructure (labs and equipment)		X		X		
4. Innovation projects of SME's		X		X		
5. Demonstration projects / pilot projects (limited scale)		X		X		
6. Launching customer projects (full scale)		X		X		
7. Incubator facilities (e.g. offices for start ups)		X		X		

8. Cluster organizations		X				X
9. Venture capital		X				X
10. Education (e.g. study tracks etc)		X		X		
11. Export preparation (e.g. trade fairs)		X		X		
12. Export (grants)		X				X
13. Housing / real estate		X				X
14. Co-funding EU-projects (ERDF, Interreg, other ….)		X				X
Financial support for water technology test sites						
15. Construction of the site		X				X
16. Operation and maintenance (exploitation)		X				X
17.Support of users (direct or indirect via site owner)		X				X

The questions and answers in the table are rather straight forward. If you want to make a remark or give more explanation please use the table at this page.
Put in the number of the instrument in the first column and put your remark or explanation in the second column.

Number of the instrument	**Comments, remarks and nuances**
8,10,11,13	**Innovation Instruments are available but not specifically for Water Technology**

Questionnaire part 2: Regional innovation system water technology

A functional innovation system consists of interactions between Government-Industry-University. Yet the strength of the interaction differs per region. With the questions in this part we try to clarify the place of your organisation in the triple helix framework in Baden-Württemberg.

1. What kind of contacts do you have with universities ?

- universities make use of our (lab) facilities: No
- universities give us assignments to do analyses / tests Yes
- we give universities assignments to do research No

- we work together with universities in (subsidised) projects: Yes
- Other type of contact: bachelor/master/PhD theses……
- Most important universities: Karlsruhe (KIT), Stuttgart, Hamburg, Duisburg-Essen……

2. What kind of contact does TZW have with Landesregierung Baden-Württemberg (B-W)?

- B-W gives us yearly funding for our basic activities	No
- B-W gives us assignments to do analyses / tests	Yes
- Occasionally we get grants from B-W for special projects	Yes
- Did you inform B-W about the WTN-project ?	Yes
- Does B-W co-fund the WTN-project ?	No
- We have regular meetings with the economic department of B-W	No
- We have regular meetings with the environmental department of B-W	by case
- We have regular meetings with the water policy department of B-W	No

3. Do you have a contact person at the Landesregierung of Baden-Wurttemberg who we could send our questionnaire about policies for water technology? No
There is another organisation that might help:

Name: Umwelttechnik BW GmbH
e-mail: jonas.umgelter@umwelttechnik-bw.de
phone number: 0049 711 25284147

4. What kind of contacts does TZW have with companies ?

- companies make use of our (lab) facilities:	Yes
- companies give us assignments to do analyses / tests	Yes
- we work together with companies in (subsidized) projects:	Yes
- Other type of contact: ……	
- The number of companies we have contact with is ca . 300….	

5. Are you member of a cluster organisation in the field of water technology ? **Yes**

Water Europe

CEN/DIN

DVGW is partner of the German Water Partnership

6. Do you have a contact person from DVGW who could tell us more about the role of DVGW and the facilitation of companies and SMEs for water technology?

DVGW is dealing with standardisation for the drinking water sector and not promoting specific water technologies.

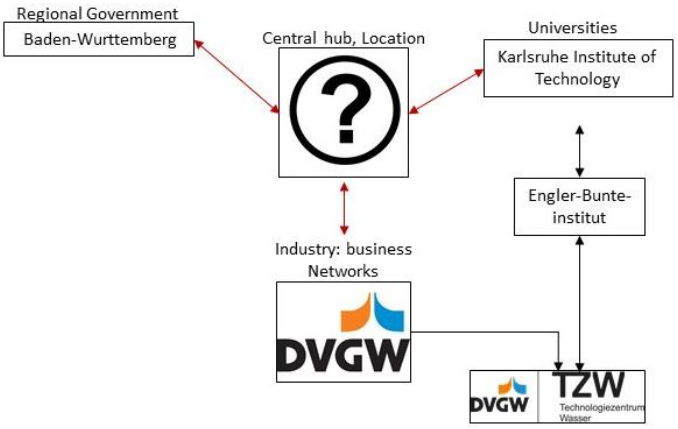
Figawa is the organisation that is promoting companies and technologies.

Name: figawa (Bundesvereinigung der Firmen im Gas- und Wasserfach e.V.)
e-mail: meyer@figawa.de
phone number: 49 221 37668-51

7. Is there a physical location, hub or campus where all partners in water technology can meet each other and cooperate together ? No

if so which location? ……

Based on desk research we have made the following picture of the Triple Helix in the field of water technology in Baden-Württemberg:
It is true that there is no central hub for water technology but on a local level DVGW is not acting as business network and there are other universities than the listed ones. Therefore, the picture reflects not the actual situation and has to be revised.



8. We have placed TZW among the research institutes. Is this correct ? Yes
TZW is performing research but offers also his test facilities for the water sector and companies.

9. Are there important players/stakeholders missing among the regional authorities ?
Yes
(if yes please mention these)

Other local authorities like LUBW

Project management organisations like BWPLUS

10. Are there important players/stakeholders missing among the universities/research institutes ?
Yes
University of Stuttgart

University of Biberach

KomS (Kompetenzzentrum Spurenstoffe)

And all water related universities in BW

11. Are there important players/stakeholders missing among the industries/ business organisations ?
Yes

Umwelttechnik BW (see question 3)

(if yes please mention these)

12. Are there external partners (partners outside Baden-Württemberg) who are important for water technology innovations in Baden-Württemberg ?
Yes
(if yes, please mention these)

BMBF (German Federal Ministry for Education and Research)

BMWi (German Federal Ministry of Economy)

13. What is the role of the Engler-Bunte institute in the collaboration between TZW and Karlsruhe Institute for Technology?

EBI is part of the KIT but is also a research institute of DVGW; in former times TZW was a part of EBI. Since than TZW developed as independent water hub for the water sector driven by bridging science and practice by Research – Consulation-Testing

14. Are there specific study tracks for water technology in Baden-Wurttemberg?
Yes

15. If yes at which levels could a student follow a study-track in water technology?
(more answers possible)

1. PHD education
2. University education
3. ~~College level~~
4. Vocational education
5. ~~High school education~~

16. Do students also make use of the laboratory facilities of TZW which are available for SME's?

Yes

Christophe Mouvet – BRGM

Questionnaire WTN (sub)partners

Name:……Christophe Mouvet
Organisation:……BRGM
Function:……Project Leader
Email:……c.mouvet@brgm.fr
Telephone:…….

This questionnaire is filled in at the Aquatech by Thomas van Balen during the interview with Christophe.

Christophe did not know for sure which instruments were available for BRGM or in the region, So he was not able to answer part 1.

Questionnaire part 2: Regional innovation system water technology

A functional innovation system consists of interactions between Government-Industry-University. Yet the strength of the interaction differs per region. With the questions in this part we try to clarify the place of your organisation in the triple helix framework in Centre-Val de Loire.

1. What kind of contacts do you have with universities ?

- universities make use of our (lab) facilities: **Yes** / No
- universities give us assignments to do analyses / tests Yes / **No**
- we give universities assignments to do research Yes / **No**
- we work together with universities in (subsidised) projects: Yes / **No**
- Other type of contact: ……
- Most important universities: ……

2. What kind of contacts do you have with the region Centre-Val de Loire ?

- Centre-Val de Loire give us yearly funding for our basic activities **Yes** / No
- Centre-Val de Loire give us assignments to do analyses / tests Yes / **No**
- Occasionally we get grants from Centre-Val de Loire for special projects **Yes** / No
- Did you inform the Centre-Val de Loire about the WTN-project ? **Yes** / No
- Does the Centre-Val de Loire co-fund the WTN-project ? **Yes** / No
- We have regular meetings with the economic department of Centre-VdL Yes / **No**
- We have regular meetings with the environmental department of Centre-VdL Yes / **No**
- We have regular meetings with the water policy department of Centre-VdL Yes / **No**

3. What kind of contacts do you have with companies ?

- companies make use of our (lab) facilities: **Yes** / No
- companies give us assignments to do analyses / tests **Yes** / No
- we work together with companies in (subsidized) projects: **Yes** / No

- Other type of contact: ……
- The number of companies we have contact with is ca .10-20

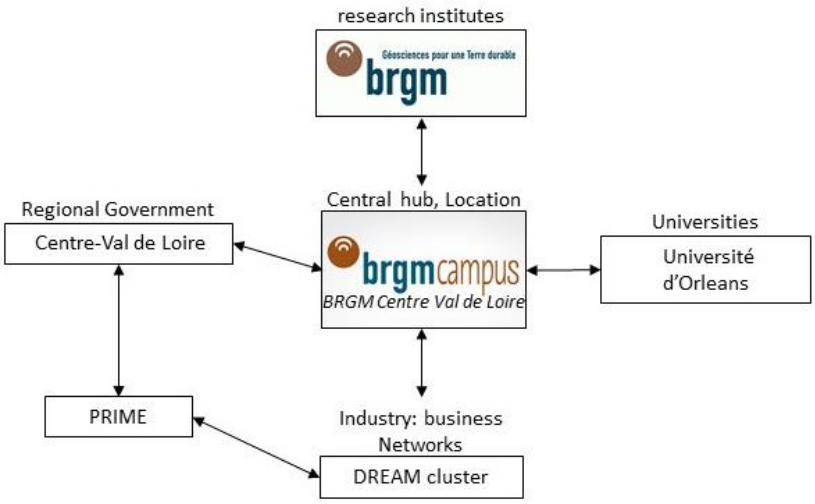
4. Are you member of DREAM the cluster organisation in the field of water technology ? **Yes** / No

5. If yes, please describe the collaboration between BRGM and DREAM?
Working together in Pivots programme

6. Is there a physical location, hub or campus where all partners in water technology can meet each other and cooperate together ? Yes / **No** / don't know

if so which location? …but all stakeholders are located next to each other in Centre-Val de Loire

Based on desk research we have made the following picture of the Triple Helix in the field of water technology in Centre-Val de Loire:



7. We have placed BGRM among the research institutes. Is this correct ? **Yes** / No
If not please explain the correct situation:

8. Are there important players/stakeholders missing among the regional authorities ?
Yes / No
(if yes please mention these)

Water board Loire-Bretagne

9. Are there important players/stakeholders missing among the universities/research institutes ?
Yes / No
(if yes please mention these)

University of Tours

CNRS, INRA

10. Are there important players/stakeholders missing among the industries/ business organisations ?
Yes / No
(if yes please mention these)

DEV'UP

11. Are there external partners (partners outside the own region) who are important for water technology innovations in Centre-Val de Loire ?
Yes / No
(if yes, please mention these)

12. Is BRGM involved in the Prime project? (if yes, please describe how)

Yes, see pivots programme

13. Is there a university or other institute who are using the facilities of PRIME?
yes, university of Orléans

Stefan Bergsma – WaterAlliance

Questionnaire WTN (sub)partners

Name: Stefan Bergsma
Organisation: Water Alliance
Function: International Project Coordinator
Email: s.bergsma@wateralliance.nl
Telephone: +31(0)611101240

Interreg North-West Europe Water Test Network	**Financial Support** For own organisation by regional authorities				**Financial Support** For other organisations by regional authorites		
	Yes	No	Don't know		Yes	No	Don't know
	Instruments innovation cycle						
1.Scientific R&D (e.g Phd projects)		x			x		
2.Applied R&D		x			x		
3.Research infrastructure (labs and equipment)		x			x		
4. Innovation projects of SME's		x			x		
5. Demonstration projects / pilot projects (limited scale)		x			x		
6. Launching customer projects (full scale)		x			x		
7. Incubator facilities (e.g. offices for start ups)		x			x		
8. Cluster organizations	x						
9. Venture capital		x				x	
10. Education (e.g. study tracks etc)		x			x		
11. Export preparation (e.g. trade fairs)	x				x		
12. Export (grants)	x				x		
13. Housing / real estate	X				X		
14. Co-funding EU-projects (ERDF, Interreg, other ….)	x				x		
	Financial support for water technology test sites						
15. Construction of the site		x			x		
16. Operation and maintenance (exploitation)		x			x		
17.Support of users (direct or indirect via site owner)		x				x	

Number of the instrument	Comments, remarks and nuances
13	**Not regional government but provided by local government**
17	**I filled in no, but of course province of Fryslân finances Water Alliance and therefore if we participate in an EU funded project (for example WTN) this is indirectly paid by the province of Fryslân**
All	**Because we are a network organisation the financial support is not directly for us but of course we 'use' the financial support by linking these to our companies and network**

Questionnaire part 2: Regional innovation system water technology

A functional innovation system consists of interactions between Government-Industry-University. Yet the strength of the interaction differs per region. With the questions in this part we try to clarify the place of your organisation in the triple helix framework in Friesland.

1. What are the main tasks of Wateralliance?
   The WA is the network organisation for the Dutch water technology sector with more than 100 members (mostly SMEs). WA supports SMEs in the water technology industry in terms of (international) matchmaking, networking and business development. Its core activities are: International and national branding and lobby, international and cross-sectoral matchmaking, organising and coordinating incoming missions and outgoing visits, organising and coordinating (international) events and in-depth advice for innovative water technology SMEs.

2. What are the goals Wateralliance is aiming for?
   Main goal is to support the growth of the Dutch water technology sector

3. To which category of the Triple Helix for water technology would you reckon Wateralliance ?

- Government No
- Company/business organisation No
- University/research organisation No
- Cluster organisation Yes
- Combination of: ……

4. What kind of contacts do you have with universities ?

- we give universities assignments to do research No
- we work together with universities in (subsidised) projects: Yes
- Other type of contact: linking companies to research, to Wetsus; linking companies to WAC (Van Hall Larenstein)

- Most important universities: Wetsus (combined study track of universities of Groningen, Wageningen and Twente), Van Hall Larenstein

5. What kind of contacts do you have with the provincie Friesland ?

- Occasionally we get grants from provincie Friesland for special projects Yes
- Provincie Friesland give us yearly funding for our basic activities Yes
- Did you inform provincie Friesland about the WTN-project ? Yes
- Does provincie Friesland co-fund the WTN-project ? Yes
- We have regular meetings with the economic department of Friesland Yes
- We have regular meetings with the environmental department of Friesland No
- We have regular meetings with the water policy department of Friesland No

6. What kind of contacts do you have with the municipality of Leeuwarden ?

- Occasionally we get grants from gemeente Leeuwarden for special projects Yes
- De gemeente Leeuwarden give us yearly funding for our basic activities Yes
- Did you inform gemeente Leeuwarden about the WTN-project ? Yes
- Does gemeente Leeuwarden co-fund the WTN-project ? No
- We have regular meetings with the economic department of gemeente Leeuwarden Yes
- We have regular meetings with the environmental department of gemeente Leeuwarden No

7. What kind of contacts do you have with companies ?

- companies give us assignments to do (technical or economic) studies No
- we assist companies in innovation projects Yes
- we work together with companies in (subsidized) projects: Yes
- Other type of contact: facilitate matchmaking/promotion (events, trade fairs): support them with business development; connect them with partners/challenges in the Netherlands and abroad; organise network meetings for companies to meet each other
- The number of companies we cooperate with is ca 150-200

8. Is there another cluster organisation besides Wateralliance in the field of water technology ?

Yes, namely: In the region of Friesland no, but in the Netherlands yes. NWP and ENVAQUA. These are not water technology clusters. NWP is network organisation for the whole Dutch water sector (delta technology and water technology) and ENVAQUA is more a branche organisation for the environmental sector (including water sector)

No

9. If yes, is there a collaboration between Wateralliance and this organisation?
Yes, we work together with ENVAQUA and NWP in a construction called NL Water Coalition and within this coalition we organise activities and services for the Dutch water technology sector

10. Is there a physical location, hub or campus where all partners in water technology can meet each other and cooperate together ? Yes

if so which location? Leeuwarden, WaterCampus

11. Who are the important players/stakeholders among the regional authorities for water technology ?

Province of Fryslân

Municipality of Leeuwarden

Wetterskip Fryslân
Vitens

Ynbusiness

NOM

Inqubator Friesland

12. Who are the important players/stakeholders among the universities/research institutes for water technology ?
Wetsus

Van Hall Larenstein university of applied research

CEW

CIV

WLN

13. Who are the important players/stakeholders among the industries/ business organisations for water technology?

Water Alliance

Paques

Landustrie

14. Are there external partners (partners outside the own region) who are important for water technology innovations in Friesland ?
Yes
WLN

National government (TKI Water technology)

Other regional water authorities

All kind of industries/end-users with water technology challenges in the Netherlands but also abroad

Other companies which can work together with the regional water tech companies

15. Is Waterallliance responsible for the acquisition of SME's to make use of the Water Test Network?

Partly. We are responsible for the communication of the project and therefore responsible to attract SMEs to the demosites. Furthermore, we have a large network of companies which we also inform and link (if they are interested in making use of the demosites of the WTN project) to the WTN project
If so, how?

16. Are there specific study tracks for water technology in Friesland?
Yes
If so, which schools:

Wetsus (university of Groningen, university of Twente and university of Wageningen)

Van Hall Larenstein

Nordwin

17. If yes at which levels could a student follow a study-track in water technology?
(more answers possible)

1. PHD education yes
2. University education yes
3. College level yes
4. Vocational education yes
5. High school education not a study track, but there are like information sessions at high schools but this is more for promoting water technology as a possible future study track

18. What is the most important driver in Friesland to foster water technology ?

a. Economic development of the water technology sector

Edwin de Buijzer – Watervallei & Veluwe

Questionnaire WTN (sub)partners

Name: Edwin de Buijzer,
Organisation: Regional Water Authority (Waterschap) Vallei and (en) Veluwe
Function: project manager WTN Apeldoorn
Email: edebuijzer@vallei-veluwe.nl
Telephone: 06-5436 2245

	Financial Support For own organisation by regional authority			**Financial Support** For other organisations by regional authority		
	Yes	No		Yes	No	Don't know
Instruments innovation cycle						
1.Scientific R&D (e.g Phd projects)		x				x
2.Applied R&D	x			?		
3.Research infrastructure (labs and equipment)	X (o.a. WTN)					x
4. Innovation projects of SME's	X (o.a. WTN)					x
5. Demonstration projects / pilot projects (limited scale)	x					x
6. Launching customer projects (full scale)	x					x
7. Incubator facilities (e.g. offices for start ups)		x				x
8. Cluster organizations	X (oa Cleantech)					x
9. Venture capital	?					x
10. Education (e.g. study tracks etc)	x					x
11. Export preparation (e.g. trade fairs)	X (niet zozeer als standhouder, wel als bezoeker)					x
12. Export (grants)		?				x
13. Housing / real estate		?				x
14. Co-funding EU-projects (ERDF, Interreg, other ….)	x					?
Financial support for water technology test sites						
15. Construction of the site	X (alleen als we er zelf ook belang bij hebben,					x

	bv Nereda en Kaumera)					
16. Operation and maintenance (exploitation)	idem					x
17.Support of users (direct or indirect via site owner)	X (o.a. Blue deals)					x

Questionnaire part 2: Regional innovation system water technology

A functional innovation system consists of interactions between Government-Industry-University. Yet the strength of the interaction differs per region. With the questions in this part we try to clarify the place of your organisation in the triple helix framework in Gelderland.

1. What kind of contacts do you have with universities ?

- universities make use of our (lab) facilities: Yes ~~/ No~~
- universities give us assignments to do analyses / tests ~~Yes /~~ No
- we give universities assignments to do research Yes ~~/ No~~
- we work together with universities in (subsidised) projects: Yes ~~/ No~~
- Other type of contact: the universities as (scientific) knowledge providers……
- Most important universities: Wageningen University and Research (WUR), Technical University Delft (TUD)……

2. What kind of contacts do you have with the provincie Gelderland ?

- Occasionally we get grants from provincie Gelderland for special projects ~~Yes /~~ No
- Did you inform provincie Gelderland about the WTN-project ? Yes ~~/ No~~
- Does provincie Gelderland co-fund the WTN-project ? ~~Yes~~ / No
- We have regular meetings with the economic department of Gelderland ~~Yes~~ / No
- We have regular meetings with the environmental department of Gelderland ~~Yes~~ / No
- We have regular meetings with the water policy department of Gelderland Yes / No (I don't know, but I think so)

3. What kind of contacts do you have with companies ?

- companies make use of our (lab) facilities: Yes ~~/ No~~ (bijvoorbeeld SEA)
- companies give us assignments to do analyses / tests ~~Yes /~~ No
- we work together with companies in (subsidised) projects: Yes ~~/ No~~
- Other type of contact: companies discharge water to our WWTP, sometimes we are there authorithy. Also we digest (liquified) waste from several companies.……

- The number of companies we have contact with is ca .....I think we digest for something like 20 companies, we have contact with much more companies (because of for example struvite, discharge, technologie providers, counsulting firms etcetera)

4. Is waterschap Vallei en Veluwe a member of a cluster organisation in the field of water technology ?

Yes, we are member of STOWA, but I don't know if you find STOWA a cluster organisation in the field of water technology in this case. Also KIEMT and others I 'm not aware off……..

No

5. If yes, please describe the collaboration between waterschap Vallei en Veluwe and this organisation?

Vallei en Veluwe is one of the participants in STOWA and also a Waterschap where more than an average amount of research is done in the context of STOWA

6. Is there a physical location, hub or campus where all partners in water technology can meet each other and cooperate together ? ~~Yes /~~ No ~~/ don't know~~

if so which location? ……

8. Who are the important players/stakeholders among the regional authorities ?

Other regional water authorities, STOWA,…..

9. Who are the important players/stakeholders among the universities/research institutes ?

As already mentioned (question 1) TUD, WUR and others like Hogescholen en KWR

10. Who are the important players/stakeholders among the industries/ business organisations ?

RHDHV, WItteveen&Bos, …..etc

11. Are there external partners (partners outside the own region) who are important for water technology innovations in Gelderland ?

Yes / No
(if yes, please mention these)

12. Is there a collaboration between waterschap Vallei en Veluwe and an educational institution at the test site? (if yes, please describe how) No, not yet. Maybe in the future.

13. Is there a university or other institute who are using the facilities of waterschap Vallei en Veluwe?

See the answers before. But for the WTN test facility at the WWTP Apeldoorn not at the moment

14. Is there an organisation who supports the SME's to test at your facility?
(if yes, please describe how) Yes, our own organisations (the Innovation Chaser, but also colleague with specialist knowledge) and also Cleantech Region (for example also for business development)

15. Does the cooperation with the cleantech region involve more than the water test network?
(if yes, please describe how) Yes, we also work together on different kind of topics

Barry Greig – Scottish Government
Questionnaire conducted by Eric Vos

Questionnaire project partners and stakeholders

Organization: The Scottish Government
Name: Barry Greig
Email: Barry.Greig@gov.scot
Telephone: 0131 244 0255

Questions

1. What is the position of your organization within the water technology sector ?
   - Water authority: National Government, *de facto* owner of single, publicly-owned water utility, Scottish Water

2. Do you have contacts with regional authorities ?

   - YES – We liaise with the environmental and economic regulators for water in Scotland – respectively the Scottish Environment Protection Agency and Water Industry Commission for Scotland

   Name(s): ……..
   Which department(s):
   - Economic Department
   - Environmental Department
   - Water (management) Department
   - R&D Department
   - Education Department
   - Other Department: ……

Regional economic policy

3. Does your region have a -RIS- Regional Innovation Strategy (ERDF) ?
Yes. The Scottish Government published its Innovation Action Plan in 2017 (https://www.gov.scot/publications/scotland-innovation-action-plan-scotland/). This innovation action plan builds on the progress we have made, working together, to boost Scotland's innovation performance.

4. Does your region have a specific Economic Policy Document ?

Yes. The Scottish Governement has an Economic Strategy (https://www.gov.scot/publications/scotlands-economic-strategy/). We aim to make Scotland a more successful country, with opportunities for all, through growing our economy in a sustainable (steady and long-lasting) way. Our Economic Strategy sets out our approach for achieving this, based around increasing competitiveness and tackling inequality.

5. What are the main goals of the economic and/or innovation policy in your region?

Our Economic Strategy highlights four key priorities for supporting sustainable economic growth in Scotland:

- investing in people and infrastructure to safeguard Scotland's future.
- fostering a culture of innovation, entrepreneurship and research and development.
- stimulating inclusive growth and creating opportunity through a fair and inclusive jobs market.
- promoting Scotland's international trade, investment, influence and networks.

Our Innovation Action Plan sets out four high-level areas of activity (see link above for detail):

- Directly encourage more business innovation
- Use public sector needs and spend to catalyze innovation
- Support innovation across sectors and places
- Make best use of University research knowledge and talent to drive growth and equip Scotland's people with the tools and skills needed to innovate

6. Are there economic sectors that have priority or special attention ? If yes which sectors ?

No. We aim to achieve economic growth in Scotland that is inclusive. This means growth that combines increased prosperity with greater equality, creates opportunities for all, and distributes the benefits of increased prosperity fairly.

7. Does the water technology sector belong to one of those sectors ?

No. It is a key component of our Hydro Nation agenda. We believe that innovation is critical to the health of our water industry and the contribution it makes to the overall economy, driving down costs for consumers and helping to differentiate businesses by developing new processes, technology or materials that are more efficient, effective and cheaper than those they replace. That is why we established the Hydro Nation Water Innovation Service (HNWIS) – in collaboration with Scottish Enterprise – to assist the identification and exploitation of key opportunities for Scotland to bring new technologies forward that can reduce costs and raise standards. This will help Scottish businesses bring forward their innovative ideas to market more quickly providing benefits to them and to the wider economy as a whole.

In part 2 of the questionnair (Excelsheet) questions are asked about specific policy instruments:
- for your own organization
- for other companies or organizations in your region

Environmental policy c.q. water quality policy

Environmental poilicy or water quality policy can be a driver for water technology companies for innovations, new products and new services. The buyers are obliged to meet regulations or want to decrease the costs of dissolving waste water. As a side effect governments creates market opportunities for the water technology sector.

8. Does your region have a Policy Document in which water quality is an item?

Yes – see https://www.gov.scot/policies/water/improving-water-services/ for details. Key document is Ministerial Directions (i.e. to Scottish Water) and 'Quality and Standards 4'

9. Water authorities

a. Do water authorities get subsidies for improving water quality in your region ?

Not subsidies *per se*, but the Scottish Government provides preferential rate loans to Scottish Water for its investment programme.

b. Are there regulations for water authorities for water quality standards ?

Yes. The Water Supply (Water Quality) (Scotland) Regulations 2001, set drinking water standards in Scotland and require Scottish Water to take and analyse samples in a specified manner. The Public Water Supplies (Scotland) Regulations 2014 set standards for drinking water quality and specify monitoring and sampling requirements. The Public and Private Water Supplies (Miscellaneous Amendments) (Scotland) Regulations 2015 amend the Private Water Supplies (Scotland) Regulations 2006 and the Public Water Supplies (Scotland) Regulations 2014 to implement European Council Directive 2013/51/Euratom.

10. Industries

a. Do industries get subsidies for treating (or reusing) their waste water ?

No

b. Do industries pay taxes or leges for dissolving their wastewater ?

No, but they do incur costs either from Scottish Water or a licensed provider for wastewater services

c. Are there regulations or quality standards for industries regarding their waste water ?

Yes. The Water Services and Sewerage Services Licences (Scotland) Order 2006 (SSI 2006/464) introduces the non-household retail licensing scheme.

11. Agriculture

a. Do farmers get subsidies for treating (or reusing) their waste water ?

No

b. Do farmers pay taxes or leges for dissolving their wastewater ?

No, but they do incur costs either from Scottish Water or a licensed provider for wastewater services

c. Are there regulations or quality standards for farmers regarding their waste water ?

The reuse of treated urban wastewater is not directly regulated, although there are several EU water-related directives establishing quality standards and legal restrictions for certain applications. Nitrate Directive (91/676/EEC), aims to protect groundwater and surface water quality by reducing nitrate contamination from agricultural sources and is particularly relevant to effluent reuse for agricultural purposes. Sewage Sludge Directive (86/278/EEC), not directly related to reuse of wastewater effluent, but may still be relevant to effluent reuse in agriculture, where many of the human health and environmental risks associated with sewage sludge application to agricultural land are similar to those for effluent reuse.

ADDITIONAL QUESTIONS AQUATECH AMSTERDAM

Vlaanderen:

1. The role of watercircle in the WTN project.
2. Watercircle and Vlakwa both cluster organisations to attract SME's for WTN?
3. Difference between Vlaanderen and Province of West-Vlaanderen in funding and tasks?
4. Fragmentated market, driven by food industry (VEG-I-TEC), and water industry (CAPTURE)

Baden-Württemberg:

1. The regional authorithy knows about the WTN, Do they have a task?
2. How are BWPLUS (programme) and LUBW(State Institute for the Environment, Measurements and Nature Conservation Baden-Württemberg) involved in your daily activities or WTN?
3. National authorities like BMBF (German Federal Ministry for Education and Research) and BMWi (German Federal Ministry of Economy) do provide funding?
4. Umwelttechnik BW provides funding? Or attract SME's?
5. So, technology and innovation based? Or ecology?
6. TZW is part of DVGW, how does DVGW support the activities at TZW?

Centre-Val de Loire (fill in questionnaire):

1. The PRIME-platform, how does it work?
2. National regulation and funding for water and/or ecology? Or does Centre have its own legislation and subsidies?
3. Central location at BRGM near University of Orleans?
4. Ecology driven? (ministeré de la transition écologique et solidaire)
5. How does the regional authority provides funding?
6. DREAM cluster supports PRIME and connects SME's?

Scotland:

1. Fill in questionnaire for James Hutton Institute
2. The role of the Hydronation International Centre? As central hub?
3. Connection between Scottish Water and James Hutton Institute
4. External partners who are important for water technology?

Gelderland: see questionnaire Waterboard Vallei & Veluwe.

EUROSTAT MOST RECENT DATA OF THE REGIONS

retrieved at 10-07-19

REGION	FRIESLAND	GELDERLAND	KARLSRUHE	WEST-FLANDERS	CENTRE-VAL DE LOIRE	HIGHLANDS AND ISLANDS	NORTH EASTERN SCOTLAND	EAST SCOTLAND
AREA KM2 (2015)	5.749	5.136	6.919	3.144	39.150,9	41.974	6.544	18.296
POPULATION (2018)	647.268	2.060.103	2.795.783	1.192.254	2.571.632	470.743	494.624	1.988.307
POPULATION DENSITY INHABITANTS/KM2 (2017)	190,5	410,8	406,3	307,9	65,6	11,6	75,9	150,0
REGIONAL COMPETITIVE INDEX (2019)	0,37 (86)	0,72 (20)	0,77 (15)	0,45 (63)	0,10 (125)	0,08 (147)	0,41 (73)	0,48 (52)
GDP PER CAPITA (2017)	25.900	31.300	39.900	33.700	25.100	26.800	42.000 (including revenues from oil and gas)	29.800
EMPLOYMENT RATIO (2017)	44%	47%	51%	43%	37%	48%	53%	48%
UNEMPLOYMENT RATE (2017)	5.6%	4.5%	3.3%	3.2%	8.6%	2.6%	4.2%	3.9%
WORKING AGE (25-64) WITH TERTIARY EDUCATIONAL ATTAINMENT	29%	34.3%	31.4%	37.4%	30.2%	46.3%	46.6%	51.4%
PERCENTAGE OF GDP SPEND ON R&D (2016)	0,83%	2,18%	4,56%	1,12%	1,63%	1,55% (Scotland is measured as one identity)	‘’	‘’
UNIVERSITY AFILIATED WITH WATER TECHNOLOGY	Yes, Wetsus European centre of excellence for sustainable water technology	Yes, Wageningen University	Yes, Karlsruhe Institute of Technology	Yes, Ghent-University	Yes, University of Orleans	No, University of the Highlands and Islands not affiliated with water technology	No, university of Aberdeen is not affiliated with water technology.	Yes, University of Glasgow is affiliated with water management.

TOPSECTORS IN THE REGION (RIS3)	Agrofood, Energy, Smart sensor systems, Water technology and Healthy ageing (Program of the Northern Netherlands)	Agrofood, Health, Hightech systems and Materials, Energy and Environment technology	Sustainable mobility concepts, ICT and Intelligence, Health, Environmental technologies, renewable energies.	Smart systems & services, Sustainable chemistry, Specialised manufacturing, sustainable living, Agrofood, Responsible entrepreneurship, personalised care (Flanders region)	Environmental engineering, ICT services, Energy efficiency and storage, Biotechnologies and services for health and cosmetic.	Food & beverages, Energy, Universities, Tourism, Life Science, Marine Energy, Financial & business services (program of Scotland)
CLUSTERING IN THE REGION FOR WATER TECHNOLOGY	Water campus	Cleantech Region	Automotive industry (not affiliated with water)	Food industry (cross-sector)	DREAM cluster	Hydronation (covers all of Scotland)