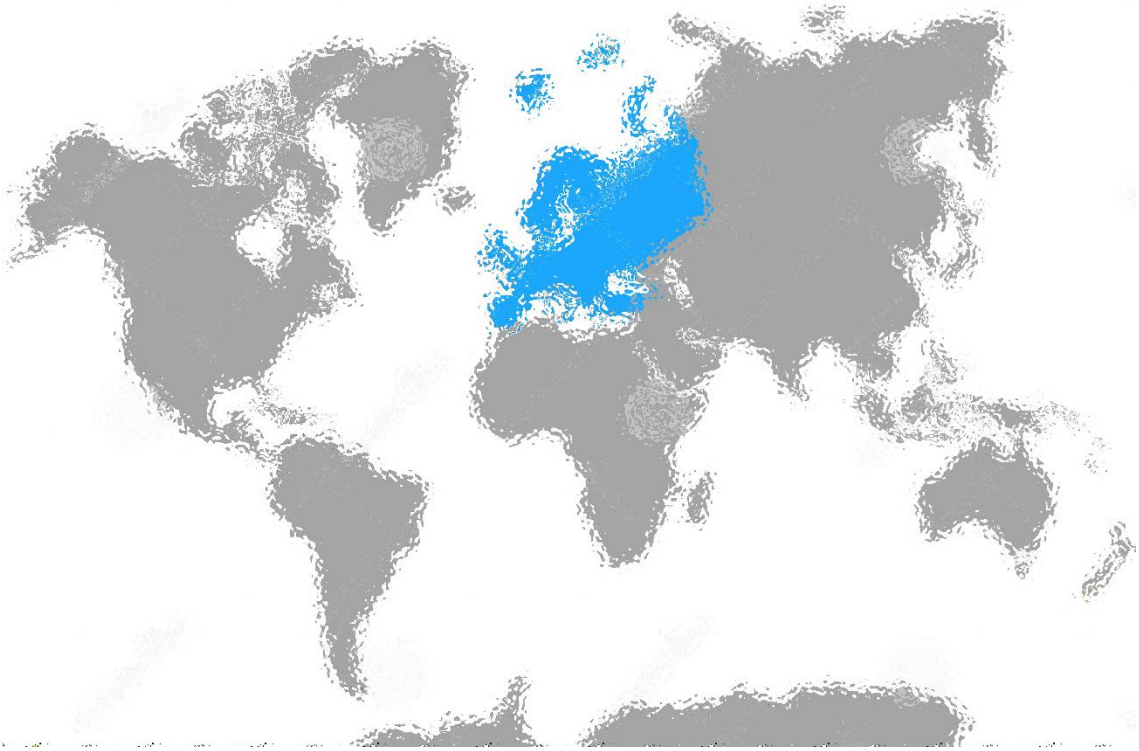
World Water Forum

European report on water

Pre-forum version



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Executive summary

The European Regional Process was part of the Regional Process of the 8th World Water Forum. It was coordinated by the Ministry of Environment of Portugal (as Lead Coordinator), through the Portuguese Commissioner, the Executive Commission and the Advisory Commission. The European Pact for Water, an informal network of 35+ European-based NGOs and CSOs, is the Co-Coordinator of the European Regional Process. Additionally, 254 focal points where identified in the 52 European countries, covering representatives from public administration, academia, water utilities, NGOs and European based-organizations. These focal points where invited to participate in the preparatory process since its beginning.

This process considered the relevant international frameworks like the UN 2030 Agenda and its Sustainable Development Goals, the UN resolutions declaring access to safe drinking water and sanitation as essential human rights, the UN Paris Climate Agreement, the Addis Ababa Action Agenda on Financing for Development, the Sendai DRR Summit, the European Consensus on Development, the OECD principles of water governance, and the IWA Lisbon Charter for Guiding the Public Policy and Regulation of Drinking Water Supply, Sanitation and Wastewater Management Services. The European Regional Process took as a main guideline for its work the thematic matrix (themes and topics) defined for the 8th World Water Forum.

The deliverables of the European Regional Process were this European Report on the region and several regional and inter-regional sessions at the Forum, assessing the following themes: climate, people, development, urban, ecosystems, financing, sharing, capacity, and governance.

The report is structured in 11 chapters and 3 annexes. Chapter 1 (Presentation of this report) describes the World Water Council, the World Water Forum, the Regional Process, and the European Regional Process. Chapter 2 (European region) describes the territory, the people, the climate, the hydrology, the water resources, the soil resources, and the economy. Chapter 3 (European regional approach) describes the activities developed, the survey about the relevance of themes and topics for the Europeans, the survey about the European case studies, the survey about the willingness to participate in the sessions, the survey about financing, the consultation meetings, and the specialised thematic contributions.

Chapters 4 to 9 describe and assess the relationships between water and the Forum Themes: Climate (chapter 4), People (chapter 5), Urban (chapter 6), Ecosystems (chapter 7), Financing (chapter 8), and Governance (chapter 9), presenting 22 cases studies and concluding with conclusions and recommendations.

Chapter 10 (Integration with the other processes) assesses the integration of the European Regional Process with the other processes, namely the thematic, the political, the sustainability focus group and the citizens, and describes the established partnerships. Chapter 11 (Sessions organised by Europe) describes sessions organised by Europe. Chapter 12 (Key messages) synthetises key messages and recommendations.

In Annex 1 the European national focal points invited to participate in the Process are identified. In Annex 2 the results of the survey about the relevance of themes & topics for the Europeans are presented. In Annex 3 are defined the indicators of the city blueprint® framework. In the Acknowledgements the contact points of the European countries that have been actively involved in the process during the last year are identified.

The 8th World Water Forum selected 9 Themes and 32 Topics, linking them with the Sustainable Development Goals/2030 Agenda and the Implementation Roadmaps.

The prioritization of topics in terms of relevance in Europe, relevance in country/region, public perception, performance, level of engagement and existence of case studies, both at European level and sub-regional level has led to the following key messages:

- Almost every topic is considered very relevant both for Europe and for countries; however, the level of engagement and, particularly, public perception are still low.
- In general, topics are considered more relevant for Europe than for countries themselves. This can represent a perception that water problems are more global than national.
- The circular economy is the most relevant topic in Europe. Enough safe water for all and integrated sanitation for all are the least relevant topics. However, Europe presents significant asymmetries in different sub-regions, which were detailed in chapter 3.
- Water and public health is the topic with the highest public perception. On the opposite, the communication between science and decision/policy making is the topic with the least public perception.
- Enough safe water for all and water and public health are the topics with the best performance and the highest level of engagement. On the contrary, finance for sustainable development is the topic with the worst current performance and lower of engagement.
- Relevant cases studies have been proposed for all topics. Financing issues are those with the fewest case studies.

The results of the analysis by theme have shown that:

- In the theme Climate, water and adaptation to climate change is at the top of the concerns. Managing risk and uncertainty for resilience and disaster preparedness is also at the top of the countries / regions' priorities. Water and adaptation to climate change is also the topic with greater public perception. Managing risk and uncertainty for resilience and disaster preparedness presents better performance and higher level of engagement. On the other hand, the communication between science and decision/policy making is where there is still a greater way to go.
- In the theme People, water and public health issues are the highest priority and those who gather greater public perception. Enough safe water for all and water and public health are the topics with the best performance and the highest level of engagement. By contrast, the major challenges respect to integrated sanitation for all.
- Regarding the theme Development, the issues of efficient use of surface water and groundwater are the highest priority, with greater public perception and level of engagement. Infrastructure for sustainable water resource management and services is the top performing topic. These two topics are also the ones that have the highest level of engagement. On the contrary, infrastructure for sustainable water resource management and services present the worst relevance and topic inclusive and sustainable growth, water stewardship and industry the worst performance and levels of public perception and engagement.
- In the Urban theme, circular economy is the major concern and the focus of public perception. Topics water and cities and treatment and reuse technologies are the best performers. Water and cities is the topic with the highest level of engagement. Treatment and reuse technologies issues present less public perception and level of engagement. Circular economy is the topic with the lowest performance.
- In the theme Ecosystems, topic managing and restoring ecosystems for water services and biodiversity stands out as the most relevant, with greater public perception, better performance and level of engagement. On the other hand, natural and engineered hydrological systems is the least relevant topic, while water

and land use is the one that presents less public perception, worse performance and lower level of engagement.

- With regard to the Financing theme, economics and financing for innovative investments is the most relevant, with greater public perception and level of engagement. Financing implementation of water-related Sustainable Development Goals and adaptation to climate change is the one that performs best. On the contrary, finance for sustainable development issues present the greatest challenges in terms of relevance, public perception current performance and level of engagement.

The key messages from the assessment presented in the chapter on water and climate in Europe are the following:

- Climate change affects Europe in many ways, although the nature and dimension of impacts varying throughout Europe. All regions are affected, thus making climate change one of the continent's most important challenge.
- If not properly addressed, climate change impacts to health, ecosystems and biodiversity, property and economic activity are likely to become more severe in the coming decades and could become very costly. Most OECD countries have serious concerns over the impacts of climate change and report that changes are already occurring.
- Water plays a vital role on how society feels climate change impacts and this fact is recognized by European countries and individual stakeholders. The areas of highest concern are extreme events and water shortage.
- Europe is at the forefront of greenhouse gases emission reduction efforts, but mitigation can only lead to a meaningful reduction of climate change risk if concerted efforts, joining all nations in the world, significantly reduce global greenhouse gases emissions.
- Adaptation is inevitable. It seeks to reduce the vulnerability to climate change by enhancing the society preparedness and capacity to respond to the unavoidable impacts. Since 2013, the European Union has a strategy on adaptation to climate change, as well as most European countries.
- Climate change adaptation is a decision-making process under significant uncertainty. A risk-based approach that explicitly identifies the range of possible future scenarios and considers the available options to manage the associated risks is a useful tool.
- An adaptation strategy on water resources needs to cover a number of policy areas, such as land planning, agriculture, energy, infrastructures, biodiversity and health, among others. The adaptation strategy also needs to distribute the planned activities to different levels of government, from a local municipality to regional or national institutions or even supra-national entities, ensuring effective action by selecting the most appropriate government level to manage each issue.
- An effective water management practice, supported by a sound water governance arrangement, is a key success factor to reduce the vulnerability to climate change. Mainstreaming adaptation efforts into the existing governance frameworks and management tools following the principles of integrated water resources management can support adaptation efforts.
- The challenges of climate adaptation are amplified within transboundary basins and aquifers as the coordination efforts among policy sectors and government levels needs to be achieved also across the border, which requires a strong cooperation between riparian countries and the involvement of a larger number of stakeholders.

- To date, most adaptation strategies focus on the development of information-based instruments directed to knowing the risks, raising awareness and disseminating information. The emphasis on information-based instruments within the national adaptation strategies puts in evidence the difficulties in designing and implementing other types of actions that require an active attitude to address specific threats.
- The key challenges to adaptation are: how to develop effective integrated policies to promote change; how to overcome uncertainties and start effective adaptation action; how to strengthen the links between national, regional and local planning and actions; how to adapt the legal and regulatory framework; and how to ensure funding and what financial mechanisms are needed.

The key messages from the assessment presented in the chapter on water and people in Europe are the following:

- Although many people take water and sanitation for granted in Europe, there are still many actions needed to ensure water and safe sanitation for all by 2030 and to fulfil the human right to water.
- The aging infrastructures of Europe, some more than one century old, may even deteriorate more because the investments are far from sufficient for operation, maintenance and rehabilitation, let alone to cope with demographic changes.
- The impacts of climate change are becoming more apparent across Europe. Large areas of continental European Union suffered severe drought in several years, due to the combination of rain shortages and very high temperatures. In recent years, on average 17% of Europe's territory and at least 11% of Europe's population have been affected by water scarcity. If temperatures keep rising, the water situation in Europe is expected to deteriorate further. Due to climate change, water is no longer a problem for a few regions, but became a concern for all 500 million Europeans.
- Therefore, it is recommendable to pay attention to: rural dwellers, disadvantaged people and people with low incomes as well as migrants; the role women can play as actors, experts and partners in ensuring water and safe sanitation for all; investments not only to big scale systems but also to small scale systems, an important component of supplying water in Europe; improving water, sanitation and hygiene practices in schools all over Europe, including menstrual hygiene management and attention for healthy behaviour; assessment and data collection to get up-to-date information about the situation, disaggregated in terms of women, men, and age.

The key messages from the assessment presented in the chapter on water and urban in Europe are the following:

- For the development of water-wise communities in Europe, it is essential to: create a sense of urgency, bottom-up approaches (community engagement) and strong political leadership on sustainable water management; improve soft skills to achieve better collaboration between institutions, departments; improve intra institutional cooperation for addressing water challenges beyond improving soft skills: it also requires long-term funding security, stakeholder engagement, common goals and strategy formulation, and clear benefits for the involved stakeholders and institutions; create adaptive regulations that encourage a water cycle approach, closing the loop on resources, and water sensitive urban design; identify cost-sharing for co-benefiters of multi-purpose infrastructures (where water is one component) at the basin, city or utility level; define the problem to be solved using a holistic approach rather than sub-systems approach, i.e., when governments assign missions to an institution, or define a new investment project, there is an opportunity to apply a more integrated approach, which will then bring up new ways for solving the individual problems; and accelerate these processes

by creating alliances of cities, which are urgently needed as the time window to address the challenges of water, waste and climate change in cities is rapidly closing.

- In order for cities to take action, establishing a baseline is a key step. The baseline assessment provides the diagnosis and can lead to clear steps for improvement. Currently, there are no standardized assessments of European cities and the only attempt until now is the publication of the Urban Water Atlas for Europe, which covers about 40 cities, mainly in Western Europe. Promoting the importance of assessment frameworks is essential, while at the same time continuously improving these frameworks, so that they best guide cities to identify progression pathways to water-wise urban development. The assessment of the challenges in cities and the options for improvement should be shared actively at regional or European level. The creation of city-to-city learning or learning alliances of cities will greatly benefit the transition to water-wise cities (European Commission 2017). Probably, the biggest barrier in solving the diverse water challenges in Europe is a lack of sufficient governance capacity.
- Principles for water-wise governance of Smart Cities can be summarized by seven C's: citizen-centred – create adaptive, healthy and liveable cities for people; children and grandchildren first – focus on anticipatory long-term strategies; collaboration – involve stakeholders right from the start; comprehensive and coherent planning – integrate water and other sectorial agendas; co-benefits or win-wins must be explored; cost-effective and cost-efficient solutions; and collaborative learning: enhance city-to-city learning.

The key messages from the assessment presented in the chapter on water and ecosystems in Europe are the following:

- Access to good quality water resources is indispensable for sustaining economic prosperity and jobs in the region. But water is also needed for the healthy functioning of ecosystems and the provisioning of ecosystem services. However, man-made changes to the structure and functioning of European water bodies have undermined their resilience and the provision of several important water-related ecosystem services. Under these circumstances, and if no action is taken, impacts of pollution, water abstraction, and changes in land-use and climate risk threaten availability of water resources, and thus public health, welfare and jobs.
- In spite of very clear legal and policy frameworks for water, flood risk management, nature protection and biodiversity, implementation is lagging behind and needs to be reinforced. There is a need for increased integration into other related policy areas, such as agriculture, land-use and energy, which in some cases are pursuing different policy objectives and where legal and implementation frameworks need to be better aligned with the Sustainable Development Goals and policy objectives for water and nature protection. There is also a need for improved arrangements to facilitate the mobilisation of the significant financial resources needed especially for innovation, establishment of green/blue infrastructure and re-establishing ecosystem connectivity.
- If these issues are not fully addressed, the United Nations' Sustainable Development Goals, and in particular the target to protect and restore water-related ecosystems by 2020, will be difficult to attain in the European Region. Failure to deliver on that target will inevitably have knock-on effects on the provision of ecosystem services and may create difficulties in attaining other Sustainable Development Goals than that related to water.
- In order to attain the Sustainable Development Goals and develop a sustainable, circular and climate-resilient economy and hydrological systems, authorities and stakeholders in the European region need to reinforce cooperation across jurisdictions, including transboundary cooperation.

European stakeholders need to step up efforts to control pollution by:

- Filling the gaps in efforts to treat sewage and industrial wastewater discharges, implementing more effective technologies for removing hazardous pollutants from discharges and ensuring that the regions of Eastern and South-East Europe and Central Asia that are lagging behind catch up.
- Stepping up efforts to control diffuse agricultural pollution and to use agricultural policies that guarantee that mainstream agriculture and livestock farming do not pollute or impair ecosystem services.
- Intensifying the preventive regulation of hazardous chemicals in products, tackling the issue of plastics and micro pollutants, including pharmaceuticals, and phasing out inputs of endocrine disrupting substances.

European stakeholders need to assure the balance between sustainability of water consumption and water availability by:

- Accelerating improvements in water efficiency, especially in agriculture.
- Strengthening management of water demand, e.g. through more flexible arrangements for accessing water resources and resource conservation by preventing over-abstraction from groundwater bodies.
- Implementing green, nature-based water retention land-use solutions to increase availability and stabilise water levels and flows.
- Promoting and increasing safe re-use of water as part of the circular economy in ways that guarantee safety of the food chain and healthy ecosystems.
- Replenishing depleted groundwater bodies by re-injection of treated wastewater free from hazardous chemicals.

European stakeholders need to implement nature-based solutions such as green/blue infrastructure and natural water retention measures to recuperate and guarantee future provision of water related ecosystem services by:

- Reactivating flood plains and reconnecting wetlands to water bodies to provide flood protection, flow regulation and to re-establish diverse ecosystems, re-meander channelized rivers, and re-establish riverbed habitats.
- Restoring river connectivity to allow species migration and to maintain sustainable river hydrology and sediment transport by removing barriers or regulating their performance.
- Implementing policies to ensure sustainable green and liveable cities, integrated into a circular economy.
- Reinforcing governance support for green/blue infrastructure, especially mobilisation of stakeholders and finance for investment and innovation.

The key messages from the assessment presented in the chapter on water and finance in Europe are the following:

- There is a need to improve the application of the cost-recovery principle defined in the article 9 of the European Union Water Framework Directive, making it universal in the European Union countries, in the short term, and progressively in the enlargement countries and other European countries, with the concession of grants for the latter. This objective would enhance the financing of infrastructure contributing to the SDG 6.
- It is important to focus investment on efficiency gains to attract financing at lower costs. For this, knowledge and management of assets should be improved, and conditions, e.g. technical assistance or grant support, should be created to accelerate the availability of expertise and management tools.

- There is a need to develop the potential for more repayable financing to complement the public funding and reduce the existing gap, namely through the use of grants to leverage it, blending/pooling financial resources and risks, coupled with available guarantees.
- Innovation promotion is essential, especially when it can minimise investment needs, or support innovative business models that can scale to make innovative solutions competitive, reflecting the full cost of supplying water, sanitation and flood protection services in pricing mechanisms;
- Promoters and lenders should develop project life cycle funding approaches to help addressing the current asset renewal backlog and the need to raise progressively the tariffs for that purpose;
- European policy-makers should support and encourage the current trend towards the use of European Structural Investment Funds for the improvement of the quality and management of water resources by dedicating them a higher portion of the funds in detriment of investment on infrastructure generating revenues; it is important to use European Structural Investment Funds wisely to attract and leverage other sources of financing, including domestic commercial finance;
- Investment and financing statistics of the European water sector should be made available through a database and the assessment of future needs by the national and European Union entities should be continuous, to estimate future financial requirements and to monitor progress. The creation of national strategy plans should be encouraged and also the use monitoring tools.

The key messages from the assessment presented and discussed in the chapter of water and governance are the following:

- Infrastructure and technology is not enough to guarantee an adequate management of water resources and to pursue effective water policies. Good governance is a key element for the success in achieving these goals.
- Europe has a rich and diversified experience in this area, especially because of the diversity of conditions, both in terms of water availability and water needs.
- On the top of all those economic and physical differences, there are also quite distinct cultures and traditions deeply embedded in the legal and institutional systems of the various European societies. Many countries in Southern Europe are direct heirs of the Roman law, often mixed with Moorish influence, in which “public property” of water is essential. In many Northern European countries, the Celtic tradition prevails with a deeply rooted concept of “common property”. As a result of the above-mentioned circumstances, it comes as no surprise that Europe can be seen as some sort of “laboratory” in which different systems coexist side by side. There is much to be learned by comparing those governance systems, understanding how they evolved in time, what are the strong and the weak points, and what makes them fit for each society.
- In the European Union, the Water Framework Directive has played a very important role in relation to water governance. This is a legal document with obligatory compliance in the 28 Member States of the European Union, but with an impact that goes much beyond, because it establishes a standard and provides inspiration for many other countries in Europe and in the world.
- That Directive establishes the ultimate purpose of achieving a good ecological quality in all water bodies of the European Union, while recognizing that several measures in the area of governance need to be adopted to achieve this goal. This is addressed, however, in a way that assumes that there are enormous differences in the institutional set-up of the various European Union Member States and that a reasonable degree of freedom should be left to the discretion of those Member

States in shaping their systems of governance, provided that they reach the ultimate goals and comply with some key provisions established by the Directive.

- Some of those key provisions of the Water Framework Directive having significant governance implications are the need for assigning a competent authority to each River Basin District, the obligation of preparing River Basin Management Plans and Programs of Measures. Also, the need for coordinating those plans and programs of measures at the scale of the entire river basin even when it is contained in more than one Member State, or even when it includes countries beyond the European Union territory, has important governance consequences. Another relevant dimension in terms of governance is the obligation of engaging stakeholders, disseminating information, and going through extensive consultation procedures.
- In recent years, a very relevant effort for the establishment of principles and indicators of good water governance was developed by OECD. This exercise was largely based on the comparative analysis of 17 countries, with 8 of them located in Europe. The 12 principles that were formulated can be adopted, not only as an inspiration for the formulation of water policies, but also as a basis for an assessment and benchmarking of every system of water governance.
- Although inter-comparison and benchmarking of institutions, policies, and models of governance is always very inspiring and instructive, one should not forget that those arrangements are never an end by itself, but rather a mean to an end. Historical, cultural, social, and political contexts and backgrounds determine, to a large measure, the configuration of institutions relevant for water resources management in each specific country. Having recognized this, and thus paying due respect to the specificities of each society, those contexts and backgrounds should not be seen as an “inescapable prison” that blocks any possible progress. On the contrary, it is important to make a continuous effort to improve governance because the challenges are always increasing throughout the world and also in Europe. If it is a good thing that future generations grow with the memory of the past and with a strong sense of identity, they should not, however, be prisoners of atavisms that have lost meaning and block their development and progress.
- It is then clear that governance plays an important role to achieve a successful water resources management, aiming at providing water for all needs in a sustainable manner. Governance, considered as that “second leg”, is complementary to infrastructure and technology, preventing water management from “stumbling and falling”. One should never forget that infrastructure and technology without appropriate governance is “like a hammer without a hand”. Future generations deserve that we “hit the nail”.

These European key messages must be transmitted to the decision makers, namely at ministerial, parliamentarian, mayors, judges and prosecutors levels. They must be incorporated by the water professionals to influence their day-to-day activity. They must be a challenge for the private sector to promote entrepreneurship and the development of new products and services. They must be spread to the citizens and the society at large as they are the final beneficiaries of those recommendations.

1. Presentation

1.1. Contents

This chapter describes the general context of the European Regional Process, as part of the Regional Process of the 8th World Water Forum promoted by the World Water Council, the Government of Brazil and the city of Brasilia, respectively as host country and city.

1.2. World Water Council

Founded in 1996 with its permanent headquarters in the French city of Marseille, the World Water Council is an international *multi-stakeholder* platform organization bringing together nearly 400 institutions from every horizon, from nearly 70 countries around the world. By providing a platform to encourage debates and exchanges of experience, the World Water Council aims to reach a common strategic vision on water resources and water services management amongst all stakeholders in the water community.

The Council focuses on the political dimensions of water security, adaptation and sustainability, and develops the following activities:

- Conduct active hydropolitics: The Council works towards increasing the awareness of high-level decision makers on water issues. It seeks to position water at the top of the global political agenda and to produce worldwide policies to help authorities develop and manage water resources, and encourage efficient water use. The Council endeavours to reach completely the political sphere: national governments, parliamentarians and local authorities, as well as United Nations bodies.
- Co-organize the World Water Forum: The Council catalyses collective action during and in between each World Water Forum, the world's largest event on water. Organized every three years with a host country, the Forum provides a unique platform where the water community and key decision makers can collaborate and make long-term progress on global water challenges. The Forum brings together participants from all levels and areas, including politics, multilateral institutions, academia, civil society and the private sector.
- Tackle emerging challenges: The Council tackles the many issues facing water security, and seeks to challenge convention and generate new thinking as a force for change. Together with members and other stakeholders, the Council explores areas where it sees the potential to increase the visibility of water. It seeks a more distinctive contribution to global water challenges by forming alternative approaches to emerging issues.

1.3. World Water Forum

In the process, the Council catalyses initiatives and activities, whose results converge towards its flagship product, the World Water Forum. This Forum contributes to the dialogue of the decision-making process on water at the global level, seeking to achieve the rational and sustainable use of this resource. Given its political, technical and institutional scope, one of the Forum's main features is the open, democratic participation of actors drawn from different sectors, making it an event of the greatest importance on the international agenda.

To date, there have been seven editions of the World Water Forum, in different countries, and four different continents. In 2014, Brazil's candidature to host the event was successful and Brasilia was selected as the host-city for the event. Accordingly, in 2018, Brazil hosts the 8th edition of the World Water Forum. It is the first time the event is held in the Southern Hemisphere.

Figure 1.1 – World Water Forum 1997–2018 (source: World Water Council)

1.4. Regional Process

Historically, a regional approach has always had a significant place in the World Water Fora. The justification for such a prominent role in the Forum is that regions share commonalities, both in terms of challenges and solutions, which may not exist at the global level and therefore should share experiences to learn one from another to further achive the goal of sustainable water resources management. This structure also allows regions to acquire new knowledge through linking common thematic areas across regions.

It is the goal of the 8th World Water Forum Regional Process not only align its activities and initiatives with the other Forum processes, but also to use this event to make progress towards the Sustainable Development Goals (SDGs), the Paris Climate Agreement and other international commitments relevant to sustainable development. It is important to note that this edition of the Forum takes place 4 months earlier than the High Level Political Forum (HLPF) which will be held in New York and will review SDG 6. Therefore, this Forum is a unique opportunity for a global reflexion on the work towards the achievement of SDG 6 and SDG6 plus, with a view to send strong messages to the HLPF.

The core of Regional Process is the development, analysis and presentation of case studies related to sustainable water resources management issues at the regional level, different from the Thematic Process, which will take a more analytical/theoretical approach. Following as a guide the Thematic Process of the Forum and its thematic matrix, the Regional Process will incorporate local and regional perspectives throughout its own preparatory process as well as other processes and events related to the 8th Forum.

The Regional Process was supported, on an advisory basis, by the Regional Process Commission (RPC) led by a Chair (Osward Mulenga Chanda) and a Vice-Chair (Irani Braga Ramos), which reports to the Forum's overarching decision-making body, the International Steering Committee (ISC). In the development and implementation of its activities, the RPC mobilized the participation of all stakeholders, including water experts, politicians, high-level government officials, water users, NGOs, the private sector, media and civil society. Participation in all 8th World Water Forum Processes and events have been encouraged at every opportunity.

The RPC worked in a coordinated way with the Thematic Process Commission (TPC), the Political Process Commission (PPC), the Sustainability Group and the Citizens' Forum to guarantee the coherency and effectiveness of the overall program of the 8th World Water Forum.

Under the supervision of the RPC, the coordinators of the Regional Process are responsible for guiding and coordinating the inclusive multi-stakeholder work of each Region, which are tasked with preparing the specific report and organizing individual regional sessions, as well as interregional sessions at the 8th World Water Forum.

The structure of the Regional Process of the 8th World Water Forum is primarily based on six larger geographic areas, or Regions and, in some cases, where appropriate, these six Regions were divided into Sub-Regions. The Regions and Sub-regions are:

- Africa: North, West, Central, East and Southern
- Americas: North America, Central America & Caribbean, South America and Mexico
- Arab
- Mediterranean
- Asia-Pacific: Central Asia, Northeast Asia, South Asia, Southeast Asia and Oceania & Pacific
- Europe

A high priority was given during the process to build a strong link between the Regional and Thematic Processes of the 8th World Water Forum. Both processes work towards the same goal of engaging stakeholders and promote a reflection on topics of sustainable water resources management, as well as working towards the Sustainable Development Goals, therefore there are many synergies between them and it makes sense to align them as much as possible.

The preparatory works of the Regional Process started in June 2016, with the *kick-off* meeting of the World Water Forum that took place in Brasília, from 27th to 29th June 2016.

By that time a roadmap for the Regional Process was defined, based on the following activities and results for the preparation phase, during and after the 8th World Water Forum:

- Regional/Sub-Regional Process Roadmap: To guide each Region/Sub-Region, a roadmap/plan of work was required to ensure the timely achievement of important milestones leading to Brasilia 2018.
- Regional/Sub-Regional Kick-off Meeting: To mobilize and galvanize the stakeholders in each Region/Sub-Region, a Kick-off meeting was planned to launch each regional/sub-regional process.
- Regional/Sub-Regional Engagement: To engage through the Regional Coordinators continuously with stakeholders in the respective regions to work towards the development of Regional/Sub-Regional Reports.
- Regional/Sub-Regional Wrap-up Meeting: To finalize the Regional/Sub-Regional Report.
- Draft and Final Regional Reports: One of the main outputs for each Region/Sub-Region was a Final Report.
- Incorporate interlinkages with the Sustainable Development Goals, where appropriate.
- Nominate a Regional Thematic Focal Point for each of the 6 primary thematic areas of the 8th World Water Forum to ensure streamlined work between Regional and Thematic Processes.

- Lead a bottom-up sub-regional/regional process to identify case studies that will be aligned with the 6 main themes of the 8th World Water Forum defined under the Thematic Process.
- Session Design(s) and Framework: The Regional Coordinators were required to organize and structure sessions with a regional framework.

1.5. European Regional Process

The European Regional Process is part of the Regional Process of the 8th World Water Forum.

The European Regional Process was coordinated by the Ministry of Environment of Portugal (as Lead Coordinator), through the Portuguese Commissioner, the Executive Commission and the Advisory Commission. The executive structure included Jaime Melo Baptista (Portuguese Commissioner), Pedro Liberato and Diana Carlos (International Department - Ministry of Environment), Luís Morbey and Luís Chainho (Portuguese Environmental Agency), Alexandra Serra and Simone Pio (Águas de Portugal International) and Rita Amaral (Technical Secretary).

The European Regional Process has the European Pact for Water as Co-Coordinator, which is an informal network of 35+ European-based NGOs and CSOs. The facilitating team consists of Lesha Witmer (Women for Water Partnership/ WfWP), Annemiek Jenniskens (WfWP), Meral Koebrich (BORDA) and Sergiy Moroz (European Water Partnership).

The common chapters of the Report where written with the contribution of the core team previously referred. The thematic chapters of this Report (4 to 9) have been written by invited international experts:

- Climate: Rodrigo Oliveira, Instituto Superior Técnico, University of Lisbon, Portugal.
- People: Lesha Witmer and Annemiek Jenniskens, Women for Water Partnership (European Pact for Water).
- Urban: Corinne Trommsdorff (IWA), Stef Koop (KWR Watercycle Research Institute) & Kees van Leeuwen (KWR Watercycle Research Institute & Utrecht University). Reviewers: Oliver Loebel (EUREAU, Belgium), Joaquim Comas (ICRA, Spain), Natasa Atanasova (University of Ljubljana, Slovenia).
- Ecosystems: Peter Gammeltoft, International Commission for the Protection of the Danube River (ICPDR).
- Financing: José Veiga Frade, independent expert, Portugal.
- Governance: Francisco Nunes Correia, Instituto Superior Técnico, University of Lisbon, Portugal.

Additionally, about 254 focal points have been identified in the 52 European countries (+ Uzbekistan), covering representatives from public administration, academia, water utilities, NGO and European based-organizations. These focal points have been invited to participate in the preparatory Process since its beginning and are listed in Annex 1.

The 52 countries considered for this European Regional Process were: Albania, Andorra, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia (FYROM), France, Georgia, Germany, Greece, Holy See, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Moldova, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russia, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, England, Wales, Scotland, Northern Ireland (United Kingdom). Additionaly, Uzbekistan as requested to take part on the European Regional Process.

Due to Europe diversity of situations inside its geographic limits, in this report the following groups have been adopted (Figure 1.2):

- Group 1 (UK and Ireland): England, Ireland, Northern Ireland, Scotland and Wales.
- Group 2 (North Europe): Denmark, Estonia, Finland, Iceland, Latvia, Lithuania, Norway and Sweden.
- Group 3 (Central Europe): Austria, Belgium, Czech Republic, Germany, Hungary, Liechtenstein, Luxembourg, Netherlands, Poland, Slovakia and Switzerland.
- Group 4 (Mediterranean): Andorra, Cyprus, France, Greece, Holy See, Italy, Malta, Monaco, Portugal, San Marino, Spain and Turkey.
- Group 5 (Southeast Europe): Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Former Yugoslav Republic of Macedonia (FYROM), Montenegro, Romania, Serbia and Slovenia.
- Group 6 (Eastern Europe): Armenia, Azerbaijan, Belarus, Georgia, Moldova, Russia and Ukraine.

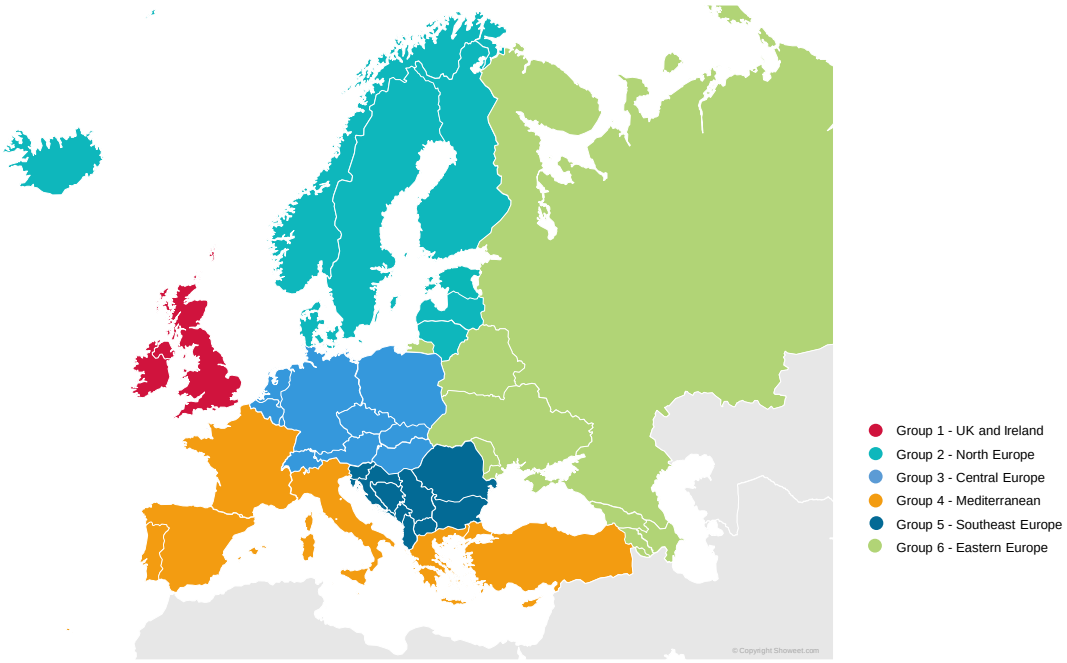


Figure 1.2 – European sub-regions adopted for the European Regional Process

2. European region

2.1. Contents

This chapter defines the European Region, briefly describing its territory, people, climate, hydrology, water resources, soil resources and economy.

2.2. Territory

Europe is the world's second smallest continent and occupies nearly one-fifteenth of the world's total land area. It is bordered, on the north, by the Arctic Ocean, on the west, by the Atlantic Ocean, and on the south (west to east) by the Mediterranean Sea, the Black Sea, the Kuma-Manych Depression, and the Caspian Sea. The continent's eastern boundary (north to south) runs along the Ural Mountains and then roughly southwest along the Emba (Zhem) River, ending at the northern coast of the Caspian Sea.

A contrast exists between the configuration of peninsular or western Europe and that of Eastern Europe, which is a much larger and more continental area. The western part of the continent clearly has a high proportion of coastline with good maritime access and often with inland penetration by navigable rivers. Continental shelves, former land surfaces that have been covered by shallow seas, are a feature of peninsular Europe, while the coasts themselves are both submerged or drowned, as in southwestern Ireland and northwestern Spain, and emergent, as in western Scotland and southern Wales, where raised former beaches are in evidence. East of the Vistula River, Europe's expansive lowlands have something of the scale and character of those of northern Asia. The European continent also includes numerous islands, some of them, namely the Faroe Islands and Iceland, located at a long distance from the mainland.

The highest elevations and the most rugged relief of the European continent are found south. In the Alps, Mont Blanc rises to a height of 4,807 metres, which is the highest point on the continent. In the Pyrenees and the Sierra Nevada of Spain, the highest of the peaks exceed 3,400 metres. The Apennines, Dinaric Alps, and Balkan Mountains, as well as the arc-shaped Carpathian Mountains and their southern portion, the Transylvanian Alps, also exhibit high elevations.

Four broad topographic units can be simply, yet usefully, distinguished in the continent of Europe. Those are coastal and interior lowlands, central uplands and plateaus, the northwestern highlands, and southern Europe.

More than half of Europe consists of lowlands, standing mostly below 180 metres but rarely rising to 300 metres. Most extensive between the Baltic and White seas in the north and the Black, Azov, and Caspian seas in the south, the lowland area narrows westward, lying to the south of the northwestern highlands.

The highlands and central plateaus feature distinctive landscapes with rounded domes, steep slopes, valleys and depressions. Examples of such physiographic features can be found in the Southern Higlands of Scotland, the Massif Central of France, the Meseta Central of Spain, and the Bohemian Massif. The well-watered plateaus give rise to many rivers and are well adapted to pastoral farming. Volcanic rocks add to the diversity of those regions.

The ancient, often mineral-laden rocks of the northwestern highlands, their contours softened by prolonged erosion and glaciation, are found throughout much of Iceland, Ireland, and northern and western Britain and Scandinavia. These upland areas include abundant rainy lands. A world of peninsulas and islands, southern Europe is subject to its own climatic regime, with fragmented, but predominantly mountain and plateau landscapes. The Iberian Peninsula features interior tablelands of Paleozoic rocks that are flanked by mountains of Alpine type. Restricted lowlands lie within interior basins or fringe the coasts; of Portugal, Former Yugoslav Republic of Macedonia (FYROM),

Thrace (in the southeastern Balkans), and northern Italy are relatively large. The outflow from the Alps provides water for power stations, as well as for the flow regimes of the major rivers.

2.3. People

According to the United Nations, the European population was estimated to be 740 million, which is slightly less than 11% of world population. The sub-replacement fertility and high life expectancy in most European countries mean a declining and aging population as it is not offset by the current immigration level. This situation expected to be a challenge for their economies, political and social institutions.

Territorial differences in language and other cultural aspects are well known, and these have been of immense social and political import in Europe. Europe became the home of many linguistic and national core areas, separated by mountains, forests, and marshlands. The European cultural groups have been associated into some 21 culture areas. The groupings are based primarily on similarities of language and territorial proximity. Although individuals within a primary group generally are aware of their cultural bonds, the various groups within an ethnographically determined culture area do not necessarily share any self-recognition of their affinities to one another.

2.4. Climate

Patterns of some permanence controlling air mass circulation are created by belts of air pressure over five areas. They are the Icelandic low, over the North Atlantic; the Azores high, a high-pressure ridge; the (winter) Mediterranean low; the Siberian high, centred over Central Asia in winter but extending westward; and the Asiatic low, a low-pressure summertime system over southwestern Asia. It is because of the interplay of so many different air masses that Europe experiences highly changeable weather.

Four regional European climatic types can be loosely distinguished.

Characterizing western areas heavily exposed to Atlantic air masses, the maritime type of climate, given the latitudinal stretch of those lands, exhibits sharp temperature ranges. Precipitation is always adequate, indeed, abundant on high ground, and falls year-round. The greatest amount of precipitation occurs in autumn or early winter. Summers range from warm to hot depending on latitude and elevation, and the weather is changeable everywhere.

The central European, or transitional, type of climate results from the interaction of both maritime and continental air masses and is found at the core of Europe, south and east of the maritime type, west of the much larger continental type, and north of the Mediterranean type. That rugged region has colder winters, with substantial mountain snowfalls, and warmer summers, especially in the lowlands. Precipitation is adequate to abundant, with a summer maximum.

The continental type of climate dominates a giant share of Europe. Winters, much colder and longer, with greater snow cover, than in Western Europe, are coldest in the northeast, and summers are hottest in the southeast. Summer is the period of maximum rain, which is less abundant than in the west. In parts of the south, the unreliability of rainfall combines with its relative scarcity to raise a serious aridity problem.

The subtropical Mediterranean climate characterizes the coastlands of southern Europe, being modified inland in response to elevation and aspect. The main features of that climatic region are mild and wet winters, hot and dry summers, and clear skies for much of the year, but marked regional variations occur between the lands of the western and the more southerly eastern basins of the Mediterranean; the former are affected more strongly by maritime air mass intrusions.

The local and regional effects of climate on the weathering, erosion, and transport of rocks clearly contributes much to the European landscape, and the length and warmth of the growing season, the amount and seasonal range of rainfall, and the incidence of frost affect the distribution of vegetation. Wild vegetation in its turn provides different habitats for animal life. Climate is also an important factor in the making of soils, and regional climatic variations help determine where crops are grown commercially. The winter freeze in northern and Eastern Europe is another aspect of climate, and the spring thaw, by creating floods, impedes transport and harasses farmers. The snow cover of the more continental regions is useful to people, however, for it stores water for the fields and provides snow for winter sports and recreation.

In sum, in only a modest proportion of Europe does climate somewhat restrict human occupation and land use. Those areas include regions of high elevation and relief, such as the subarctic highlands of the Scandinavian Peninsula and Iceland, the Arctic areas along the White Sea of northern Russia, and the arid areas of interior Spain.

2.5. Hydrology

The drainage basins of most European rivers lie in areas that receive heavy precipitation, including snow. The courses and valley forms of the major rivers result from an intricate history involving such processes as erosion by the headstream, down cutting, capture of other rivers, faulting, and isostatic changes of land and sea levels.

The water volume of and discharge from the rivers of Europe are governed by factors that include local conditions of precipitation, snowmelt, and rock porosity. In consequence, the rivers in the western area have more volume and higher discharges in the winter season and are at their lowest in summer. In areas of mountainous and continental climate, thanks to the runoff of snowmelt, the rivers are highest in spring and early summer. The longer rivers of the continent have complex regimes, since their basins extend into areas of contrasting climate. Although embanking measures have reduced the problem, flooding is a continued threat. In the Mediterranean region some rivers tend to dry up in summer through a combination of scant rainfall, evaporation, and porous limestone beds.

2.6. Water resources

The mountainous and upland areas of Europe collect great amounts of surface water, which supply the rivers and lakes; the lowlands, with lower rainfall, thus receive much water from the higher portions of their river basins. In the Mediterranean lands, surface water is minimal in summer, exceptions being northern and north-western Iberia, which receives ample rain; the North Italian Plain, which has Alpine rivers, lakes, and springs and receives summer rain; and the Apennine zone of Italy, which has rivers fed by snowmelt and rain. In the east, surface water is relatively abundant in Belarus and central and northern Russia, but it decreases to the south and southeast; in the drier regions, however, rivers drain extensive basins, and dams on the Volga and Dnieper have created enormous reservoirs.

The increasing water requirements of thermal power stations and industry and, to a lesser extent, domestic needs make the little-populated and little-industrialized European highlands, which offer surplus water, indispensable to the lowlands. The pollution of water by effluents containing nonoxidizable detergents from urban areas and by those from oil refineries and chemical and metallurgical plants has reached such proportions as to present serious problems and to incur high reclamation costs. Water pollution has been especially severe in the section of the Rhine below Basel, Switzerland, and in the Ruhr, Lakes Geneva and Garda (Switzerland and Italy, respectively), and many areas in Eastern Europe. In reaction to water shortages, water is, as in the Thames and Elbe, recycled many times.

Because the water table is normally not far below the surface in the lowlands, wells and springs are widely available there; underground water supplies (groundwater) that are held particularly in porous rocks are sporadically utilized through the process of pumping. A trend that appears to be growing is to artificially add to supplies of groundwater and thus integrate surface and underground water; much of Sweden's urban water requirements are thus supplied. The needs of the major European cities and of the industrial regions involve continuing efforts to collect enough water by impounding surface water, by pumping groundwater, and by encouraging the economy, reuse, and reclamation of water.

2.7. Soil resources

The origin, nature, variety, and classification of Europe's soils raise highly complex problems. So many factors, bedrock, drainage, plant decomposition, biological action, climate, and time, are involved. Humans, moreover, have done much to modify soils and, with increasing scientific knowledge, to render soils of greater and continuing value by drainage, crop rotation, and the input of suitable combinations of chemicals. In such ways, naturally poor soils can be made productive. The practice of an enforced "resting" of soils, by leaving fields fallow to recuperate, began to disappear with the agricultural revolution of the 18th century, and agronomic science continues to show how the best results can be achieved from specific soils and also how to curtail soil erosion.

2.8. Economy

Europe was the first of the major world regions to develop a modern economy based on commercial agriculture, industrial development, and the provision of specialized services. Its successful modernization can be traced to the continent's rich endowment of economic resources, its history of innovations, the evolution of a skilled and educated labour force, and the interconnectedness of all its parts, both naturally existing and man-made, which facilitated the easy movement of massive quantities of raw materials and finished goods and the communication of ideas. During the 20th century, Europe experienced periods of considerable economic growth and prosperity, and industrial development proliferated much more widely throughout the continent. However, continued economic development was handicapped to some degree by the continent's multinational character, as well as by the exhaustion of many of Europe's resources and by increased economic competition from overseas. Moreover, governmental protectionism, which tended to restrict the potential market for products, deprived many companies of the efficiencies of large-scale production serving a mass market. This tendency was greatly reduced with the establishment of the European Economic Community, ultimately replaced by the European Union. In the late 20th and early 21st centuries, manufacturing remained important to Europe's economy but increasingly was overshadowed by the dramatic growth of the service sector. Manufacturing also showed great regional disparity. Western Europe tended to attract high-value-added manufacturing industries, whose finished products are worth much more than the materials and labour needed to create them. Lower value-added manufacturing was prevalent in east-central and south-eastern Europe. Meanwhile, the rise in service-sector employment helped to compensate for a loss of manufacturing jobs, while it also contributed to the growth of urban regions. Many metropolitan areas, particularly in Western Europe, have become national and international centres of specialized business and high-technology services.

Regarding agriculture, forestry, and fishing, arable land in Europe covers less than one-third of the total area. Europe's industrialization and urbanization tend to conceal the fact that it is a great producer of cereals, roots, edible oils, fibres, fruit, and livestock and livestock products. Its yields of rye, potatoes, oats, and wheat are among the world's largest. Europe's climatic range has helped to delineate production areas. The great advances made in agronomic science during the 20th century have benefited all of

Europe, but the hazards of harvest shortfalls caused by unfavourable weather have not been eliminated. The timber and fisheries extractive industries are of considerable scale. Fishing is a large industry.

Regarding mineral resources, with rocks and structures from virtually all geologic periods, Europe possesses a wide variety of useful minerals. Useful minerals include those that provide energy, ferrous and nonferrous metals and ferroalloys, and those that furnish materials to the chemical and building industries. Europe commands abundant resources of hard and soft coal, which remains of considerable, if declining, importance as a fuel for the smelting of minerals and as the source of many by-products. Known petroleum and natural gas reserves are inadequate for Europe's rising requirements. Sources of uranium for use in nuclear reactors have been discovered in many European countries. Large iron reserves were historically found but high-quality ores have been exhausted or have become expensive to mine. The richest ferroalloy deposits occur in Russia and in Ukraine. With notable exceptions, known European reserves of nonferrous base metals are small, partly because of the depletion. Europe's once widely available reserves of gold appear are largely exhausted. Minerals within the large non-metallic category are widely available.

Regarding industry, the change from charcoal to coke as fuel in blast furnaces led to the localization of Europe's iron and steel industries on its coalfields to economize transport costs. Europe produces a significant portion of the world's steel and iron ore. Steel-using industries that make heavy machine tools and mining, smelting, construction, and electrical equipment favour coalfield locations, while those engaged in shipbuilding and motor vehicle and aircraft construction show a wider distribution. Covering many products, chemical industries expanded greatly, partly in relation to hydroelectricity generation and partly because of the market-oriented use of refinery by-products. Many heavy chemicals have been produced on the coalfields. Other chemical industries make use of Europe's deposits of salt, potash, phosphates, and sulphur. The increased production of synthetic rubber, plastics, synthetic fibres, detergents, insecticides, and fertilizers, particularly from petrochemicals, revolutionized the chemical industries. Europe is also a large producer of pharmaceutical drugs. A wide range of light or small-scale industries, those that produce nondurable goods, is found throughout Europe. Many countries produce distinctive food products and beverages, notably the wines of the west and south, the northern beers, and whiskeys. Printing and publishing, are substantial industries that have worldwide effects, notably in the educational field. Of small importance in a continent where mass production predominates, handicrafts nevertheless survive to serve a wide market, including that of tourists who seek specialty goods.

Regarding trade, with its ever more sophisticated industry producing outstanding exports and its large importation of petroleum products, metals, other raw materials, and foodstuffs, Europe accounts for a large percentage of world commerce. Internal and external trade, both by land and by sea, always has been a vigorous part of Europe's economy. Trade is further aided by Europe's central position in the densely populated Northern Hemisphere, well served by oceanic and air transport systems. Within each European country, a wide variety of goods is moved continually from ports and production centres to urban markets. In addition, a major part of the trade of Europe takes place between the various countries, since, with regional specialization, dense populations, and relatively high standards of living, they provide strong markets. European trade extends to all other parts of the world. The extra continental exports of Europe include machine tools, automobiles, aircraft, chemicals (including pharmaceutical drugs), and such consumer items as clothing, textiles, books, specialty food products, expert services, and works of art. Western Europe depends heavily on imported petroleum from the Middle East, Algeria, and Libya and on many imported raw materials and metals. Europe imports much natural rubber, tea, coffee, cacao, cane sugar, oilseeds, tobacco, and fruit, fresh, canned, and dried, although it has attempted

to lessen its dependence on imported agricultural products with greater domestic production and the manufacture of synthetic substitutes for natural fibres.

Regarding tourism, the outstanding growth industry of tourism, supplementing business, professional, and student travel, brings employment and foreign exchange to many Europeans, especially in the Mediterranean countries, with their combination of sunshine, beaches, scenery, and historical monuments. The world-renowned cities of Europe attract large numbers of tourists as well. In fact, European countries are consistently among the top tourist destinations of the world; they draw visitors from within Europe as well as from other continents.

As regards power, coal, used to drive steam engines and, as coke, in the smelting of metals, was long the predominant European power source. There was very little increase in coal production during the late 20th century, however, as European countries made greater use of other forms of energy. Nevertheless, in the early 21st century coal continued to provide energy to coalfield-based industries and was still important for the production of electricity. Petroleum and natural gas now provide a large share of the energy consumed. Natural gas has replaced coal gas in many parts of Europe. Fuel oil is widely used by diesel locomotives and electricity-generating stations as well as for space heating. Nuclear reactors generate a significant amount of electricity. Hydroelectric power has been markedly developed where precipitation and landforms provide good opportunities to dam rivers. Geothermal energy, using underground waters heated by volcanic action, is available. Wind power and tidal power are being harnessed as well.

Concerning transportation, much of Europe today has a network of high-speed, limited-access highways provides fast movement for commerce and travel. Road tunnels supplement railway tunnels beneath the Alpine passes. Railways link European ports with their hinterlands and fan out from capitals and major cities to points on the international frontiers, where they meet the railway systems of their neighbours. In addition, underground railways (subways), streetcar systems, and suburban railways play an indispensable role for metropolitan commuters across Europe. Seaports have been modernized and enlarged to deal efficiently with the increased size of ships and volume of oceanic trade. Inland waterway transport, slow but cheap, is regionally important for the carriage of heavy and bulky commodities. Giant tankers deliver their cargoes by pipelines that, for petroleum, natural gas, and water, provide the cheapest overland form of transport. Air services between principal European cities and to all parts of the world are extensively organized. Passengers, mail, and commodities of high value in relation to their weight make use of air transport.

2.9. References

In the writing of this chapter the following bibliographic reference has been used:

ENCYCLOPAEDIA BRITANNICA: Europe continent (Written By: Brian Frederick Windley, William H. Berentsen. W. Gordon East and Thomas M. Poulsen), Last Updated: 12-20-2017

3. European regional approach

3.1. Contents

This chapter describes the European regional approach, briefly listing the activities carried out wich includes the quest on the relevant European themes and topics, identification of relevant European case studies, inquiry about the willingness to participate, survey on financing, consultation meetings and specialised thematic contributions.

3.2. Activities developed

The following activities have been developed within the European Regional Process:

- Identification of contact points for each of the 52 European countries to be involved in the process, representing water resources administration, water services administration, water industry, European CSOs/ NGOs on water, as well as regional and international organisations, totalising 254 organisations (March 2017).
- Design and implementation of a qualitative survey to assess the importance for Europe of the themes and topics selected by the Thematic Process (March-June 2017).
- Collection, statistics processing and analysis of information provided by the survey and by the kick-off meeting (March - June 2017).
- Identification of the topics to be bridged with other specified Regions, based on the priorities selected by each one.
- Preparation of a detailed structure of the European Regional Report.
- Preparation of the terms of reference for the specialised thematic contribution to the European Regional Report.
- Selection and invitation of six external experts and/or organizations to support the preparation of the European Regional Report (June-July 2017).
- Identification and selection of relevant case studies, covering the different topics, to be included in the report (March - September 2017).
- Design and implementation of a survey about potential contributions to the European sessions (November 2017).
- Collection, processing and analysis of information provided by this survey (December 2017).
- Design and implementation of a survey about financing, due the scarcity of information received in the previous surveys (December 2017).
- Collection, and evaluation of the information provided by this survey (December 2017).
- Design and implementation of a survey about willingness to participate in the European regional sessions in the forum.
- Design and organization of the European Regional sessions, as well as the inter-regional sessions (January 2018).
- Preparation of this European Regional Report by the core team and the specialised thematic contributors (January 2018).
- Final coordination meeting between the Thematic Process and the European Regional Process in Lisbon (February 2018).

After the Forum, this European Regional Report shall include also its outputs for its final version (May 2018).

3.3. Survey about European relevance of themes and topics

A 1st survey was launched by the European Regional Process, in April 2017, inviting the identified European Focal Points to assess the relevance, public perception, performance, engagement and existence of case studies regarding the main topics of the thematic matrix of the 8th World Water Forum, identified below:

Theme: CLIMATE – Water security and climate change

(SDGs Links: SDG 13, SDG11, COP 21-22, SENDAI DRR Summit)

Climate change impacts water resources first and foremost. Changes in climate mean changes in the water cycle, in rainfall distribution patterns, in river water flows, in groundwater recharge and quality, and in the occurrence of extreme hydrological events, such as drought, flooding, storms, ice melting, etc. Climate change further exacerbates existing freshwater challenges related to both quantity and quality for human activities and ecosystems. Its cross-sector nature makes water security the key to successful adaptation measures – which require articulated policy, planning and action, involving governments at all levels, sectors and society. At the same time, water is critical for successful climate change mitigation, as many low-carbon solutions depend on reliable access to water resources. Progress will be dependent on good communication between science and decision/policy making and implementing actors. With the 2015 Sendai, SDG's and COP21 agreements, the world committed itself to ambitious goals and targets for both water and climate. Our common task is now the Implementation of these goals and targets. This WWF8 is a unique opportunity to discuss between governments, science, NGOs and the private sector how to jointly organize the implementation process in a speedy and effective way. The 8th World Water Forum discussions should focus on sharing inspiring examples of the necessary policies and measures and proposing and financing and mechanisms with which these ambitious goals and targets can be reached. The 8th World Water Forum discussions under this theme will focus on climate risk assessment, water safety and protection of people and livelihoods and should result in climate being a major consideration in sharing water and the implementing the SGDs, including the Paris Climate Agreement.

- Topic a. Managing risk and uncertainty for resilience and disaster preparedness
- Topic b. Water and adaptation to climate change
- Topic c. Water and climate change mitigation
- Topic d. Climate science and water management: the communication between science and decision/policy making

Theme: PEOPLE - Water, Sanitation and Health

(SDGs links: SDG 6 targets 6.1, 6.2, 6.3, 6.b and SDGs 1 and 3)

Access to safe water and sanitation is indispensable to everybody, everywhere and all the time. WASH, water scarcity and pollution have become systemic global risks with negative impacts on people's lives. SDG6 and human rights to safe water and sanitation (HRWS) provide a people centred approach to sustainable development in countries at every level of development. Water connects people through their lives. Providing access to water and sanitation is essential for guaranteeing well-being and ending poverty. Solving water related issues is a primary requirement for other development actions, sharing prosperity and sustainability. However, even today, many people still lack adequate access to safe water and sanitation facilities. Monitoring, analysis and advocacy have become increasingly tangible and contribute to evidence-based decision-making, dialogue, and improved coherence of the global water agenda. Considering these aspects, under the perspective of peoples' dignity, ensuring human equality, as well as considering new realities such as those related to migrants and refugees, this theme aims to create a space in which all water sector actors, including youth, can discuss development and implementation of effective water and sanitation services

delivery models and technical innovations, scaling them to strengthen public health through new financial mechanisms. In addition, it wants to be a space for showing innovation and partnership models, fostering know-how transfer, scaling-up best practices, access to data and attracting additional funds. Putting all together, the discussions for developing sustainable access to safe water and sanitation services, while protecting public health, will be both challenging and rewarding.

- Topic a. Enough safe water for all
- Topic b. Integrated sanitation for all
- Topic c. Water and public health

Theme: DEVELOPMENT - Water for Sustainable Development

(SDGs links: SDG 6 targets 6.4 and SDGs 2,7,8,11 and 12)

Water plays a critical role for sustainable development. From food and energy security to human and environmental health, water contributes to improvements in social well-being and inclusive growth, affecting the livelihoods of billions. Our current pathway of development puts considerable pressure on water resources – agriculture, energy, industry and cities all affect the quality, availability and accessibility of water. Competing demands, inefficiency and lack of financial support impose difficult allocation decisions and set limits for all sectors. As the largest water user, agriculture plays a key role in addressing water issues. At the same time, agriculture must produce enough food with less water to feed a growing world population, requiring profound changes in our food and agricultural systems. Meeting ever-growing demands for energy will generate increasing stress on freshwater resources with implications for other users, such as agriculture and industry, which also require energy, creating some synergies as they develop together. The theme will discuss how this can be done by the water-using sectors in terms of efficiency, sustainability and governance through a Nexus approach. Water stewardship has come to redefine the role of industry and business in sustainable development challenges. Companies are beginning to understand what water means to them, their profits and their long-term viability. Wise investment in both hard and soft infrastructure that is adequately financed, operated and maintained facilitates the structural changes necessary to foster advances and efficiency in many productive areas of the economy. The outcomes of this theme must support the development and implementation of policies and actions for the sustainable use of water, to achieve the goals and targets of the 2030 Agenda for Sustainable Development.

- Topic a. Water, energy and food security nexus
- Topic b. Inclusive and sustainable growth, water stewardship and industry
- Topic c. Efficient use of surface water and groundwater - urban and rural
- Topic d. Infrastructure for sustainable water resource management and services

Theme: URBAN – Integrated Urban Water and Waste Management

(SDGs links: SDG 6 targets 6.3 and SDGs 11 and 14, Habitat 3)

Urban water security is increasingly under pressure, due to a growing demand for water, depletion of water resources, flooding, water pollution and poor wastewater management, the whole being aggravated by impacts of climate change. The upcoming predominance of urban population puts responsibilities directly into cities' hands. Rapid urbanization is also often accompanied by a worsening social gap: water has to be affordable and its associated services equitably provided. The demand for reliable infrastructure and the pressing need for improved institutional effectiveness make those challenges even greater in emerging countries. Water governance cannot be limited to city boundaries but requires adopting an integrated vision considering upstream and downstream implications, and involving technical, economic and social actors in systems thinking approaches, as recommended by the New Urban Agenda and the Sustainable

Development Goals. To make a city healthier, greener and safer, water is a major means. Opportunities rely in adopting integrated approaches in city planning, taking into account all water uses, introducing new financing models, promoting multi-sector circular economy, promoting behaviour change, fomenting dialogue among key stakeholders, making wastewater and rainwater potential new resources, and adjusting regulatory frameworks. Betting on innovation and technologies as well as on collective intelligence and wisdom is key to success. The Urban Theme engages "water actors" into partnerships where collective action efficiently drives the urgent change needed. It also seeks to inspire participants to take action towards 1) bridging to other professionals for active collaboration, and 2) develop tools to support the transition. Join the journey to water-wise cities!

- Topic a. Water and cities
- Topic b. The circular economy - reduce, reuse, recycle
- Topic c. Treatment and reuse technologies

Theme: ECOSYSTEMS – Water Quality, Ecosystem Livelihoods and Biodiversity

(SDGs links: SDG 6 targets 6.3, 6.6 and SDGs 15)

Protecting and rehabilitating freshwater ecosystems represents an important shift towards sustainability in water resources development approaches for the 21st Century. Human pressures on our rivers, lakes and wetlands continue to grow, not only threatening biodiversity but also many essential services that healthy freshwater ecosystems provide, including the provision of clean drinking water. Balancing the water needs for humans and nature is a major challenge for society, requiring improvements in water use efficiency in rural and urban settings, through improved technologies and water planning reforms that can incentive behavioural change. Restoration of hydrological connectivity and the identification and provision of environmental flows for river and wetland systems will also be important to achieve this balance. Cost-effective approaches combining grey and green infrastructure to reduce water pollution are needed, not only for urban and industrial sources but also to minimize the delivery of sediment, nutrients and other contaminants from diffuse sources. Improving resilience of our catchments and waterways to extreme weather events will also become increasingly important in the face of a changing climate and growing population. New strategies and tools are needed to quantify the full costs and benefits of these actions to society, not simply in monetary terms, and to effectively communicate these values to decision makers and the broader community. This theme will explore these challenges and identify ideas and actions that can be condensed into technical, social, legal and political proposals that influence and enable society to adopt a new agenda for development and lead to a sustainable water future.

- Topic a. Managing and restoring ecosystems for water services and biodiversity
- Topic b. Natural and engineered hydrological systems
- Topic c. Water and land use
- Topic d. Ensuring water quality from ridge to reef

Theme: FINANCING – Financing for Water Security

(SDGs links: SDGs 6 and 17)

Water Security is multidimensional and a key-driver for achieving the Sustainable Development Goals. However, long-term investments to guarantee water security pose challenges on good governance and political stability as well as uncertainties due to climate change. To address these challenges, the discussions about financing water infrastructure and water management systems will tackle the issue of investments through a review of innovations on payments for environmental services and green infrastructure, land value capture tools, performance-based contracts, microfinance for

small-scale water services, research and innovative technologies, and PPP approaches on irrigation and water/wastewater services. On the other hand, the implementation of the water-related Sustainable Development Goals (SDG) and adaptation to climate change will be addressed by discussions on how to bridge the investment gap and ageing infrastructure replacement. Additionally, it will explore opportunities, mitigation of risks and the improvement of public policies and water management to stimulate investments, including those from capital markets. Furthermore, it will review the practical applications of tariffs, taxes and transfers and best global practices to assess the economic value of water, including cost/benefit and cost/effectiveness analyses. Finally, reinforcing the idea of water at the core of sustainable development, the thematic sessions will discuss water security holistically by linking water and growth and the water-energy-food nexus. It will also discuss the role of the private sector for water sector development, including mechanisms/metrics adopted by the financial markets to identify business risks associated to water.

- Topic a. Economics and financing for innovative investments
- Topic b. Financing implementation of water-related Sustainable Development Goals and adaptation to climate change
- Topic c. Finance for sustainable development - supporting water-friendly business

For each Topic within each Theme, the following questions were raised in the survey:

- What is the relevance of this topic in Europe?
- What is the relevance of this topic in your country or region?
- What is the public perception of the relevance of this topic in your country or region?
- What is the current performance of your country or region regarding this topic?
- What is the level of engagement of your country or region on this topic?
- To what extent can you identify a relevant case study in your country or region?

The assessment was qualitative in a scale: Low, Medium, High, Very high. It was also possible to select the option no reply or non-applicable (NR/NA).

If they have answered High or Very high to the last question, European stakeholders have been kindly invited to send a short description of the case-study, with a maximum 1500 characters with spaces, introducing, describing and highlighting the relevant aspects, together with a picture with a minimum resolution 300dpi.

A total of 100 answers were received from different countries and type of stakeholders.

Figure 3.1 presents the spacial distribution of answers. Figure 3.2 and Figure 3.3 present the distribution of answers by sub region and by type of stakeholder.

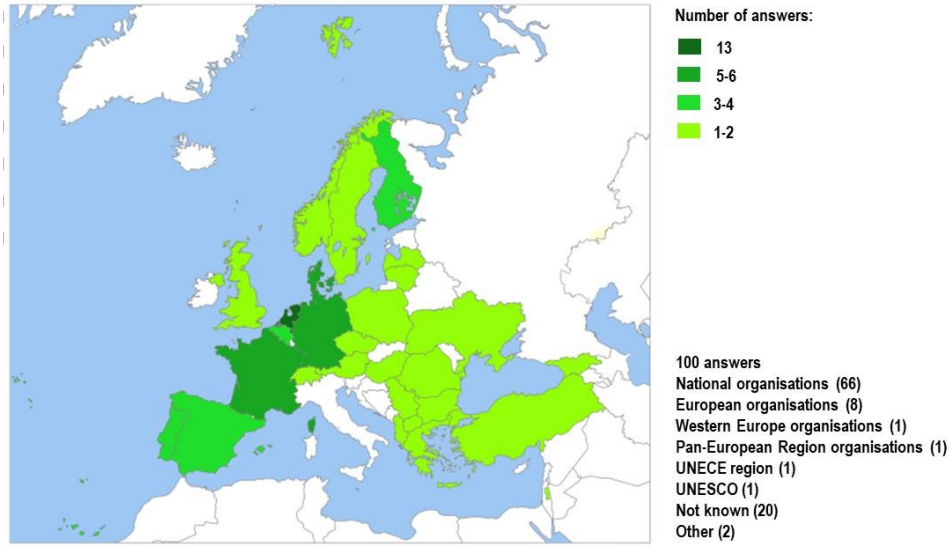


Figure 3.1 – Survey on European relevance of themes and topics - spacial distribution of answers.

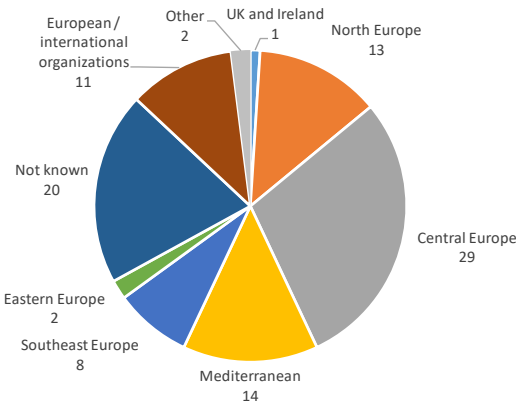


Figure 3.2 – Survey on European relevance of themes and topics - distribution of answers by sub region

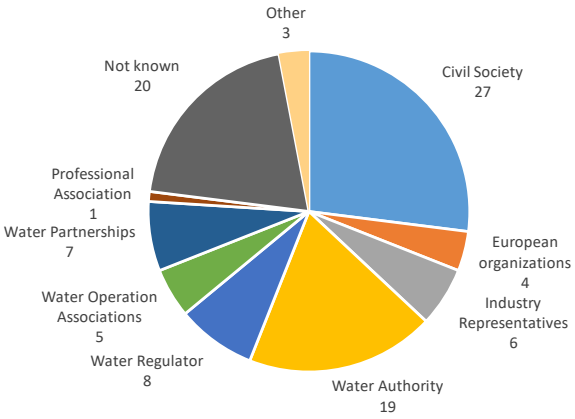


Figure 3.3 – Survey on European relevance of themes and topics - distribution of answers by type of stakeholder

As presented in Figure 3.1 and Figure 3.2, a good representation of Europe both in terms of countries and regions was obtained. 27 out of the 52 countries consulted replied, mostly located in central Europe (36% of the identified responses). Answers from regional (Western Europe and Pan-European Regional), European and international (UNECE and UNESCO) organisations were also received. Netherlands followed by Germany, Denmark and France were the most represented countries. Figure 3.3 shows a great diversity of stakeholders, with great representativeness of civil society (34% of the identified responses) and water authorities (24% of the identified responses). 20 respondents did not identify their organization (20% of total responses).

Figure 3.4 to Figure 3.15 present the prioritization of topics regarding relevance to Europe, relevance in country / region, public perception, performance, level of engagement and existence of case studies, both at European level and sub-regional level. Presented values were calculated considering the following criteria: weighted sum of ‘very high’ and ‘high’ responses (‘very high’ = 1.5 ‘high’).

The priority order for each theme is presented in Figure 3.16. Table 3.1 and Table 3.2 summarizes the top and the worst-ranked topics for each theme.

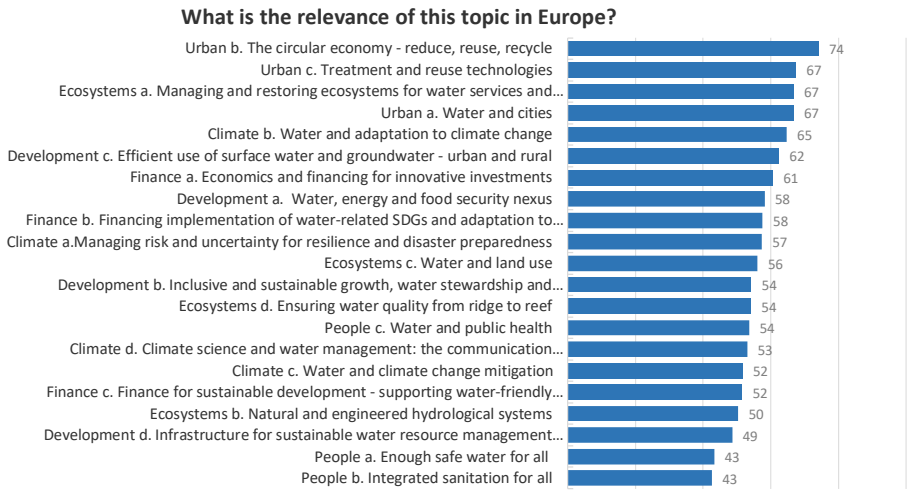


Figure 3.4 - Survey on European relevance of themes and topics – prioritisation of topics in terms of relevance in Europe

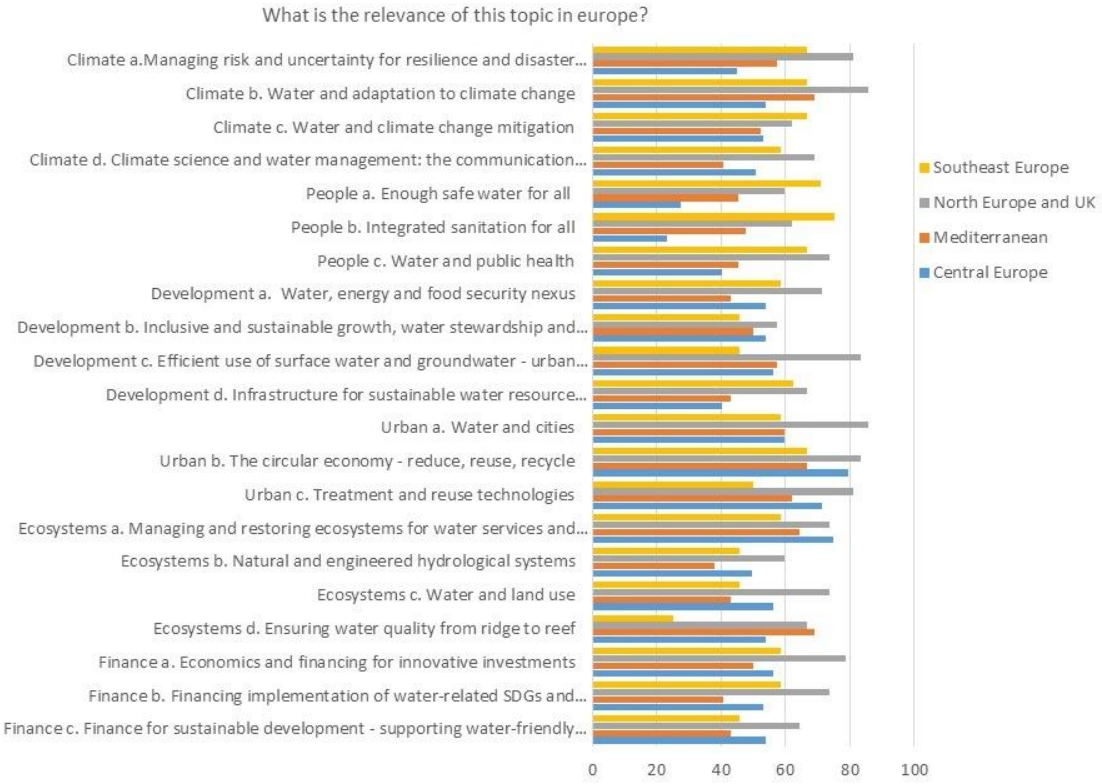


Figure 3.5 - Survey on European relevance of themes and topics – relevance of topics in Europe – analysis by sub region

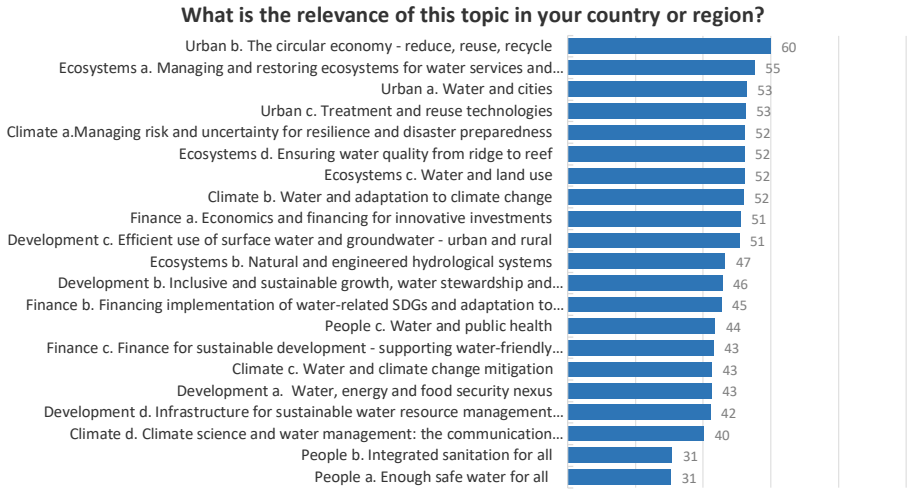


Figure 3.6 - Survey on European relevance of themes and topics – prioritising of topes in terms of relevance in a country or region

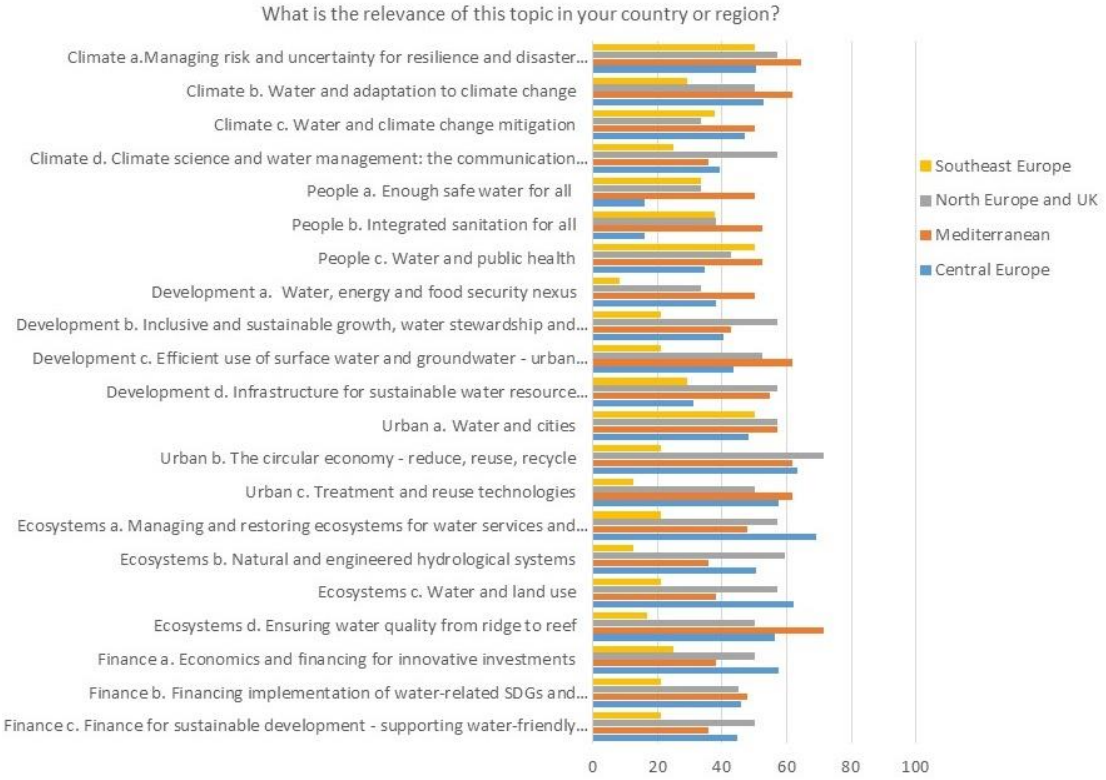


Figure 3.7 - Survey on European relevance of themes and topics – relevance of topics in a country or region – analysis by sub region

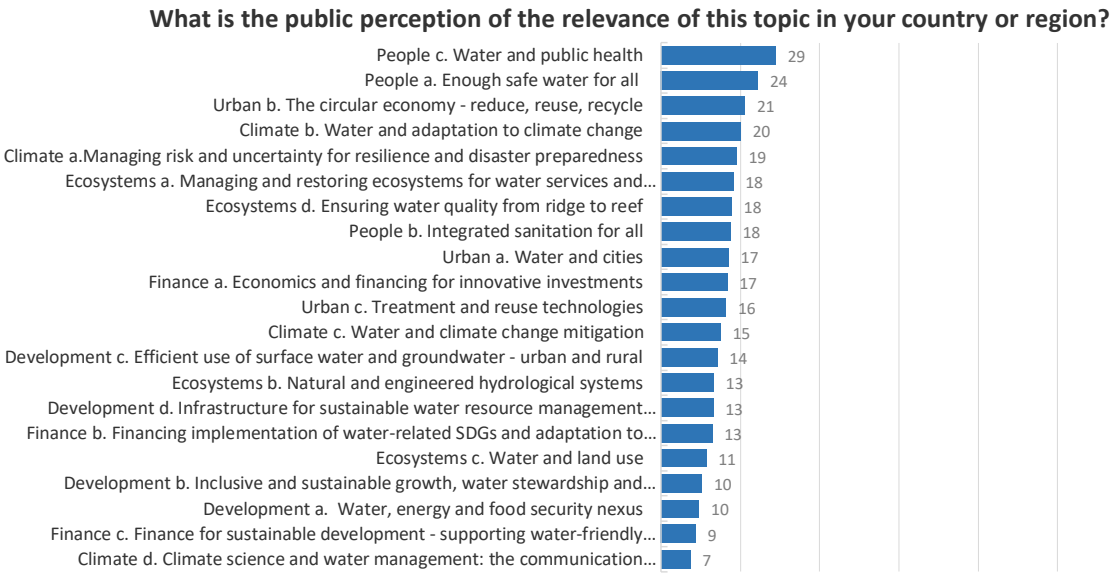


Figure 3.8 - Survey on European relevance of themes and topics – prioritising of topes in terms of public perception

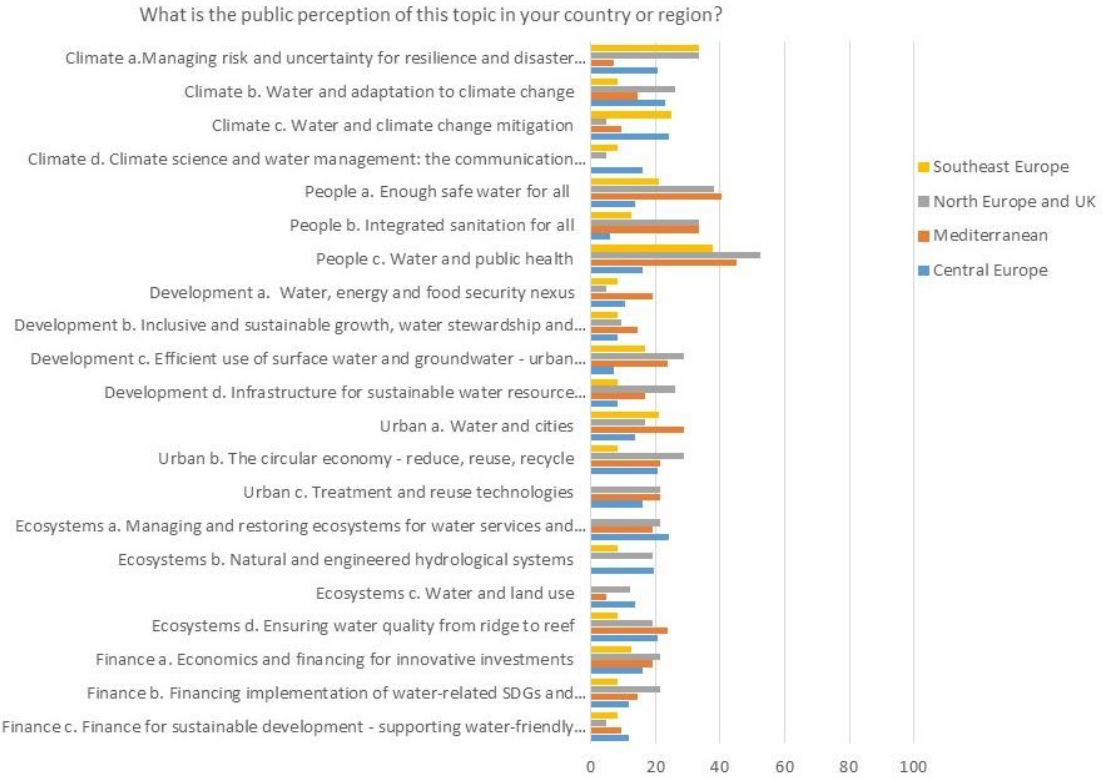


Figure 3.9 - Survey on European relevance of themes and topics – public perception of topics in a country or region – analysis by sub region

Figure 3.10 - Survey on European relevance of themes and topics – prioritising of topes in terms of current performance

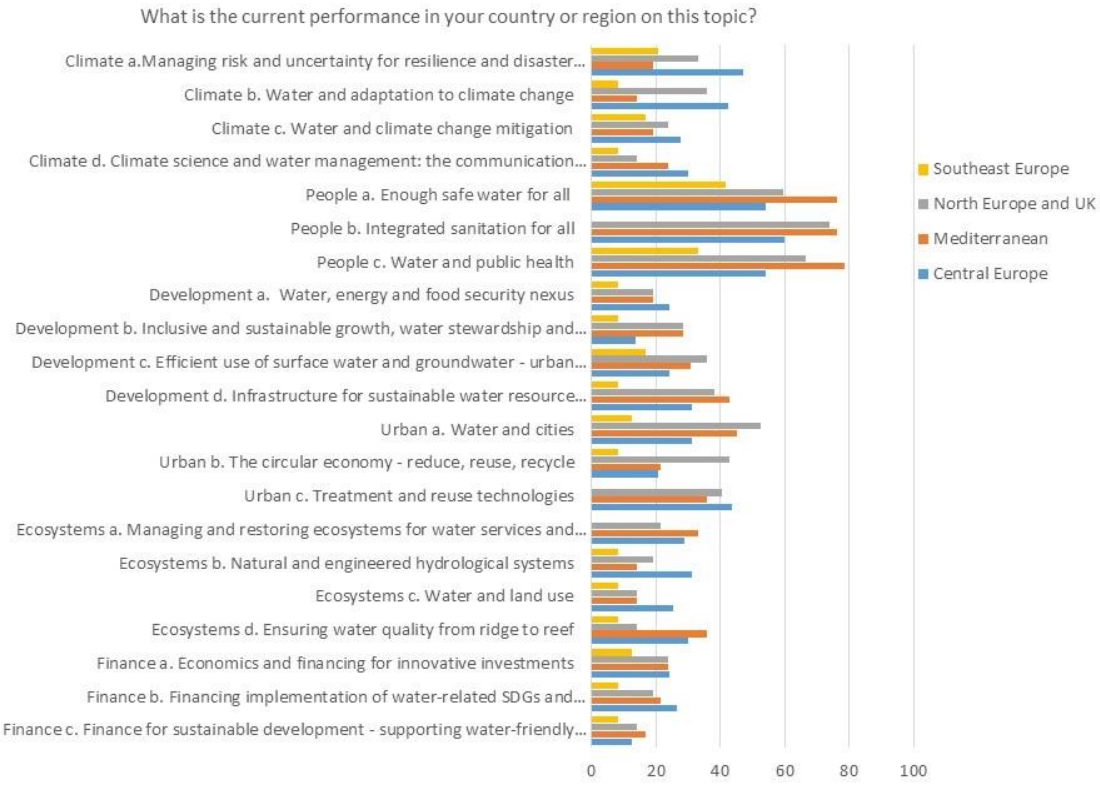


Figure 3.11 - Survey on European relevance of themes and topics – current performance in a country or region – analysis by sub region

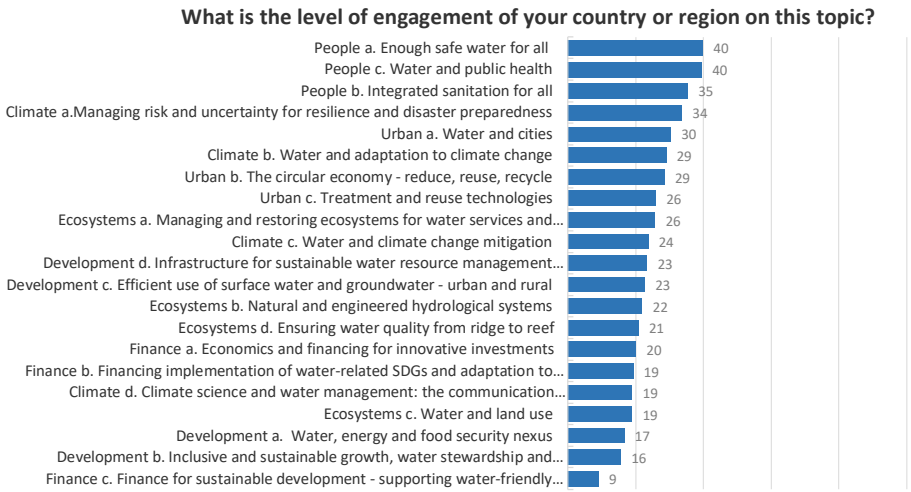


Figure 3.12 - Survey on European relevance of themes and topics – prioritising of topes in terms of the level of engagement

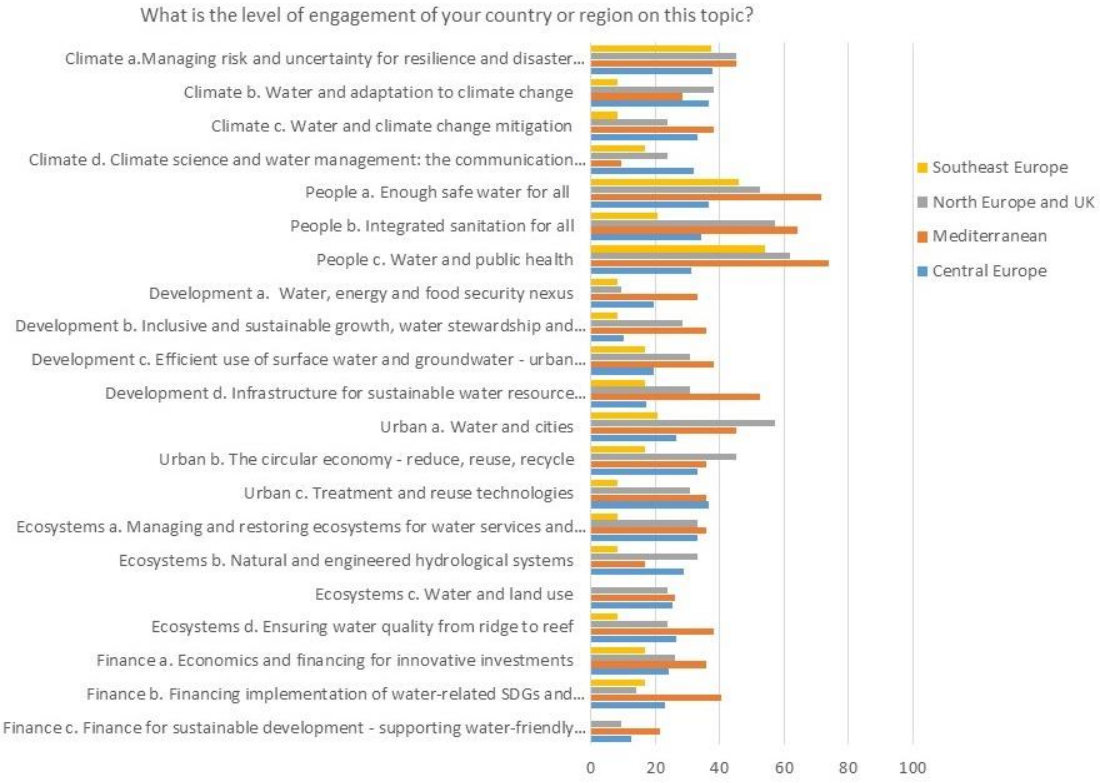


Figure 3.13 - Survey on European relevance of themes and topics – level of engagement in a country or region – analysis by sub region

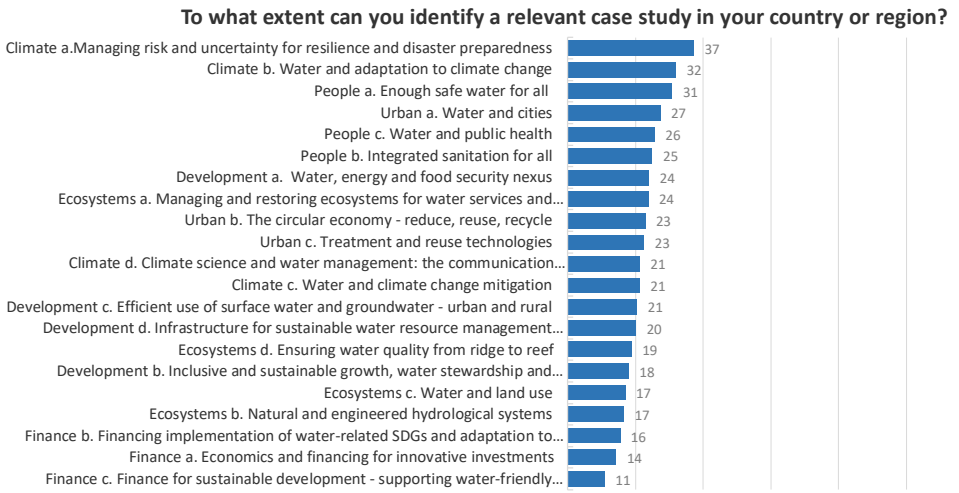


Figure 3.14 - Survey on European relevance of themes and topics – prioritasion of topis in terms of existence of case studies

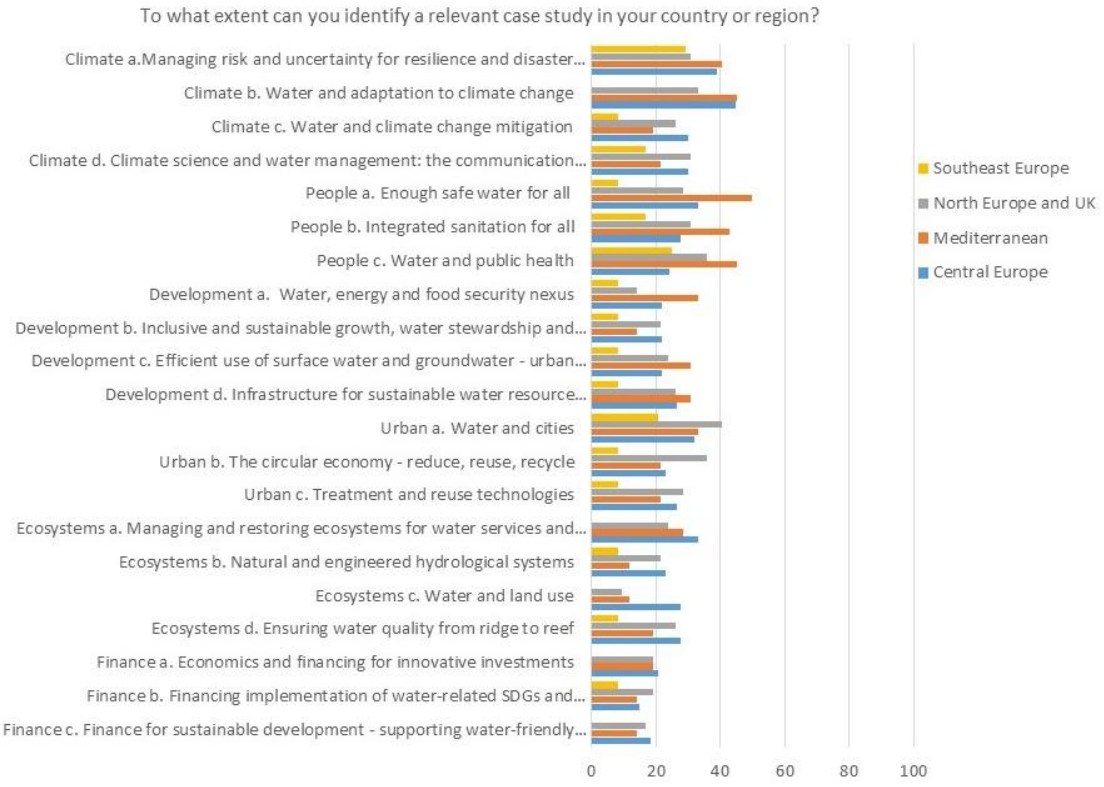


Figure 3.15 - Survey on European relevance of themes and topics – existence of case studies in a country or region – analysis by sub region

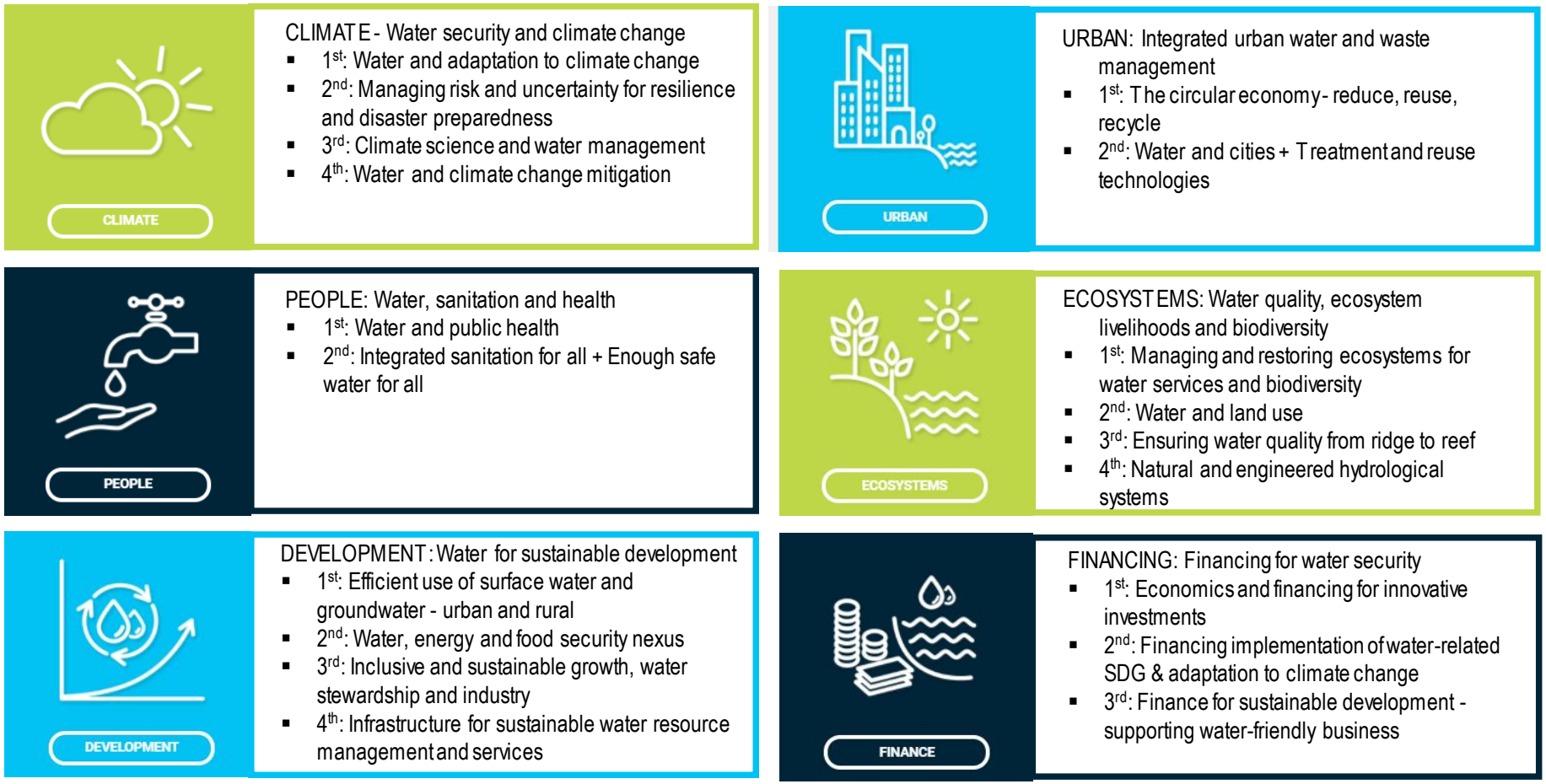


Figure 3.16 - Survey on European relevance of themes and topics – priority order for each theme

Table 3.1 - Survey on European relevance of themes and topics – top-ranked topics for each theme.

Themes	CLIMATE	PEOPLE	DEVELOPMENT	URBAN	ECOSYSTEMS	FINANCING
Most relevant topic in Europe	b. Water and adaptation to climate change	c. Water and public health	c. Efficient use of surface water and groundwater - urban and rural	**b. The circular economy**	a. Managing and restoring ecosystems for water services and biodiversity	a. Economics and financing for innovative investments
Most relevant topic in country/region	a. Managing risk and uncertainty for resilience and disaster preparedness b. Water and adaptation to climate change	c. Water and public health	c. Efficient use of surface water and groundwater - urban and rural	**b. The circular economy**	a. Managing and restoring ecosystems for water services and biodiversity	a. Economics and financing for innovative investments
Topic with greater public perception in country / region	b. Water and adaptation to climate change	**c. Water and public health**	c. Efficient use of surface water and groundwater - urban and rural	b. The circular economy	a. Managing and restoring ecosystems for water services and biodiversity d. Ensuring water quality from ridge to reef	a. Economics and financing for innovative investments
Topic with better current performance in country / region	a. Managing risk and uncertainty for resilience and disaster preparedness	**a. Enough safe water for all** **c. Water and public health**	d. Infrastructure for sustainable water resource management and services	a. Water and cities c. Treatment and reuse technologies	a. Managing and restoring ecosystems for water services and biodiversity	b. Financing implementation of water-related Sustainable Development Goals and adaptation to climate change
Topic with a higher level of engagement in country / region	a. Managing risk and uncertainty for resilience and disaster preparedness	**a. Enough safe water for all** **c. Water and public health**	c. Efficient use of surface water and groundwater - urban and rural d. Infrastructure for sustainable water resource management and services	a. Water and cities	a. Managing and restoring ecosystems for water services and biodiversity	a. Economics and financing for innovative investments

Topic with the highest result among all topics

Table 3.2 - Survey on European relevance of themes and topics – worst-ranked topics for each theme

Themes	CLIMATE	PEOPLE	DEVELOPMENT	URBAN	ECOSYSTEMS	FINANCING
Less relevant topic in Europe	c. Water and climate change mitigation	**a. Enough safe water for all** **b. Integrated sanitation for all**	d. Infrastructure for sustainable water resource management and services	a. Water and cities c. Treatment and reuse technologies	b. Natural and engineered hydrological systems	c. Finance for sustainable development – supporting water-friendly business
Less relevant topic in country/region	d. Climate science and water management: the communication between science and decision/policy making	**a. Enough safe water for all** **b. Integrated sanitation for all**	d. Infrastructure for sustainable water resource management and services	a. Water and cities c. Treatment and reuse technologies	b. Natural and engineered hydrological systems	c. Finance for sustainable development – supporting water-friendly business
Topic with less public perception in country / region	**d. Climate science and water management: the communication between science and decision/policy making**	b. Integrated sanitation for all	a. Water, energy and food security b. Inclusive and sustainable growth, water stewardship and industry	c. Treatment and reuse technologies	c. Water and land use	c. Finance for sustainable development – supporting water-friendly business
Topic with worst current performance in country / region	d. Climate science and water management: the communication between science and decision/policy making	b. Integrated sanitation for all	b. Inclusive and sustainable growth, water stewardship and industry	b. The circular economy	c. Water and land use	**c. Finance for sustainable development – supporting water-friendly business**
Topic with lower level of engagement in country / region	d. Climate science and water management: the communication between science and decision/policy making	b. Integrated sanitation for all	b. Inclusive and sustainable growth, water stewardship and industry	c. Treatment and reuse technologies	c. Water and land use	**c. Finance for sustainable development – supporting water-friendly business**

Topic with the lowest result among all topics

After an **overall analysis** of the survey's results may be concluded that:

- Almost every topic is considered very relevant both for Europe and for countries; however, the level of engagement and, particularly, public perception are still low.
- In general, topics are considered more relevant for Europe than for countries themselves. This can represent a perception that water problems are more global than national.
- The circular economy is the most relevant topic in Europe. Enough safe water for all and integrated sanitation for all are the least relevant topics.
- Water and public health is the topic with the highest public perception. On the opposite, the communication between science and decision/policy making is the topic with the least public perception.
- Enough safe water for all and water and public health are the topics with the best performance and the highest level of engagement. On the contrary, finance for sustainable development is the topic with the worst current performance and lower of engagement.
- Relevant cases studies have been proposed for all topics. Financing issues are those with the fewest case studies.

The results of the **analysis by theme** have shown that:

- In the theme Climate, water and adaptation to climate change is at the top of the concerns. Managing risk and uncertainty for resilience and disaster preparedness is also at the top of the countries / regions' priorities. Water and adaptation to climate change is also the topic with greater public perception. Managing risk and uncertainty for resilience and disaster preparedness presents better performance and higher level of engagement. On the other hand, the communication between science and decision/policy making is where there is still a greater way to go.
- In the theme People, water and public health issues are the highest priority and those who gather greater public perception. Enough safe water for all and water and public health are the topics with the best performance and the highest level of engagement. By contrast, the major challenges respect to integrated sanitation for all.
- Regarding the theme Development, the issues of efficient use of surface water and groundwater are the highest priority, with greater public perception and level of engagement. Infrastructure for sustainable water resource management and services is the top performing topic. These two topics are also the ones that have the highest level of engagement. On the contrary, infrastructure for sustainable water resource management and services present the worst relevance and topic inclusive and sustainable growth, water stewardship and industry the worst performance and levels of public perception and engagement.
- In the Urban theme, circular economy is the major concern and the focus of public perception. Topics water and cities and treatment and reuse technologies are the best performers. Water and cities is the topic with the highest level of engagement. Treatment and reuse technologies issues present less public perception and level of engagement. Circular economy is the topic with the lowest performance.
- In the theme Ecosystems, topic managing and restoring ecosystems for water services and biodiversity stands out as the most relevant, with greater public perception, better performance and level of engagement. On the other hand, natural and engineered hydrological systems is the least relevant topic, while water and land use is the one that presents less public perception, worse performance and lower level of engagement.
- With regard to the Financing theme, economics and financing for innovative investments is the most relevant, with greater public perception and level of engagement. Financing implementation of water-related Sustainable Development

Goals and adaptation to climate change is the one that performs best. On the contrary, finance for sustainable development issues present the greatest challenges in terms of relevance, public perception current performance and level of engagement.

The results of the **relevance of the topics in Europe attributed by the different European sub-regions** have revealed that:

- Issues such as climate, development, urban and finance, as well as water and health, in the theme people, and water and land use and natural and engineered hydrological systems, in the theme ecosystems, are considered more relevant for stakeholders in North Europe and UK. Safe water, integrated sanitation and climate change mitigation issues in Europe are more valued in Southeast Europe. The Mediterranean is the sub-region that considers ensuring water quality from ridge to reef issues more relevant in Europe.
- The relevance of integrated sanitation for all in Europe according to the different sub-regions is very different, especially between Central Europe, which views the topic as a low priority for Europe, and Southeast Europe, which places it at the top of the European priorities.
- For the Mediterranean countries, Europe's main concerns are the climate change adaptation and the water quality from ridge to reef. The natural and engineered hydrological systems are the minor concerns.
- According to North Europe and UK, Europe's main concerns are related to the adaptation to climate change and water and cities. Inclusive and sustainable growth, water stewardship and industry is considered the least priority topic.
- For Central Europe, circular economy is at the top of Europe's priorities, while integrated sanitation for all is the least priority topic.
- For Southeast Europe, integrated sanitation for all is the hottest priority in Europe and ensuring water quality from ridge to reef is the lowest priority in Europe.

The results of the **relevance of the topics in the different sub-regions** have shown that:

- Issues on climate (except for the topic climate science and water management), people, water, energy and food security nexus and efficient use of surface water and groundwater, on the theme development, water and cities and treatment and reuse technologies, on the theme urban, ensuring water quality from ridge to reef, on the theme ecosystems, and financing implementation of water-related SDGs and adaptation to climate change, are considered more relevant in the Mediterranean.
- Issues on climate science and water management, on the theme climate, inclusive and sustainable growth, water stewardship and industry, and infrastructure for sustainable water resource management and services, on the theme development, water and cities and circular economy, on the theme urban, and finance for sustainable development are considered more relevant in North Europe and UK.
- Managing and restoring ecosystems for water services and biodiversity, water and land use, on the theme development, and economics and financing for innovative investments are more valued in Central Europe.
- Southeast Europe is, in general, the sub-region that places the least relevance regarding the different topics. Southeast Europe considers safe water and integrated sanitation to be very relevant for Europe, but not so much in the sub-region.
- In general, North Europe and the UK consider the topics much more relevant to Europe than to the region itself.
- The major differences between sub-regions are related to the ecosystem theme, which considered to be very important, especially in Central Europe, but not so

important in Southeast Europe. The major similarities between the sub-regions are in terms of water and cities and managing risk and uncertainty for resilience and disaster preparedness.

- Ensuring water quality from ridge to reef is the main concern in the Mediterranean. Climate science and water management; natural and engineered hydrological systems and finance for sustainable development are the least priority topics.
- Circular economy is the top priority topic in the North Europe and UK, while minor concerns are related to enough safe water for all and water, energy and food security nexus topics.
- Managing and restoring ecosystems for water services and biodiversity is the most relevant topic in Central Europe. Enough safe water for all and integrated sanitation for all are the least priority topics.
- Managing risk and uncertainty for resilience and disaster preparedness, water and public health and water and cities are the major concerns in Southeast Europe. Water, energy and food security nexus is the least priority topic.

The results of the **public perception** of the topics in the European sub-regions have shown that:

- The topics enough safe water for all and integrated sanitation for all, on the theme people, water, energy and food security and inclusive and sustainable growth, water stewardship and industry, on the theme development, water and cities and treatment and reuse technologies, on the theme urban, and ensuring water quality from ridge to reef, on the theme ecosystems, have greater public perception in the Mediterranean.
- The topics managing risk and uncertainty for resilience and disaster preparedness and water and adaptation to climate change, on theme climate, Integrated sanitation for all and water and public health, on the theme people, efficient use of surface water and groundwater and Infrastructure for sustainable water resource management and services, on the theme development, circular economy and treatment and reuse technologies, on the theme urban, economics and financing for innovative investments and financing implementation of water-related SDGs and adaptation to climate change, on the theme finance, have greater public perception in the North Europe and UK.
- Climate science and water management, topics on the theme ecosystems (except ensuring water quality from ridge to reef) and finance for sustainable development, have greater public perception in Central Europe.
- Managing risk and uncertainty for resilience and disaster preparedness and water and climate change mitigation have greater public perception in Southeast Europe.
- Enough water for all is the topic with greater public perception in the Mediterranean, while climate science and water management and natural and engineered hydrological systems are the topics with less public attention.
- Water and public health is the topic with greater public perception in the North Europe and UK, while water and climate change mitigation, climate science and water management, water, energy and food security nexus and finance for sustainable development are at the other end.
- Water and climate change mitigation and managing and restoring ecosystems for water services and biodiversity are the topics with greater public perception in Central Europe; efficient use of surface water and groundwater is the topic with less public attention.
- Water and public health is the topic with greater public perception in Southeast Europe, while treatment and reuse technologies, managing and restoring ecosystems for water services and biodiversity, water and land use are the topics with less public attention.

The results of the **current performance** of the European sub-regions regarding each topic have shown that:

- Issues on theme people, inclusive and sustainable growth, infrastructure for sustainable water resource management and services, managing and restoring ecosystems for water services and biodiversity, ensuring water quality from ridge to reef, economics and financing for innovative investments, finance for sustainable development have better performance in the Mediterranean.
- The following topics have better performance in the North Europe and UK: inclusive and sustainable growth, water stewardship and industry, efficient use of surface water and groundwater, water and cities, the circular economy, economics and financing for innovative investments.
- The performance in terms of climate, water, energy and food security nexus, treatment and reuse technologies, natural and engineered hydrological systems and water and land use is higher in Central Europa.
- The most marked differences in performance are related to integrated sanitation for all. It is still a major challenge in Southeast Europe, while in other sub-regions the situation has already reached a good global level of performance.
- Water and public health is the topic with better current performance in the Mediterranean, while water and adaptation to climate change, natural and engineered hydrological systems and water and land use are the topics with worst current performance.
- Integrated sanitation for all is the topic with better current performance in the North Europe and UK, while climate science and water management, water and land use, ensuring water quality from ridge to reef and finance for sustainable development are the topics with worst current performance.
- Integrated sanitation for all is the topic with better current performance in Central Europe, while finance for sustainable development is the topic with worst current performance.
- Enough safe water for all is the topic with better current performance in Southeast Europe, while integrated sanitation for all, treatment and reuse technologies and managing and restoring ecosystems for water services and biodiversity is the topic with worst current performance.

The analysis of the results of **level of engagement** in European sub-regions has shown that:

- Mediterranean has the highest level of engagement in most topics, except for the following: managing risk and uncertainty for resilience and disaster preparedness, water and adaptation to climate change, water and cities, the circular economy, natural and engineered hydrological systems (North Europe and UK), climate science and water management and treatment and reuse technologies (Central Europe).
- Southeast Europe is the sub-region with the lowest level of involvement on almost all topics.
- Water and public health is the topic with higher level of engagement in Mediterranean, while climate science and water management is the topic with the lowest level of engagement.
- Water and public health is the topic with higher level of engagement in North Europe and UK, while water, energy and food security nexus and finance for sustainable development are the ones with the lowest level of engagement.
- Managing risk and uncertainty for resilience and disaster preparedness is the topic with higher level of engagement in Central Europe, while inclusive and sustainable growth, water stewardship and industry is the topic with the lowest level of engagement.

- Water and public health is the topic with higher level of engagement in Southeast Europe, while water and land use and finance for sustainable development present the lowest level of engagement.

Figure 3.17 summarizes the top-rated topics in different sub-regions, in terms of relevance in Europe, relevance in country, public perception, current performance and level of engagement.

The detailed results of the survey are presented in Annex 2.

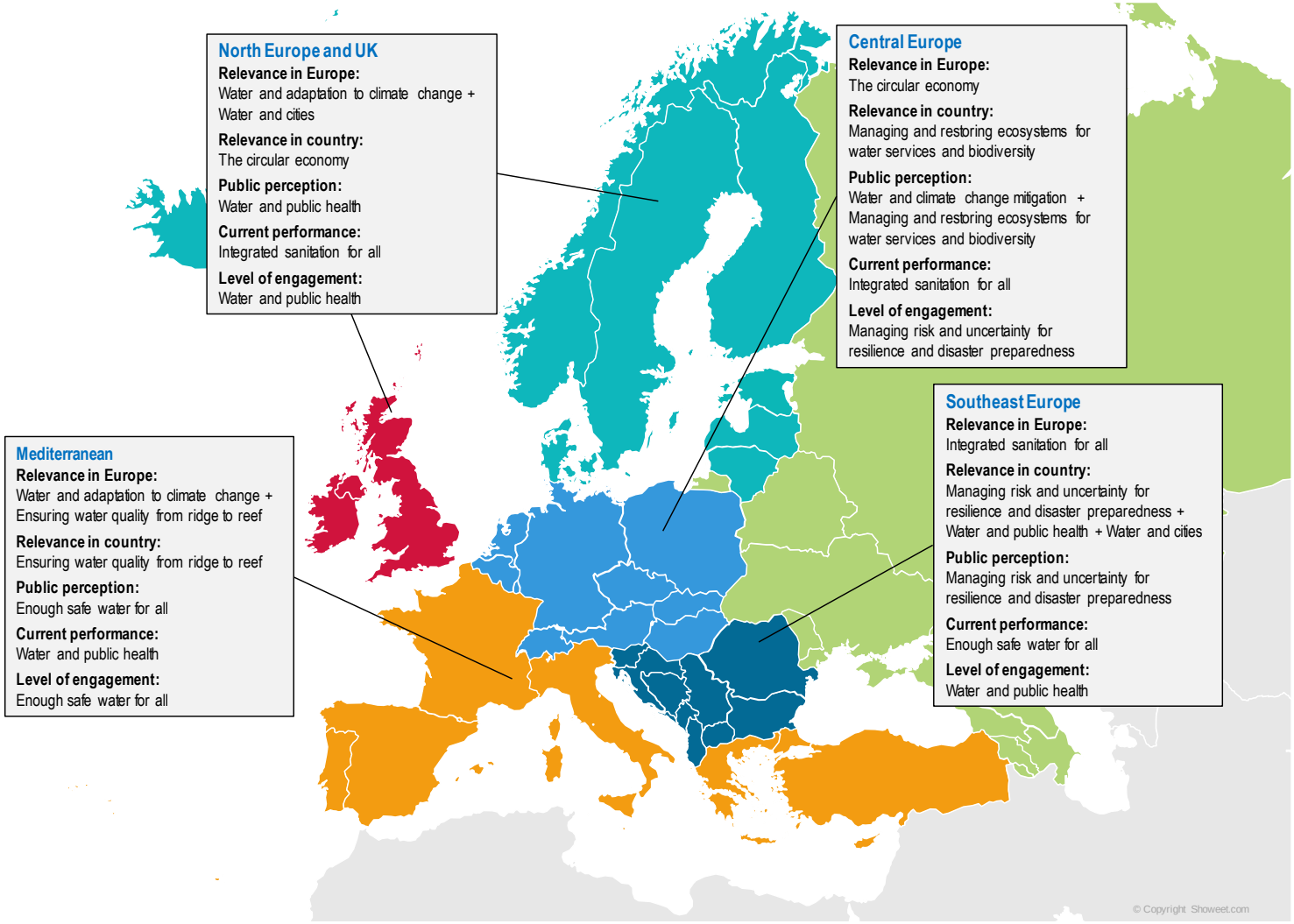


Figure 3.17 – Survey on European relevance of themes and topics – top-rated topics in different sub-regions, in terms of relevance in Europe, relevance in country, public perception, current performance and level of engagement.

3.4. Survey about the European case studies

European stakeholders were asked to send proposals of case studies for each of the topics. A total of 34 proposals of case studies from 9 countries were received (Figure 3.18). Portugal was the country with the highest number of proposals (52%). People and Development were the most addressed themes (Figure 3.19).

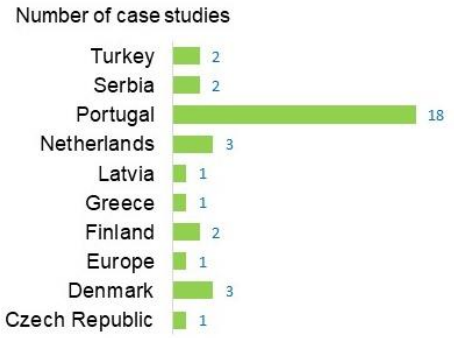


Figure 3.18 – Distribution of case study proposals by country / region

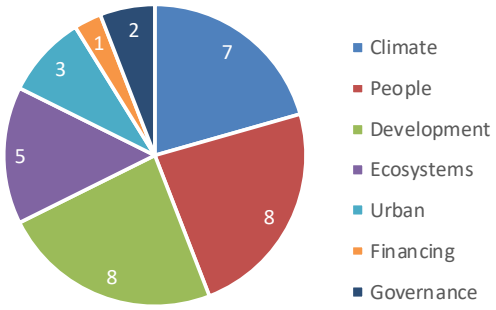


Figure 3.19 - Distribution of case study proposals by themes

A set of 32 case studies OECD about governance (Water Governance stories) were also made available, adding in a total of 66 case studies.

3.5. Survey about the willingness to participate in the sessions

A 2nd survey was launched by the European Regional Process in November 2017 inviting the European Focal Points to express their willingness to participate in the 7 European Regional Sessions already defined. For each one of these sessions the questions of this survey were:

- Would you be available to actively participate in this session? (Yes / No)
- If you answered "yes" to the previous question, please indicate how do you wish to contribute? (Moderator / Speaker / Panellist / Rapporteur)
- Would you like to present a case study in this session? (Yes / No)
- If you answered "yes" to the previous question, please indicate the title of the proposed case study
- Comments / suggestions (optional)

From this survey, 45 answers were received from 13 different countries. The results of this survey are presented in Figure 3.20 and Figure 3.21. Portugal was the country with the highest number of proposals (20%). Sessions about acquawareness and governance were the most addressed (13 suggestions each one).

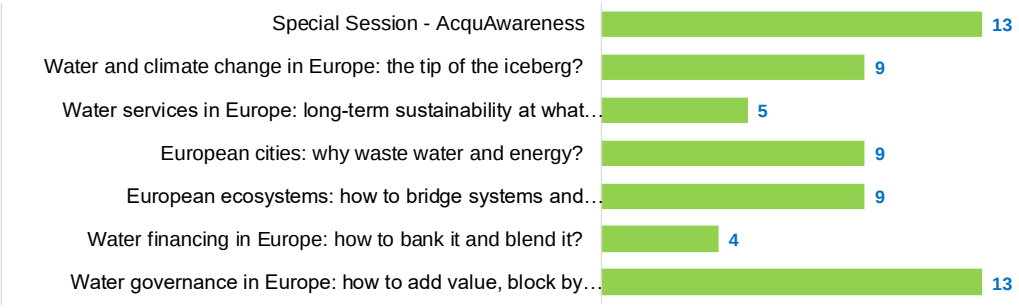


Figure 3.20 - Expressions of interest to participate in the sessions

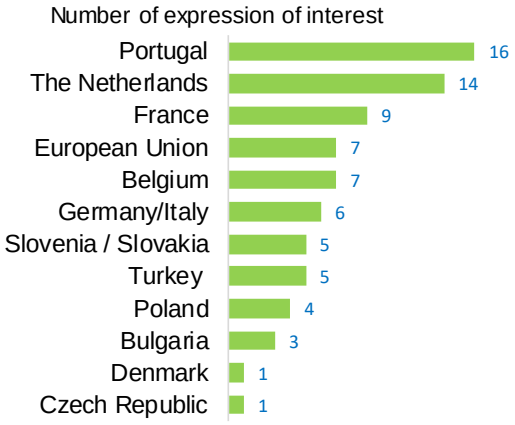


Figure 3.21 – Number of expressions of interest to participate in the sessions by country / region

3.6. Survey about financing

A 3nd survey was launched by the European Regional Process in November 2017 inviting the 254 European Focal Points to focus on the water and financing theme, where previous contributions have been not enough.

The questions raised in this survey was:

- Topics more relevant, investment needs and main sources: Topics more relevant on “Financing for water security in Europe” for incorporation in the Europe report and debate in the Regional session. Select and rank 5 topics by order of relevance (1-higher, 5-lower): economics and financing for innovative investment; financing implementation of water-related Sustainable Development Goals & adaption to climate change, finance for sustainable development – supporting water friendly business; water prices, cost transparency, sustainable cost recovery, affordability; financing efficiency gains of the water and wastewater services; financing the asset renewal gap/backlog. Priority vs expansion or efficiency; circular economy: financing wastewater & sludge reuse; governance and regulation of financing; comments (if you have answered other(s), please specify)
- More important investment needs with a financing gap in Europe or in your country (in case you belong to a European institution, please refer to Europe; in case you belong to a national organisation, please refer to your specific country). Select and rank 5 topics by order of relevance (1-higher, 5-lower): water supply expansion/coverage (SDG 6 - target 6.1): improvement of water quality for domestic use (SDG 6 - target 6.1); wastewater expansion/coverage (SDG 6 - target 6.2) and effluent quality (SDG 6 - target 6.3); asset renewal (SDG 6 - target 6.4); improving efficiency of services (non-revenue water, energy consumption, etc.) (SDG 6 - target 6.4); improving water resources management and quality (SDG 6 - target 6.5); adaptation to climate change (SDG 13); innovative technology.

- Main sources of funding used in the country, rank by order of relevance (1-higher, 5-lower) and an estimated percentage: tariffs estimate; taxes (national) estimate; taxes (regional) estimate; taxes (local) estimate; and transfers estimate.

Bridging the capex finance gap of repayable sources in your country (or region):

- Main source of loans: European Investment Bank (EIB) average annual loans; European Bank for Reconstruction and Development (EBRD) average annual loans; Nordic Investment Bank (NIB) average annual loans; Council of Europe Development Bank (CEDB) average annual loans; World Bank average annual loans; bilateral funding agencies average annual loans; others.
- Main source of grants/transfers: European Union structural funds; average annual loans; bilateral grants; average annual loans; others.
- Degree of contribution of other sources; equity; annual estimated amount; bonds (national, municipal, utility); annual estimated amount; investment funds; annual estimated amount; pension funds; annual estimated amount; other funds (TA, Trust, Climate; Green); annual estimated amount; others.

Innovative financing mechanisms:

- Indicate innovative financing mechanisms that are being applied in your country and the relevant contribution to financing the sector: revolving funds; other blending mechanisms; output based; other (indicate).

From this survey, 18 answers from 11 different countries and from European Union were received beyond the European Union. European organisations were the most represented (Figure 3.22).

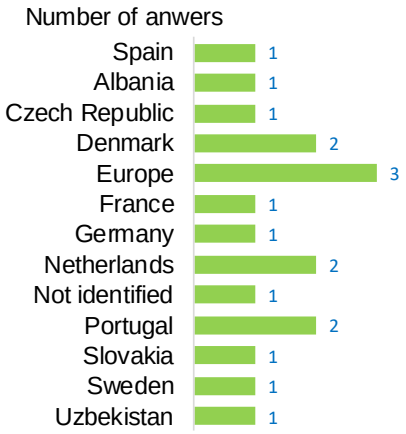


Figure 3.22 – Survey on financing - distribution of answers by country / region

The detailed analysis of the results is presented in chapter 8.

3.7. Consultation meetings

Involvement and participation of stakeholders around Europe was a constant during this European preparatory process. Adding to the surveys that allowed the regional coordinators to maintain constant contact with Europe, the preparatory process involved also the organization of several meetings to present the process, engage stakeholders and get inputs. A brief summary of these meetings is presented below.

Kick off meeting, in The Hague, Netherlands, April 2017, with the local organisation of the European Water Pact

The European Regional Process kick off meeting took place on the 17th of May 2017, in Scheveningen, Netherlands. This meeting was hosted by the Ministry of Environment of

Portugal and the European Pact for Water, supported by the Dutch Ministry of Infrastructure and Environment.

This meeting aimed to present the 8th World Water Forum and the European Regional Process to European stakeholders, as well as to share with them the first results of the survey conducted on the priority themes and topics of the thematic forum to be further analysed within the European Region. This meeting was also an opportunity to interact to participants and get their feedbacks on the way forward.

This meeting assembled almost 30 people (examples of participating organizations were Netherlands Water Partnership, CDP, End Water Poverty, INBO, Borda) that had the opportunity to learn about the World Water Forum and the Regional Process, as well as to make their voice heard in the construction of European Report and Sessions to take place in March in Brasilia.

Relevant conclusions emerged from this meeting. For instance, it confirmed the result already pointed out through the survey that climate change adaptation was considered as one of the critical issues to be addressed at the forum, as well as one of the most relevant problems that Europe need to tackle. In the same spirit, it turned clear the need for raising awareness on water issues. An idea started to be generated on this meeting on the need to have a special session on the forum dedicated to Water Awareness, since it became clear that people around Europe were not conscious about the role and the value of water, and that, for that reason, many public policies on this field were not understood. Lack of public awareness and communication on all the topics related to water was a critical aspect that the preliminary survey and this kick off meeting just highlighted. Another issue that was on the spot during this meeting was the lack of pressure for financing on these themes, what is directly connect with the previous theme, because if people are not aware nor informed they will not feel the need for investments to be made. Furthermore, the classic topic of improving transboundary water cooperation was also debated and discussed as a priority issue for Europe. Other aspects like governance, integrated water resources management, water stewardship were also deeply debated. Finally, on financing an exchange also took place on the role of water banks and water bonds in Europe.

This kick-off meeting was very relevant to consolidate the results achieved through the survey and to start designing the sessions to take place in the Forum, as well as to start collecting case-studies for the European Report.

2nd stakeholder consultation meeting, in Stockholm World Water Week, 30th August (cancelled)

The planned 2nd stakeholder consultation meeting, in Stockholm World Water Week, 30th August, was cancelled due to lack of financial support from the World Water Forum budget.

3rd stakeholder consultation meeting, in Oporto, Portugal, 26th September, with the organisation of the Ministry of Environment of Portugal.

The European Regional Process 3rd stakeholder meetings took place on the 26th of September 2018, in Oporto, Portugal. This meeting was hosted by the Ministry of Environment of Portugal and the European Pact for Water, with the local support the company Aguas do Porto and it took place together with the European Innovation Partnership on Water Conference 2017 (27th- 28th), the Mayors & Water Conference 2017 (29th September) and other events during the Porto Water Innovation Week.

This meeting aimed to present the 8th World Water Forum and the European Regional Process to European stakeholders, to forward the discussion on the preparation of the regional report, as well as to advance on the preparation of the sessions for the Forum. During this meeting the proposed structure of the regional report was discussed with participants. A relevant contribution to this meeting was also the presence of the six

thematic experts of the European Regional Process, what allowed that an in depth thematic analysis of the current European situation in the six main themes of the Forum (Climate, Development, People, Urban, Ecosystems and Financing) could take place.

This meeting assembled more than 50 people coming from different parts of Europe. It counted also with the presence of relevant international experts on water, such as Mr. Francisco Nunes Correia (Governance), Mr. José Veiga Frade (Financing), Mr. Diane D'aras (Urban), Mr. Rodrigo Oliveira (Climate), Mr. Lesha Witmer (People) and Mr. Peter Gammeltoft (Ecosystems).

If this meeting confirmed that adaptation to climate change is a high priority issue for most of the European countries, a relevant discussion took place on the different existing perceptions of Europe's sub-regions when we speak, for instance, on People and Development. Levels of development on water services are different in different parts of Europe and that makes clear that also the needs for investment and financing are different. Asset management was a particular topic debated on this context. On the other hand, and when we addressed People we clearly understood that the way to achieve the targets on SDG6 will not be an easy task. A bridge was made with the work of the UNECE Protocol on water and health, however, more financing is needed to improve sanitation inside Europe. On Ecosystem's it was widely addressed the difficulty of data accessin many parts of Europe as well as often data comparability. Finally, regarding Financing a debate on concepts such as "water-friendly business" and "innovative financing" took place.

4th stakeholder consultation meeting, in Bonn, Germany, 16th November, "Water and Climate Change in Europe", side event at the margins of the 23rd Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change

The European Regional Process 4th stakeholder meetings, under the theme "Water and Climate Change in Europe", took place on the 16th of November of 2017, in Bonn, Germany. This meeting was hosted by the Ministry of Environment of Portugal and the European Pact for Water and it took place as a side event of the 23rd Conference of the Parties (CoP) of the United Nations Framework Convention on Climate Change.

This meeting aimed to present the 8th World Water Forum and the European Regional Process to European stakeholders, to continue the discussion on the preparation of the regional report, specifically on the thematic chapter on climate; as well as to advance on the preparation of the session dedicated to water and climate to the Forum. His Excellency the Minister of Environment of Portugal was present, which show the importance of this theme as a big challenge for southern European countries were climate change impacts on water resources are already being felt.

This meeting had around 30 participants from different parts of Europe. It was based on the preliminary conclusions of the European thematic report on climate, presented in the session by our climate expert, Rodrigo Proença de Oliveira. This was an opportunity to discuss the results with climate change community present at the Conference of the Parties and to put water issues high in the international climate agenda. This meeting counted also with the participation of the General Director on Climate Action, from European Commission, whose intervention was quite relevant to inform the current work being developed by the Commission on climate adaptation.

5th consultation meeting, in Lisbon, Portugal, February 2018, with the coordinators of the thematic process.

On 8 February 2018 the coordinators of the European Regional Process and some of the experts jointed the Thematic Process Preparatory Meeting held in Lisbon, Portugal. There was an overview of the Forum program with all sessions slots planned, including the opening plenary and thematic closing sessions, a discussion on clashes and

continuity of topics, and about proposed changes to the program. Regarding the session logistics, there was an overview of location and logistics. Regarding the special sessions and the high-level panels, there was an overview of the latest status and linkages/coordination between those and the sessions. Regarding session design there was general comments to drafts received, cross-cutting questions and how to generate and summarize thematic outcomes. Regarding the connection with other processes, there was an overview, the next steps and connections with the Thematic Process, the thematic/TCG input to Political Process (2nd PrepCom and ministerial thematic Roundtables) and linkage to Sustainability and Citizen Processes.

On February 9 2018, the Regional Process leaders met the TC members and the TCG leaders. Regarding the connection with the Regional Process (continuation from previous day), there was an overview of the Regional Process session program, and the Regional Europe sessions, with discussion on links between Thematic/Regional Processes.

3.8. Specialised thematic contributions

This European Report includes specific chapters prepared by the specialised thematic contributors, in articulation with the European regional coordinators. This report must summarize the work carried out by the European Region during the preparatory process, as well as to identify the priority topics in the region, present regional best practices/case studies and provide specific lessons, messages and recommendations for Europe and the world. After the forum, this Report shall include the relevant outputs of the sessions held during the Forum.

The specialised thematic contributors' main responsibilities have been, as follows:

- Write a first draft of the report chapter, in accordance with the terms of reference and in articulation with the European Regional Coordinators.
- Participate in the consultation meetings to present and discuss the draft of the report chapter with the European Regional Coordinators and other stakeholders.
- Liaise with organizations that have expressed an interest to contribute to a topic or chapter.
- Identify, if necessary, additional case studies to be included in the report chapter.
- Evaluate, select and editing / processing of case studies to be included in the report chapter, in articulation with the European Regional Coordinators.
- Identify and incorporate (existing) data on the topic (to be mainly provided by existing sources like European Commission, OECD, EEA, UNECE, etc.) with support of the European Regional Coordinators.
- To approach and involve relevant international and European organizations as contributors to the report.
- Incorporate comments and feedback, namely by the Regional Coordinators, into draft versions of the report chapter.
- Complete a final draft of the report chapter.
- Prepare a draft PowerPoint presentation summarizing the main outcomes of the report chapter to be considered in the Regional Process sessions in Brasilia.
- Support the European Regional Coordinators on the design and organization of the European and related inter-regional sessions.
- Participate in the European and related inter-regional sessions held on the 8th World Water Forum.
- Develop other tasks deemed appropriate for the fulfilment of the finalization of the report.

Each specific chapter includes the following contents:

- A brief overview of the theme and topics in Europe; All themes under the theme must be addressed but focusing on priority topics (according to the results of the European Regional Process survey and consultations).
- A diagnosis in Europe, namely in terms of relevance, perception, level of engagement and performance.
- Examples of good case studies (successful or unsuccessful stories) in Europe (maximum 5 case studies per chapter).
- Key lessons, messages and recommendations for Europe and the world.
- Links with Agenda 2030 and respective SDG's.

The following specific guidelines have been considered in the preparation of the report:

- A comprehensive and multidisciplinary perspective of the theme and topics, namely including public policy, technology, economic, environmental, and social components shall be provided (so covering all three components of sustainability).
- 3 cross-cutting themes (sharing, capacity and governance) should be addressed, using the below presented questions:

  Sharing:

  - How to share solutions and good practices for the water-related SDG implementation and with whom?
  - How to involve all in water management and governance: public, private, civil society - women and men - young and old - in bottom up and top down approaches?
  - How to ensure respect for cultural diversity, justice and equity in the water sector, while sharing science and traditional knowledge?

  Capacity:

  - Education and capacity building: How can education and capacity building for water be enhanced in your theme/topic?
  - Science policy interface: What is being done in your theme/topic to better link water science and technology to decision/policy making?
  - ICT and monitoring for capacity building: What opportunities do new technologies offer to improve water monitoring and ICT in relation to your theme/topic?
  - Capacity development to developing countries: How do international cooperation initiatives enhance water capacity development for your theme/topic?

  Governance:

  - How do you contribute to designing and implementing IWRM-wise policies/projects in your theme?
  - How do you foster transboundary co-operation in your theme?
  - How do you ensure multi-level governance, engage stakeholders and assess the results of policies in your theme?

Additionally, to all the knowledge and information of the specialised thematic contributor, the following supporting elements have been provided:

- The concept note of the thematic process of the 8th World Water Forum;
- The results of the qualitative survey carried out on the scope of the European Regional Process (mentioned in section 2);
- The mailing list of contact points in European countries;
- Selected case studies;

- Inputs from the consultation meetings.

The specialised thematic contributors contacted with relevant European organizations (e.g., EC, OECD, EEA, EU Stat, etc.) in order to obtain additional information to the report, namely to include up-to-date quantitative information provided by those institutions.

The specialised thematic contributors have been in contact with the corresponding focal points of the Thematic Process, in order to gain cross fertilization between the two processes.

Sustainability issues as defined by the Sustainability Focus Group of the 8th World Water Forum was also addressed. The specialised thematic contributors tried to answer 3 questions in terms of sustainability outcomes:

- How can this topic/session help mainstream sustainability issues related to water to the centre of decision-making and strategy definition by governments and business?
- How can this topic/session help improving society resilience to water issues, giving that water availability is reducing in most countries and the consumption is increasing?
- Water issues are regional, hard to be solved individually by local governments or companies. How can this topic/session stimulate collaborative actions that will lead to a sustainable use of water resources?

Based on the existing expertise, results of the meetings and the surveys, a detailed analysis of Europe and water was presented in the following chapters, focused on:

- Europe and climate: water security and climate change (Chapter 5);
- Europe and people: water, sanitation and health (Chapter 6);
- Europe and urban: integrated urban water and waste management (Chapter 7);
- Europe and ecosystems: water quality, ecosystem livelihoods and biodiversity (Chapter 8);
- Europe and financing: financing for water security (Chapter 9);
- Europe and governance: water governance for the 2030 Development Agenda (Chapter 10).

For each one of this chapters a diagnosis is presented, to enable a wide and integrated view of the water status in the European region, to observe the thematic framework and the overarching theme of the 8th forum, and to observe SDG, international agreements, etc.

An assessment was done (experiences, achievements, examples and challenges; extent of occurrence, urgency / criticality, relevance, problems faced, difficulties; associated environmental, social and economic impacts (positive and/or negative); to observe the thematic framework and the overarching theme of the 8th forum; that issues of common national and\or regional interest are highlighted; to observe SDG, international agreements, etc.).

Crosscutting themes have been included: Sharing (sustainability through stakeholder involvement); Capacity (education, capacity building and technology exchange); and Governance (water governance for the 2030 Development Agenda).

4. Water and climate in Europe

4.1. Contents

This chapter details the assessment made in the European Regional Process about Europe and climate: water security and climate change. This text was prepared by Rodrigo Proença de Oliveira (Instituto Superior Técnico, University of Lisbon, Portugal).

4.2. Climate change and water resources. What is at stake?

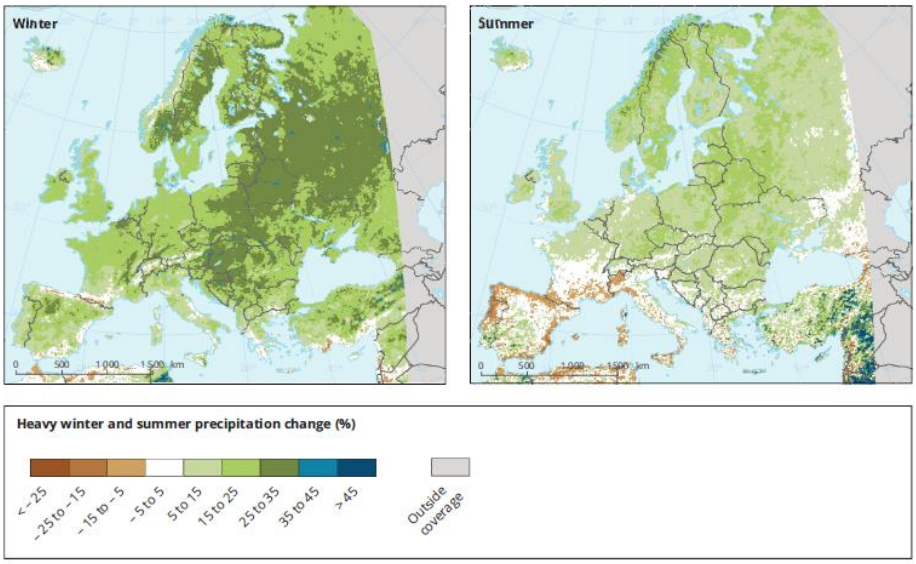
Climate change affects Europe in many ways, as increasing air temperature, new precipitation patterns, warmer oceans, rising sea level and shrinking snow and ice cover cause a wide range of impacts on society and ecosystems (EEA 2017a). The nature and dimension of the impacts vary throughout Europe, but all regions are affected, thus making climate change one of the continent's most important challenge. If not properly addressed, climate change impacts to health, ecosystems and biodiversity, property and economic activity are likely to become more severe in the coming decades and could prove to become very costly.

Water plays a vital role on how society feels climate change impacts and this fact is recognized by European countries and individual stakeholders. The European Union adaptation strategy (EC, 2013) and the member states national strategies consider the water as a priority sector or a cross cutting theme.

Precipitation is increasing in most of northern Europe, particularly in winter, and is decreasing in southern Europe, particularly in the summer, with river flows and aquifer recharge naturally following this trend. Summer flows are decreasing in most of Europe. The increase of temperature and the change of precipitation from snow to rain add to this pattern change, with peak spring and summer flows coming earlier. The regional asymmetry and seasonality of water availability is increasing, putting stress on fresh water ecosystems and on water-use intensive economic sectors, such as agriculture and energy production (EEA, 2017a).

Climate extremes such as heat waves, heavy precipitation and droughts are increasing in frequency and intensity in many regions (Figure 4.1). The number and severity of floods in Europe are expected to increase, particularly in northern and north-eastern Europe. Conversely, the risk of spring flooding may decrease in areas where snow accumulation is projected to decrease (EEA, 2017a).

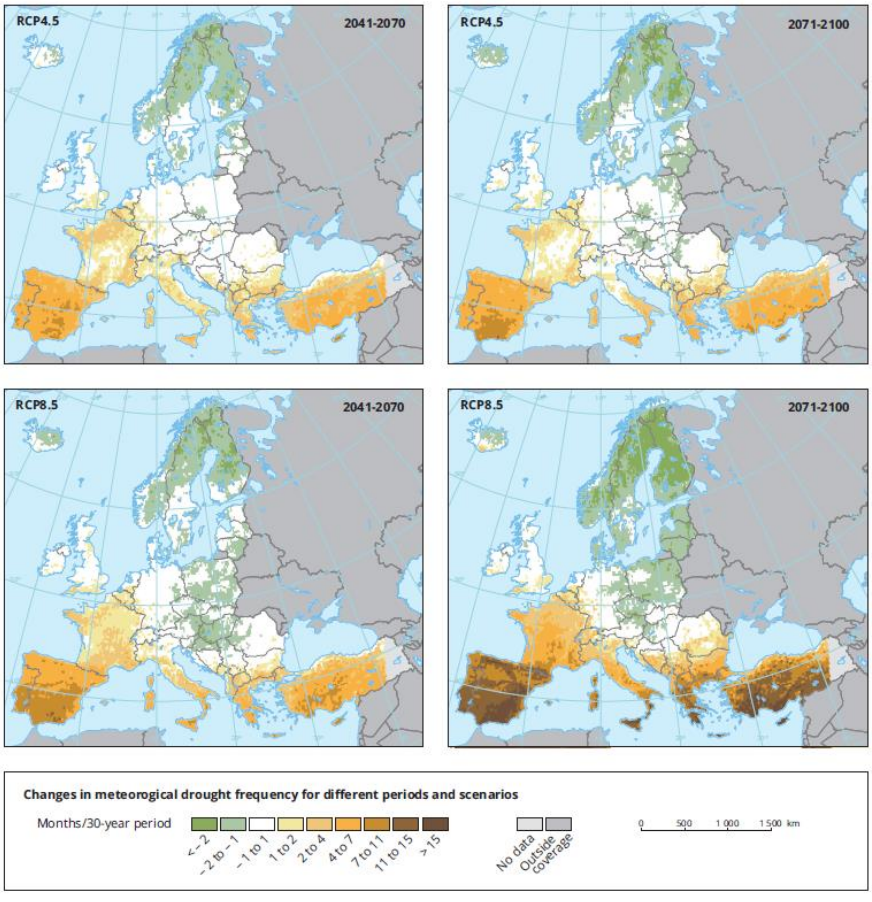
In parts of Europe, particularly in southern and southern-eastern Europe, the frequency, duration and severity of droughts is appearing to have increased which is consistent with projections for the future (Figure 4.2). The competition for water among various users is, consequently, likely to grow in these regions.



Note: Projected changes in heavy daily precipitation (%) in winter and summer 2071-2100, compared with the baseline period 1971–2000 for the RCP8.5 scenario based on the ensemble mean of different regional climate models (RCMs) nested in different general circulation models (GCMs). Heavy precipitation is defined as the intensity of the heavy precipitation events defined as the 95th percentile of daily precipitation (only days with precipitation > 1 mm/day are considered).

Source: EURO-CORDEX (Jacob et al., 2014).

Figure 4.1 – Projected changes in heavy precipitation in winter (left) and summer (right) (source: EEA, 2017c)



Note: This map shows the projected change in the frequency of extreme meteorological droughts (number of months in a 30-year period where the SPI accumulated over 6-month periods (the SPI-6) is below – 2) between the baseline period 1971-2000 and future periods 2041-2070 (left) and 2071-2100 (right) for the RCP4.5 (top row) and RCP8.5 (bottom row) scenarios.

Source: Adapted from Stagge et al., 2015.

Figure 4.2 – Projected changes in frequency of meteorological droughts (source: EEA, 2017c)

The sea ice extent, glacier volume and snow cover are shrinking in northern Europe and in high altitude regions, especially in spring and summer. The reduction of water storage as snow and ice over land has impacts on river flows, water supply and drainage systems and hydropower generation systems. Both early winter floods and summer water shortages may occur.

Sea levels are rising along most European coasts and will continue to rise, probably at a faster rate. The IPCC Fifth Assessment Report estimates a rise between 21 cm and 81 cm until the end of the XXI century, depending on the efforts to restrain greenhouse emissions (IPCC, 2014), but several recent studies have put the upper bound of this rise in the range of 1.5 to 2.0 m (EEA 2017a).

Sea level rise, together with projected increase of storm activity, will result in coastal erosion and flooding of low-lying areas. Sea level rise also increases the risk of salinization of coastal aquifers and downstream rivers stretches discharging into the ocean and affects existing water uptakes for population supply and irrigation. With half of its population living less than 50 km from the sea[1], the socio-economic and ecologic loss in Europe will be quite significant, unless costly adaptation measures are implemented.

The rise of air temperature is leading to an increase of water temperature in river and lakes, which together with change in river flow patterns, leads to a deterioration of water quality and to important impacts on fresh water ecosystems. Algae blooms and species invasion become more likely, and changes in the phenology and distribution of species may occur. As ecosystems respond to hydrologic changes in complex and non-linear ways, climate change impacts in this domain may occur in dramatic shifts when some tipping points are crossed (OCDE, 2013).

In southern Europe, the rise in water temperature induce health risks from water related deceases and will likely affect cooling schemes of hydropower systems, through the diminishing of cold-water availability in the summer.

Changes in temperature, precipitation and runoff will also lead to the modification of soil conditions, namely towards an increase of soil moisture in northern Europe and to a decrease in southern Europe. In turn, this trend will lead to changes in land cover and will affect agricultural activity and terrestrial ecosystems.

Europe is also vulnerable to climate change impacts outside Europe. Impacts on the international trade of agricultural and non-agriculture commodities, on infrastructures of the global transport system, human migrations and finances are pathways through which Europe is affected by spill overs from other regions (EEA, 2017a).

A survey published in 2013 revealed that most OCDE countries have serious concerns over the impacts of climate change and report that changes are already occurring (OCDE, 2013). The areas of highest concern are extreme events and water shortage, which were flagged by 32 and 24 countries, respectively (Table 4.1).

[1] The EU has a coastline of 68 000 km, which increases to 185 000 km when other EEA member countries (Iceland, Norway and Turkey) are included. Almost half of the EU's population lives less than 50 km from the sea, with the majority being concentrated in urban areas along the coast. In 2001, 70 million people or 14% of the entire EU population lived within 500 meters of the coast (EEA, 2008. Coasts and seas, https://www.eea.europa.eu/themes/coast_sea/intro).

Table 4.1 – Primary concerns in OECD and the EC (source: OCDE, 2013)

Area of concern / Country	QN	QL	WSS	Extreme weather events		ECO
				Flood	Drought	
Australia	●	●	●	●	●	●
Austria	●		●		●	●
Belgium	●	●	●	●	●	●
Canada	●	●			●	
Chile	●	●	●	●	●	●
Czech Republic	●	●		●	●	
Denmark			●		●	
Estonia	●	●	●	●		●
Finland					●	
France	●				●	
Germany	●			●	●	
Greece	●				●	
Hungary				●	●	
Iceland						
Ireland			●			
Israel	●	●			●	
Italy	●				●	●
Japan					●	
Korea	●	●	●	●		●
Luxembourg	●	●	●	●		
Mexico	●		●	●	●	●
Netherlands	●			●	●	
New Zealand				●	●	
Norway					●	●
Poland	●	●	●	●	●	●
Portugal	●			●	●	
Slovak Republic				●	●	
Slovenia	●	●	●	●	●	
Spain	●	●	●	●	●	●
Sweden				●		
Switzerland		●			●	●
Turkey	●	●	●	●	●	●
United Kingdom	●		●	●		
United States	●	●	●		●	
European Commission	●				●	

Note: QN = quantity; QL = quality; WSS = water supply and sanitation; ECO = freshwater ecosystems.
In cases where the box under the extreme weather events is merged, countries have indicated extreme weather events as primary concern, but not specified whether this relates to flood, drought, or both.
Source: See country profiles associated with this publication on iLibrary as well as at *www.oecd.org/env/resources/waterandclimatechange.htm*.

Climate change is not the only global driver affecting our society, nor are these drivers independent. Environment, socio-economic systems and human development trends, such as demographic dynamics, urbanization, land use change, resources use and environmental pollution, hold feedbacks and interdependencies with climate and amplify the impacts of climate change (EEA, 2017a; EEA, 2017c).

Taken together, these drivers increase the stresses on water and test the way society protects, manages and uses this vital resource. Resolute action is needed to avoid the most damaging impacts, but many challenges remain to convert this determination into concrete achievements. Europe recognized its vulnerability to climate change early on and has developed a strategy to address it. This chapter discusses the state of Europe's climate action, highlighting the main difficulties and suggesting ways to move forward.

4.3. Climate action. What are the priorities?

The magnitude of climate change impacts can be reduced by cutting greenhouse gases emissions substantially (mitigation) and by preparing society for coping with the unavoidable impacts resulting from past and near future emissions (adaptation).

Europe, and in particular the European Economic Area, is at the forefront of greenhouse gases emission reduction efforts, but mitigation can only lead to a meaningful reduction of climate change risk if concerted efforts, joining all nations in the world, significantly reduce their greenhouse gases emissions. But current non-binding commitments by the signatories' states of the Paris Climate Accord will not prevent global temperatures to stay below 2 degrees Celsius above preindustrial levels, the threshold above which the risk is deemed as unacceptable.

Many argue the 2ºC goal is already unachievable (Nordaus, 2018). Atmospheric carbon concentrations would need to stay below 450 parts per million, which requires carbon neutrality within 40 to 60 years. This requires avoiding to burn most of the coal reserves currently beneath the ground, half the natural gas, and about one-third of the oil (McGlade and Ekins, 2015). It also requires the so-called negative emissions in the latter half of this century, i.e. taking carbon out of the atmosphere. There is, however, hope that the Paris deal and its soft diplomacy is nudging countries toward greater action to attenuate the rise of global temperature and of climate related risks.

Adaptation, conversely, seeks to enhance society preparedness and capacity to respond to the unavoidable impacts of climate change and thus reduce its vulnerability. It encompasses the consideration of different emission scenarios and the assessment of their hazards, impacts and corresponding risks. Furthermore, it includes a discussion on the level of acceptable risk and innovative thinking on how to deal with the identified hazards and risks. The response should include a mix of soft measures (e.g. knowledge gathering, capacity building, regulations, planning documents, and financial instruments), structural measures (infrastructures) and green measures (nature or ecosystem based).

Since 2013, the European Union has a strategy on adaptation to climate change (EC, 2013) fostering the attention to climate change in all relevant EU policies and programmes. Most EU policy instruments, including directives, regulations and finantial instruments, include climate concerns in their scope. The European Union strategy on adaptation to climate change is currently under evaluation to examine its actual state of implementation and to assess the progress made and the results achieved. The report will be completed by the end of 2018.

The European Union strategy encourages all Member States to adopt comprehensive adaptation strategies (NAS) and to detail them into adaptation plans (NAP). As of 2013, 25 European Union Member States and three other EEA member countries had adopted National Adaptation Strategies. In addition, 15 European Union Member States and two other EEA member countries had developed NAPs. European Union Member States not having NAS or NAP today were in the process of drafting one, as well as more specific adaptation policies and actions in line with their strategies and plans (OCDE, 2013).

In recent years, the knowledge on climate change has increased substantially and there is a growing awareness on the range of threats society is facing. Yet, many gaps remain that challenge the development and the implementation of effective and site-specific adaptation responses.

At the forefront of these challenges is the uncertainty associated with emissions projections and the complexity of the climate system, which translate into uncertainties on the change of key climate parameters at specific locations and their expected impacts. Under these conditions, the decision on when and how to invest in adaptation is not an easy task and the existing interdependencies between climate and the environment, socio-economic systems and human development trends do not make it easier.

To design an effective and adequate response a careful and detailed evaluation of the impacts brought by each climate scenario and by other ongoing socio-economic and environmental trends is needed. Moreover, each response needs to be coordinated with policy action on key areas such as land planning, agriculture, energy, infrastructures,

biodiversity and health, among others. This means that an adaptation strategy needs to cover a number of policy areas and to ensure that the set of actions in each area is coherent and synergetic.

An important element of this effort is the alignment with international agendas and commitments like the 2030 agenda for sustainable development and its goals (UN, 2015b) and the Sendai Framework for Disaster Risk Reduction (UN, 2015a).

An area that poses specific challenges is urban adaptation, i.e. actions that need to be implemented in cities where more than 70% of Europeans live. Cities are centres of innovation and growth and the engines of European economic development. Well-adapted and climate-resilient cities therefore matter for a climate-resilient Europe (EEA, 2016). In EU, a Covenant of Mayors Initiative on Climate Change Adaptation was launched to engage cities in taking action to adapt to climate change.

The need to distribute adaptation activities to different levels of government and to harmonize the responses from different levels of government puts additional stress to the design of an adaptation strategy. The assessment and selection of a concrete and tailor-made response is better performed at a level close to the system under analysis, knowleagable of its details because it is responsible for managing it and for planning its future. This means that in many areas adaptation is better addressed at the local level, being a business, a municipality or a regional government. However, national governments or even supra-national entities must assume their responsibility whenever the scope of the problem outsizes the local scale and a national or supra-national body is the most appropriate decision level to manage an issue (principle of subsidiarity). There is then a need to ensure sound communication and co-decision mechanisms among these levels.

Finally, while adaptation brings positive returns by reducing the overall climate impacts cost, it nonetheless requires large investments that need to be funded. The European Union agreed to spend 20% of the resources under multi financial framework 2014-2020 on climate related activities, namely enhancing research under the Horizon 2020 programme for environment and climate action, promoting information sharing through the European Climate Adaptation Platform and funding for actions (EEA, 2017a; EEA 2017c).

During the preparatory work of this report, a survey on the relevance, public perception and current performance of several climate change topics was sent to several European stakeholders (Annex 2). The answers show that climate change is considered relevant or highly relevant, although the public perception on several main topics is low to moderate. The stakeholders also considered that the current performance and the level of engagement in each country is low to moderate and that more action is needed. The following topics were ranked as the most relevant.

- Water and adaptation to climate change;
- Managing risk and uncertainty for resilience and disaster preparedness;
- Climate science and water management priority: the communication between science and decision/policy making;
- Water and climate change mitigation.

These topics are further discussed in this chapter.

4.4. Water and climate change adaptation

Managing uncertainty

Water resources vary significantly in time and space. The water cycle has a natural seasonal and inter-annual variability and each of its components assume diverse

magnitudes in different locations. This variability affects both the quantity and quality of water resources at different time scales.

Climate change will reinforce and exacerbate this variability by accelerating the water cycle and by increasing the uncertainty over the distribution of water in time and space and over the occurrence and magnitude of extreme events (Huntington, 2006; Milly et al., 2018). Additional uncertainty rises from the lack of knowledge on the future greenhouse gases emissions and other trends affecting the water cycle, from the climate models capacity to reproduce the current climate and simulate future climate, as well from the hydrological models capacity to simulate the water cycle.

Water managers always have always dealt with an uncertain future by assessing possible scenarios and considering them when taking decisions. Climate change constitutes an additional source of uncertainty that needs to be considered in the decision-making process, together with other risk drivers, which are often dominant (OECD, 2013). A major conceptual change is however required: the rejection of the traditional engineering assumption that considers the historical climate as a reliable indicator of future conditions (Milly et al., 2018).

Climate change adaptation is therefore a decision-making process with incomplete information. Although it must be recognized that climate change is not relevant to all water management decisions, nor are all choices strongly affected by climate uncertainties (Stakhiv, 2011), the added uncertainty brings complications to many, if not most, decisions, namely on infrastructures investments and land planning.

Climate change adaptation requires the assessment of climate related risks and the planning of an adequate response to deal with these risks. When designing site-specific climate adaptation actions at a local scale, decision makers need to consider different elements of threat of varying magnitude and their corresponding impacts.

A risk-based approach that explicitly identifies the range of possible future scenarios and considers the available options to manage the associated risks is a very useful tool (Loucks, 2011; Hall, 2012; OECD, 2013). By considering the range of all possible risks and their associated probabilities, as well and their interrelationships, a clear discussion may follow on the level of acceptable risk and on needed responses to achieve that target. The discussion should include the option of doing nothing and bearing the consequences of climate risks, as well as the consideration of the remaining residual risks after the implementation of selected adaptation measures. Hopefully, innovative solutions may arise from this discussion.

The planned response needs to be flexible and scalable so that adequate measures are in place when a specific threat materializes. The mix of grey, green and soft measure should be implemented in flexible way that allows their tuning with knowledge gathering, changing climate and socio-economic conditions.

Soft measures to improve governance and management procedures often offer better perspectives to reduce vulnerability and build resilience than hard technological solutions. They also offer more flexibility due to lower investment costs and the possibility to implement them in a phased way, with corrections being easily introduced at later stages, following an assessment of their early results. Green adaptation making use of hydrological and ecological processes is increasingly being adopted in Europe because it provides benefits in different areas and avoids large initial investments with uncertain future returns (OCDE, 2013; EEA, 2017b). Nonetheless, hard structural solutions are required in many situations, after the first set of no-regret or low-regret adaptation measures is implemented.

The selection, prioritization and scheduling of the actions to be included in an adaptation strategy should be based on a cost-benefit analysis of the alternative actions and activities. These cost-benefit analysis are however hard to perform, given the significant uncertainty associated with future climate scenarios and the length of time horizons

required to build and achieve returns of water works (EEA, 2007). While the cost of adaptation may be estimated with some degree of certainty, for it is usually associated with actions to improve or build infrastructures or to change their operational procedures, the benefits from adaptation are far more difficult to estimate. The net benefits of an adaptation action are the costs of the avoided impacts deducted by the costs of the remaining impacts, with both estimates depending on the impacts of the assumed climate scenarios. As the first adaptation actions, with higher returns, are adopted, the decision on whether to execute or not to execute some actions becomes at some point extremely difficult. The consideration of the risk of severe irreversible impacts is another challenge to this approach for irreversible impacts are extremely hard (if not impossible) to evaluated.

The need to consider the adaptation benefits in a long-term perspective adds another difficulty. The costs to execute a given action have to be assumed immediately but the benefits arising from that decision last for a very long time (may be 100 or 500 years). The present value of those benefits is therefore a function of a discount rate value which needs to be selected, a decision that directly determines if a given adaptation action is to be executed or not. There is a substantial discussion on whether present value estimates are adequate for analysing projects with very long horizons (EEA, 2007).

Nevertheless, the cost-benefit analysis provides a useful framework to decide upon the most adequate strategy and to identify those actions definitely leading to benefits greater than costs or those associated with a low expectation of regret. It also helps focus on the more costly measures or with more uncertain benefits, which require a deeper knowledge to decide if and how to implement them.

The implementation schedule of an adaptation strategy is another challenge. Whenever possible a progressive approach should be adopted where a sequence of low impact actions are implemented to increase the level of preparedness and maintaining the risk level below a given acceptable threshold. By deferring the larger investments to the future, this approach has clear financial advantages and the benefit of reaching the growing understanding of the climate change process as research continues. Unfortunately, this progressive approach may also lead to higher adaptation costs, as short-term solutions are implemented at the expense of long-term solutions that require sizeable investments to revolutionize water management practise.

Whatever the challenges, the risk analysis and cost benefit analysis of climate adaptation efforts should be mainstreamed into the water resources decision making process to ensure a good water management strategy, as an adequate adaptation strategy often coincide with sound water management practices. The integrated evaluation of trade-offs between actions, costs and risk reduction also reduces the possibility of mal adaptation as all risks are considered simultaneously, including the risks resulting from responding to risks (OECD, 2013).

Bridging policy sectors and government levels

Water is a crucial resource and a potential threat to economic, social and environmental development and well-being. As climate change impacts on water affect many domains of our society, an adaptation strategy on water resources needs to cover a number of policy areas, such as land planning, agriculture, energy, infrastructures, biodiversity and health, among others.

An important element of this effort is the alignment of climate change action with international agendas and commitments like the 2030 agenda for sustainable development and its goals (UN, 2015b) and the Sendai Framework for Disaster Risk Reduction (UN, 2015a).

The adaptation strategy also needs to distribute the planned activities to different levels of government, from a local municipality to regional or national institutions or even supra-national entities, ensuring effective action by selecting most appropriate government

level to manage each issue (principle of subsidiarity). Climate adaptation efforts are often better managed at a local level, as they require an in-depth and detailed knowledge of the impacts and of the most appropriate responses. The idea that adaptation is often best dealt with at a local level have been highlighted in guidance documents since 2013 (EC, 2007; EC 2009a).

However, upper levels of government also have an important role whenever the spatial scope of the problem outsizes the local scale or when there is a need to ensure the coordination and coherence of adaptation response in different policy areas. For example, the European Union adaptation strategy (EC, 2013) argues that ensuring that energy and transport networks and other major national infrastructures are capable of coping with climate change is a mission that should be attributed to national government bodies. National institutions also have to develop a suitable environment for enhancing adaptation at all levels and the offering of the needed means and instruments. This includes promoting research and knowledge dissemination, reviewing the legal and regulatory framework to enhance adaptation action, eliminating hurdles that may exist and guarantying financing instruments to implement the adopted solutions.

Mainstreaming adaptation efforts into each government area and using the existing institutional arrangement and policy instruments contributes to overcoming these challenges, as these arrangements and instruments are expected to address the coordination requirements among policy sectors and government levels, in an appropriate manner. Good governance offers the conditions to deal with climate related risks in the most appropriate way. An effective water management practice, supported by a sound water governance arrangement, is a key success factor to reduce the vulnerability to climate change. The control of existing pressures and the enhancement of water bodies' status improve the base line conditions and provide some leeway to accommodate the additional pressures arising from climate change.

By requiring a higher degree of coordination, climate action may emphasize existing problems arising from institutional and multi-level government fragmentation and poor management. It therefore provides an opportunity to review and improve governance arrangements. The OECD Water Governance Principles offers guidance on how to design and implement effective, efficient and inclusive water policies (OCDE, 2015).

The European Union strategy on adaptation to climate change stresses the importance of mainstreaming strategies to tackle climate change impacts on water resources (EC, 2013). Member states must consider climate change when designing strategies and plans, such as the River Basin Management Plans and Flood Risk Management Plans, and verify that their programs of measure are climate-proofed. A guidance document was published for that purpose (EC, 2009).

Examples of mainstreaming climate change response into policy instruments include the EU's civil protection legislation, the EU Directive on the Assessment and Management of Flood Risks (2007/60/EC) and the revised EU Directive on Environmental Impact Assessment (EIA) (2014/52/EU). Although the Water Framework Directive (WFD) does not mention explicitly the risks arising from climate change, the systematic approach put forward by the directive and its focus on the identification of anthropogenic pressures, the need to take into account long term forecasts of supply and demand for water and the requirement to perform an economic analysis of the relevant investments are drivers to consider climate change into river basin management practice and, in particular, into the river basin plans.

Bridging national boundaries

Climate and water know no borders. Around 60% of global freshwater flows cross national boundaries, defining transboundary basins that cover 45% of the total land surface of our planet, where 40% of the world's population lives (UNECE, 2009; 2015). In Europe, there are close to 70 transboundary basins, which cover more than 80% of

the continent's land surface (Wolf et al., 1999). Internationally shared or transboundary groundwater resources also play an important role in sustaining water needs.

The challenges of climate adaptation are amplified within transboundary basins and aquifers as the coordination efforts among policy sectors and government levels needs to be also achieved across the border. The involvement of a larger number of stakeholders and the absence of a common analysis, planning, legislative and regulatory framework defies a strong cooperation between riparian countries (UNECE; 2009; UNECE, 2015). A good example of this type of challenges is reaching a consensus on the magnitude of climate change impacts or on the assessment of the status of shared water resources under non-stationary conditions.

Yet, strong cooperation is needed to develop an efficient and effective adaptation strategy in transboundary contexts. The sharing of resources (data, models and knowledge) generates a common understanding of the arising vulnerabilities that is key for a coordinated response. A joint analysis of the possible actions enlarges the set of options to address the threats, increases its efficacy and avoids transferring vulnerabilities from on part to the other part of the basin. It also ensures that each adaptation is implemented where it has the most impact to the whole basin and the least socio-economic cost. If needed, payments between riparian states should be considered to share the costs. (UNECE; 2009; UNECE, 2015).

As with any adaptation strategy, climate risks in transboundary contexts are best met with flexible approaches covering different policy sectors and involving the diverse stakeholders at different levels of government and proper communication between science and decision-making and policy. Mainstreaming adaptation efforts into the existing governance frameworks and management tools of the riparian states and following the principles of integrated water resources management (IWRM) can support adaptation efforts.

Within an transboundary context, international legal frameworks such as the United Nations Economic Commission for Europe (ECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) and the United Nations Convention on the Law of the Non-navigational Uses of International Watercourses (United Nations Watercourses Convention) can help countries to jointly adapt to climate change (UNECE, 2015). The European Union Water Framework Directive mandate coordinate action among member states with the aim of producing a single international river basin management plan is another important tool towards this goal.

Effective transboundary adaptation strategies are more easily developed if the riparian states participate in a common river basin organization. The majority of the existing examples of transboundary adaptation strategies were produced by such bodies, as it is the case of the Rhine and the Danube (UNECE, 2015). When such bodies do not exist, strategy may be developed by other international organization but the political acceptance and implementation of the final agreed result is much harder. Riparian governments can also directly assume the responsibility to coordinate their adaptation efforts, a task that is made easier if an agreement to manage the share resources jointly exists.

4.5. Managing risk and uncertainty for resilience and disaster preparedness

Climate change affects society through long-term and permanent trends, for example the rising of temperature or the change of the precipitation seasonal distribution. The increase of the frequency and magnitude of extreme occasional wheater events, such as floods and droughts, is identified by many states and stakeholders as a primary concern (OECD, 2013). Climate change is recognized as a key driver to these increasing

trends and to the resulting damages and life-threatening situations. The losses from extreme events are amplified by ongoing changes in demographics and land use, with the expansion of residence and economic activities to growing risk prone areas.

According to Munich Re, the year 2017 was the costliest year on record, with the insurance industry having to support more than 260 thousand million euros of damages, with 90% being climate related (Munich Re NatCatService). In Europe, there were two events that each caused billions in overall economic losses. Mid-April saw the sudden return of winter over Europe, leading to an overall loss of €3.3bn in the agricultural sector, particularly in fruit growing. Dry weather and drought in large parts of southern and southeast Europe also caused overall losses of €3.5bn. In addition, Winter Storms Herwart and Xavier, in October, swept over Germany, Poland and the Czech Republic, causing aggregate economic losses of more than €800m.

To address these risks, European countries are gradually implementing comprehensive and integrated risk and disaster management approaches that consider climate change within the full cycle of prevention, preparedness, response and recover (EEA, 2017). At the European Union level, policy instruments such as the European Union Civil Protection Mechanism, the European Commission's Action Plan on the Sendai's Framework for Disaster Risk Reduction (EC, 2016), the European Union Water Framework Directive and the European Union Adaptation Strategy to Climate Change (EC, 2013) provide the overarching framework that contributes to achieving this goal. The European Union funding mechanisms support this integrated policy, which is increasingly being mainstreamed into more concrete programs and plans, including investment plans.

Civil protection and disaster-risk reduction instruments cover a wider range of emergency risks than climate change adaptation, but the integration of both these efforts provides significant benefits by promoting coherence in the prevention and reduction of risks. Enhanced knowledge on hazards and risks, stronger collaboration among different policy areas, effective and efficient policies and practices, more efficient use of human, technical and economic resources, and better preparedness and response to disasters are some of the potential benefits at European, national and local level (EEA, 2017c).

Both approaches aim at preventing and reducing the risks of disasters by reducing the vulnerability and increasing the resilience of societies. To design risk reduction strategies, both approaches perform an assessment encompassing a risk identification stage (identification the possible threats or hazards and their consequences or impacts), a risk analysis stage (estimating the probability of occurrence and severity of each threat or hazard) and and a risk evaluation stage (comparing the level of risk with a commonly agreed level of acceptable or tolerable risk) (EEA, 2017c).

The methods to perform these tasks are similar in both approaches and include models describing the causal relationships between climate and non-climate factors that originate threats or hazards with the correspondent social and economic impacts, as well cost-benefit or cost-effectiveness analysis to help identify the appropriate risk reduction or adaptation responses. Given the uncertainty and complexity associated with many of these hazards and relationships, qualitative assessment, based on expert judgement, are often employed.

Integrating disaster risk reduction and climate adaptation efforts is particularly valuable at the prevention and preparedness stages of the risk management cycle, with climate adaptation being less relevant at response and recover stages. In particular, prevention offers the best opportunities for avoiding the adverse impacts of hazards by joining efforts in identifying and characterizing climate related risks and designing appropriate responses. A key element of the response is part of the preparedness stage where the response capacity of governments, civil protection organizations and civil society is developed.

As with any complex problem, there is not single “silver bullet” solution. In most situations the appropriate response includes a mix of grey, green or soft measures. Notwithstanding the need for some grey infrastructural solutions, there are numerous examples in Europe of the adoption of green solutions for controlling flood risks due to its comparative higher benefits, including in cross-related areas like human wellbeing and biodiversity conservation (EEA, 2015; EEA, 2017b; EEA, 2017c). Examples of soft solutions to reduce the adverse impacts of climate related events include the adoption of regulatory or financial measures to induce water savings and increase water use efficiency, and therefore reduce vulnerability to droughts.

At preparedness stage, soft measures like capacity building, development of emergency management plans and dissemination of insurance instruments enhance the adaptation capability and increase the resilience of the systems under threat. In the European Union, Directive 2007/60/EC on the assessment and management of flood risks requires Member States to assess the flooding risk and to take adequate and coordinated measures to reduce this flood risk, though flood management plans. Some Member States also have drought management plans.

4.6. Climate science and water management

The knowledge base on climate change and its impacts has improved significantly in the recent years. The key factors that ensure an effective response through a coherent mix of mitigation and adaptation efforts are also well known. This is the result of a strong investment on monitoring, modelling and research by different European countries and institutions. Knowledge gaps and uncertainty remain but there is a good understanding of the main risks to support the design of appropriate adaptation responses. Practical experience in implementing adaptation strategies remains scarce but this acquis is growing (OCDE, 2013).

So far, most adaptation strategies focus on the development of information-based instruments directed to knowing the risks, raising awareness and disseminating information (OCDE, 2013). The idea is that scientific knowledge and information, together with training and guidance to actors at all levels of government and businesses, enable the distribution of the adaptation effort to the regional and local levels. Based on this knowledge and guidance and their own deep understanding of the systems under their management, actors at the local level can build effective and efficient adaptation responses. The sharing of the same knowledge base at a national or continent scale also helps build coherent strategies across policy sectors and spatial scales.

The information available through these knowledge-based instruments includes data, model results and maps, as well guidance documents and case studies (OCDE, 2013). At the European Union level, the European Commission has developed the CLIMAT-ADAPT platform that helps users to access and share information on expected climate change, potential vulnerabilities of regions and sectors, and available adaptation options (http://climate-adapt.eea.europa.eu).

The emphasis on information-based instruments within the national adaptation strategies puts in evidence the difficulties in designing and implementing other types of actions that require an active attitude to address specific threats.

4.7. Climate change mitigation

The magnitude of future climate change and its impacts from the middle of the century onwards depend on the effectiveness of global climate mitigation efforts.

Europe, and in particular the European Economic Area, is at the forefront of greenhouse gases emission reduction efforts. Data from 2015 show that the European Union greenhouse gas emissions have decreased 22%, when compared to 1990, and Member

States expect that planned policies will result in further emissions reductions that will reach 30-32% by 2030 (EEA, 2017d). European Union long-term commitment is to achieve an 80 to 95% reduction by 2050, an important contribution to global emission reductions. However, under current policies the projected global trends are insufficient to keep global warming below two degrees Celsius, estimated as the target to control major climate change impacts.

The water sector contributes to greenhouse gases emission through the consumption of energy for water abstraction, conveyance, distribution and treatment, as well as for wastewater collection, treatment and disposal. These activities are energy intensive and are responsible for around 1% of European Union greenhouse gases emissions, with the heating of water at homes adding another 4% to these emissions - estimates extrapolated from the UK case (EA, 2008). Despite not being a significant emitter of greenhouse gases, the water sector must strive to reduce its carbon footprint, namely by promoting water savings and by introducing innovative solutions for more energy-efficient treatment schemes.

The main role of water sector within the mitigation efforts is as the resource for electricity production in hydropower schemes and as a mean to store energy and match energy demand and production from renewable, but intermittent, sources like wind and solar. In 2016, electricity generation from renewable sources contributed more than 29.6% to total EU-28 gross electricity consumption. Although hydropower remained the single largest source for renewable electricity generation in the EU-28 in 2016 (36.9%), the amount of electricity generated in this way was relatively similar to the level recorded a decade earlier. By contrast, the shares of wind power and solar power in the total quantity of electricity generated from renewable energy sources rose to 31.8% and to 11.6% in 2016, respectively (EUROSTAT).

4.8. Case studies

This section presents some case studies to illustrate the chapter, based on the collection and selection of proposals sent by different European organisations, as part of the European Regional Process approach described in chapter 3.

Case study: Regulation of Hautaperä reservoir, Finland

Contact: Finnish Environment Institute and Ostrobothnia Centre for Economic Development, Transport and the Environment, Noora Veijalainen, noora.veijalainen@ymparisto.fi

Hautaperä reservoir in Ostrobothnia region was constructed in 1970s, mainly for flood protection purposes by reducing damages caused by spring floods and ice jam floods in the Kalajoki basin. The reservoir regulation includes other puporses, such as recreational use and hydropower production. The regulation permit of Hautaperä reservoir includes a calendar-based draw-down of water level in spring. In the future, this regulation permit will not function well because of the milder winters, earlier spring with less snow and higher potential for winter floods caused by climate change. There has already been need to apply for exemption permit for regulation during the mild winter of 2014. Therefore, Finnish Environment Institute and Ostrobothnia Centre for Economic Development, Transport and the Environment conducted a study to estimate the future hydrological conditions in Hautaperä reservoir and to improve the regulation rules. Climate scenarios and model simulations were used together with a regulation algorithm to simulate future hydrological scenarios and to test the function of different regulation rules. The difficulty was finding a balanced regulation practice, which reconciled contradicting interests for flood protection, recreational use and hydropower.

The result of the case study was a plan for the changes in regulation permits, in which the snow water equivalent is used to determine the water level during spring. The

changes increase the flexibility of the regulation permit and potentially improve the future flood protection and recreational use.

Lake and reservoir regulation is topical in many regions in Europe as climate change impacts are already being observed and will become more evident in future years. Improved regulation can function for flood protection and hydropower production, while also taking into account recreational use and ecological state of the rivers and lakes. The case study demonstrates the need for more flexibility in the regulation of lakes and reservoirs in order to adapt to the changing climate.

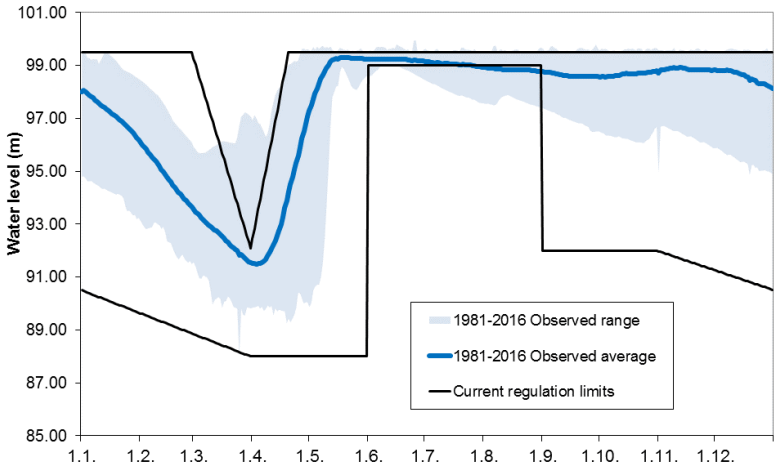


Figure 4.3 - Current regulation limits and observed water levels 1981-2016 at Hautaperä reservoir.

Figure 4.4 - Low water level during 2014 at Hautaperä reservoir.

Case study: Climate change adaptation on the roof of Europe, in the Czech Republic

Contact: Ministry of Agriculture, Czech Republic, Pavel Puncochar, pavel.puncochar@mze.cz

Scenarios of climate change for the territory of the Czech Republic indicate the negative consequences on water regime, which is dependent solely on the precipitation as all water outflows to the neighbouring countries. Water resources of the Czech Republic are limited due to this fact and, therefore, there are vulnerable to drought and water scarcity.

The annual amount of precipitation should not differ substantially from the long term average during the expected future development of climate, but the time distribution of precipitations will change dramatically causing higher occurrence of hydrological extremes. This development has been confirmed during past 20 years, in which 9 large (even extreme) floods and several droughts occurred.

Therefore, the preparation and implementation of measures and activities are necessary for decreasing negative effects of extreme hydrological events, which caused large damages for inhabitants, agriculture and all national economy.

The conception and strategies for prevention of floods and droughts were prepared and adopted and the efficient measures are realized against climate change consequences. Programmes of subsidies have been adopted for support of flood and drought protection, namely for construction and rehabilitation of fish ponds, for rehabilitation and modernization of irrigation facilities, for renaturation of small water courses, for the improvement of agriculture practices and landscape structures and also for the preparation of some dam – reservoirs. The national financing sources (namely from the state budget) and EU funds are used for the implementation of these programmes.

The essential condition for the effectiveness is the implementation of complex measures, i.e. consisting of “soft measures” (“ecological plausible”) as well as of “technical measures” (i.e. new water management constructions).

The integrated management of water resources based on the planning in watersheds is used as the main tool for the realization of the measures aiming to the decrease the danger of climate change consequences and to achievement of sustainable availability of water resources and their good status. The plans for the transboundary watersheds are prepared in the International Commissions for the River Elbe, the River Oder and the River Danube because the international collaboration is essential for the protection against floods and water scarcity worldwide.

Figure 4.5 - Low River basins on the territory of the Czech Republic

Case study: Holistic climate change adaptation in Copenhagen

Contact: Greater Copenhagen Utility, Denmark, Jes Clauson, jecl@hofor.dk

Copenhagen Cloudburst Management plan revolves around more than 350 projects of varying size and complexity, where every intervention – a green street here, a tunnel there - has a role to play in the complete hydraulic control of the city. The focus of the Cloudburst Management Plan is to direct rainwater by gravity towards the nearest body of water, lakes or the sea, or to larger green areas like parks and sportsgrounds.

Surface solutions focus on creating ‘blue and green spaces’ that integrate water in the urban space and create green corridors that increase biodiversity and also combat urban heat island effects. Water retention parks have been completed at Sankt Kjelds Kvarter, Sankt Annæ Plads and Valbyparken, with many more on their way, as existing parks are

being reshaped to receive large volumes of water during cloudbursts without preventing the everyday use of the parks or diminishing their recreational value.

Two tunnels are almost complete, while three more tunnels are under project preparation. Projects of a smaller scale include a new system of line drains introduced in central Copenhagen at Slotsholmen, Havnegade and Toldbodgade, which direct storm water to the harbour in a separate, new pipe system, and outlets with non-return valves leading surface water to the harbour.

The total investment for realizing the plan is about EUR 1.3 billion, which should be compared to a potential direct loss of over EUR 2 billion.

Figure 4.6 - The completed Sankt Kjeld climate neighbourhood, from asphalt to green space

Case study: Energizing sustainable delta's: Bridging Implementation gaps

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As a low-lying delta on the North Sea, the Netherlands has a long tradition of water management. Dutch engineers work around the world to make shores safe and to keep shipping routes navigable. Climate change and rising sea levels pose new challenges. The Netherlands is therefore investing in innovative methods for coastal maintenance and safety such as building with nature and to create a more dynamic and open delta, which contributes to the restoration of ecosystem services, sustainable energy from water and the implementation of multifunctional flood defenses. The Dutch integrated approach is distinctive in international context because of the challenge to deal with climate adaptation (flood protection), climate mitigation (producing sustainable energy) and the problems of water quality and water supplies, at the same time.

The case Energizing Sustainable Delta's provides insight into the way this is done for some major multifunctional water defences in the Netherlands such as the Afsluitdijk, the Brouwersdam, the Grevelingendam and the Oosterscheldekering. The case study describes how field experiments and test facilities contribute to bridge gaps between knowledge, policies and implementation.

A major example is the integrated approach that is adopted to restore a limited tide in the Grevelingen Lake, the largest salt water lake of Europe, through a passage in the Brouwersdam as a robust solution for the water quality of the lake. This creates at the same time the possibility to use the passage for the construction of a large scale tidal power plant and offers new chances for regional development for fisheries and tourism.

Figure 4.7 - Brouwersdam tidal power plant in The Netherlands (Artist impression)

4.9. Key messages

From the assessment presented in this section the following key messages result:

- Climate change affects Europe in many ways, with the nature and dimension of impacts varying throughout Europe. All regions are affected, thus making climate change one of the continent's most important challenge. If not properly addressed, climate change impacts to health, ecosystems and biodiversity, property and economic activity are likely to become more severe in the coming decades and could prove to become very costly.
- Most OCDE countries have serious concerns over the impacts of climate change and report that changes are already occurring.
- Water plays a vital role on how society feels climate change impacts and this fact is recognized by European countries and individual stakeholders. The areas of highest concern are extreme events and water shortage.
- Europe is at the forefront of greenhouse gases emission reduction efforts, but mitigation can only lead to a meaningful reduction of climate change risk if concerted efforts, joining all nations in the world, significantly reduce global greenhouse gases emissions.
- Adaptation is inevitable. It seeks to reduce the vulnerability to climate change by enhancing the society preparedness and capacity to respond to the unavoidable impacts. Since 2013, the European Union has a strategy on adaptation to climate change, as well as most European countries.
- Climate change adaptation is a decision-making process under significant uncertainty. A risk-based approach that explicitly identifies the range of possible future scenarios and considers the available options to manage the associated risks is a useful tool.
- An adaptation strategy on water resources needs to cover a number of policy areas, such as land planning, agriculture, energy, infrastructures, biodiversity and health, among others. The adaptation strategy also needs to distribute the planned activities to different levels of government, from a local municipality to regional or national institutions or even supra-national entities, ensuring effective action by selecting most appropriate government level to manage each issue.
- An effective water management practice, supported by a sound water governance arrangement, is a key success factor to reduce the vulnerability to climate change. Mainstreaming adaptation efforts into the existing governance frameworks and

management tools following the principles of integrated water resources management (IWRM) can support adaptation efforts.

- The challenges of climate adaptation are amplified within transboundary basins and aquifers as the coordination efforts among policy sectors and government levels needs to be also achieved across the border, which requires a strong cooperation between riparian countries and the involvement of a larger number of stakeholders.
- To date, most adaptation strategies focus on the development of information-based instruments directed to knowing the risks, raising awareness and disseminating information (OCDE, 2013). The emphasis on information-based instruments within the national adaptation strategies puts in evidence the difficulties in designing and implementing other types of actions that require an active attitude to address specific threats.
- The key challenges to adaptation are: How to develop effective integrated policies to promote change? How to overcome uncertainties and start effective adaptation action? How to strengthen the links between national, regional and local planning and actions? How to adapt the legal and regulatory framework? How to ensure funding and what financial mechanisms are needed?

4.10. References

In the writing of this chapter the following bibliographic references have been used:

EA (2008). Greenhouse gas emissions of water supply and demand management options, Science Report – SC070010, UK Environment Agency.

EC (2007). Adapting to climate change in Europe – Options for EU action. Green paper from the Commission to the European Parliament, the Council, the European Economic and Social Council and the Committee of the Regions. SEC (2007) 849.

EC (2009a). Adapting to climate change: Towards a European framework for action. White paper. COM (2009) 147 final.

EC (2009b). River Basin Management in a Changing Climate. Final common implementation strategy for the water framework directive (2000/60/EC). Guidance document n 24.

EC (2010). Commission staff working paper “Risk assessment and mapping guidelines for disaster management”, SEC (2010) 1962 final.

EC (2013). An EU Strategy on adaptation to climate change. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Council and the Committee of the Regions. COM (2013). Final.

EC (2016). European Commission's Action Plan on the Sendai’s framework for disaster risk reduction: 2015-30 – A disaster risk informed approach to all EU policies. Commission Staff Working Document. SWD (2016). 205 final.

EEA (2013). Adaptation in Europe: Addressing risks and opportunities from climate change in the context of socio-economic developments. EEA Report No. 3/2013.

EEA (2016). Urban adaptation to climate change in Europe 2016: Transforming cities in a changing climate. EEA Report No 12/2016.

EEA (2017a). Climate change, impacts and vulnerability in Europe 2016. An indicator-based report. EEA Report No 1/2017.

EEA (2017b). Green Infrastructure and Flood Management: Promoting cost-efficient flood risk reduction via green infrastructure solutions. EEA Report No 14/2017.

EEA (2017c). Climate change adaptation and disaster risk reduction in Europe. Enhancing coherence of the knowledge base, policies and practices. EEA Report No 15/2017.

EEA (2017d). Environmental indicator report 2017 (online).

Hall (2012). Water security and environmental risk. Brief nº 2. International Conference on Water Security, Risk and Society. University of Oxford, 16-18 April.

IPCC (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC.

Loucks (2011). Risk and uncertainty in water planning and management: A basic introduction. In Quentin and Hussey (eds) Water Resources Planning and Management, Cambridge University Press.

McGlade, C.; Ekins, P. (2015). The geographical distribution of fossil fuels unused when limiting global warming to 2 °C. Nature, vol. 517, pages 187–190.

Milly, P.C.D., Betancourt, J., Falkenmark, M.,Hirsch, R., Kundzewicz, Z., Lettenma, D. (2008). Stationarity is dead: Wither water management, Science, vol 319, American Association for the Advancement of Science.

Nordhaus, T. (2018). The two-degree delusion: The dangers of an unrealistic climate change target. Foreign Affairs. February, 2018. The Council of Foreign Relations.

Stakhiv, E.Z. (2011). Pragmatic approaches for water management under climate change uncertainty. Journal of the American Water Resources Association, 47 (6).

OECD (2012). Global modelling of natural hazard risk: Enhancing existing capabilities to address new challenges. OECD.

OECD (2013). Water and climate change: Policies to navigate uncharted waters. OECD studies on water. OECD Publishing.

OECD (2015). OECD Principles on Water Governance. OECD.

UN (2015a). Sendai Framework for Disaster Risk Reduction 2015–2030, A/RES/69/283, General Assembly, 69th session.

UN (2015b). Transforming our world: The 2030 Agenda for Sustainable Development, A/RES/70/1, General Assembly, 70th session

UNECE (2009). Guidance on water and adaptation to climate change. ECE/MP.WAT/30. United Nations Publication.

UNECE (2015). Water and Climate Change Adaptation in Transboundary Basins: Lessons Learned and Good Practices. ECE/MP.WAT/45. United Nations Publication.

Wolf, A.T., Natharius, J.A., Jeffrey J., Danielson, J.J., Ward, B.S., Pender, J.K. (1999). International River Basins of the World, International Journal of Water ResourcesDevelopment, 15(4).

5. Water and people in Europe

5.1. Contents

This chapter details the assessment made in the European Regional Process about Europe and people: water, sanitation and health. This text was prepared by Lesha Witmer and Annemiek Jenniskens (Women for Water Partnership), with contributions inter alia from UNECE WC Secretariat, Aquafed, Marta Moren-Abat of the European Commission as well as Shinee Enkhtsetseg, World Health Organisation (WHO).

5.2. Introduction

The new Agenda 2030 is universal, all-inclusive and has extended targets compared to the MDGs, when it comes to access to safe water and sanitation: access to drinking water and basic sanitation are human rights and should be ensured in 2030 (SDG 6.1 and 6.2).

As part of the preparation of the regional process leading to the World Water Forum in Brazil in 2018, a survey was held in the wider-Europe. Not unexpected drinking water and sanitation access for Europe did not come out as a major concern overall. In general people in Europe seem to believe there is no real problem here. However, the regional differences are huge: especially in Eastern Europe there is a big gap in terms of access to sanitation; in the Pan-European region around 62 million people lack access to adequate sanitation facilities, safe means to dispose of human faeces.

Earlier research done by the European Commission in 2011 already revealed and reconfirmed again that reuse of water and the connection to public health and waste water treatment are major issues[2].

Very recent developments are the draft new drinking water directive[3], the consultations on a possible directive on reuse of water and the start of discussions on a reference document by the European Commission on the European Union strategy for water in the context of development. There is still some disappointed on how the human rights are encompassed especially sanitation in the new regulations, following the European referendum on the topic[4].

The survey made it very clear: Awareness of citizens on water-related issues in general is estimated to be very low. Europeans don't think much about having an ample supply of safe water or having a toilet. Turning on the kitchen tap or running a bath is an effortless decision. Current statistics are predicting very far away in the future events of shortages or abundances of water. In many areas in Europe and beyond, people take water for granted. Also, in Europe people face water shortages and floods. Rural dwellers and poor people are the most disadvantaged. However, there is low awareness on the actual state of affairs of access to and use of water for all kind of purposes (drinking, hygiene, food, energy, business); Europeans think our infrastructure is sustainable, future proof.

An additional questionnaire amongst European organisations and amongst young people in Europe and Africa, revealed (again) low awareness on "water" and its impacts. Believing that there will always be sufficient water for multiple uses, not being aware of the reality and the changing situation, there is too little political priority, too little long-term investments made to cope with Operation and Maintenance of the water infrastructure

[2] http://ec.europa.eu/environment/water/blueprint/index_en.htm

[3] http://europa.eu/rapid/press-release_IP-18-429_en.htm

[4] http://right2water.eu/nl

and meeting quality standards. Not being sufficiently informed happens at all levels: citizens, levels of government.

The reality of WASH in schools and work places is a great concern in all countries in Europe, regardless the economic status of a country or the existence of policies and regulations. Access to water for drinking and handwashing in schools is often not ensured. Toilets are frequently reported to be dirty, overcrowded and smelly; soap, toilet paper, drying devices and disposal bins to be insufficient. In practice healthy behaviour is not promoted. Menstrual hygiene management is often not a priority. There are very little data available and collected on this aspect so it also does not shpw up on the "radar".

Lack of water can be a reason for people to migrate, more for men than for women who often stay behind in their home countries. The impact of migration on the infrastructure of water and sanitation in Europe is still not fully known. The situation for displaced persons/ refugees is in general not reported separately but information from e.g. NGOs working in camps suggests there here is a serious concern especially regarding sanitation and hygiene.

Part of the problem is that although in general there is no lack of data in Europe, the way even disaggregated data are consolidated and published – and hence used by policy makers - does not show regional and circumstance differences and e.g. data on eco-sanitation especially in rural areas and data on (menstrual) hygiene are also mainly lacking.

A major emerging concern is the sustainability of the infrastructure in Europe. A lot of the current infrastructure is near end of life-cycle. Major investments, forward-looking asset management is highly needed. Small-scale systems are an important component of water supplies and sanitation in the Pan European Region[5] end definitely need more acknowledgement.

The next chapters will elaborate on the different issues and main challenges for Europe:

- Rethink and develop long term asset management;
- enhance the awareness of citizens on water-related issues to enhance their own involvement and stimulate prioritization in national and European policy;
- improve monitoring and data collection on (mensutral) hygiene, non-flush toilets and state of assets; improve and the method of reporting with disaggregated data (urban/ rural; gender; regions; types of facilities; special circumstances like for refugees, ROMAs, etc.) to enhance the quality of made-to-measure policies;
- Look at used water treatment and reuse.

5.3. State of affairs

In this paragraph the situation with regard to access to water and sanitation in the Pan-European region will be addressed as well as, the human rights and the infrastructure in the smaller European region. Next, two relevant subjects require attention: Wash at schools and migration.

[5] Status of small-scale water supplies in the WHO European Region. Results of a survey conducted under the Protocol on Water and Health (2016) carried out by the WHO Regional Office for Europe and the United Nations Economic Commission for Europe requesting country-specific information in 2012–2013 under the Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes. The survey had a high response rate (81%), and this analysis of the results includes responses from 43 of the 53 countries in the WHO European Region.

Access to water and sanitation

According to the WHO[6], the Pan-European region did not meet the MDG's for water and sanitation in 2015. The Pan- European region consists of 53 countries and the situation is as follows:

- More than 62 million people lack access to adequate sanitation facilities in terms of functioning toilets and safe means to dispose of human feces.
- Almost 1.7 million people in 11 countries practice open defecation – their feces are disposed of in fields, forest, bushes, open bodies of water, beaches or other open spaces or disposed of with solid waste. These people without access to appropriate sanitation facilities are denied the opportunity to live in a healthy environment and deprived of the human right to adequate sanitation.
- The MDG target for drinking-water was officially met in 2015. Still, about 14 million people do not enjoy access a basic drinking-water source, and 62 million people do not have access to piped water on premises. Seven out of ten people without access to a basic drinking-water source live in rural areas. In some cases the services are not uninterrupted and quality is not up to the new SDG standards (currently updated figures are not complete yet).
- More than 4.3 million people still rely on surface water from rivers, dams, canals, streams, lakes, ponds or irrigation channels as their primary source, posing severe risks to health. Nine of ten people using surface water live in rural areas.

Inequalities exist in access to drinking-water and sanitation services. Rural dwellers, migrants and the poor are the most disadvantaged. In the Caucasus and central Asia, for example, 19% of the rural population lives in homes without access to a basic drinking-water source, as opposed to only 2% of urban dwellers. Even more significantly, 62% of the rural population lacks access to piped water on premises whereas only 10% of town and city residents are similarly disadvantaged.

According to the latest survey of EurEau (EurEau, 2017)[7], in its 29 member countries, 499 million people are connected to a drinking water network, while 450 million inhabitants are connected to a waste water collection network and 435 million people are connected to a waste water treatment plant. Note that the connection to a collection system and a waste water treatment plant presented does not include those people connected to an individual sanitation system.

Small-scale systems are an important component of water supplies in the Pan European Region[8]. About 23% of the population of the Region receives their drinking-water from small-scale systems.

Human right to water and sanitation Europe[9]

The human rights to water and sanitation are about availability, accessibility, affordability and safe water and sanitation for all.

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[6] http://www.euro.who.int/en/health-topics/environment-and-health/water-and-sanitation/data-and-statistics

[7] This edition updates the first survey, which was carried out in 2009. Eureau believes that their survey is the most comprehensive currently available.

[8] Status of small-scale water supplies in the WHO European Region. Results of a survey conducted under the Protocol on Water and Health (2016) carried out by the WHO Regional Office for Europe and the United Nations Economic Commission for Europe requesting country-specific information in 2012–2013 under the Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes. The survey had a high response rate (81%), and this analysis of the results includes responses from 43 of the 53 countries in the WHO European Region.

[9] Taken from Eureau (2016)

In its communication responding to the Right to Water initiative the European Commission recognizes that affordability is “a key element because it relates to effective access to water services for all”. They acknowledged that the European Union “has no role in the setting of water prices, which are determined at national level. European Union water-related environmental legislation does, however, establish some basic principles for water pricing policies in the Member States. The draft revision of EU drinking-water-directive, published in January 2018 does however address some of the concerns and issues related to the Human right to water[10]; in line with the principles of the new European pillar of social rights, the proposal contains an obligation for EU countries to improve access to safe drinking water for all and to ensure access for vulnerable and marginalised groups. The Water Framework Directive requires Member States to ensure that the price charged to water consumers reflects the true costs of water use. This encourages the sustainable use of limited water resources. European Union water policy is based on the principle that affordability of water services is critical. National authorities are competent for taking concrete support measures safeguarding disadvantaged people and tackling water-poverty issues (e.g. through support for low-income households or through the establishment of public service obligations)”. Comparing the “5% threshold of household income with figures from European Union Member States, figures for water supply and sanitation bills range between 0.3% and 1.2% on the basis of average net disposable income and between 1.4% and 7.9% on the basis of the lowest decile of the OECD population, both figures calculated at purchasing power parity”.

This means that water services can be considered generally affordable in the EU, but special attention should be paid to the lowest income decile of the OECD population.

Aging infrastructure

In the survey of Eureau amongst their 29 country members, the annual investment in water infrastructure is approximately €45 billion (Eureau, 2017). This means that, on average, water services invest €93.5 per inhabitant per year. This investment is financed mainly through tariffs (water bill), taxes and transfers (from European Union financing schemes) or loans from other countries.

There is a growing concern that the infrastructure in Europe is aging - and therefore not sustainable – and that too little long term investments are being made to cope with the requirements in terms of Operation & Maintenance, the impacts of a growing and in some areas a shrinking population, of climate change, of meeting new standards in terms of water quality and new developments in terms of technology or thinking (e.g. circular economy).

Wash in schools

Under the protocol of Water and Health the status of WASH in schools in the pan-European region was investigated in 2016 (WHO and UNECE, 2016). The main findings were as follows:

- Most countries have standards in place, but these are diverse and often neglect critical WASH aspects. Important aspects are not always addressed or regulated in line with international standards on, for example, pupil–toilet ratios.
- The legal framework is complex and spreads responsibilities among numerous institutions without a clear leading actor, thus compromising accountability, coordination and compliance. Leadership on WASH in schools in the education sector is often weak, as WASH in schools is not considered an education intervention.

[10] http://ec.europa.eu/environment/water/water-drink/review_en.html

- Policies and targets on WASH in schools are mostly in place and national targets or programmes for improving WASH in schools have been approved in many countries, however, enforcement mechanisms are not always well established. Coverage and the WASH aspects considered may vary, with hygiene less prioritized than water and sanitation. Successful implementation is associated with active participation of the school community, which fosters improvement in cleanliness and maintenance, promoting healthy behaviour and disease prevention.
- Data from many countries indicate that surveillance systems and specific surveillance requirements for WASH in schools are often in place. Nevertheless, actual monitoring is not always regular and often does not actively engage either schools or education authorities. Indicators may be inadequate and/or heterogeneous, affecting data accuracy and comparability, and monitoring is not seen as a tool for informing and implementing policies and improvement interventions.
- The reality of WASH in schools does not reflect the aspirations of standards in place and is not adequate to pupils' needs. WASH in schools presents many challenges, regardless of the economic status of the country and the existence of policies and regulations. The most frequently reported issues relate to inappropriate planning; problems with physical infrastructure; a lack of consumables; poor cleaning and maintenance; and inadequate operation of water supply, sanitation and hygiene services. Pupil perception surveys reveal frequent dissatisfaction due to insufficient cleaning and maintenance, which is not always acknowledged by school management and staff, hindering healthy behaviour and promoting antisocial behaviour, such as vandalism.
- Access to water for drinking and handwashing in schools is often not ensured. Water may be absent, intermittent, unsafe and/or hard to access, far away or not allowed in class. Insufficient numbers or inadequate handwashing facilities and overly cold temperatures also hinder handwashing practices.
- Hygiene management and practice are not always adequate in schools. Toilets are frequently reported to be dirty, overcrowded and smelly; soap, toilet paper, drying devices and disposal bins to be insufficient. As a consequence, toilet avoidance is common among pupils and a lack of adequate hygiene education means that the practice of healthy behaviour is not promoted. There is very little real data on menstrual and reproductive hygiene when it comes to situation in Europe/ UNECE (except from some companies for marketing purposes). Every country handles pads/ tampons etc. differently when it comes to taxes (luxury or necessity); hence, costly. The cultural aspects play a still very negative picture. Reprodctive health products specifically for women are still very hard to come by (SCA, 2014; Erdbeerwoche, 2017; Rembeck *et al*., 2006; Newton and Hoggart, 2015; Vora, 2016; Unicef and U-Report, 2017).

  Sanitation is not always adequately provided and maintained or accessible. Sanitation facilities may be absent or inadequate to pupil numbers and needs. Use of sanitation facilities is hindered by insufficient maintenance and cleanliness, poor building materials, lack of privacy, cold temperatures and poor illumination.
- Disparities and inequalities permeate WASH accessibility in schools. Children with disabilities do not have equal access to WASH facilities in schools. Girls' needs, especially during menstruation, are often not considered. Members of minority groups in rural areas or specific regions do not have equal access to WASH facilities in schools and are neglected by policies and funding programmes.

The studies undertaken indicate a clear association between children's health and WASH conditions in schools. A significant number of pupils avoid using WASH facilities,

with consequences on health, well-being and cognitive performance. Inadequate WASH in schools may result in dehydration, urinary infections and constipation and, in some countries, parasitic infections. The evidence shows that toilet avoidance is fostered not only by insufficient and inadequate facilities but also by a lack of awareness among both teachers and children concerning the importance of WASH and the consequent school policies for drinking and toilet visits. Available studies also reported a beneficial effect of hygiene interventions, with a significant reduction of absenteeism due to infections during and/or after the intervention.

Important WASH-related topics like menstrual hygiene management, hygiene education and WASH-related health assessments still lack prioritization. As a consequence, the data available on the association between WASH in schools and related health problems or learning outcomes, as well as on the effectiveness of interventions to support informed policy action, are very limited.

Migration[11]

Evidence shows that growing climatic variability has impacts on water availability and quality, which in turn jeopardizes social stability and jobs for the younger generations. This is particularly true in arid and semi-arid regions, where often migration is both the result of and a way to adapt to climate-induced environmental stresses.

According to the latest report of UNESCO WWAP (Miletto *et al.*, 2017), in 2015 the number of international migrants reached 244 million – an increase of 71 million, or 41%, compared to 2000. Nearly two thirds of all international migrants live in Europe (76 million) or Asia (75 million). In terms of gender, the female share of migrants globally was estimated at 48.2%, with 52% of international migrants in Europe being women. Of all migrants, 30% are under the age of 29, with 35 million of international migrants under the age of 20, up from 31 million in 2000, and another 40 million between the ages of 20 and 29.

In the Mediterranean region, the limited water resources are already stretched to capacity and climate change will lead to extreme manifestations in MENA and Europe in the coming decades, which will inevitably reduce the reliability of public water supply, power generation and irrigation.

Climatic threats to water availability and access have different impacts on women and men. Men tend to migrate. Although there is no conclusive evidence on how temperature and precipitations affect men´s migration, it is apparent that they diversify their household income by migrating when farming becomes uncertain. Women, on the other hand, resort to using gardens/small-scale agriculture with different seed varieties and collecting forest products to counterbalance the impact of climate variability. Women´s mobility in the Global South is restricted. This condition makes them less likely to evacuate or to migrate in the aftermath of natural disasters. Accordingly, women tend to follow later in the migratory process and, when they do, they often leave behind children with other family members.

Once in the host country, integration is experienced differently by women and men depending on various factors, amongst which their inclusion in the job market, and the impact of migration on their status. Different immigration rules might be in place when it comes to work eligibility or refugee status eligibility depending on one´s gender. It has emerged, for instance, that women are more often than men denied full citizenship.

How migration impacts the already aging infrastructure of water and waste services in the Pan-European region is not known. Figures are lacking, however images and articles in the media make clear that e.g. for Greece and also Italy it is not always easy to cope with the increasing requirements for water, sanitation and waste services due to the high

[11] Based on Miletto *et al.* (2017)

influx of migrants in their countries. Coping with different needs of male and female migrants is even more challenging.

5.4. Case studies

This section presents some case studies to illustrate the chapter, based on the collection and selection of proposals sent by different European organisations, as part of the European Regional Process approach described in chapter 3.

Case study: Women for right to safe water and sanitation in Ukraine

Contact: Mama 86, Anna Tsvietkova, Ukraine

Ukraine is facing the regress on access to water and sanitation in centralized water supply (WS) and Sanitation (S) services, especially in rural areas without taking into account military conflict in the East (National Summary Report on implementation of the Protocol on water and health (the Protocol) 2016).

Table 5.1 - Access to water and sanitation

	2013		2014	
	Water supply	Sanitation	Water supply	Sanitation
Cities	99.8%	96.7%	89.8%	87.1%
Township	85.9	57.2	68.8	47.9
Rural settlements	22.1	2.4	17.2	1.9

In 2014-2015 using score-card on equal right to W & S (approved by Meeting of the Parties to the Protocol) MAMA-86 made baseline analysis for 12 project areas at region, city or rural community levels. The key common findings were: lack of implementation and financing for WSS; geographical disparities between rural and urban areas, regions and within the areas; law quality of drinking W, moratoria on inspections since July2014, lack of access to WS of vulnerable groups (in preschool and schools, health care facilities, others), increasing affordability problems and non-payment. MAMA-86 carried analyses of 363 drinking W samples in 12 localities, W of 172 samples did not meet the standards. MAMA-86 initiated national workshop and local trainings for trainers to take up WSP in Ukraine and at local levels. 27 MAMA-86's staff and 50 local stakeholders: authorities, administrations, W operators were trained in summer 2015. In 8 regions the WHO Guidelines on Water/Sanitation safety planning were introduced. 9 local teams were set and in 6 months 9 W/SSP for selected vulnerable groups\communities were developed. By 2016 8 pilots on WSSP measures were implemented in partnership with local authorities and communities. Due to SIDA funded project 17 000 people, mainly children (3 urban and 4 rural schools and preschools, 1 city children health care facility) got access to SAFE drinking W or S.NGO MAMA-86's (80% members are women) was agent of changes by sharing knowledge and tools to empower and involve local communities in WSS safety planning and implementation.

Case study: Pushing forward with social tariffs and aid in France

Contact: Neil Dhot, Aquafed

Affordability is universally recognised as a key element of the human right to water and sanitation and private operators have implemented a wide range of affordability measures.

It is important to note that policy and decisions on social tariffs and affordability measures are, and must always be for responsible authorities - private operators' implement these decisions.

In France, private operators are involved in 24 of the 50 trials registered under the Brottes Law, which aims to prepare a new national legislation on social tariffs by 2018.

In partnership with local actors, private operators in France contribute to social funds and aid created to support customers facing difficulties in paying their water bills. Every year, private operators allocate around 4.5 million euros to support complementary social mechanisms that exist in France. These are the 'Fonds de Solidarité Logemont' through which 35,000 customers were helped in 2014; and aid granted by the operators and delivered through the 'Centres Communaux d'Actions Sociaux' (Community Centres) for a maximum amount of 200 euros/year/household, to help them pay their water bills (Paris suburbs, Lille, Lyon, Toulouse, Metz; Dijon, Orléans, Cholet).

In England and Wales, the private water companies provide a range of support for customers experience financial difficulties. Each year they provide measures worth more than £40 million, for example through trust funds, debt matching and write-off schemes, debt advice and water efficiency measures to help customers on meters reduce their bills.

As part of their package of affordability support measures, all water companies currently either have social tariffs already in place, or are on track to implement a social tariff.

Companies are also spending millions of pounds to ensure customers are aware of the potential support on offer. Companies have invested in specialist staff and training so that they proactively seek customers who are struggling. Companies also donate hundreds of thousands of pounds to Citizens Advice and other regional debt and advice charities.

Customers on water meters get extra help from companies to bring down their bills even further. For example, some companies install free water saving products such as dual flush convertors, tap inserts and shower adapters that help customers use less water so they save money.

Case study: Ericeira world surfing reserve – How can pollution control be at the service of People?

Contact: Câmara Municipal de Mafra, Portugal

Ericeira is a small seaside fishing community on the western coast of Portugal, in the municipality of Mafra, about 35 kilometres northwest of the capital, Lisbon.

Ericeira was declared a World Surf Reserve in 2011, by the international organisation Save the Waves Coalition. It was the 2nd Reserve to be distinguished worldwide, and remains the only one in Europe. A World Surfing Reserve is a place that stands out for its quality, recognized all over the world for the practice of surf and other water sports, with the mission to protect and preserve. Ericeira's Reserve constitutes a system of great biological and ecological importance, as well as a natural heritage of extreme relevance for the practice of water sports, and local sustainable development. The Municipality takes special attention in its protection and management, since it is vulnerable to the impact of activities such as hunting, fishing, tourism and construction.

Ericeira World Surfing Reserve was approved mainly due to the quality and consistency of the 7 waves along the 4 km of coast. These waves allow surfing in different weather conditions and offer various degrees of difficulty for the practice of the sport for all levels of surfers, from beginners to professionals. The coastline is constituted by rock and sand formations, preceded by bluffs and cliffs that surround the small bays with sand or pebble beaches. This cost lodges a great diversity of marine fauna, with a diversity of molluscs.

But the excellent quality of the coastal waters was a decisive factor for this nomination. Over the last decade, there was a large investment on wastewater abatement project. The cleanliness of the rivers and coastal waters, as well as the continuous cleaning work of the rivers, and the progressive renaturation of the banks and riparian galleries were critical. The Blue flags[12] that have been attributed to Ericeira's beaches are proof of this effort. In 2017, Blue Flags were attributed to 6 beaches in the Municipality – Foz do Lizandro, São Lourenço, Praia da Baleia, Porto da Calada, Algodio and Ribeira de Ilhas.

So, what can be the role of waste water services and how can pollution control be at the service of People?

This nomination was only possible due to the preservation of the coastline and to the environmental state of the surrounding area of the coastline, both on land and at sea, Currently, the water lines that flow into the sea front are unpolluted, since all waste water systems are adequately served with their own treatment plants. Different wastewater treatment solutions were implemented, with different scale (urban to rural areas) and technologies. Special challenges were: population pressures resulting from tourism, since this is a touristic destination, particularly in summer; and, the combination in this region of low density rural areas, together with urban areas. The implemented systems were designed in accordance with these specificities to adequately respond to these challenges.

The positive effects of the priority that was addressed to water resources goes well beyond positive impacts on environmental ones. Social and economic impacts were also achieved.

Surf is one of the sectors where it is possible to combine a sustained growth with creating new economic opportunities. The nomination as World Surfing Reserve had an immediate impact on Ericeira's local economy. There was a significant increase in the number of surf schools, surf industry and accommodations. Also, around 3000 jobs directly or indirectly related to surf were created, leading to a flourishing economy that has changed reality.

Ten years ago, Ericeira was essentially a fishing village, where holidays and weekends were spent. The population was mainly compose by fishing men's families. Today, Ericeira is an international surfing destination, but it is much more than that. It a vibrant, young fishing village that does not lose its identity but become more trendy and shinning.

Case study: ERSAR assessment of the quality of service provided to users by water utilities, the Portuguese model

Contact: Paula Freixial, ERSAR, Portugal

The Portuguese water and waste services regulation authority (ERSAR) promotes the annual assessment of the quality of service provided to users by almost 350 water utilities. The regulation of the quality of service aims to improve the efficiency and effectiveness of the water and waste services by assessing the performance of the various utilities. The annual assessment cycle is illustrated in the following figure.

[12] https://bandeiraazul.abae.pt/

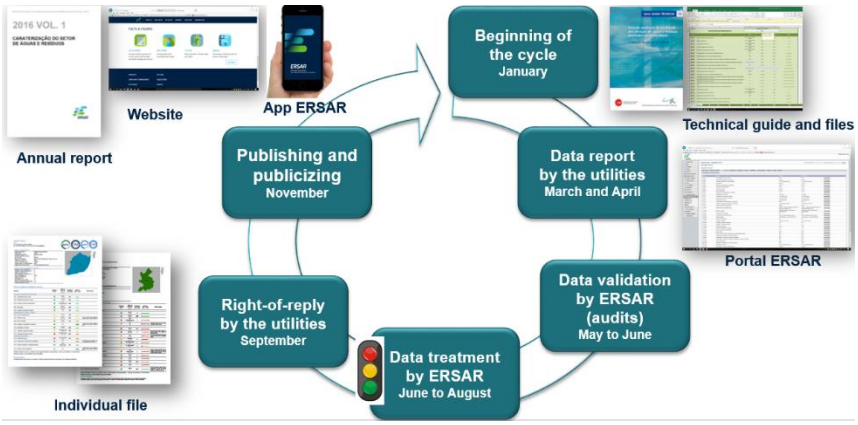


Figure 5.1 Annual assessment of the quality of service

The Portuguese model is based on a set of performance metrics, namely performance indicators (PI) and indices. The PI translate, in summary form, the most relevant aspects of the quality of service. Some are addressed to assess the utilities' efficiency, as others are shaped to measure the utilities' effectiveness. The use of PI allows monitoring the utilities' performance, to analyse trends over time and to identify and prioritize improvement opportunities. The 1st generation of the assessment system was implemented in 2004, and was replaced by the 2nd generation of indicators in 2011. A further step was taken in 2016, with the publication of the 3rd generation of the assessment system, where some concepts and metrics were adapted and revised. The assessment system is aligned with the Sustainable Development Goal 6 "ensure availability and sustainable management of water and sanitation for all". The model also includes mechanisms to compare the results of similar utilities operating in different geographical areas (benchmarking). The Portuguese experience reveals that benchmarking regulation is a powerful regulating tool that can lead to the improvement of the utilities' performance, as it naturally compels utilities to overcome their own performance or to achieve the same results that their peers have achieved. In fact, the quality of service assessment and benchmarking are two complementary tools that promote transparency and accountability to the water sector. ERSAR publicly discloses the results of this regulatory component through its website, by publishing the annual report on water services for professional use, and through interactive mobile apps for non-professional use. Nearly thirteen years after the implementation of the 1st generation of the quality of service assessment system, this system remains a key tool for regulation, recognized by the Portuguese water and waste services' stakeholders.

Case study: Water, Sanitation and Hygiene (WASH) in Rural Schools of Central Serbia (Sumadija and Pomoravlje Regions)

Contact: Biljana Filipovic, Ministry of Environmental Protection of the Republic of Serbia

The situation analysis of access to safe drinking water and sanitation for children in primary schools of the rural regions of Central Serbia was a unique water, sanitation and hygiene (WASH) project. It was funded by the Italian Ministry for the Environment, Land and Sea the Project Leader was the Regional Development Agency from Kragujevac. The project was implemented in 13 municipalities, 238 school facilities in rural environments attended by approximately 11000 children between ages 6 and 15.

We identified challenges that limit access to drinking water; opportunities, how to increase drinking water availability and consumption; and funding needed in this area. This project created a methodology that can be replicated in other parts of Serbia, the model for management of water sources and more efficient funding for the improvement of the situation in schools.

The results of this project: GAP analysis of access to safe drinking water and sanitation for children are contributing to the implementation of the Protocol on Water and Health and the achievement of national goals, related to the improvement of water supply and sanitation.

This study intends to review how water in school environments has potential to impact health of children and their attendance in schools. Adequate water supply means healthy and safe drinking water available to all pupils in the school premises in sufficient quantities and at all times when needed.

Environmental and economic arguments were the main priorities for action and the result of the project was assessing the preliminary needed investments to develop sustainable school facilities.

Considering the framework within the Sustainable Development Goals, this study comprises elements of SDG 6: “Ensure availability and sustainable management of water and sanitation for all”. This pilot project is a success story for the environment and health process, since it is directly impacting the implementation of the PWH in Serbia.

5.5. Conclusions and recommendations

From the assessment presented in this section the following conclusions and recommendations result:

Although many people in Europe take water and sanitation for granted, there are still many actions needed to ensure water and safe sanitation for all by 2030 or to adhere to the human right to water. The aging infrastructure in Europe may even deteriorate the present situation since investments are far from sufficient for operation and maintenance, let alone to cope with demographic changes. The impacts of climate change are becoming more apparent across Europe. In some years a large part of the continental European Union was affected by a severe drought, as a consequence of the combination of rain shortages and very high temperatures. In recent years, on average 17% of Europe's territory and at least 11% of Europe's population have been affected by water scarcity. If temperatures keep rising, the water situation in Europe is expected to deteriorate further. Water is no longer a problem for a few regions, but now concerns all 500 million Europeans.

Therefore, it is recommendable to pay attention to:

- Rural dwellers, disadvantaged people and people with low incomes as well as migrants
- The role women can play as actors, experts and partners in ensuring water and safe sanitation for all
- Investments not only in big scale systems but also in small scale systems because they are an important component of supplying water in Europe
- Improving Wash practices at schools all over Europe including menstrual hygiene management and attention for healthy behaviour
- Assessments and data collection to get up to date pictures of the situation and disaggregated in terms of women, men, age.

5.6. References

In the writing of this chapter the following bibliographic references have been used:

Erdbeerwoche (2017). Austria (Österreich): Umfrage zur Menstruation unter Jugendlichen, http://menstrualhygieneday.org/austria-osterreich-umfrage-zur-menstruation-unter-jugendlichen-2/

EurEau (2016) Making the human right to water and sanitation a reality in Europe. Brussels.

EurEau (2017). Europe’s water in figures. An overview of the European drinking water and wastewater sectors. 2017 edition. The European Federation of National Water Services.

Miletto, M., Caretta, M. A., Burchi, F. M. and Zanlucchi, G. (2017). Migration and its interdependencies with water scarcity, gender and youth employment. WWAP. Paris, UNESCO.

Newton, V., Hoggart, L. (2015). Menstruation and contraception: social and cultural issues on young women's decision making. Contraception 92(2015) 359-414.

Rembeck, G.; Möller, M.; Gunnarsson, R. (2006). Attitudes and feelings towards menstruation and womanhood in girls at menarche. Acta Paediatrica, 95(6), 707-714.

SCA (2014). SCA's Hygiene Matters 2014 consumer survey; Continued global need for increased access to hygiene products and knowledge.https://www.sca.com/en/about-sca/currently-in-sca/press-releases/2014/scas-hygiene-matters-2014-consumer-surveycontinued-global-need-for-increased-access-to-hygiene-products-and-knowledge/

Unicef and U-Report (2017) U-Reporters. https://ureport.in/

Vora, S. (2016). The experiences of menstruation by homeless women: a preliminary report. https://static1.squarespace.com/static/58f4731cff7c502ccf3f22e1/t/590c0e5a2994cabf97996025/1493962336527/Homeless-Menstruation-Report.pdf The experiences of menstruation by homeless women: a preliminary report (UK)

WHO and UNECE (2016). The situation of water, sanitation and hygiene in schools in the pan-European region. World Health Organization and UNECE.

Links:

http://ec.europa.eu/environment/water/blueprint/index_en.htm

http://ec.europa.eu/environment/water/water-drink/review_en.html

http://europa.eu/rapid/press-release_IP-18-429_en.htm

http://right2water.eu/nl

http://www.euro.who.int/en/health-topics/environment-and-health/water-and-sanitation/data-and-statistics

http://www.oecd.org/cfe/regional-policy/water-governance-netherlands.htm

http://www.un.org/womenwatch/feature/climate_change/downloads/Women_and_Climate_Change_Factsheet.pdf

https://bandeiraazul.abae.pt/

6. Water and urban in Europe

6.1. Contents

This chapter details the assessment made in the European Regional Process about Europe and urban: integrated urban water and waste management. This text was prepared by Corinne Trommsdorff (IWA), Stef Koop (KWR Watercycle Research Institute) & Kees van Leeuwen (KWR Watercycle Research Institute & Utrecht University). Reviewers: Oliver Loebel (EUREAU, Belgium), Joaquim Comas (ICRA, Spain), Natasa Atanasova (University of Ljubljana, Slovenia).

6.2. Urban water challenges in Europe

European towns have achieved significant progress over the past decades. Practically all urban dwellers have access to clean, healthy and wholesome drinking water. Most of them are connected to wastewater networks. Secondary Wastewater is treated at the minimum with secondary treatment and increasingly additional treatment stages are introduced to further disinfect or remove micro-pollutants in more advanced countries. Thanks to the effective treatment of municipal and industrial wastewater, surface water bodies in European towns can again be used for recreational purposes. Last but not least, many former industrial sites along surface water bodies have been transformed in residential and recreational sites bringing water bodies back to urban dwellers.

In spite of these achievements, a number of challenges remain that need to be urgently addressed:

- In Europe, as well as in other parts of the world, a systematic assessment of Urban Water Cycle Services (UWCS) is lacking. In most cities operation of existing infrastructure is sufficient, but many cities have been less successful at financing the upgrade or replacement of water-related assets.
- The lack of systematic assessment, also leads to a lack of vision and incentives to adapt urban water management to changes in 1/ water availability and quality associated to climate change, 2/ consumption patterns (OECD 2015a; UNEP, 2013), 3/ higher treatment requirements (e.g. emerging contaminants, GHG, DBPs, sewer emissions or CSOs-related pollution), or 4/ more effective rainwater management.
- Steps need to be made towards resource recovery and circular economy: increase water savings and re-use, produce and save energy and recycle nutrients or materials from wastewater (WWAP, 2017; European Commission 2015a; Holmgren, 2016; Van Leeuwen et al. 2018). This puts water in the broader context of the circular economy and requires addressing the issues related to regulatory and public acceptance of recycled products, so that a market may be defined, products sold and the investment costs recovered.
- European urban water services often lack integration with urban planning to enable reuse, energy recovery, or capturing alternate water supplies, as well as to deliver other benefits to cities such as increasing well-being in cities through additional green spaces, reduced heat islands, and increased security from extreme weather events.

Cities are the major problem holders (OECD 2015a), but active civil societies including the private sector with visionary local government can cope with water challenges. It requires a long-term strategy, a bottom-up approach and collaboration among cities and regions by sharing best practices (Philip et al. 2011; Koop and Van Leeuwen 2017). Such learning alliances of cities can facilitate rapid and cost-effective implementation. This is needed as the time window to improve urban water cycle services (UWCS) is narrow and rapidly closing. Reports from the European Environment Agency (EEA 2012; 2016)

warns that cities are particularly at risk from climate change and that delaying action to adapt will be much more costly in the long term than immediate action. Similar observations have been made by the OECD (2015b). The adaptation to extreme climatic events to prevent destruction of valuable assets within the City – buildings, roads, power supply, but also the loss of business and time – is developed under a separate chapter under the Theme Climate of the WWF8. However, our UWCS need to specifically adapt to climate change to provide sustainable services in the near and long term. In fact, the longer political leaders wait, the more expensive adaptation will become and the danger to citizens and the economy will increase. Too much, too little or too polluted water are major governance challenges (OECD 2016; Koop et al., 2017a). As the aging assets are to be renewed there is an opportunity to address these challenges in future assets.

European initiatives and frameworks relating to urban water management

The following European initiatives or frameworks are supporting cities in Europe addressing their water challenges:

- Urban Water Agenda 2030, including the Porto declaration 2017. This is a joint initiative of the European Commission and local governments to safeguard Europe's water resources and strengthen the implementation of European Union water policies by fostering sustainable urban water management water in cities. Elected representatives from local governments all over Europe can sign the Porto Declaration on the Urban Water Agenda 2030.
- EU -JPI - Urban Europe, an agenda for research and innovation in cities regarding sustainability, water and environment; The NSFC and JPI Urban Europe have agreed to a long-term cooperation under the strategic theme Sustainable Urbanisation in the Context of Economic Transformation and Climate Change.
- H2020 and the financing of nature-based solutions. Sustainable cities though Nature-based solutions focusses on providing evidence that re-naturing of cities through the deployment of innovative, locally adapted, systemic solutions - that are inspired and supported by nature - can be a cost-effective and economically viable way to make cities more sustainable, resilient, greener, and healthier.
- EIP Water (European Innovation Partnership). is an initiative within the EU 2020 Innovation Union.“The EIP Water facilitates the development of innovative solutions to address major European and global water challenges. At the same time, the EIP Water supports the creation of market opportunities for these innovations, both inside and outside of Europe.” “The EIP Water aims to remove barriers by advancing and leveraging existing solutions. Its implementation has started in May 2013 with the main objective to initiate and promote collaborative processes for change and innovation in the water sector across the public and private sector, non-governmental organisations and the general public. This is mainly done via the establishment of Action Groups.”

In addition, international frameworks are also supporting European cities in tackling their water challenges:

- The City Blueprint Approach (KWR), which offers a systematic assessment framework for cities to establish their baseline, strategize their improvement and monitor their progress. The Urban Water Atlas for Europe (Gawlik *et al*., 2017) provides an overview of UWCS in 40 European Cities, with performance illustrations based on the City Blueprint approach. Since then, 44 European cities have been assessed with this framework.
- The IWA Water-Wise Cities Initiative: Inspiring cities to rally their stakeholders around a shared vision on sustainable urban water management. The over-arching vision is described in the “Principles for Water-Wise Cities”. The initiative supports champions in cities in rallying the urban stakeholders around a shared local water vision.

The City Blueprint® Approach

The City Blueprint Approach is a quick scan to assess the sustainability of urban water management and governance in municipalities and regions. It is a baseline assessment and part of a strategic planning process. The City Blueprint® Approach is a diagnosis tool and consists of three complementary frameworks (Figure 6.1). It is described here in more details than other approaches, as its results are presented in the below sections as a means to provide an overview of the current status of water management in European cities.

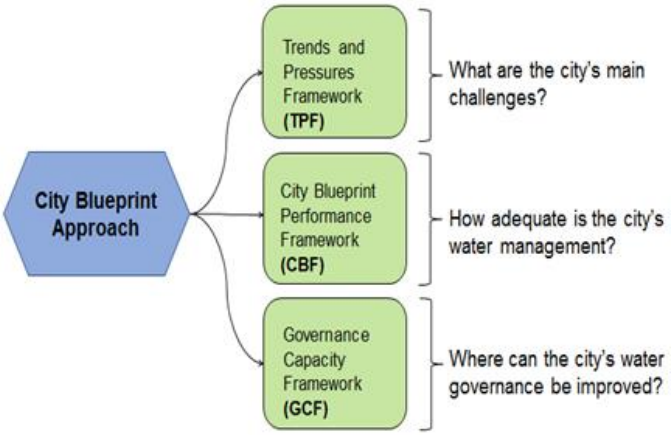


Figure 6.1 - Overview of the City Blueprint Approach with three complementary assessment frameworks. The TPF and CBF are based on questionnaires, whereas the GCF is based on interviews

The main challenges of cities are assessed with the Trends and Pressures Framework (TPF). It refers to exogenous social, environmental and financial challenges that can hardly be influenced by the local authorities. The City Blueprint® Framework (CBF) assesses how cities are managing their water cycle. The third component consist of pointing to where cities can improve their water governance, and it is assessed through the Governance Capacity Framework (GCF). The City Blueprint Approach (TPF+CBF+GCF) is just the first step (the baseline assessment) in a long-term journey of communication and co-operation within and between cities (Figure 6.2). The methods were developed through a learning by doing approach (Koop and van Leeuwen, 2015a; Koop et al. 2017a). As the results of the CBF and GCF analyses will be shown for some European Cities these two frameworks will be explained in more detail below.

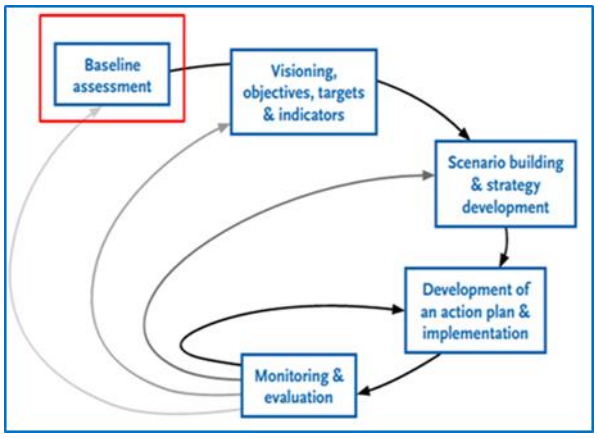


Figure 6.2 - Function of the City Blueprint (red box) in the strategic planning process of managing UWCS according to SWITCH (Philip *et al*. 2012)[13]

The City Blueprint® Framework is an interactive quick scan that generates a baseline assessment of the sustainability of UWCS in a municipality or urban region. The CBF consists of twenty-five performance indicators that are scored from 0 (low performance) to 10 (high performance) and divided over seven broad categories covering the entire urban water cycle (Table 6.1). The Blue City Index (BCI) has been calculated for these municipalities and regions and represents the geometric mean of all 25 indicators (Table 1). Detailed information about the data sources, calculation methods and scaling methods and limitations of the CBF are provided by Koop and Van Leeuwen (2015a,b) and on the website of EIP Water (European Commission 2017). This baseline assessment or City Blueprint can be used as a first step to benchmark UWCS in cities and may help: (1) to communicate a city's UWCS management performance and exchange experiences, (2) to select appropriate water supply, sanitation and climate adaptation strategies, (3) to develop technological and non-technological options as future alternatives for the water cycle, where several possible changes in the use of technology, space and socioeconomic scenarios can be introduced. This should finally lead to: (4) a selection of measures, including an evaluation of their costs and benefits under different development scenarios, and how to integrate these in long-term planning on urban investments (European Commission 2017; OECD 2015a, b and c; Koop and Van Leeuwen, 2017).

Table 6.1 - Basic method and features of the City Blueprint Framework (CBF)

Goal	Baseline performance assessment of the state of UWCS
Framework	Twenty-five indicators divided over seven broad categories: Water quality 1. Secondary WWT 2. Tertiary WWT 3. Groundwater quality Solid waste 4. Solid waste collected 5. Solid waste recycled 6. Solid waste energy recovered Basic water services 7. Access to drinking water 8. Access to sanitation 9. Drinking water quality

[13] The SWITCH project (2006-2011) aimed to improve sustainable urban water management in the "City of the Future". A consortium of 33 partner organisations from 15 countries led by UNESCO-IHE worked on innovative scientific, technological and socio-economic solutions with the aim of encouraging widespread uptake around the world. Note that the SWITCH project fed its visionary content on water in "cities of the future" to the Principles for Water-Wise Cities (IWA 2016).

	Wastewater treatment 10. Nutrient recovery 11. Energy recovery 12. Sewage sludge recycling 13. WWT energy efficiency Infrastructure 14. Storm water separation 15. Average age sewer 16. Water system leakages 17. Operation cost recovery Climate robustness 18. Green space 19. Climate adaptation 20. Drinking water consumption 21. Climate-robust buildings Governance 22. Management and action plans 23. Public participation 24. Water efficiency measures 25. Attractiveness
Data	Public data or data provided by the (waste)water utilities and cities based on a questionnaire
Scores	0 (low performance) to 10 (excellent performance)
Overall score	Blue City Index® (BCI), the geometric mean of 25 indicators varying from 0 to 10

Note: A detailed explanation of the CBF indicators is provided in Koop and Van Leeuwen (2015a), Gawlik *et al*. (2017) and on the City Blueprint Website https://www.eip-water.eu/City_Blueprints, as well as in Annex 3.

Overview of water management performance of European cities

The City Blueprint approach has assessed 44 European Cities. Even though other assessment frameworks exist, the City blueprint is the only one that provides a systematic assessment of different cities, and is therefore useful to present the current performance of European cities in the below sections.

Overview of European cities performance through the Blue City Index scores of municipalities or metropolitan areas

The results of the City Blueprint Framework for 44 European municipalities or metropolitan areas are shown in Figure 6.3. Please note, that cities have participated on a voluntary basis. Therefore, the selection of cities has not been random at all, but regionally biased towards Western Europe. There is a real underrepresentation of Eastern and Central Europe, as many cities in eastern and central Europe have not expressed interest in performing this baseline assessment with the City Blueprint framework. This might result from a lack of awareness, lack of political will, low citizen participation in decision making and thus low information exchange between different stakeholders or a combination thereof.

Many cities and regions in this eastern and central Europe are struggling with establishing the basic water infrastructure. According to the GWP-CEE and the World Bank[14] 65% of the population in the Danube region is not connected to a sewer system and thus lacking basic services. There are attempts to improve the situation, and moreover to skip conventional centralized wastewater collection and treatment and switch to sustainable resource-oriented sanitation (*e.g.*, the SANDANUBE project). However, it takes time to make this big step and brake the well rooted mental frameworks, working in favour to conventional centralized water management.

The few Eastern and Central European cities analysed with the BCF are probably cities that have a stronger political will to address water-related issues, probably as a result of their bigger involvement and engagement in European Union strategies related to urban

[14] http://www.gwp.org/en/GWP-CEE/WE-ACT/Projects/SANDANUBE/

sustainability and circular economy issues but are otherwise representative of other cities in this region. In terms of performance, only few cities rank in the category 4-6 (water efficient cities). Others rank in the category 2-4, (wasteful cities), mostly due to poor water services, lack of infrastructure maintenance and awareness. Again, the majority of the cities in this region were not evaluated and thus it is difficult to give a more thorough estimate.

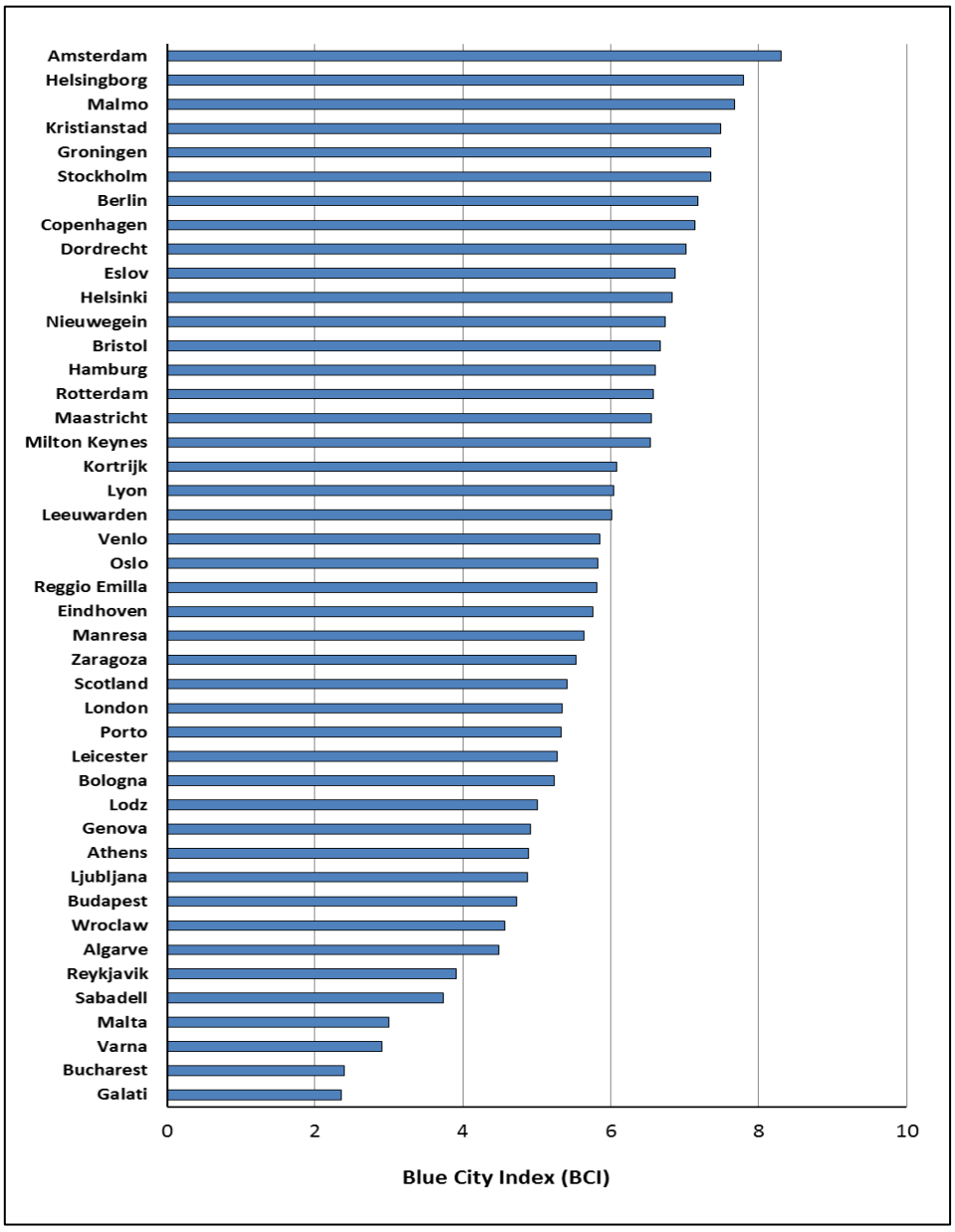


Figure 6.3 - The Blue City Index of 44 municipalities and regions.

The challenges on water, waste and climate change can be discussed more easily by clustering cities into distinct categories of sustainability and by providing additional data and information. Results of the cluster analysis are provided in Table 6.2. Most cities in Europe with BCIs of 4-6 can be categorized as water-efficient cities (Table 6.2). In North-Western Europe many cities can be categorized as resource efficient and adaptive cities. These cities have BCI scores of 6-8 (Figure 6.3 - Figure 6.5; Table 6.2).

Table 6.2 - Categorization of UWCS performance based on a cluster analysis of 25 City Blueprint indicators of municipalities and regions (Koop and Van Leeuwen 2015b)

BCI score	Classes of sustainable urban IWRM	% of European municipalities & regions
0-2	Cities lacking basic water services Access to potable drinking water of sufficient quality and access to sanitation facilities are insufficient. Typically, water pollution is high due to a lack of wastewater treatment (WWT). Solid waste production is relatively low but is only partially collected and, if collected, almost exclusively put in landfills. Water consumption is low but water system leakages are high due to serious infrastructure investment deficits. Basic water services cannot be expanded or improved due to rapid urbanization. Improvements are hindered due to governance capacity and funding gaps.	5
2-4	Wasteful cities Basic water services are largely met but flood risk can be high and WWT is poorly covered. Often, only primary and a small portion of secondary WWT is applied, leading to large scale pollution. Water consumption and infrastructure leakages are high due to the lack of environmental awareness and infrastructure maintenance. Solid waste production is high and waste is almost completely dumped in landfills. Governance is reactive and community involvement is low.	5
4-6	Water efficient cities Cities implementing centralized, well-known, technological solutions to increase water efficiency and to control pollution. Secondary WWT coverage is high and the share of tertiary WWT is rising. Water efficient technologies are partially applied, infrastructure leakages are substantially reduced but water consumption is still high. Energy recovery from WWT is relatively high while nutrient recovery is limited. Both solid waste recycling and energy recovery are partially applied. These cities are often vulnerable to climate change, e.g. urban heat islands and drainage flooding, due to poor adaptation strategies, limited storm water separation and low green surface ratios. Governance and community involvement has improved.	45
6-8	Resource efficient and adaptive cities WWT techniques to recover energy and nutrients are often applied. Solid waste recycling and energy recovery are largely covered whereas solid waste production has not yet been reduced. Water efficient techniques are widely applied and water consumption has been reduced. Climate adaptation in urban planning is applied e.g. incorporation of green infrastructures and storm water separation. Integrative, centralized and decentralized as well as long-term planning, community involvement, and sustainability initiatives are established to cope with limited resources and climate change.	45
8-10	Water-wise cities There is no BCI score that is within this category so far. These cities apply full resource and energy recovery in their WWT and solid waste treatment, fully integrate water into urban planning, have multi-functional and adaptive infrastructures, and local communities promote sustainable integrated decision making and behaviour. Cities are largely water self-sufficient, attractive, innovative and circular by applying multiple (de)centralized solutions.	0

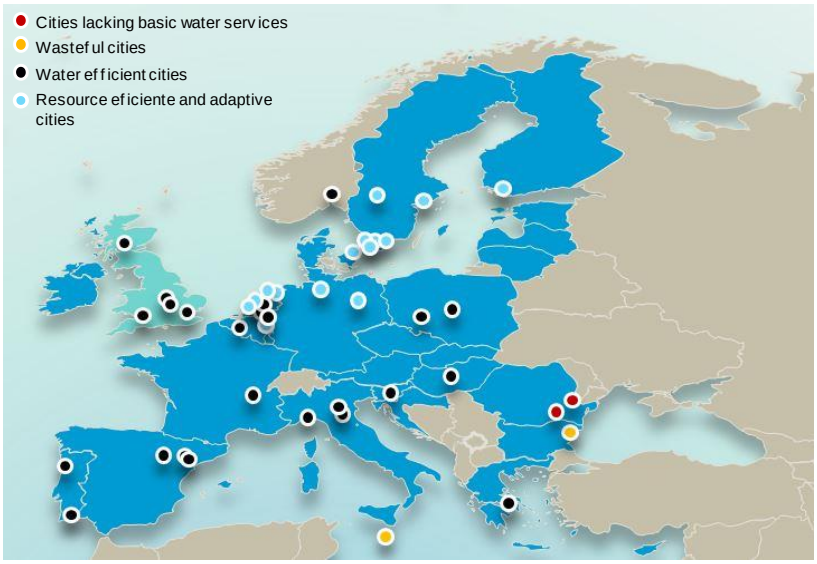


Figure 6.4 - Municipalities and regions in Europe as categorized according to Table 6.2.

Performance on efficiency and circular economy

A more detailed analysis of the current state of European municipalities and regions shows that there are major differences between the cities (Figure 6.3 and Figure 6.4) and their indicator scores. Figure 6.5 shows that Europe performs well on access to drinking water, drinking water quality, access to sanitation, drinking water consumption and secondary wastewater treatment (indicators 7, 9, 8, 20 and 1, respectively). On all other indicator scores the variation is much higher. In Europe there are major challenges regarding nutrient and energy recovery, solid waste production (collection) and recovery, as well as sewer maintenance (as represented by the average age of the sewer), storm water separation, green space and operation cost recovery (indicators 6, 10, 4, 15, 18, 14, and 17). The bias towards NW-Europe probably even leads to too optimistic results for the EU-28 because of the underrepresentation of cities of Eastern and Central Europe. Another remarkable feature is leakage of drinking water (indicator 16). The average indicator score of 6.1 means that on average more than 18% of drinking water is lost, in some cities this was more than 40%. Europe is still far from a full implementation of a circular economy of water. Nutrient recovery and energy recovery are taking place, but at modest scale, mainly due to an unsupportive regulatory framework restraining the development of a real market for recovered products. The average age of the sewer, taken as an estimate of sewer and treatment facilities maintenance, is in line with the general observation of the OECD that infrastructures are aging and often lack behind in proper management. Solid waste production and recycling are also big challenges. In some countries improper solid waste collection contributes to the pollution of fresh and marine surface waters.

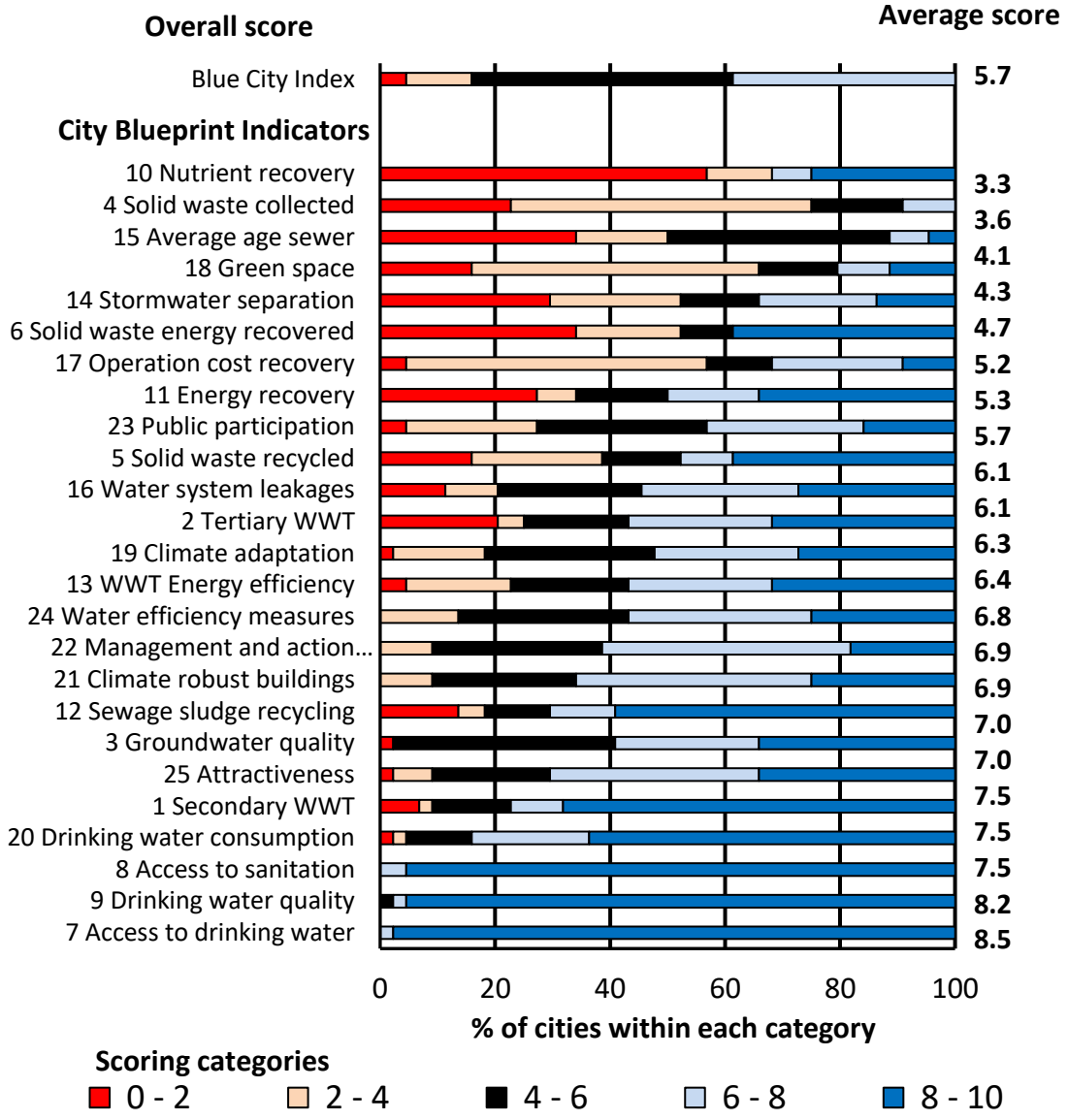


Figure 6.5 - Indicator scores of 44 municipalities and regions in Europe. The bars in red, pink, black, light blue and dark blue represent indicator scores between 0-2, 2-4, 4-6, 6-8, 8-10, respectively.

Climate adaptation

Climate adaptation on flooding, drought and urban heat stress is on the agenda of most cities. The City Blueprint Framework indicators relevant to climate adaptation, such as green space, storm water separation, climate adaptation, management and action plans also show a great variability across Europe. It means that great variations are observed in the ways plans are made and implemented and much can be accomplished by sharing best practices between cities (See Theme CLIMATE chapter). Cities greatly vary with regard to their green space (EEA, 2012). For instance, many cities in Sweden have a high percentage of green space (> 40%), whereas some cities in Southern Europe have barely any green space left. Reinforcing Blue-Green infrastructure is important not only for climate adaptation (water scarcity, flooding and urban heat), but also to support eco-system services (see Theme Ecosystems chapter), and to improve the liveability and attractiveness of cities.

Co-learning, co-creation and multi-level governance

The City Blueprint analysis and the subsequent categorization of municipalities and regions can facilitate bilateral and regional cooperation when cities explore options to improve their UWCS. The different stages allow for different best practices to be implemented and learning alliances of cities can greatly contribute to the effectiveness and efficiency of these transitions.

Furthermore, the assessment of cities should not focus just on one aspect (e.g. transition to circular economy), as water is interlinked with many other challenges of cities and needs to be considered holistically. Figure 6.6 represents a simplified city in which nine urban sectorial agendas are shown: ICT (Information and Communications Technology), energy and transport, solid waste, green and blue space, water supply, wastewater, climate adaptation, houses and factories. Governance is considered to be a horizontal issue linked with all other agendas in a city. In addition, enabling local food production is a governance issue more and more considered, that also links to water and the circular economy and is also a cross-sectorial governance issue (European Commission 2013; Koop and Van Leeuwen, 2017).

Figure 6.6 - Simplified city in which nine urban sectorial agendas are shown (European Commission, 2013; Koop and Van Leeuwen, 2017).

In fact, during the development or reconstruction of cities optimal use should be made by exploring options for win-win's or co-benefits for the different challenges that need to be addressed in cities. For instance, road reconstruction can be combined with the renewal or installing of water distribution networks, sewer systems, and the creation of blue and green space. This would save a lot of time, money and nuisance for citizens.

From Table 6.3 it can be demonstrated that a smart city policy addressing only ICT, transport and energy can be considered as a maximization of missed opportunities in cities as more than 90% of the potential interactions or win-wins between these sectorial agendas are not explored. The recent decision to include also waste and water is a step forward, but still many opportunities (58%; Table 6.3) are not explored, including climate adaptation in cities, which is another omission. The obvious conclusion is that smarter cities develop a cohesive long-term plan and integrate/combine agendas as this will save time and money and better serves the needs of their citizens.

Table 6.3 - Illustration of the relevance of co-benefits of integration in city planning as part of a cohesive long-term strategy for cities (Koop and Van Leeuwen, 2017).

Policy	Number of issues (n)	Number of P.I.[a]	Issues addressed	Interactions addressed	Missed P.I.	Missed P.I. (%)
Smart cities [b]	9	36	3	3	33	92
Smart cities [c]	9	36	6	15	21	58
SMARTER cities [d]	9	36	9	36	0	0

(a) P.I. is the total number of potential interactions. The number of potential interactions is calculated as follows: P.I. = ½n x (n-1)
(b) Issues addressed are ICT, transport and energy (European Commission 2013)
(c) Issues addressed are ICT, transport, energy, waste (taken as solid waste and wastewater) and water (European Commission 2015b)
(d) Example of a cohesive integral urban agenda addressing all nine topics in a city

The City Blueprint Approach attempts to keep an overview on many aspects to provide a holistic assessment of water issues in the urban systems. The approach can of course continuously be improved, in particular in providing a better assessment of the city's ability to close the loops on resources and improve well-being However, it is a good step towards promoting integration of water in city planning and identifying co-benefits.

6.3. Conclusion on the current performance of European cities

Climate adaptation and wastewater treatment including energy and resource recovery from wastewater are among the big challenges in many European cities, especially in Eastern Europe. On solid waste and wastewater, big steps are needed in European urban areas to follow the transition path to truly circular metropolitan areas.

6.4. The solutions

As an outcome of the WWF7 theme Water and Cities, the Principles for Water-Wise Cities was produced and validated by a large group of water and urban professionals. It outlines a vision of sustainable urban water that can easily be shared with politicians, regulators, and all urban stakeholders. This vision is bringing together years of discussion that took place in various professional forums. It's a framework to guide strategic thinking in urban areas that is intended to be implemented into action in many different context specific ways. The principles also provide a framework to address all urban water related targets of the SDG, beyond SDG6.

Figure 6.7 - Overview of the Principles for Water-Wise Cities (IWA, 2016)

The previous sections show that water challenges in Europe can be articulated around the 4 scales or levels of action of the Principles for Water-Wise Cities: 1/ Regenerative water services for all, 2/ water-sensitive urban design, 3/ basin connected cities, 4/ water-

wise communities. The Principles provide the vision of what each European city should target to achieve. Below are extracts of the Principles for Water-wise cities (IWA, 2016), with minor amendments resulting from the on-going review process. The levels of actions are presented below in reverse order (from 4 to 1) in order to emphasize the importance of PEOPLE taking action, people as enablers to water-wise cities. In addition, this reverse order highlights the value of thinking about the Basin first, before addressing water services challenges.

Level 4. Water-Wise Communities: The implementation of the any of the below Principles requires a holistic approach and strong partnerships. This fourth level of action is about people building on their existing capacities to govern and plan; professionals becoming more “water-wise” in their area of expertise, so that they can integrate water across sectors, highlighting the co-benefits of integrated solutions to unlock investments. It is also about people becoming “water-wise” in their behaviours as citizens. This level of action is where the transition starts; it is where each stakeholder realises the role they have to play to make a difference. Striving to build water-wise communities is the main enabler to addressing the water challenges of urban areas and needs to start with a baseline assessment. The City Blueprint analysis is one assessment tool, presented in the previous chapter to provide an overview of the current status of water management in European cities. However, this framework is in continuous improvement and others are also currently being developed to relate more closely to the below listed objectives.

Level 3. Basin Connected Cities: The city is intrinsically connected and dependent on the basin it is part of and interacts with neighbouring basins. By proactively taking part in basin management, the city secures water, food and energy resources, reduces flood risk and enhances activities contributing to its economic health. This level of action includes three principles:

- Secure the water resource and plan for drought mitigation strategies by sharing the water resource with other users in the basin, namely agriculture, industry and energy sectors, and other cities who all contribute to the basin’s and city’s global economy.
- Protect the quality of the water resource together with the other basin stakeholders, to ensure high quality drinking water achieved with minimal treatment and energy requirements, and ecosystems services (e.g. forest catchment areas, wetlands).
- Prepare for and respond to extreme rain events, by managing flow regimes in rivers, and maintaining adequate vegetation in the basin to minimise flash floods. Invest in coastal storm risks mitigation and flood warning systems.

Level 2. Water Sensitive Urban Design seeks the integration of urban planning with the management, protection and conservation of the total urban water cycle to produce urban environments that are 'sensitive' to water sustainability, resilience and liveability co-benefits. This level of action includes four principles:

- Plan and implement urban design enabling regenerative water services. Design domestic and industrial precincts and buildings in ways that enables regenerative water services. This reduces the water, energy and carbon footprint of housing, contributing to its affordability through lower monthly bills. It also leads to cleaner waterways, benefiting ecosystems and people, while also improving social and urban amenities. It includes building green infrastructure to capture and treat storm water for a range of co-benefits.
- Design urban spaces to reduce flood risks and increase the benefits of rainwater. Increase resilience to flood risks by developing improved drainage solutions integrated with urban infrastructure design so that safe flooding spaces are provided and the city acts as a “sponge”, limiting surges and releasing rain water as a resource. Plan vital infrastructure to enable quick disaster recovery.

- Enhance liveability with visible water from roadside green infrastructure to major blue-green corridors as opportunities for social inclusion: recreation, inclusive public space, economic development and transportation, creating multi-purpose spaces and infrastructure. Urban water services are essential for ensuring sustainable irrigation of parks and gardens, providing habitats for plant and animal species, shade and mitigation of heat islands.
- Modify and adapt urban materials to minimise their impact on water pollution: The urban materials of roofs, walls, surfaces, roads, and urban furniture ought to be carefully selected to prevent the release of pollutants when exposed to sun and rain.

Level 1. Regenerative Water Services for all. The main goal is to ensure public health while protecting the quality and quantity of water resources for future generations by efficient production and use of water, energy and materials. Regenerative water services are underpinned by five principles. Embedding these principles in water and wastewater systems rehabilitation, extension or new development will ensure the resource is protected and not overused. It will create value from energy and resource recovery not only from water but also from other services, and will facilitate financing by generating new revenue, whilst delivering broader economic, social and environmental benefits to the city:

- Replenish water bodies and their ecosystems within the basin by taking from or discharging to them only what can be given or absorbed by the natural environment. Reduce water abstractions to sustainable levels enabling the environment to maintain its capacity for self-renewal. Preserve the quality of these same water sources from wastewater and urban run-off so that it is fit for ecosystems and for use with minimal treatment requirements.
- Reduce the amount of water and energy used. Reduce the demand for unsustainably produced water, depleting storages. Minimise the energy used in moving and treating urban waters, including rain water.
- Reuse and use diverse sources of water with treatment that matches the use, applying the “fit for purpose” water quality approach and Integrated Water Resources Management (IWRM[15]); Recover energy from water whether through heat, organic energy or hydraulic energy; Recycle and recognise the value of “upcycled” materials, such as nutrients or organic matter, using these materials within the systemic approach, as explained below;
- Use a systemic approach integrated with other urban services. Consider the different parts of a water system as one system, and connect water to other services such as health, transport, food production, waste or energy as a whole system, to enable solutions which reduce and reuse while improving services costs efficiently (Figure 6.1, Figure 6.2and Figure 6.6).
- Increase the modularity and ensure there are multiple resource, treatment, storage and conveyance options available throughout the system for ensuring service levels and resilience of urban water systems in the face of either gradual or sudden changes - gradual changes as a result of persistent stresses, sudden changes as a result of shocks to the system and failure to cope any longer with persistent stresses.

By applying the principles for regenerative services when adapting to population growth or decline, or to the impacts of climate change, water services contribute to carbon neutral cities and to rehabilitating their basins.

[15] Integrated Water Resources Management is a process which promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.

In Europe, there is a strong interest of Cities to transition to circular economy. A good overview of technologies that enable resource recovery can be found in the State of the Art Compendium Report on Resource Recovery from Water, published by IWA in 2016 (Holmgren *et al*., 2016). The transition to circular economy approaches requires an enabling legislative framework, a sound economic case, capacity development in applying these new technologies, as well as in business models, innovative financing tools, but also in how to best integrated between urban planning, urban services and water (Van Leeuwen *et al.*, 2018).

As cities transition to circular economy, Cities know they have to adapt to climate change and protect and strengthen ecosystems. They also need to enhance the well-boing and health of citizens. Achieving all this through better water management is the goal. It requires people with adequate soft skills to foster integration of water in the many aspects of city planning and management.

Building blocks towards implementing the vision

Addressing the challenges of cities to become more and more water-wise requires taking action along the "5 building blocks for implementation" outlined in the Principles for Water-Wise Cities. These five building blocks are the enablers to the transition, and areas in which new collaborative actions and partnerships may be fostered at the 8th World Water Forum. Below are extracts of the Principles for water-wise cities:

Shared Vision

- A shared vision moves stakeholders from defending solutions for their own specialties, to defining a set of common drivers for the greater benefit of the urban community.
- A shared vision is an essential prerequisite for ensuring the implementation of new policies and strategies.
- A resilient city vision including water enables people to work together at different scales and across disciplines. It supports the political will needed to invest in long term measures. It provides consistency beyond political cycles.

Governance

- Governance and institutions provide the framework for urban stakeholders to work together, breaking silos to integrate water in all urban services at the building, neighbourhood, metropolitan and catchment scales.
- Policies provide incentives for urban stakeholders to unlock the synergies across sectors, maximising the benefits of water to cities.

Knowledge and Capacities

- Implementing the sustainable urban water vision starts with the existing capacities and competencies of the different urban stakeholders.
- The starting point is upgrading existing educational programs with contents related to sustainable management of urban resources and urban resilience. Current education programs are too fragmented, and often biased to either technological or social challenges, but integrated approaches are missing.
- To fully realize the vision, increased capacities and competencies are needed, through sharing success stories from other cities, learning to work differently with new tools, pooling resources, and opening to other sectors approaches and methods.

Planning Tools

- Asset management, master plans or decision support systems are the means for urban stakeholders to initiate action.

- These tools, developed and used by cross sectoral teams, allow for assessing risks, identifying benefits and co- benefits of projects, defining levels of service, ensuring ownership by stakeholders, and enabling public participation and engagement.

Implementation Tools

- Regulations[16] create incentives. Based on quality assurance, equity, transparency, accountability and sound financing, they provide a solid frame for stakeholders to invest in sustainable urban water.
- Financial tools linked to rigorous asset management plans enable long lasting improved service levels with a well-maintained infrastructure.
- Financing tools which value the ability of solutions to adapt to changes or recover from disasters allow cities to adopt more efficient solutions and transition towards systems requiring smaller and more frequent investments.
- Integrated services combined with shorter investment cycles, and the valuing of co-benefits bring new funding opportunities, providing options to overcome the lack of financial capacity for cities.
- Augmenting traditional financing and contracting models with innovative instruments involving private and public financing, including circular economy mechanisms, opens new funding opportunities which promote regenerative water services.

6.5. Case studies

This section provides tangible examples of European cities that have initiated their transition to becoming more water-wise using vision, governance, capacities, planning tools and implementation tools.

Case study: Amsterdam- Resource recovery city

Amsterdam is the capital of the Netherlands and home to over 850,000 people. Amsterdam and water are intimately connected; the name of the city refers to the adjacent Amstel River, which terminates in the well-known historical canals that run through the city centre. The city's aim is to develop as a competitive and sustainable European metropolis in the face of economic, demographic and climate challenges. Amsterdam has a prominent international position in water management. In the Blue City Index, Amsterdam ranks number one (Figure 6.3 and Figure 6.8). Its water company was the first to deliver piped water in the country (1853) and the first in the world that does not use chlorine in the treatment of its surface water. In 2006 the various urban water-related services were brought under one roof, culminating in the country's first water cycle company called Waternet. Waternet has responsibilities for surface water (rivers, canals, ditches and lakes), groundwater, storm water, drinking water supply and wastewater treatment.

[16] Refer to the IWA Lisbon Charter.

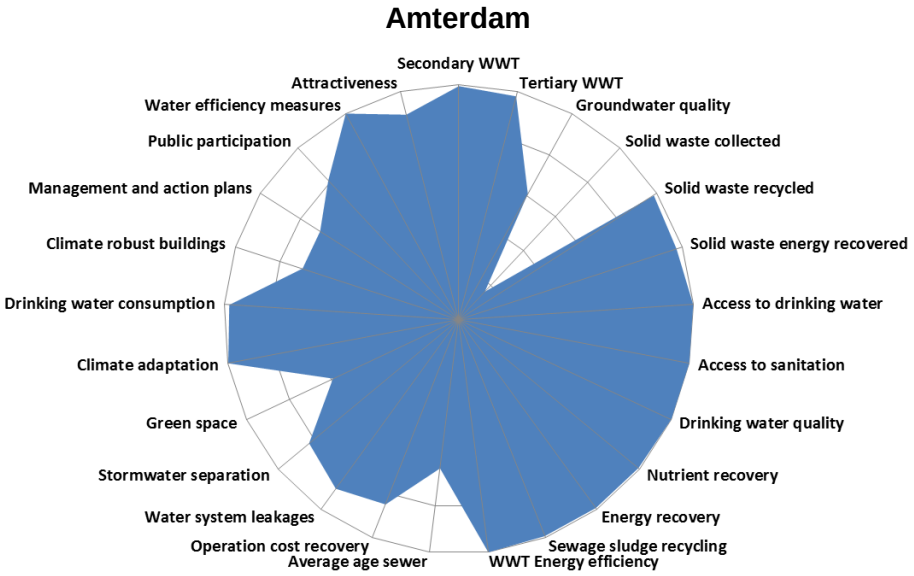
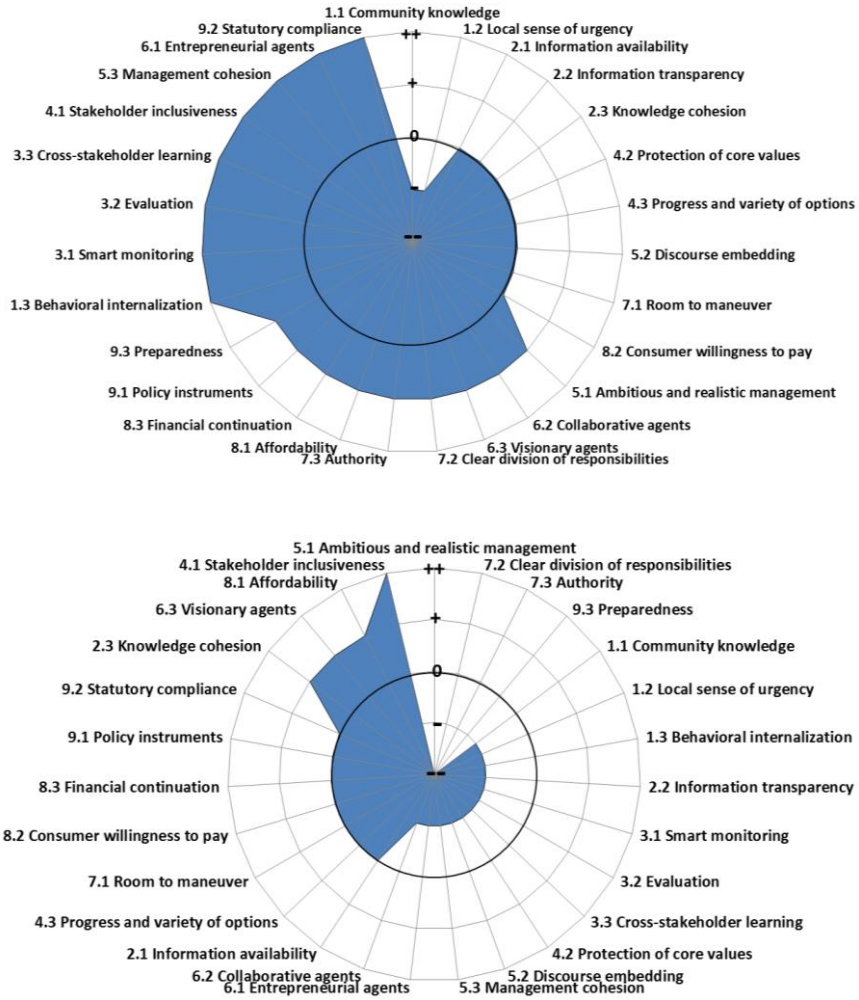


Figure 6.8 - City Blueprint of Amsterdam. The range of the scores varies from 0 (centre of the circle) to 10 (periphery of the circle). The BCI (Blue City Index) is 8.3.

Analysed through the City Blueprint Framework, Amsterdam, like many other urban areas face five main water-related challenges: 1) water scarcity, 2) flood risk, 3) wastewater treatment, 4) solid waste treatment, and 5) urban heat islands (Koop et al. 2017a).

The city's strong vision (water cycle approach) combined with adaptive and flexible policymaking, as well as with strong capacities through linkages to research and education institutions, enabled to work towards closing the loop on urban resources. Four wastewater harvesting strategies are pursued: 1/ production of alginic acid, 2/production of bioplastics, 3/ recovery of cellulose, and 4/ recovery of phosphorus (Van der Hoek et al., 2016; 2017). Therefore addressing the "regenerative services" level of action, while also developing water sensitive urban designs for addressing flood risk through their holistic "water cycle" approach.

The issue of heat stress, however, has not yet reached the political agenda (Figure 6.9), as illustrated by the GCF results of Figure 6.9, comparing the governance capacities on the topic of wastewater and resource recovery with the topic of heat stress.



Governance capacity framework (GCF), third step of the City Blueprint Framework

The GCF addresses specifically the issue of governance on five urban water challenges: (1) water scarcity, (2) flood risk, (3) wastewater treatment, (4) solid waste treatment, and (5) urban heat islands (Koop et al. 2017).

This framework can: (1) compare cities and provide a better empirical-based understanding of the key enabling governance conditions, and (2) reveal the limiting conditions in order to formulate pathways for an effective and efficient improvement in the local capacity to govern water challenges.

The GCF comprises nine governance conditions, each with three indicators. For each of the twenty-seven indicators, a Likert-type scoring scale has been developed that ranges from very encouraging (++) to very limiting (--). The 27 indicators are presented in a clock-wise order from very limiting to very encouraging to assess progression pathways on the specific challenge.

Figure 6.9 - Scores of the 27 indicators of the GCF water governance performance on wastewater treatment (top) and urban heat islands (bottom) for the city of Amsterdam (Koop *et al*., 2017a)

What can we learn from the case study of Amsterdam?

- It is a nice example of building water-wise communities at all levels: political, policies and regulations, research, engineers and operators, and citizens.
- The starting point to improving governance has been to critically assess existing governance practices in an inclusive process and learn from and with involved stakeholders on improving limiting conditions. The City Blueprint Approach facilitated this.
- The method of adaptive policy making has been key in the transition to resource recovery. It enables to update and expand relevant topics in a city when new information becomes available, implying that new opportunities can be seized and threats can be spotted early. This approach applied in Amsterdam to create a policy on resource recovery helped to develop an adaptive policy that functions well in a highly uncertain future.
- In Amsterdam, the critical ingredients for improving the UWCS management has been: (1) High ambitions and political will, (2) technological progress, and (3) good governance.

Case study: Kalundborg, a small city transformed by industrial symbiosis

The Kalundborg Utility is situated on the north-western coast of Zealand, in the City and Municipality of Kalundborg, Denmark, serving about 20,000 people. Due to a change in

legislation, the company separated from the Kalundborg Municipality in 2009 to continue as a private limited company with all shares owned by the municipality. The company provides products and services including drinking water, processed water, wastewater treatment and district heating.

Since the Kalundborg Utility's separation from the municipality in 2009, it has developed a solid strategy to emphasize its sustainability goals and integrate a secured water supply into its business model. The current 4-year strategy of the utility aspires to inspire and create social and environmental value within the Kalundborg Utility and City. The goal of this strategy is to re-define sustainability while fulfilling traditional virtues including: low prices, high quality, and security of water supply.

How does the Symbiosis partnerships work?

Kalundborg Symbiosis is a circular economy collaboration project between the City of Kalundborg and a number of private companies in the area. These companies benefit from the residuals from their collaboration partners. One partner's waste becomes another partner's resource. This model was developed more than 40 years ago and was founded with economic interests in mind, and it was not until later that the environmental benefits of the symbiosis were recognized. In Kalundborg the wastewater from the industry is used for biogas production, heat pumps for district heating and there is a discussion to look into phosphorus and nitrogen removal and production.

The Kalundborg Utility is involved in three main types of water streams in the Kalundborg symbiosis. First, the utility supplies treated and untreated surface water in two qualities from Lake Tissø to Novo Nordisk and Novozymes (pharmaceutical and enzymes factories). By using surface water, the scarce groundwater resources are preserved. Second, the utility receives industrial and household wastewater, which is cleansed at one of Europe's most advanced wastewater treatment plants in Kalundborg. Here, complex wastewater from the industry can be treated in one of the many specialized processes including an ozone plant and moving bed biofilm reactor (MBBR) technology. The ozone plant was built in 2002 and it was co-financed by Novozymes and Novo Nordisk. At the time, it was necessary to make use of this best available technology to comply with legal requirements to the discharge quality. The industry has since then developed their pre-treatment of the wastewater, and today Kalundborg Utility only runs the ozone plant during rare peaks.

The industries' production of insulin and enzymes has shown great potential for biogas production. Novozymes, Novo Nordisk, DONG Energy, and Bigadan have agreed to produce biogas from 2018 using residual products from fermentation processes. The sludge from the biogas production will be used for agricultural purposes. Currently, Kalundborg Utility is exploring the possibility to put up a digestion tanks for sanitary sludge to produce gas for Bigadan's upgrading facility.

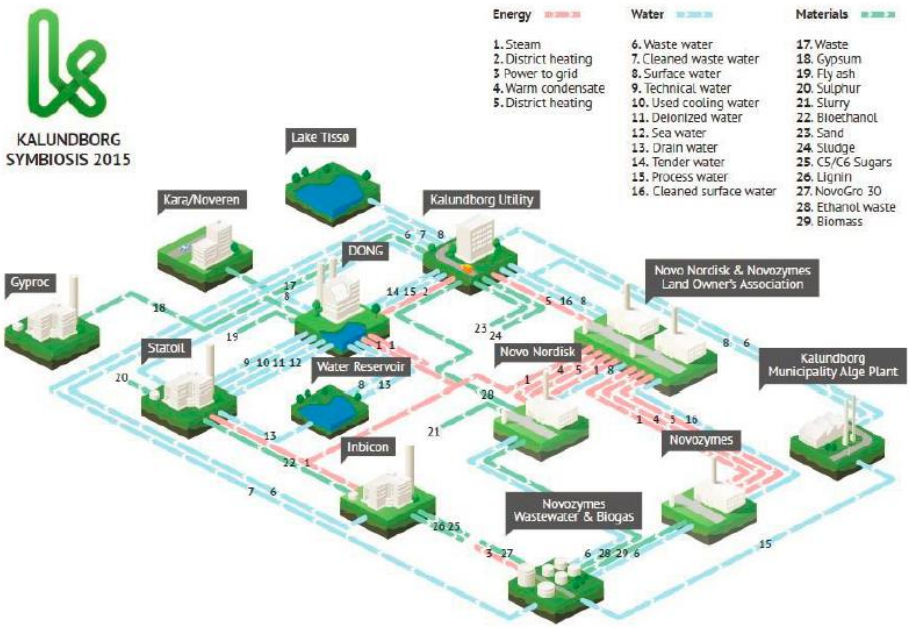


Figure 6.10 - Schematic of water, energy and materials flow between producers and users. One partner's waste becomes another partner's resource.

There is a high degree of reuse of water, i.e. water used for cooling will afterwards be used as feed water to district heating. Sustainable and safe handling of wastewater from the treatment plant is also important and this can be used by farmers as fertilizer

Until now, the only by-product from Kalundborg Utiliy's wastewater treatment plant has been sand and sludge. The utility uses the residual sand to refill sewer renovations after a sanitation process. While the sand is re-used internally in the company, the sludge, which lives up to national regulations, is drained and spread on farmland.

As of 2017, the utility has constructing a large-scale heat-pump, which will be able to transfer heat from the unusually hot industrial wastewater to the district heating network. By doing so, Kalundborg Utility will supply district heating with a minimum of negative environmental externalities and can lower the temperature of the effluent. This innovation reduces carbon emissions by 16.000 tons yearly and covers 30% of the annual district heating supply.

What can we learn from the case study of Kalundborg? Kalundborg has approached closing the loop on resources (water, energy and materials) in a holistic systems approach. Its leaders have overcome the cross-sectorial governance challenge, simplified by the small size of the system (compared to large metropolitan areas). This is a great demonstration of technical, business cases and financing models that could be applied at larger scale or district by district in larger cities. It fully demonstrates the level 1 of the Principles for water-wise cities, "regenerative water services", while fully integrating the value water-sensitive urban design and the connection to the basin in the city's strategies. This symbiosis project is enabled by a strong water-wise community in Kalundborg.

Case study: Lyon, permeable city

Lyon is the third largest city in France and has a history of more than 20 centuries. The central city has a population of almost 500 000 and the wider metropolitan area about 2.1 million. Situated in eastern France at the confluence of the rivers Rhône and Saône, Lyon is a major economic center. Its location, quality of life and economic condition help rate Lyon as one of the most attractive French cities.

The main challenges of Lyon are: 1/ Urban heat islands, 2/ droughts with stress (quantity and quality) on water resources (groundwater and Rhône River) and 3/ increasing the attractiveness of the city center for people and business. The vision of the Greater Lyon is reconciling the urban and aquatic environment for the wellbeing of the population and to preserve ecosystems in the basin. This means increasing natural areas and the permeability in the city. Lyon recognizes that integrating water in urban planning is key to achieve this.

The greater Lyon Metropolis was one of the first endorsers of the Principles for Water-Wise cities in 2016. They have used this water-wise vision to rally many of their basin stakeholders and water governance at national, regional and local scale. This strong shared vision is supporting their “Lyon – permeable City” plan to further increase natural areas and permeability to replenish their water resources, create alternative resources, control flooding, reduce heat islands and in general improve quality of life through green spaces. With this action plan Lyon is anticipated to score much higher on the several indicators of the blue City Framework in the future, in particular on “green space” (Figure 6.11).

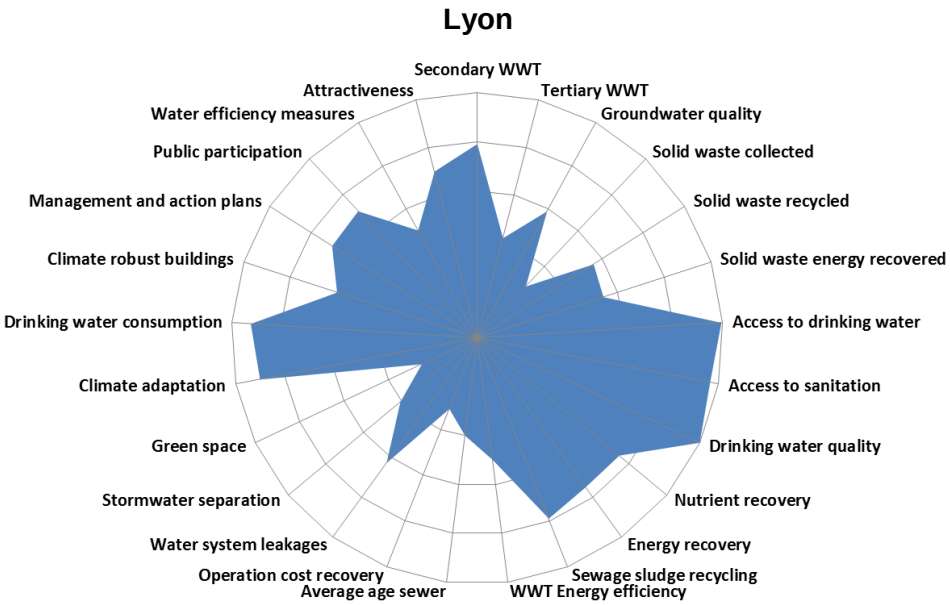


Figure 6.11 - City Blueprint of Lyon. The range of the scores varies from 0 (centre of the circle) to 10 (periphery of the circle). The BCI (Blue City Index) is 6.0.

What can we learn from the case study of Lyon?

- It is a great example of building water-wise communities at all levels: rallying politicians, regulators, research &education, engineers and operators, and citizens around the water-wise cities vision and the “Permeable City” action plan.
- Transitioning to becoming a fully water-wise city is a step by step process. First steps have been taken: The « Miribel Jonage » area was redeveloped to include natural flooding areas upstream of the City to better protect it against flooding from the Rhône. This area also offers a secondary water supply source, a recreational zone, and a wetland network with the richest biodiversity in the region. In the city itself, the riversides have been transformed to provide city dwellers with a connection to their waterways, raising awareness to water benefits and risks.

Case study: Porto, preserving a scarce water resource

Porto is the second largest metropolitan area in Portugal, with a population of around 1.8 million people. It's known as the "capital of the north". The city is located along the Douro river estuary in Northern Portugal. Porto is one of the oldest European centres, and its

historical core was proclaimed a World Heritage Site by UNESCO in 1996. This is one of the reasons why Porto receives over 500,000 tourists per year.

A recent analysis of Porto with the TPF (Figure 6.12) revealed the following five challenges for the City: heat risk, economic pressure, high unemployment, salinization and urban drainage flooding. These challenges relate to water either directly or indirectly in the way they affect potential progression pathways. In that context it is interesting to know that the green space of the inner city of Porto is only 18.6%. The CBF analysis revealed that Porto performs well for almost all water management indicators. The city can improve on: reducing solid-waste production, nutrient recovery, energy recovery, WWT Energy efficiency, average age of the sewer, green space and operation cost recovery

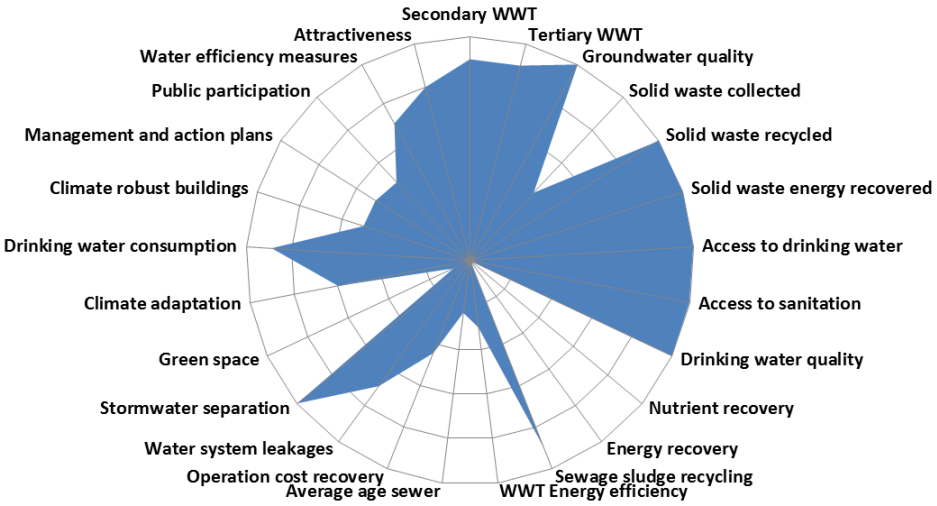


Figure 6.12 - City Blueprint of Porto. The BCI of Porto is 5.3. Water consumption and waste production includes non-resident population of 500.000 tourists.

What can we learn from the case study of Porto? It's about the way forward, and taking action towards becoming a fully water-wise city:

- The 'Porto, a Water Sensitive City' programme promotes the incorporation of the best management practices of UWCS in the planning policy, in order to improve the population's quality of life and to contribute to sustainable economic development and regional competitiveness, fulfilling the vision for the future of the 'Europe 2020' Strategy.
- 'Porto without Water Losses' project, which consists of a drastic reduction of water purchased but which does not reach consumers taps. With effective management measures, almost without investment, Aguas do Porto has reduced water loss by half in just eight months (56,000 m^3 to 28,000 m^3 per day). The city of Porto, has becomes a case study at national and international level, promoting the benchmarking with similar organisations and the transferability of this model.
- New initiatives are also taking place to increase green space in the city.

Water sensitive urban design is an innovative management approach to a scarce resource, allowing all the relevant aspects of the water cycle to be dealt with in a holistic way. Water scarcity and efficient water management is of high public concern for the Southern part of the European Union as water is an increasingly scarce resource.

6.6. Conclusions and recommendations

From the assessment presented in this section the following conclusions and recommendations emerged, in order to further implement resource recovery in European cities, and have cities truly become water-wise cities:

- Creating a sense of urgency, bottom-up approaches (community engagement) and strong political leadership on sustainable water management are all needed for the development of water-wise communities
- Improving soft skills to better collaborate between institutions, departments.
- Improving Intra institutional cooperation to address water challenges beyond improving soft skills: it also requires long-term funding security, stakeholder engagement, common goals and strategy formulation and clear benefits for the involved stakeholders and institutions
- Adaptive regulations that incentivize a water cycle approach, closing the loop on resources, and water sensitive urban design
- The ability to identify cost-sharing for co-benefiters of multi-purpose infrastructure (where water is one component) at basin, city or utility scale
- Defining the problem to be solved by engineers using a holistic approach rather than sub-systems approach, i.e., when governments assign missions to an institution, or define a new investment project, there is an opportunity to apply a more integrated approach, which will then bring up new ways of solving the individual problems. This message is the same from all sectors (transport, energy, waste, etc.; see Figure 6.6).
- Learning alliances of cities can greatly accelerate these processes, and this is urgently needed as the time window to address the challenges of water, waste and climate change in cities is rapidly closing.

In order for cities to take action, establishing a baseline is a key step. The baseline assessment provides the diagnosis and can lead to clear steps for improvement. Currently, there are no standardized assessments of European cities and the only attempt until now is the publication of the Urban Water Atlas for Europe that covers about 40 cities, mainly in Western Europe. Promoting the importance of assessment frameworks is essential, while at the same time continuously improving these frameworks, so that they best guide cities to identify progression pathways to water-wise urban development. The assessment of the challenges in cities, options for improvement should be shared actively at regional or European level. The creation of city-to-city learning or learning alliances of cities will greatly benefit the transition to water wise cities (European Commission 2017). Probably, the biggest barrier in solving European diverse water challenges is a lack of sufficient governance capacity. This has also been clearly highlighted by the OECD (OECD 2015a, b).

Smart Cities are cities that have water-wise governance. We suggest to summarize this by the Seven C's of Water-Wise Cities (Koop et al. 2017b). (Note: these are not yet included in the "Principles for Water-Wise cities"):

- Citizen-centred: create adaptive, healthy and liveable cities for people
- Children and grandchildren first: focus on anticipatory long-term strategies
- Collaboration: involve stakeholders right from the start
- Comprehensive & coherent planning: integrate water and other sectorial agendas
- Co-benefits or win-wins must be explored
- Cost-effective & cost-efficient solutions
- Collaborative learning: enhance city-to-city learning

6.7. References

In the writing of this chapter the following bibliographic references have been used:

Agenda. SWD (2015) 109 final/2. Brussels.http://ec.europa.eu/regional_policy/en/conferences/cities-2015/ Accessed September 30, 2015.

EEA (2012). Urban adaptation to climate change in Europe: Challenges and opportunities for cities together with supportive national and European Policies. Copenhagen: European Environment Agency. (EEA Report 2/2012).

EEA (2017). Climate change, impacts and vulnerability in Europe 2016. An indicator-based report. Copenhagen: European Environment Agency. (EEA Report 1/2017).

European Commission (2013). European innovation partnership on smart cities and communities: Strategic implementation plan. Brussels: European Commission.

European Commission (2015a). Closing the Loop—An EU Action Plan for the Circular Economy. Brussels, Belgium. http://ec.europa.eu/priorities/jobs-growth-investment/circular-economy/docs/communicationaction-plan-for-circular-economy_en.pdf. Accessed 17 December 2015

European Commission (2015b). Results of the public consultation on the key features of an EU Urban

European Commission (2017). European Innovation Partnership on Water. Brussels, Belgium. http://www.eip-water.eu/City_Blueprints. Accessed 12 March 2015.

Gawlik BM, Easton P, Koop S, Van Leeuwen K, Elelman R (eds) (2017). Urban Water Atlas for Europe. European Commission, Publication Office of the European Union, Luxembourg

Holmgren, KE, Li H, Verstraete W, Cornel, P (2016). State of the Art Compendium Report on Resource Recovery from Water. International Water Association, The Hague

IWA (2016). The IWA Principles Water Wise Cities. The International Water Association.

Koop S.H.A. and Leeuwen, C.J. (2017). The challenges of water, waste and climate change in cities. Environment, Development and Sustainability19(2): 385–418.

Koop S.H.A., Aartsen M., Goswami B., Oost J., Schmidt G., Van Leeuwen C.J. (2017b). City Blueprint Approach: Key opportunities for India's urban water challenges. Water Digest India, March 22: 66-73. http://thewaterdigest.com/Emagazine_2017/magazine.html

Koop SHA, Koetsier L, Van Doornhof A, Reinstra O, Van Leeuwen CJ, Brouwer S, Dieperink C, Driessen P (2017a) Assessing the Governance Capacity of Cities to Address Challenges of Water, Waste and Climate Change. Water Resources Management, 31(11), 3427-3443

Koop SHA, Van Leeuwen CJ (2015b) Application of the Improved City Blueprint Framework in 45 Municipalities and regions. Water Res Manag, 29(13), 4629–4647

Koop, SHA, & Van Leeuwen CJ (2015a). Assessment of the sustainability of water resources management: A critical review of the City Blueprint approach. Water Resources Management, 29(15), 5649–5670.

OECD (2015a). Water and Cities: Ensuring Sustainable Futures, OECD Studies on Water, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264230149-en

OECD (2015b). OECD Principles on water governance. Paris: Organisation for Economic Cooperation and Development.

OECD (2015c). The Economic Consequences of Climate Change, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264235410-en

OECD (2016). Water Governance in Cities, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264251090-en

Philip, R., Anton, B., van der Steen, P. (2011). SWITCH training kit. Integrated urban water management in the city of the future. Module 1. Strategic planning, ICLEI, Freiburg. http://www.switchtraining.eu/. Accessed 15 May 2013.

UN (2017). Sustainable Development Goals https://sustainabledevelopment.un.org/sdgs Accessed on 20 August 2017

UNEP (2013). City-level decoupling: Urban resource flows and the governance of infrastructure transitions. A report of the working group on cities of the International Resource Panel. Swilling M., Robinson B., Marvin S., & Hodson, M. Nairobi: United Nations Environment Programme. International Resource Panel.

Van der Hoek JP, de Fooij H, Struker A (2016). Waste Water as a Resource: Strategies to Recover Resources from Amsterdam Waste Water. Resour Conserv Recy 113, 53–64

Van der Hoek JP, Struker A, De Danschutter JEM (2017). Amsterdam as a Sustainable European Metropolis: Integration of Water, Energy and Material Flows, Urban Water J 14:1, 61-68

Van Leeuwen K, de Vries E, Roest, K en Koop, S. (2018). Energy & Raw Materials Factory of the Dutch Water Authorities: its Role in the Circular Economy of the Netherlands. Environmental Management (DOI 10.1007/s00267-018-0995-8.

WWAP (United Nations World Water Assessment Programme) (2017). The United Nations World Water Development Report 2017. Wastewater: The Untapped Resource. Paris: UNESCO

7. Water and ecosystems in Europe

7.1. Contents

This chapter details the assessment made in the European Regional Process about Europe and ecosystems: water quality, ecosystem livelihoods and biodiversity. This text was prepared by Peter Gammeltoft (International Commission for the Protection of the Danube River ICPDR).

7.2. Introduction

With increasing pressures on surface and groundwater resources, the issue of water security becomes increasingly important and water resources management becomes an ever more important tool. Historically, water management in Europe focused for centuries on resolving conflicts between and reconciling different water uses and on ensuring a supply of good quality fresh water for major human settlements.

Due to repeated cholera epidemics and other public health issues in Europe's rapidly growing cities there was from the 19th century an increasing focus on sanitation to ensure that water was safe to drink. In order to avoid contamination of drinking water, distribution and abstraction arrangements, collection of human waste and drainage networks by establishing distribution and abstraction systems for clean water and collection and disposal of human waste and drainage water through sewer networks was established in many areas to avoid contamination of drinking water resources.

In addition to drinking water supply, water bodies also provided water for economic activities such as agricultural and industrial production as well as serving other economic purposes such as fishing, aquaculture, transport of people and goods and providing energy by driving water mills.

The structure and hydrology of many of Europe's water bodies was significantly altered to increase water availability, guarantee the suitability of water bodies for uses such as navigation, increase the amount of land available and to protect human settlements and their economic activities against impacts of floods and droughts. This was done e.g. by constructing dams, reservoirs and transport infrastructure (ports and locks), draining wetlands for new land-use such as urbanization or new agricultural land, and constructing embankments to stabilize river banks and provide flood protection in urban areas.

Overall, a total of 17% of the EU's surface water bodies were classified as either "heavily modified" or "artificial" for the purpose of river basin planning in 2015 and as many as 41% of all European Union surface water bodies were identified as subject to significant pressures due to modification of structure or hydrology (EEA, 2018 – p. 8).

Good quality water is a key resource for human settlements, public health and economic activity. The challenge in the 21st century is ensuring its availability in a rapidly changing setting, while managing the resulting multiple pressures on water related ecosystems to ensure that they are healthy and protect the services they can provide to society, and to restore them where they have been lost.

Globally, all jobs in agriculture, 90% of jobs in industry and 40% of jobs in services are water dependent (WWAP, 2016). Economic performance and employment therefore depend on availability of good quality water. Good water management is thus a key building block in Europe to ensure that government policies are able to deliver good economic performance and to sustain the livelihoods of the European population.

Most livelihoods in the European region today are sustained by use of water outside the ecosystems themselves and few undisturbed or nearly undisturbed water ecosystems are left. It is conceptually more useful to discuss the role of "ecosystem services" (of

which availability of good quality water is one) and the impact on these of the changes in the water bodies rather than discussing “ecosystem livelihoods” of which few are left in Europe.

7.3. Water security - ecosystem services, sustainable development and regulatory frameworks

Water related ecosystem services are the provisioning, regulating and cultural services provided by water bodies and other water related ecosystems. They go well beyond simply providing clean water and include water supply, aquatic life, biomass, genetic resources, biodiversity preservation, water quality regulation, hydrological regulation, recreational opportunities, aesthetic and cultural values[17],[18]. Human settlements, quality of life and economic activities in all sectors (industry, agriculture, services) are critically dependent on the provision of these services and will suffer in the absence of these services.

Pollution from sanitation, agriculture and industry, changes in land-use patterns, over-abstraction, modifications of hydrology and water body structure have led to a degradation of water-related ecosystems. These degradations have had a direct and significant negative impact on the provision of the full range of ecosystem services which are normally provided by the unperturbed or slightly perturbed water ecosystems.

Ecosystem services provide significant value for society and cannot be ignored. There is currently no overall assessment available of the value of water ecosystem services in the European region. A recent estimate (Costanza *et.al*., 2014) for the global value of ecosystem services from all ecosystems in 2011 is 125-145 trillion 2007-US $ annually, corresponding to 1.7-1.9 times global GDP (in Purchasing Power Parities (PPP)). Although the value of ecosystem services includes benefits that are not accounted for in GDP and the numbers therefore are not directly comparable, the numbers clearly indicate that the loss of ecosystem services cannot be ignored when assessing the need for water management measures.

An assessment carried out in 2011 by the European Commission (European Commission, 2014) of the benefits of the EU’s Natura 2000 network of protected sites alone indicates that the overall benefit of the network is of the order of 200-300 billion €/year (265-400 2011 US $/year at Purchasing Power Parity(PPP)) and that the benefits associated with water related ecosystems are of the order 15-50 billion €/year (20-66 billion 2011 US $/year at OECD Purchasing Power Parities (PPP)).

Stakeholders are increasingly aware of the threats and challenges to water security and the importance of finding sustainable answers to their water security issues. Public authorities, water managers and the water industry are becoming very aware of the issues, more and more industrial companies are becoming aware of the issues as witnessed by the fact that water security has consistently been identified as major risk for industry and the economy by the World Economic Forum. But there is still significant scope for improvement in industry as confirmed by surveys carries out for the Carbon Disclosure Project (e.g., CDP, 2017)[19]. Furthermore, some other stakeholders, including many agricultural stakeholders, however, have not yet taken all the action needed to save and protect water in the areas where this is needed and to implement changes in land use and land management to guarantee the continued provision of ecosystem services and availability of clean water.

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[17] See e.g. COWI *et al*., (2014) which provides suggestions for how to ensure that the ecosystem services concept can be fully integrated into water management.

[18] For an overview of water ecosystem services, see e.g. Grizzetti *et.al.* (2016).

[19] For more information see https://www.cdp.net/en/research/global-reports/global-water-report-2017

Current conditions for accessing the resource do often not correspond to the need to alleviate the pressure on water resources. The longevity, and in some cases even perennity, of access permits or concessions protect incumbent users prevent optimal allocation and use of water in accordance with changing circumstances and limits the possibilities of optimising ecosystem services. Public authorities and legislators need to address this issue.

If the European region is to successfully resist the pressures from future land-use change, climate change and demographic change as set out in Chapter 4, an integrated approach to water security is needed. Changes in precipitation and temperature patterns are expected to lead to increased frequency and intensity of extreme events, pollution, risks of droughts and floods, more permanent and seasonal water scarcity which will result in a step change in negative economic and social impacts if no action is taken.

An example of the step change in water-related risks are the losses resulting from floods - which have increased significantly in Europe over the past 30 or more years[20]. They are set to increase very significantly, especially after 2050. See e.g. Figure 7.1 which shows that current average levels of flood losses in the European Union of about 5 billion euros/year could rise to close to 100 billion euros/year in 2080.

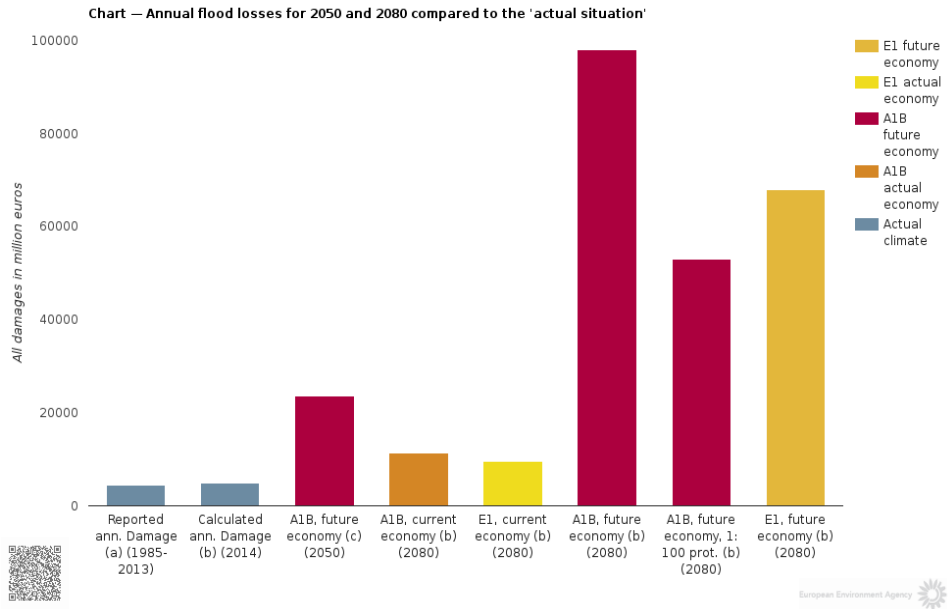

Figure 7.1 - Projected annual flood losses in the European Union for 2050 and 2080 compared to current situation (source: EEA[21])

There has so far been little or no incentive for sectors causing environmental degradation or other water related risks to take corrective measures. This is the result of the fact that, often, other sectors have born the cost of the loss of ecosystem services, including in situations where losses were diffuse and fragmented. There were no economic incentives and absence of joined-up nature and water management.

In view of the magnitude of the valuation of benefits and future risks, water resources cannot meaningfully be managed independently of water ecosystems and their restoration and conservation. Water management needs to take full account of water ecosystem services. Failing to do so will lead to significant welfare losses.

[20] https://www.eea.europa.eu/data-and-maps/indicators/river-floods-2/assessment

[21] https://www.eea.europa.eu/data-and-maps/daviz/annual-flood-losses-for-2050#tab-chart_1

It is worrying that the European region is far from meeting its target under the UNECE Water Convention[22] of protecting ecosystems and for the countries where it is applicable, the European Union target of attaining good water status[23]. The situation differs across countries and countries in Eastern Europe, Central Asia and some countries of South East Europe are generally lagging behind in implementation. In view of the economic importance of ecosystem services, it is worrying that in the countries applying the Water Framework Directive, contrary to the question of bringing down pollution, less attention has so far been given to restoring and protecting the structure and hydrology of the water related ecosystems to meet the target of "good status", thus potentially jeopardising the benefit of the many services depending on healthy ecosystems.

The need for a more integrated approach is explicitly acknowledged in the UN's 17 Sustainable Development Goals adopted in 2015. The goals take full account of the human rights dimension and have specifically been designed as indivisible. They reflect the need for more joined-up solutions in a world that will have to provide a decent life for what is likely to be 10-11 billion inhabitants. The Sustainable Development Goals are mutually supportive and attaining one goal facilitates attaining the other goals. Conversely, failing to attain a goal puts at risk attaining the remaining goals. It is therefore materially important to ensure that one goal is not attained at the expense of other goals. They should all be attained by 2030. In the European region, there is a particularly close interdependency between attaining SDG 6 and attaining the Sustainable Development Goals 2 on food and agriculture, 3 on Health, 7 on energy, 8 on work and economic growth, 10 and 11 on infrastructure and sustainable cities, 13 on climate action and 14 and 15 on life in the seas and on land.

SDG 6 contains a number of targets on provision of drinking water and sanitation for all, reducing pollution, improving water use efficiency, implementing integrated water resources management and transboundary cooperation, protecting and restoring water related ecosystems, international cooperation and support to capacity-building in developing countries and involvement of local communities[24].

As set out in Chapter 9, governance regimes are in place in most countries of the region to ensure that ecosystem health is taken into account in water management[25]. Under the UNECE Water Convention this is the case for management of transboundary rivers and lakes in the whole region, and, in countries applying the EU's Water Framework Directive[26], for all inland and coastal water bodies, whether transboundary or not. These legal frameworks are the European region's version of Integrated Water Resources Management.

Other relevant legal frameworks are the Council of Europe's Bern Convention on the Protection of European Wildlife and Natural Habitats with its Emerald Network of protected sites and the EU's Birds and habitats Directives and the associated Natura 2000 Network of protected sites.

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[22] The term UNECE Water Convention in this text refers to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes adopted in Helsinki in 1992.

[23] See e.g. SOER 2015, EEA (https://www.eea.europa.eu/soer-2015/europe/freshwater).

[24] See e.g. https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals

[25] The existing legal frameworks address water quality, ecosystem health and water related risks but do not address directly ecosystem services. However, as they generally aim at restoring water quality, ecosystems, hydrology and morphology to near natural conditions and at the same time reduce flood risks, they can be expected to lead also to a restoration of lost ecosystem services associated with the water bodies in their natural state.

[26] The EU's Water Framework Directive builds on a number of supporting Directives, including Directives on Nitrate Pollution from Agriculture, Urban Waste Water Treatment, Industrial Emissions, Chemical Substances and Nature Protection.

While the European Union has powers to enforce compliance with requirements, the UNECE Water Convention and the Bern Convention have no such powers. A number of non-EU/EEA countries have furthermore committed to implementing the European Union legislation on water or to approximate their legislation with that of the EU.

In addition to international regulation, the individual countries in the region have their national legal frameworks transposing these requirements into national law. Some countries in Eastern and South-Eastern Europe and Central Asia are, however lagging behind in this respect[27].

In spite of a significant mobilization of stakeholders, implementation continues to be a challenge (see e.g. EC, 2012). The implementation difficulties relate in particular to lack of transboundary cooperation, insufficient coordination of implementation of nature and water policies, sector policies pursuing aims that are at odds with water and nature protection policies, lack of coordination with other sector policies such as land-use, agriculture or energy policies and absence of the necessary mobilisation of finance for green/blue infrastructure investments to restore ecosystem services.

7.4. Pollution has been significantly reduced, but important challenges remain

In large parts of Europe, significant progress in reducing pollution has been made over the last 3-4 decades. However, depending on the sub regions concerned, one or more pollution issues remain a problem for water quality in most parts of the European region, either because of high densities of population or economic activities, or because of lack of sufficient implementation of measures to control pollution, or both.

Sewage and organic water pollution and its treatment

30-50 years ago, many of the European region's major rivers were very heavily polluted, receiving large amounts of untreated sewage and industrial wastewater. Sewage and wastewater are sources of organic pollutants causing oxygen depletion in the receiving waters, pathogens, excess nutrients causing problematic algal growth, and hazardous substances. Pollution with sewage can render waters unfit for use as a source of drinking water, for economic use, for leisure and for supporting ecosystems. It can thus have an important negative impact on the ability of water bodies to provide ecosystem services.

Sewage is not the only source of sediment and organic and nutrient pollution inputs to water bodies. Other significant sources are industrial discharges, especially from food and beverage industries, and fertilizer industries. Industrial wastewater discharges pollute with oxygen consuming organic pollutants, sediments and nutrients. Industrial discharges of such pollutants can normally be treated with the same technologies as those used for sewage treatment.

Implementation of urban sewage treatment and treatment of industrial wastewater has increasingly become the norm in large parts of the region. As a result, there have been significant improvements of water quality in many European rivers over the last 3-4 decades. Figure 7.2 below shows how the SDG6 water quality indicators Biological Oxygen Demand and Phosphorous in European Union river waters has fallen significantly over a 20-year period.[28]

[27] See e.g. Environment Policy Review Reports (EPR) for individual countries from UNECE – Reports can be found at https://www.unece.org/environmental-policy/environmental-performance-reviews/enveprpublications.html

[28] Both indicators are reported in the Eurostat indicator report at http://ec.europa.eu/eurostat/en/web/products-statistical-books/-/KS-04-17-780

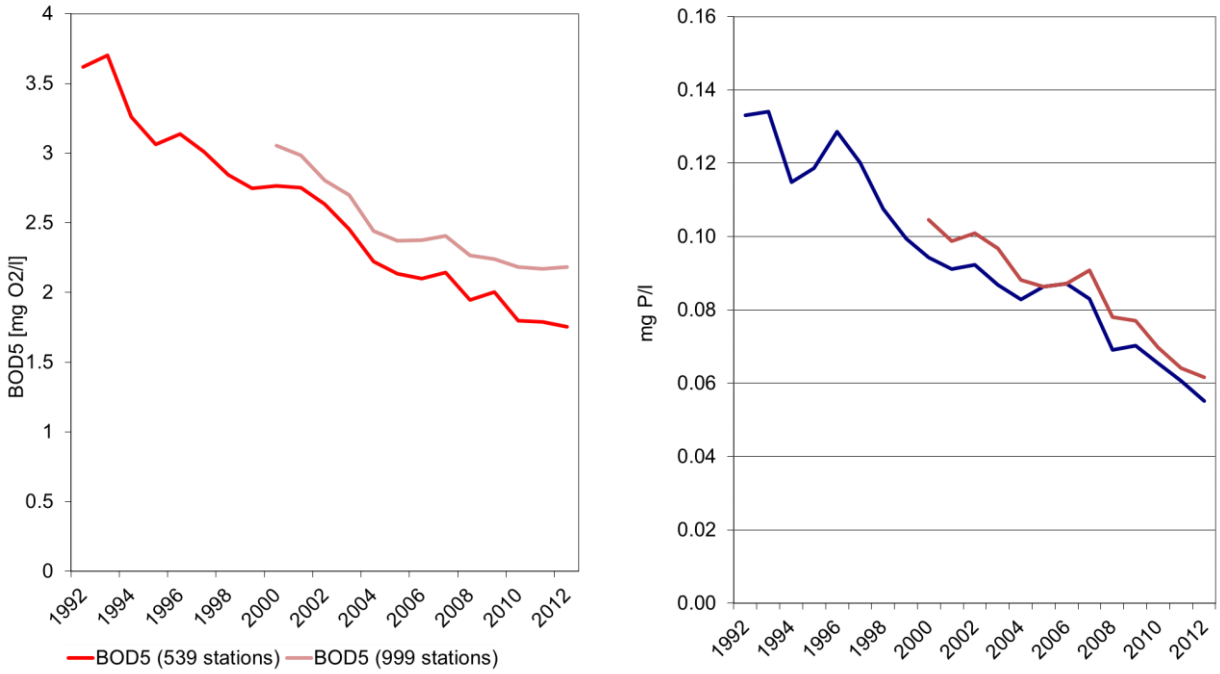


Figure 7.2 – Trend in Biological Oxygen Demand and phosphate in European rivers 1992-2012 (source: EEA[29])

In the UNECE Water Convention, all countries have committed to implement at least biological treatment of sewage in transboundary watercourses and international lakes. In the EU, more specific legislative requirements to sewage treatment are in place and are universally applicable. Based on information from 2014-15, there are high levels of compliance with treatment requirements in most of the countries that were members of the European Union before 2004 (EC, 2017a). The countries of Central and South-Eastern Europe and the Mediterranean who joined the Union later have a larger compliance backlog, as implementation has taken longer than originally foreseen (EC, 2017a). Non-EU countries in Eastern Europe, South-Eastern Europe (West Balkan countries and Turkey), the Mediterranean and Central Asia are, with respect to implementation of sewage treatment, generally lagging behind the European Union countries with the exception of Belarus. Figure 7.3 and Figure 7.4 illustrate the trends and the diversity of situations, showing the evolution over time of the proportions of different levels of sewage collection and treatment in the countries of the European Union, the European Free Trade Association, Turkey (Figure 7.3) and the West Balkans (Figure 7.4).

[29] https://www.eea.europa.eu/data-and-maps/indicators/oxygen-consuming-substances-in-rivers/oxygen-consuming-substances-in-rivers-7

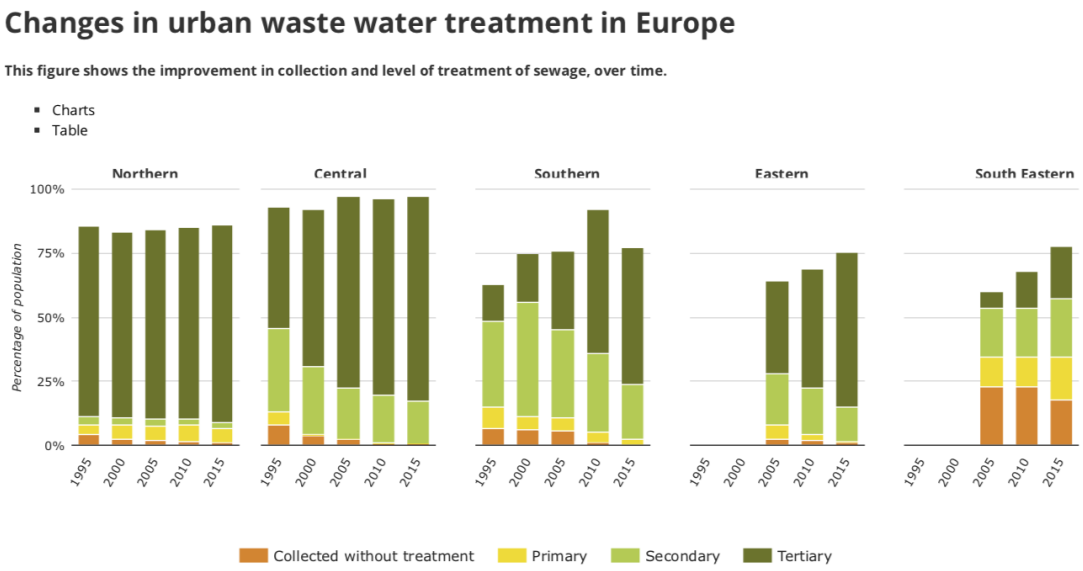


Figure 7.3 - Changes in wastewater treatment in different regions of Europe between 1995 and 2015 (source: EEA[30])

(Northern = Finland, Iceland, Norway, Sweden; Central = Austria, Denmark, United Kingdom, Germany, Ireland, Luxemburg, The Netherlands, Switzerland; Southern = Cyprus, France, Greece, Malta, Portugal, Spain; Eastern = Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia; South Eastern = Bulgaria, Romania, Turkey)

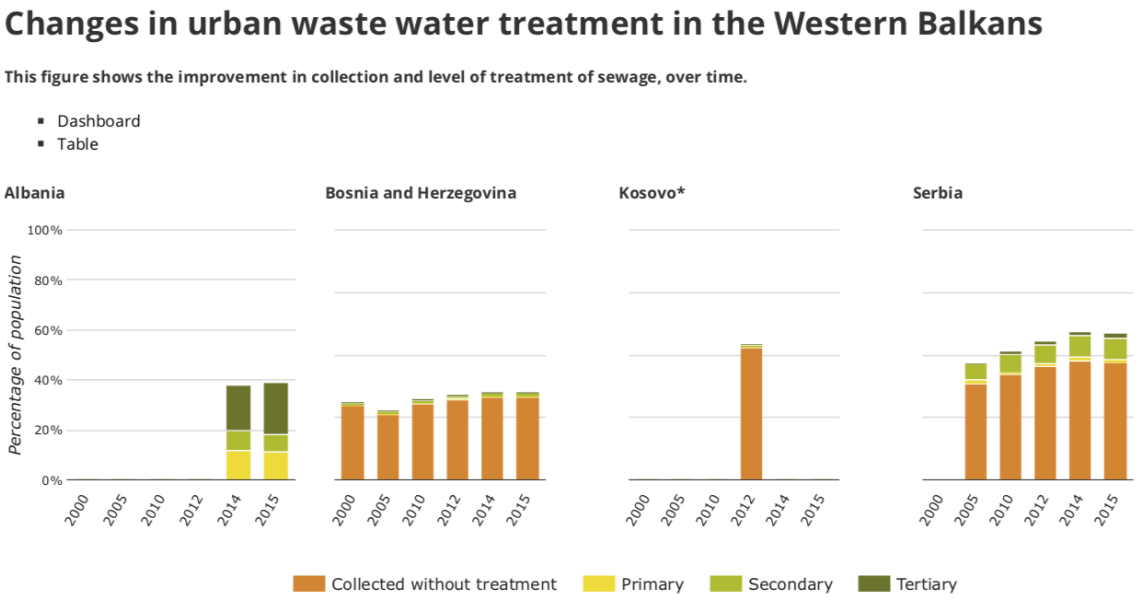


Figure 7.4 - Changes in wastewater treatment in Western Balkan countries between 2000 and 2015 (source: EEA[31]) (*This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.)

Both the UNECE Water Convention and European Union legislation require reduction of nutrient inputs from sewage and from industrial discharges. Nutrient pollution can lead to excessive algal growth and result in oxygen depletion and toxicity, either in the surface water bodies to which nutrients are lost, or in the coastal waters where the fresh waters

30 https://www.eea.europa.eu/data-and-maps/indicators/urban-waste-water-treatment/urban-waste-water-treatment-assessment-4

31 idem

are discharged to the sea. Where European Union legislation is applied, removal of nutrients from sewage and industrial wastewater is required where they could cause excessive algal growth. For the EU, EFTA Countries, the West Balkans and Turkey, Figure 7.3 and Figure 7.4 show that South Eastern Europe (including the West Balkan countries) is lagging behind.

Sewage is a significant source of input of phosphate nutrient to water bodies and several sewage treatment operators in the European region are now "mining" phosphate in sewage, recycling it to fertilizer industries as a profitable contribution to the circular economy[32].

18% of surface water bodies are subject to significant pressures from point sources of pollution (EEA, 2018).

Although much has been achieved in sewage treatment in the last 30-40 years, efforts need to continue to fill the remaining gaps. Investment in collection and treatment systems is needed take to ensure that they are future-proof, and upgraded where necessary, to guarantee a high level of performance when subjected to the pressures of demographic development and changes in land-use and climate.

Diffuse pollution from farming activities

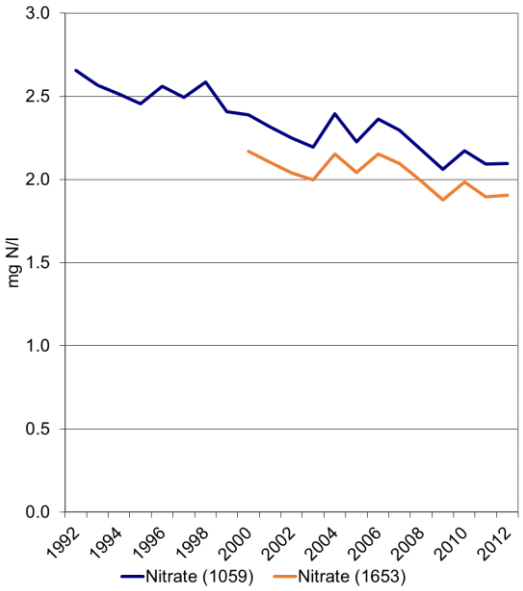
In areas of the European region with intensive agriculture or livestock farming, agriculture is the dominant source of nutrient pollution, contributing with diffuse pollution with nitrate from livestock manure and from fertilization of crops due to inefficient manure management and fertilization techniques. Diffuse nutrient losses from agriculture cause excessive algal growth in in fresh waters or in coastal waters where the fresh waters enter the sea. Furthermore, they pollute groundwater bodies, which may become unsuitable for use as a source of drinking water.

Both the UNECE Water Convention and European Union legislation require measures to be taken to control pollution with nutrients from agriculture. However, although there has been progress over the last 20 years or so, it has been slow and far from sufficient to protect waters against the impacts of algal blooms. Figure 7.5 below shows how nitrate concentrations in rivers and groundwater in the European Union have developed over a 20-year period and Figure 7.6 how it is distributed across the European Union, European Free Trade Association, West Balkan countries and Turkey. It is clear from the map that the problem of nitrate pollution is particularly acute in areas of North Western Europe where intensive farming is dominant. In Central and Eastern Europe where intensive farming has not yet replaced other forms of farming, it will be essential to put in place arrangements and alternative development trajectories to ensure that they do not move in the same direction as North-West Europe.

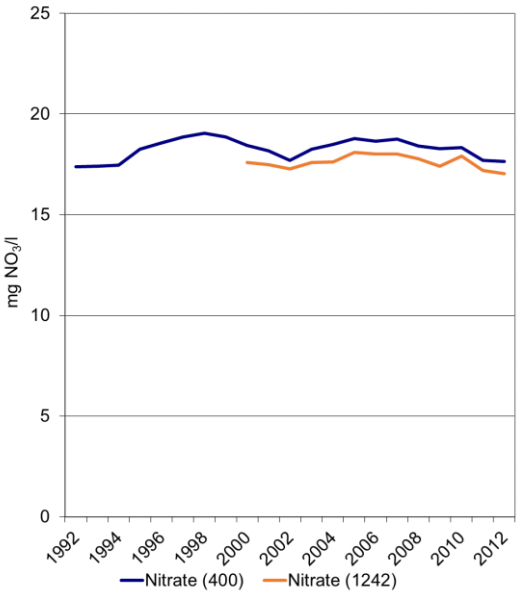
37% percent of surface waters (EEA, 2018) and 34% of the area of groundwater bodies (EEA, 2018) in the European Union are subject to significant pressures from diffuse pollution, mainly as a result of nitrate pollution of agricultural origin (EEA, 2018).

In many parts of the European region, rivers have been channelised and historical wetlands and flood plains have been drained and turned into highly fertile agricultural land. However, wetlands and flood plains are important wildlife habitats and sources of biodiversity and, in addition, channelization of water courses and drainage of wetlands are prejudicial to the self-purification capacity of water bodies. While such transformations have been beneficial for agriculture, they have thus come at the expense of the ecosystem services in the form of good quality water and their contribution to biodiversity and wildlife conservation.

[32] Examples of phosphorous recuperation from waste water are Amsterdam (the Netherlands) and Århus (Denmark).



Note: The diagram depicts two-time series: the longer time series has fewer stations (1059) and the shorter time series has more (1653).



Note: The diagram depicts two-time series: the longer time series has fewer stations (400) and the shorter time series has more (1242).

Figure 7.5 – Trend in nitrogen concentration in European Union rivers and groundwater 1992-2012 (source: provided by EEA)

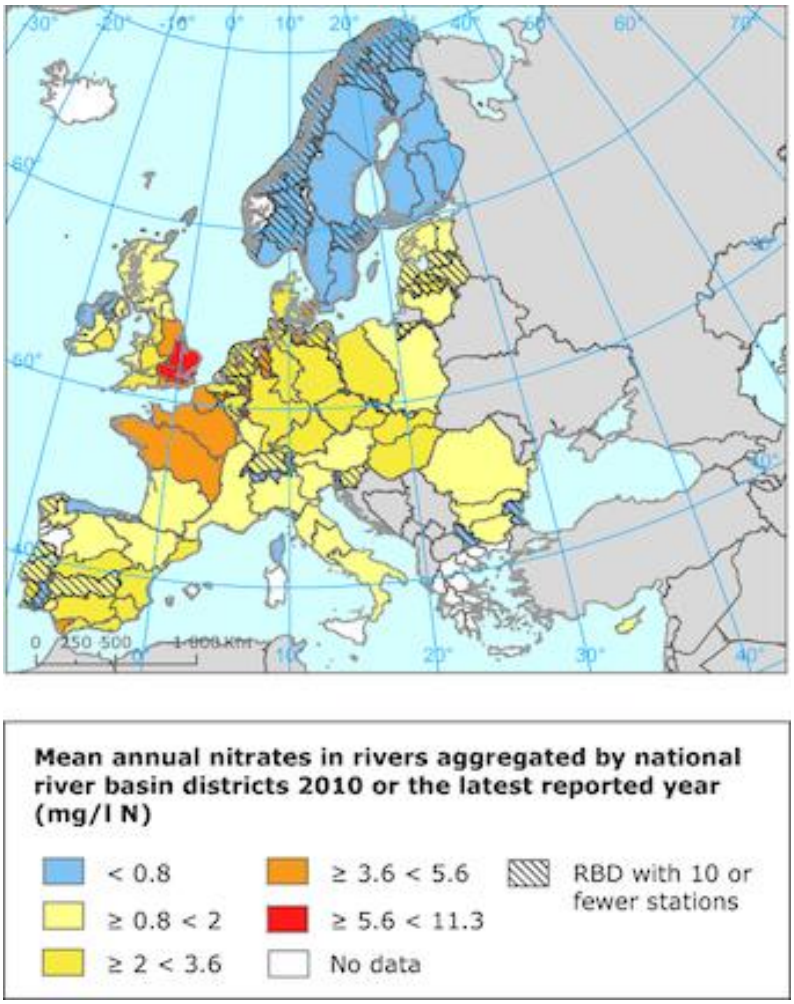


Figure 7.6 - Nitrate in rivers 2010 –by national river basin district (source: EEA[33])

There are two different ways of rising to the challenge of implementing more sustainable farming practices with respect to nitrate losses: 1) reducing the intensity of livestock farming, e.g. through wider application of organic farming; and 2) extensive application of more efficient manure management and fertilization techniques. Neither option is currently mainstream in farming in the European region, representing only a relatively small proportion of the overall farming activity in the region. In spite of an extensive water policy and legislation[34] and a Common Agricultural Policy (CAP) and legislation[35] in the EU, there are still significant remaining challenges and a need to improve coordination of sectoral administrations, overcome strictly sectorial approaches and reinforce measures to bring down nutrient loads to the levels required to ensure the sustainability of water resources (EC, 2017b).[36] Investigations carried out by the European Court of Auditors (ECA, 2016) have shown that the measures available in the CAP (rural development programmes and a cross-compliance scheme) have had either little effect or have not been fully effective and that European Union countries have been reluctant to make full use of the possible actions in the field of agriculture. A commonly reported

[33] https://www.eea.europa.eu/data-and-maps/figures/total-nitrogen-application-to-agricultural#tab-hard-copyinteractive map

[34] The EU's water policy and legislation include in particular the Water Framework, Nitrate and Sustainable Use of Pesticides Directives.

[35] The EU's CAP legislation includes in particular the Rural Development ("Pillar II") and the Direct Payments Regulations ("Pillar I").

[36] This document arrives at similar conclusions concerning chemical pollution (pesticides) from agriculture and water quantity related issues (in particular over-abstraction and water pricing policies).

obstacle to implementing programmes to reduce the pressure of agriculture on water resources is insufficient financing, but there is also a need to increase awareness and skills in the farming community (EC, 2017b). With respect to access to finance for farmers, this is also linked to the question of how the polluter pays principle should be applied in this sector. While there have been possibilities for farmers to increase agricultural production through intensification, there have been insufficient economic and regulatory incentives to ensure that the impact on the environment and ecosystem services of the sector is within sustainable bounds.

Diffuse pollution with phosphate nutrient from the use of fertilizer and manure in agriculture is also an issue.

Finally, in addition to fertilizers and manure, hazardous chemicals are also used in farming, especially pesticides in crop cultivation. Pesticides are a frequent cause, second only to nitrates, for failure to meet groundwater chemical standards in the EU (EEA, 2018)[37].

As with nitrates, pesticides are washed out of the soil and give rise to diffuse pollution of both groundwater and surface water bodies with potential impacts on the water ecosystems, and adding costs for other water users to treat the water to meet the standards needed for different uses, e.g. for distribution as drinking water. In addition, pesticides have negative impacts on species diversity where they are applied and contribute to reducing biodiversity and ecosystem services.

Intensification of agricultural production in connection with increased food or energy crop production, as is already occurring in some parts of the European Region,[38] leaching and soil erosion associated with climate change, changing precipitation patterns and higher water temperatures could all lead to future increases of diffuse agricultural water pollution with nutrients and pesticides.

Hazardous substances

Industrial discharges in many cases contain chemical substances which due to their persistence are not removed by the treatment used to remove organic pollution and nutrients. These substances include heavy metals and persistent organic substances. Many of these substances are hazardous due to their toxicity or to their interference in other ways with the functioning of living organisms or ecosystems. They occur not only in industrial discharges, but also in discharges from mining activities and from sewage treatment plants, in the latter case originating from industrial discharges into public sewer systems, from urban run-off and from use in household products.

Furthermore, there is diffuse pollution with hazardous substances, e.g. from leachate from contaminated urban sites or landfills, historical mining sites, and from airborne deposition of persistent volatile pollutants such as mercury.

There has been important progress in regulating hazardous chemicals with a view to bringing down environmental exposure to hazardous chemicals, especially in the last decades. Internationally the Stockholm and UNECE Conventions on Persistent Organic Pollutants have entered into force and the European Union is in addition implementing the 2007 REACH Regulation and the Regulation on Plant Protection Products. However, significant challenges with chemical pollution nevertheless remain in the European

[37] see https://tableau.discomap.eea.europa.eu/t/Wateronline/views/WISE_SOW_gwPollutant/GWB_gwPollutant_Europe?:embed=y&:showAppBanner=false&:showShareOptions=true&:display_count=no&:showVizHome=no

[38] See e.g. http://ec.europa.eu/eurostat/web/environmental-data-centre-on-natural-resources/natural-resources/energy-resources/energy-from-biomass

Region, the nature and magnitude of these challenges being depending on the sub regions concerned.

Both in the UNECE Water and POP Conventions and in European Union legislation there are obligations to set water quality targets and to reduce industrial discharges, including discharges of hazardous substances, to levels that are compatible with these targets. However, implementation is not uniform, and especially in Eastern Europe and in parts of South-east Europe implementation is lagging behind.

In the EU, the 18% of surface water bodies that are subject to main pressures from point sources of pollution are mainly due to oxygen depleting pollutants and nutrients, and not chemical pollution.[39]

In the EU, 46% of surface waters are reported as not complying with the applicable chemical quality standards (EEA, 2018 – p.35 priority substances). However, almost the entire non-compliance is caused by a limited number of hazardous substances, so-called "ubiquitous substances", which are so-called PBT substances (Persistent, Bioaccumulative and Toxic) (EEA, 2018)[40]. If the ubiquitous substances are disregarded, non-compliance with water quality standards falls to 3% (EEA, 2018). The ubiquitous substances are often remnants of past pollution (several have been banned for many years and are no longer in use) which are trapped in the environment and accumulated in living organisms and sediments.[41] The issue of ubiquitous substances is a difficult challenge as they are removed only very slowly from the fresh water bodies where the pollution resides.

Finally, there is a group of substances, collectively known as micropollutants, which in the past have been thought to be anodyne in low concentrations but which are now recognised as having significant impacts on ecosystem or human health via the food chain. These micropollutants, which include some of the hazardous substances referred to above, enter the environment especially as a result of diffuse pollution. They include pharmaceuticals and the so-called endocrine disruptors which interfere with the hormonal regulation of humans and other living organisms and which may, even in minute concentrations, interfere with e.g. growth, reproductive health, metabolism and immunity of humans and other living organisms. Such substances can have significant impacts on human and ecosystem health on wildlife populations.

The increasing consumption of pharmaceutical products and illicit drugs means that biologically active pharmaceutical substances can be found in all waters. Figure 7.7 below shows, e.g. groups of pharmaceutical substances that have been identified in the waters at 68 different measuring stations along the Danube River.

[39] Information from EEA, cfr also EEA (2018) – p. 32.

[40] Both by number of surface water body and by their area. To see the substances concerned see e.g. https://tableau.discomap.eea.europa.eu/t/Wateronline/views/WISE_SOW_PrioritySubstance/SWB_SWPrioritySubstance_Europe?:embed=y&:showAppBanner=false&:showShareOptions=true&:display_count=no&:showVizHome=no

[41] Almost all non-compliance linked to these substances is due to heavy metals (essentially mercury), polyaromatic hydrocarbons (PAH) and brominated flame retardants.

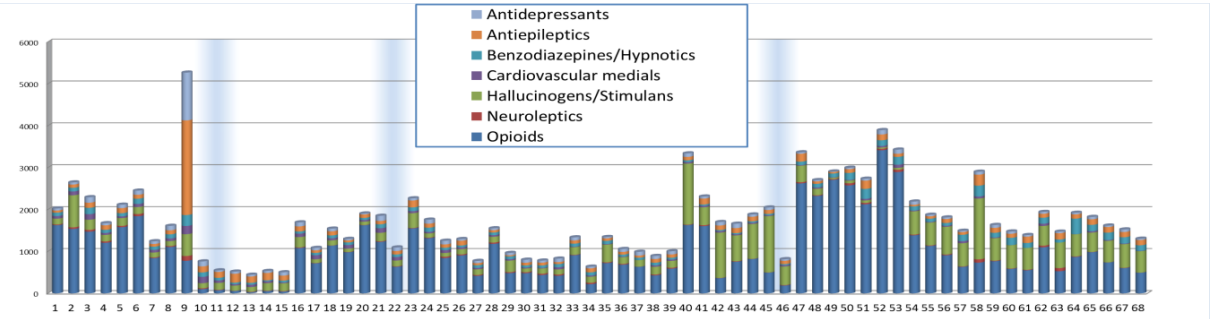


Figure 7.7 - Occurrence profile of different groups of pharmaceuticals and illicit drugs in the 68 JDS3 samples; blue vertical lines are presenting rainy period, x-axis represents sampling stations and y-axis indicates cumulative concentrations of all determined substances (in ng/l) with a quantitative proportion of the particular group of substances (cf. different colours) (source: ICPDR, 2015 – p. 320)

Summary of Pollution Related Challenges

The key water pollution challenges with which the European region is faced to benefit fully from water related ecosystem services can be summarized as follows:

- Some sub-regions, in particular Eastern and South-Eastern Europe and Central Asia, need to catch up and ensure full implementation of sewage treatment/sanitation and treatment of industrial discharges to remove organic pollution and hazardous substances.
- Some sub-regions, in particular North-Western Europe, need to develop and implement effective measures and environmentally friendly farming techniques to curb diffuse pollution with nutrients and pesticides from farming. Other regions need to ensure that any future intensification of farming activities does not result in increasing pressures from diffuse pollution.
- The issue of ubiquitous substances is a major challenge and, in some cases posing a challenge for the protection of human health and standing in the way of healthy ecosystems and their delivery of the full range of ecosystem services. Furthermore, their presence in water may stand in the way of safe re-use of treated waste-water and groundwater re-injection.
- Pressures from hazardous micropollutants, e.g. endocrine disrupting substances, with significant impacts are constantly emerging. They are likely to become more important and need to better reduced and phased out. There is a need for a more effective preventive regulation of such chemicals, including regulation of products in which they are incorporated, as well as more effective treatment technologies to remove persistent or biologically highly active substances from wastewater discharges.

7.5. Water scarcity, droughts and over abstraction of surface and groundwater – much remains to be done

Permanent or seasonal water scarcity and drought episodes are increasingly an issue in the European region, especially in areas with hot and arid summers, but also in areas with high levels of water consumption due to high population densities or high density of water consuming industrial or agricultural activities. Changes in precipitation patterns and changes in land use lead to changes in water availability, and where availability decreases, the risk of over-abstraction and impaired water quality and ecosystems increases.

The map in Figure 7.8 below shows the large geographical variation of the Water Exploitation Index (ICPDR, 2015 – p.320) by river basin district in Europe in the period 2002-2012. The higher the WEI, the higher is the likelihood of water scarcity in the river

basin. It shows that high pressure on water resources occurs mostly in the Mediterranean area, but that it also affects some North Western river basins.

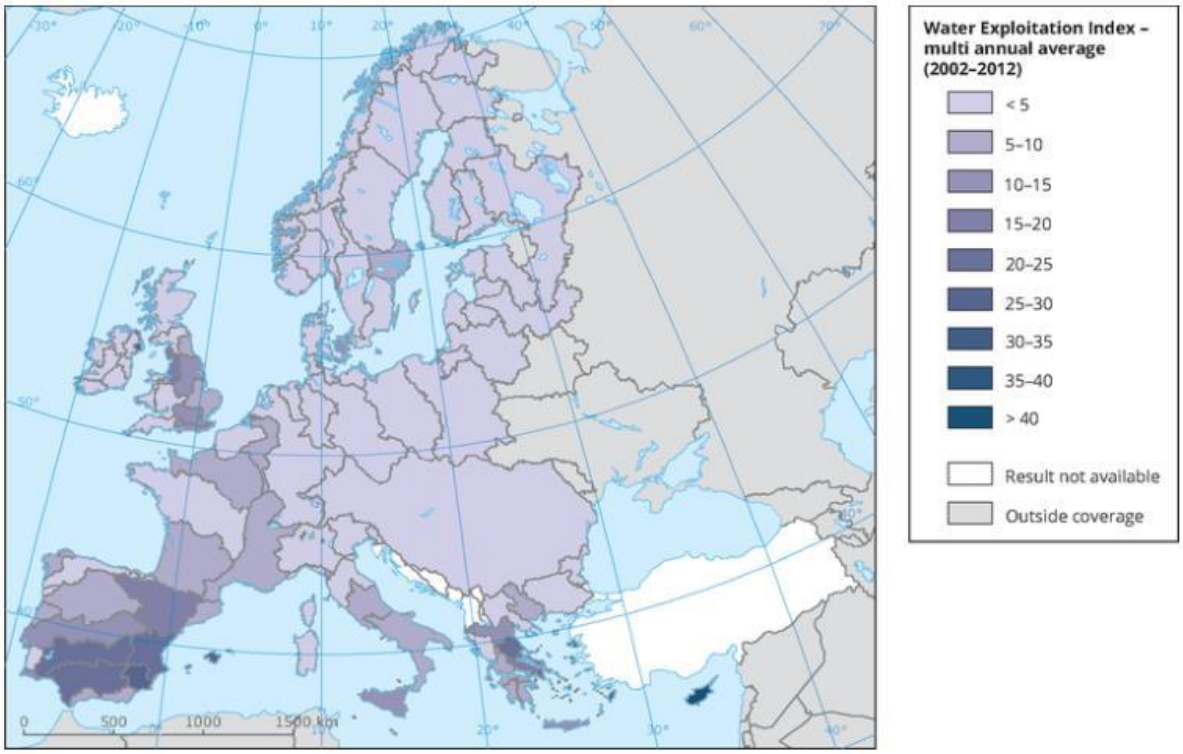


Figure 7.8 - Average Water Exploitation Index for River Basin Districts in Europe 2002-2012, which measures the pressure over freshwater available resources (EC, 2017b).

There are important seasonal variations of water consumption in Europe with significantly higher pressures in spring and autumn, when water abstraction for irrigation in agriculture is highest.

Figure 7.9 below shows the percentage of the European Union area affected by water stress in the summer period (3rd Quarter), based on the Water Exploitation Index+ indicator (WEI+).[42] Accordingly, the area in the European Union affected by summer water scarcity is about 500 000 to 600 000 km^2, with a population of approximately 60-65 million inhabitants.

[42] WEI+ is the ratio between total water consumption (abstraction corrected for water returns and changes in water storage) and total water availability – it should not be confused with the more commonly used WEI.

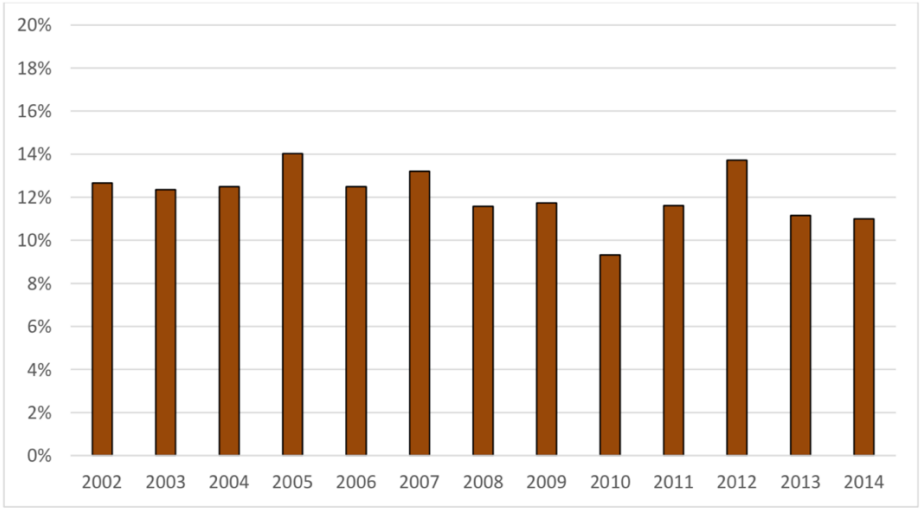


Figure 7.9 - Annual Percentage (%) of Area Affected by Water Stress Conditions (WEI+ > 20%) in summer months (Q3) in Europe 2002-2014[43]

Over-abstraction has been reported as affecting 7% of surface water bodies and 17% of the groundwater area in the European Union (EEA, 2018)[44], primarily in the Mediterranean region and in densely populated areas in North-West Europe (EEA, 2018)[45]. Pressures on groundwater bodies are primarily from public water supply utilities and agriculture. In many countries in the region, groundwater is the sole or almost the sole source of drinking water.

One of the major quantitative pressures on water resources in the European Union is agriculture which accounts for 36% of annual consumptive use, rising to 60% in the summer period. These percentages are significantly higher in areas with hot and dry summers and important agricultural production, e.g. in Southern Europe. In southern Europe, the irrigated area increased by 12% between 2002 and 2014 while the harvested agricultural production fell by 36% in the same period.[46]

The traditional response to water scarcity in the European region has been to increase supply and storage capacity, and where this was not an option, to continue abstraction beyond sustainable levels to maintain fresh water dependent economic activities so as not to sustain economic and job losses.

However, over-abstraction of surface and groundwater has led to lower water levels and flows in rivers and lakes and has in some cases resulted in flows or levels falling below the minimum required for the proper functioning of ecosystems.

This has had a direct negative impact on the ecosystem services delivered by rivers, lakes and wetlands, such as provision of sufficient amounts of clean water, capacity to dilute pollution, self-purification capacity, diversity of biota, and erosion and flood protection with negative economic and job impacts. Furthermore, lowering of water levels below what is necessary for the ecology to function may lead to economic losses in the economic and non-economic sectors that depend directly on the water bodies such as inland navigation, hydroelectric production, inland fisheries and leisure activities. In the

[43] Personal communication from Nihat Zal and Peter Kristensen, EEA.

[44] pp. 57 & 58 - The numbers on over-abstraction are not always comparable from one country to another. In some countries, seasonal over-abstraction has been included, while in others not.

[45] Idem – map on p. 52.

[46] EEA, Indicator Assessment: Use of freshwater resources (2017), see https://www.eea.europa.eu/downloads/b2b1971a46d14f349f45e25e2417757d/1500040052/assessment-2.pdf

case of groundwater over-abstraction there may be an additional risk of soil subsidence or sinkholes.

In many cases, supply has been increased through building of reservoirs to store water reserves, and in recent years also by supplementing natural fresh water sources with desalinated sea or brackish water. In recent years there has also been an increasing focus on demand management, introduction of fair and effective water pricing, awareness raising, drought management planning and water efficiency improvements, including network leakage reduction and re-use of water. However, the longevity or, in some cases, perennity of concessions and abstraction licences in many cases stand in the way of effective demand management, prevention of over-abstraction and investments in more efficient and sustainable use of water resources.

The focus on awareness raising and demand management has been accompanied by a mobilization of stakeholders, in particular the general public (households), public authorities, water utilities and some industries. Linked to this, water abstraction in the European Union has been reduced by 7% between 2002 and 2014 (ETC/ICM, 2017). In most European Union countries, annual household water consumption/capita is now 25-50 m^3/capita or 70-140 litres/capita/day.[47]

Furthermore, Drought Management Plans have been developed for several areas with participation of stakeholders with a view to minimizing the social, economic and environmental impacts of droughts. However, there is not yet an overview of the Europe-wide development of these plans.

There is still an important potential for water savings in European Union countries (Ecologic, 2007)[48], especially in the agricultural sector and in some parts of industry. The slow progress in the introduction of fair and effective water pricing has undoubtedly played a role in the slow rate of progress in this respect. However, it is also clear that water pricing will likely only provide the full incentive to improve performance when combined with other measures.[49]

With a view to avoiding loss of multiple ecosystem services associated with low water levels and flows there has in recent years been an increasing uptake of nature-based solutions and green or blue infrastructure in water management in the wider European region. Natural water retention measures can contribute as no-regret measures, independently of climate, increasing low flows, reducing flood peaks, improving ground water recharge and decreasing water stress (EU, 2012).

The impacts of climate change have already been felt in many European Union water bodies in the last 1-2 decades: Water abstraction is increasing in some areas to irrigate crops for intensive cultivation of biomass/biofuels; annual mean water temperature in the upper Danube in Austria which has significant seasonal variations has risen about 1°C over the last century, but is now being reported to rise much more rapidly, in some places up to 0,3-0,5°C per decade;[50] there have been frequent low summer water levels in major European rivers such as the Rhine and the Danube limiting navigability of the rivers; water scarcity and prolonged drought periods have limited irrigation in agriculture and the production of hydroelectric and thermal electric power, especially in the south of Europe. In addition, evidence is mounting that, as a result of changes in land use and climate, the geographical limit in Europe between areas with hot and dry summers and

[47] Based on data from Eurostat, cfr. http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdnr320&plugin=1

[48] It seems that no newer assessments are available.

[49] G. Dige et.al. op.cit.

[50] See e.g. https://www.bmnt.gv.at/wasser/wasser-oesterreich/wasserkreislauf/wtdonau2017.html

cool and those with wet summers is shifting northwards (Stagge *et.al.*, 2017), so that larger areas could become affected by water scarcity.

In future, it will likely be necessary to increase re-use of water and re-injection of water into ground water bodies which are the only water resources which are well protected against the impacts of rising temperatures. However, the sustainability of re-use and re-injection depends on finding appropriate solutions that will ensure that groundwater resources, ecosystems and the food chain will not be contaminated with unacceptable amounts of micropollutants and “ubiquitous substances”. Re-use of water can contribute significantly to the creation of a resource-efficient circular economy with exchange of water and waste streams between users leading to large scale materials recycling, e.g. as part of industrial symbioses of which there are several examples both inside and outside the European region.

The key water quantity challenges, which the European region likely will need to address to benefit fully from water related ecosystem services can be summarized as follows:

- Acceleration of efforts to improve water efficiency, particularly in agriculture,
- Significant strengthening of demand water demand management so that it can respond to the challenges posed by rapid changes in demography, land use, climate and economic activities. This includes e.g. more flexible arrangements for accessing water resources and conservation of the resource by preventing over-abstraction from groundwater bodies and ensuring that these are not used to fill “gaps” that cannot be fulfilled by abstracting (in some cases) dwindling surface water resources.
- Implementation of green, nature-based water retention solutions to retain water, increase availability and stabilize water levels and flows.
- Contributing to the circular economy by ensuring safe re-use (including injection into depleted groundwater bodies) of treated wastewater free from hazardous micropollutants and “ubiquitous substances”, guaranteeing the safety of the food chain and healthy ecosystems

7.6. Green/blue infrastructure, restoration and maintenance of ecosystem integrity has only just begun

Habitat restoration, flood protection and ecosystems

As set out in section XX.1 above, surface water bodies in the European region have been subjected to significant changes in their structure and hydrology in order to accommodate the interests of users of the water body and water users. These changes alter significantly the water related habitats.

Figure 7.10 confirms that there have been significant impacts on river and lake habitats in large parts of the European Union, with more than 80% of habitats being in unfavourable conservation status, with the exceptions being the Alpine, Macronesian and Steppic regions representing less than 10% of the area of the EU.

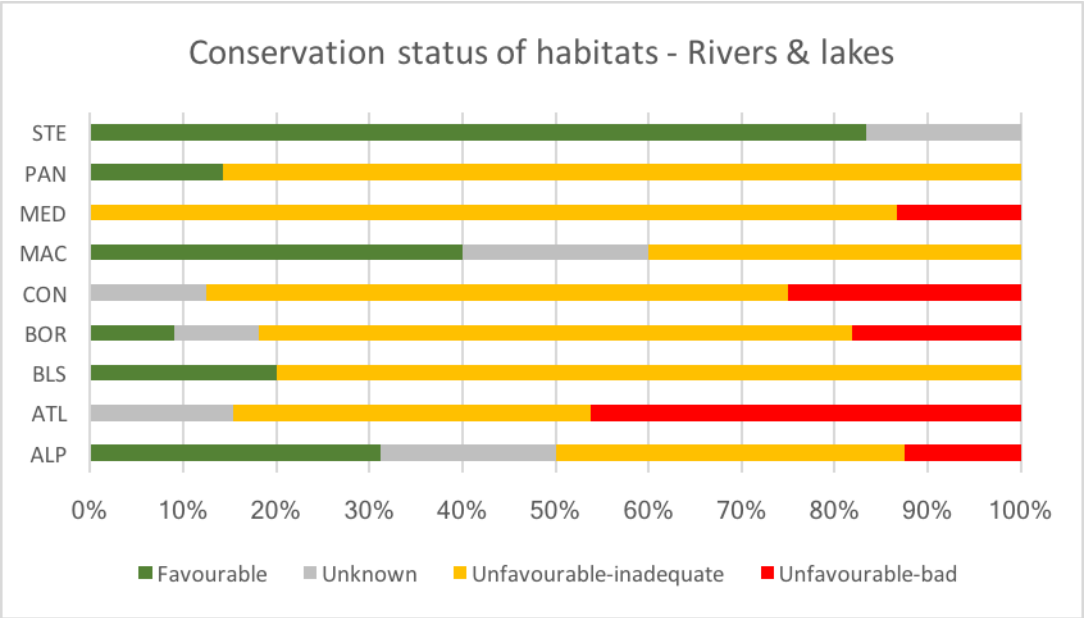


Figure 7.10 - Conservation status of river and lake habitats by region[51]

Figure 7.10 shows the conservation status of river and lake habitats by region. Except for the Macaronesian and Alpine regions, at least 80% of habitats are in unfavourable conservation status. The pattern for wetlands is similar to that of rivers and lakes.

The changes made to water body morphology and hydrology include water storage and abstraction for agricultural and energy production and the growing urban areas, wetland disconnection, culverting of urban rivers, construction of dams for water storage and/or flood protection, locks and port facilities, channelization of rivers, soil sealing and/or drainage to increase the size of urban and agricultural areas, sand and gravel extraction in water bodies, and construction of embankments for flood protection. The resulting changes of habitats have led to significant losses of ecosystem services, in particular regulation of water quality, flow regulation and flood protection, fish life and biodiversity, recreational and aesthetic value, and, as a result, reduced resilience to and ability to absorb the impacts of changes in climate, land use and demography (see e.g. EEA, 2012).

In the EU, 41% of surface water bodies are subject to significant pressures on their structure (morphology) and hydrology (EEA, 2018 – p.57), which may affect the delivery of ecosystem services dependent on ecosystem structure and function.

Natural water retention measures have an important potential to combine flood protection, habitat conservation and ecosystem services.[52] Their effectiveness as flood risk reduction measures has been subject to assessment which has confirmed the effectiveness of such measures in reducing flood risks in Europe (EU, 2012). An important advantage of these measures is that when properly applied these measures can bring significant ancillary benefits from the restoration of water ecosystem integrity and the associated ecosystem services.

An example of this is flood plains which have important functions not only in retaining and storing water and regulating river flows, but are also important for groundwater recharge and protection of water quality and biodiversity. Up to 90% of the original flood plain area in the EU (EEA, 2016) has been inactivated to allow use of the land for urban,

[51] Personal communication from Carlos Romão and Peter Kristensen, EEA.

[52] For an overview of natural water retention measures see www.nwrm.eu

agricultural or infrastructure purposes e.g. by soil sealing, drainage or construction of embankments/levees and dykes.

The issue of flood plains has attracted renewed interest in the light of the need to reduce the increasing flood risks in the European region mentioned in section 7.3. The traditional response to increased flood risks was the construction of "grey infrastructure" in the form of higher levees/embankments or dykes at the point of flood risk to contain floodwater or dams upstream of the area of flood risk.to stem the flow of water to the area of risk. Assessments in the Netherlands in the early 2000s suggested that an approach reducing flood risks through improvements in lateral connectivity by creating "room for the river",[53] based on flood plain reactivation, was significantly more cost-effective than the traditional approach of dam building and higher dykes to reduce flood risks to acceptable levels. The concept is simple: instead of letting the water flood urban areas, it is allowed to flood upstream rural flood plain areas which are able to withhold and store it by soaking it up.

Reactivation of the floodplains brings with it important ancillary benefits by restoring the floodplain ecosystem and reconnecting it with the river, thus restoring also the lost ecosystem services of the floodplain and the resilience of the hydrological system.

Also, many former wetlands have been disconnected from the hydrological systems to make room for activities such as urbanization, agricultural exploitation and infrastructure. As with floodplains, this has resulted in loss of ecosystem services. Their restoration and reconnection with water bodies brings not only water retention and hydrological regulation, but also a series of other ecosystem services including their particularly rich biodiversity.

Other forms of habitats restoration such as re-meandering of channelized rivers and stream bed re-naturalization also contribute to restoring ecosystem services that were lost in the past.

The European Environment Agency has published a study (EEA, 2017) comparing the direct and indirect effects and the cost-efficiency of flood plain restoration, wetlands, stream bed re-naturalization and re-meandering of channelized rivers[54] compared with traditional grey infrastructures for flood protection: dyke building/reinforcement and longitudinal (transversal) barriers. The comparison considers all costs over the life cycle of the measures, i.e. the investments made in land acquisition, compensation paid, construction and rehabilitation costs as well as the subsequent operation and maintenance costs.

The result of the comparison is that the results suggest that where green/blue infrastructure nature-based solutions are technically feasible, their benefit-cost ratios are greater than those of grey infrastructure for the same degree of flood protection. The analysis also shows that the use of green/blue infrastructure may incur important initial costs for land acquisition, albeit significantly less than the construction of transversal dams, but that in compensation there are a large number of ancillary benefits (flow regulation and run-off reduction, water storage, fauna improvements, biomass production, climate adaptation, erosion control, groundwater recharge, recreational value and pollutant regulation) that may largely outweigh the initial costs as is the case in the example from the Elbe river given in the text box. The recommendation is that decisions should be made on the basis of site-specific analyses on a case-by-case basis.

The analysis confirms that green/blue infrastructure measures, in addition to providing additional important ecosystem services, are often competitive as flood protection measures compared to traditional grey infrastructure flood protection measures. They may not be able to contain all floods, but they do reduce flood risk.

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[53] See https://www.ruimtevoorderivier.nl/english/

[54] Based on a large number of projects in the Scheldt, Rhône, Elbe and Vistula basins.

Longitudinal river continuity

The changes in structure and hydrology of water bodies in the European region have included the construction of hundreds of thousands of transversal structures interrupting continuity of the rivers. These structures were made to support irrigation, navigation, water supply, hydropower and flood protection and include dams, weirs, hydropower plants and locks.

These structures and their operation have direct impacts on the hydrology of rivers, transport of sediment and on migration of species in the rivers with a number of knock-on effects on provision of ecosystem services as a result of silting of rivers and reservoirs upstream of structures, and changes in downstream erosion risks and in upstream and downstream ecology and flood risk.

In recent years, several river basins including the larger transboundary river basins such as the Rhine, the Danube and the Elbe have adopted strategies and plans restoring endangered fish populations and river continuity. Measures adopted across the European region have included establishment of fish migration passes, removal of dams,[55] abolishing or mitigation of "hydropeaking", and application of technologies to facilitate sediment transport.

Thus, in the Danube basin, there is a total of 1030 barriers in the main river and its major tributaries, of which 667 are unpassable while 120 fish migration aids have already been constructed between 2009 and 2015 (ICPDR, 2015b). Similarly, in the Rhine basin, 480 measures have been implemented improving river continuity.

Green Cities

As set out in Chapter 6, water savings, water re-use and natural water retention measures and grey water re-use, such as green roofs, porous pavement materials, green spaces, and urban river restoration increasingly play a role in management of water and water related risks in many urban areas in the European region, contributing to urban water security and prosperity, human health and well-being, and the provision of ecosystem services such as flood protection, cooling to counteract urban heat island effects and urban biodiversity.

As impacts of climate change increase, water savings, re-use and natural water retention will be key measures to ensure the future sustainability of many cities in the European region.

Conclusions on Green/Blue Infrastructure, Ecosystem Integrity and Restoration

Green/blue water infrastructure holds a particular promise to provide concrete responses to some of the challenges of global development in the decades to come and will, if vigorously implemented, help make it feasible attaining SDG 6 for water without prejudicing the attainment of other Sustainable Development Goals such as the Sustainable Development Goals for food, energy, climate, cities and nature and biodiversity. Green/blue infrastructure will, together with other measures, help provide sufficient quantities of good quality clean water to sustain public health, welfare and jobs.

However, implementation of green/blue water infrastructure is still at a very limited scale in Europe and it has not yet been mainstreamed in all areas, although an additional impetus has been given through the adoption of the first flood risk management plans in 2015 under the EU's Floods Directive and the opportunity to profit from synergies with water and nature protection.

[55] Thousands of dams have been removed in the European region, either because they no longer serve a purpose or in order to restore biodiversity and ecosystem services, see e.g. http://damremoval.eu/#Removed-Dams

There are several governance hurdles to be overcome in order to roll out a wider implementation of nature-based solutions and green/blue water infrastructure. The most important difficulties are:

- Firstly, there is an issue of awareness among water managers about the potential for cost-effective solutions to multiple issues by means of green/blue infrastructure
- Secondly, implementation of green/blue infrastructure measures requires improved coordination with, and action to remove regulatory barriers in policy areas other than water management. In addition to better integration with flood risk management, nature protection, biodiversity and land use, there is an acute need for significantly improved coherence with other policy areas such as agriculture, energy and transport and coordinated action by different levels of government (national, regional, local and river basin authorities), depending on the policy areas concerned and the distribution of competences in countries.
- Thirdly, green/blue infrastructure measures differ from many other measures in that they often are very place-specific, require concerted action by many actors (e.g. many farmers taking similar action in a larger area) to be effective. This is clearly a governance challenge requiring adaptation of implementation to local circumstances and, particularly, active participation of all individual actors in all phases from analysis through planning to implementation.
- Finally, financing green/blue infrastructure measures may be challenging due to fiscal consolidation policies and difficulties in establishing cost recovery schemes for such infrastructure, due especially to the fragmented nature of the benefits where those who implement measures are often not those who benefit from them.

7.7. Case studies

This section presents some case studies to illustrate the chapter, based on the collection and selection of proposals sent by different European organisations, as part of the European Regional Process approach described in chapter 3.

Case study: Transboundary and international cooperation reducing inland nutrient losses and restoring ecosystems – beneficial for ecosystem services in both fresh and marine waters

Contact: Christian Holde Severin, GEF, and Ivan Zavadsky, ICPDR

The Danube and other rivers drain into the North-Western shelf of the Black Sea. Between 1970 and 1980, the ecosystem of the western Black Sea collapsed, an ecological and socio-economic disaster driven mainly by the enormous volume of nitrogen pollution that the Danube River was delivering to the Black Sea. By 1990, losses of bottom feeding animals were estimated at 60 million tons, including five million tons of fish, and about 40,000 km2 of the north-western shelf of the Black Sea was effectively considered a ‘dead zone,’ with insufficient levels of dissolved oxygen to support any kind of life. Unsustainable use of water resources and the release of untreated wastewater (mainly from agricultural runoff and discharge of urban sewage) into the river, resulted in reduced water quality and quantity, causing significant environmental damage, with associated threats to public health, economic activities and quality of life. Pollution in the Danube also contributed to increased downstream environmental problems in the Black Sea such as eutrophication, algal blooms, and species loss. Impoundments and other hydraulic structures have been built on the Danube, with negative impacts on wetlands and floodplains, threatening the region’s bird and fish habitats and compounding the risk of flood damage.

The International Convention on the Protection of the Danube River (DRPC) which was signed in 1994 and entered into force in 1998 required action to reduce pollution and protect ecosystems in the Basin, including through control of pollution with nutrients. The

International Commission for the Protection of the Danube River (ICPDR), established by this convention provided an political and institutional platform for the cooperation and funding from the European Union, the Global Environment Fund, the UNDP and the World Bank and with participation by 16 countries a series of regional and country projects were launched in the early 2000s to reduce land-based nutrient inputs into the Black Sea by reducing agricultural nutrient losses, nutrient inputs from municipal sewage and industrial discharges as well as by trapping nutrients in restored flood plains and wetlands. The ICPDR and the Danube countries now backed by solid environmental regulation and real investments is on its way to meet their own environmental needs. The ICPDR is strongly committed to further efforts to reduce nutrient pollution, especially from the agricultural sector.

About 500 million US $ was invested in these projects and the expected nutrient input reduction to the Black Sea, mainly from the Danube Basin, about 16 000 tonnes of nitrogen/year (20% reduction) and 5000 tonnes of phosphorous/year (50% reduction).

The Danube and Black Sea ecosystems are already responding favourably with improved water quality, less oxygen depletion, and improved biodiversity and conditions for local fisheries. Chlorophyll concentrations in the Black Sea have been reduced (see figure with map) and the number of benthic species is increasing. By 2007, the “dead zone” on the NW Black Sea shelf was virtually eliminated. In the Danube Basin, oxygen levels are now at or near saturation in most areas of the Black Sea. The downstream impact of this has been a marked decrease in the frequency of algal blooms, and the return of many species that had become locally extinct.

Many of the projects implemented were pilot projects that had a catalytic effect by generating support among stakeholders and politicians for policy decisions to implement such measures more widely, leading to further improvements. They helped countries to make full use of policy, legal and institutional reforms to advance nutrient reduction, and to increase their capacities for the protection, management and sustainable use of shared water resources. They built partnerships with donors, enhancing the enabling environment for public and private nutrient-reduction finance going forward, and paving the way for the European Union accession of seven Danube countries.

The restoration of wetlands and floodplains that had been lost in the course of the 20th Century also helps mitigate increasing flood risks in the region. However, over past the decade, under the influence of the European Union Water Framework Directive hundreds of fish migration aids have been constructed, opening up migration routes and improving the connectivity between habitats. In addition, more than 50,000 hectares of wetlands and floodplains have been partially or totally reconnected, restoring ecosystem functioning and flood attenuation services.

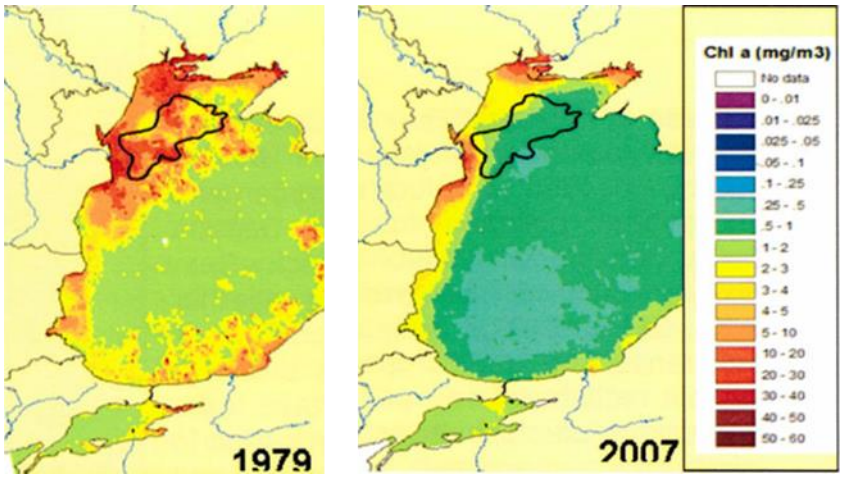

Figure 7.11 - Chlorophyll-a concentrations in the Black Sea 1979 and 2007 (source: GEF Brochure[56])

Case study: Eliminating micropollutants

Contact: Stephan Müller, Federal Office for the Environment FOEN, Switzerland

Like other countries in the European region, Switzerland is experiencing problems of pollution of waters with hazardous micropollutants that are removed neither in the biological treatment normally given to sewage or wastewaters, nor in the tertiary treatment. As long as pollution with these substances cannot be prevented or the substances removed from the wastewater, it will potentially pollute drinking water sources, increase vulnerability of water ecosystems, and pollute sewage sludge limiting its recyclability to protect the food chain. Switzerland has adopted changes in the Water Law[57] and its Water Protection Ordinance[58] to ensure that urban wastewater is subjected to a targeted treatment to remove hazardous micropollutants (IKSR-CIPR-ICBR, 2017).

Similar approaches are being applied in certain Federal states in Germany, in parts of the USA, France, Luxemburg, the Netherlands (several pilot projects), Japan and Australia.

The removal rate required for micropollutants is 80%. The technologies that are used to implement this requirement are mainly ozonisation or treatment of the wastewater with activated carbon. Reports from Switzerland indicate that the treatment is relatively costly, 0,1-0,3 €/m^3 (see e.g., Cimbritz, 2016).

The approach taken therefore targets the most important sources and problem areas. The requirement only applies to wastewater discharges from treatment plants serving 80 000 people or more, but with lower thresholds for rivers with a content of treated wastewater of 10% or more and for lake catchments.

As the benefits accrued are fragmented and the whole population benefits from the measures, an additional charge on wastewater treatment plants without treatment to remove micropollutants has been introduced in Switzerland. The revenues from the charge are earmarked for redistribution to the treatment plants to which the micropollutant requirement applies, so that the net result is that the cost of the additional treatment is evenly spread across the population.

[56] From GEF Brochure: GEF Nutrient Reduction Partnership Tackles the Black Sea «dead zone» and Danube Basin Pollution (undated).

[57] Loi fédérale sur la protection des eaux, 1.1.2016.

[58] Ordonnance sur la protection des eaux, 2.2.2016.

Case study: Green flood protection measures in the Elbe basin improve cost-efficiency of flood protection measures (based on EEA, 2017)

Contact: Gorm Dige, European Environment Agency (EEA)

The Elbe river basin spans across parts of the Czech Republic, Germany, and includes minor areas of Poland and Austria. The countries have agreed to coordinate their flood prevention actions under the International Commission for Protection of the Elbe (IKSE). In Germany, the Elbe floodplains are almost entirely protected by dykes. Downstream of the city of Dresden, where the city of Magdeburg is located, around 85% of the floodplains are protected by dykes built in the 19th and 20th centuries. In recent decades, infrastructure works to protect areas from flooding started has focused on measures that combined grey infrastructure (dykes) with green measures, especially recovering and re-naturalising floodplains. A cost-benefit assessment (Grossmann and Hartje, 2012) has shown that measures that included floodplain restoration were greatly superior to purely grey infrastructure measures.

The middle Elbe has 34 potential significant flood risk areas, 4 of which are in the immediate vicinity of the city of Magdeburg. This text box considers flood risk measures to be taken upstream of Magdeburg, in floodplain areas between the city of Dresden and Magdeburg. The area in question is a mainly rural area dominated by agriculture, pasture and forest. A catastrophic flood in the area could affect about 200 000 people and almost 300 industrial facilities, while a high probability flood could affect 3-4000 people and 4 industrial facilities.

A river basin plan from 2009 included implementation of a number of green infrastructure measures in the floodplain to improve water quality. As climate change was likely to lead to increased risks, the River Basin and Flood Risk Management Plans from 2015 prioritised the use of additional floodplains for flood management purposes, exploiting synergies between flood risk and water management. Actions include restoration and protection of flood plains, structural alterations, wetland restoration and removal or setback of levees.

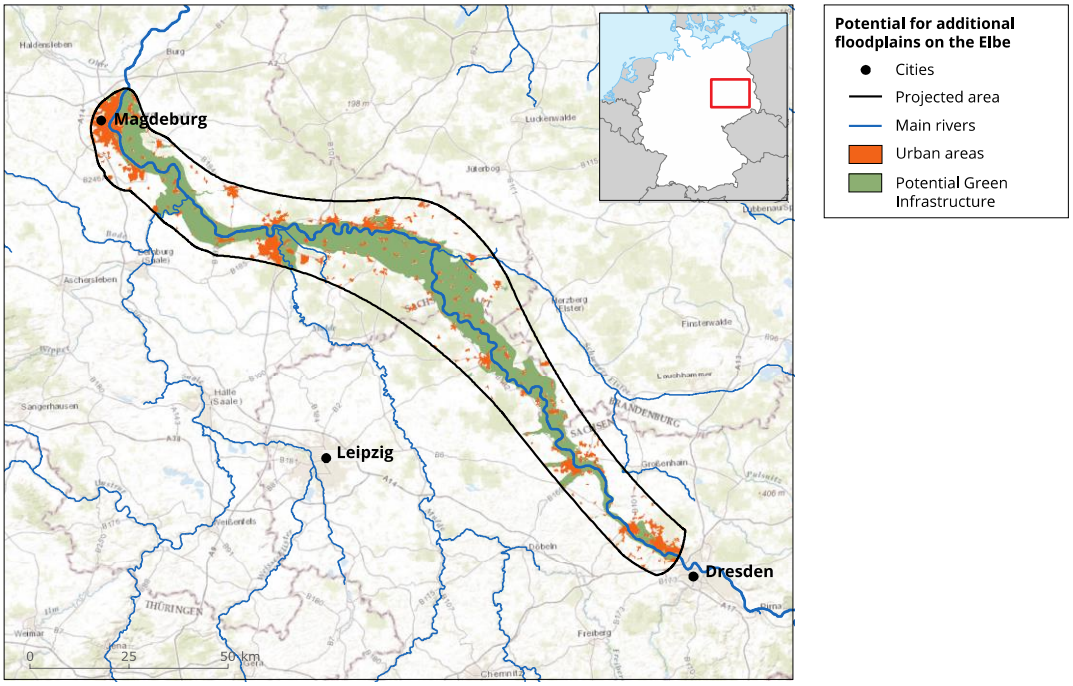

Figure 7.12 - Flood plan potential on the river Elbe, upstream of Magdeburg (source: EEA)[59]

[59] https://www.eea.europa.eu/data-and-maps/figures/potential-for-additional-floodplains-on-2

A cost-benefit assessment (for a 100-year period) was carried out showing the benefits of re-naturalising a polder area allowing for “ecological flooding”. The result was that in addition to ecosystem services worth 110 000 euros/hectare for flood protection, there are 320 000 euros/hectare worth of additional ecosystem services from the re-naturalisation. By comparison, the use of traditional grey infrastructure methods only gives benefits in the range 10 000 – 180 000 euros/hectare. The green infrastructure approach is therefore clearly superior in terms of benefits.

Case study: Dam removal projects for river restoration in France[60]

Contact: Jessica Orban, French Water Partnership

The removal and demolition of dams and weirs are very powerful and symbolic steps towards effective river rehabilitation and the restoration of ecological continuity between different natural habitats. Generally speaking, dams alter a river’s natural function and hydro-morphology and disrupt the movement of fish and sediment. Rising awareness of the benefits and necessity of dam removal for the re-establishment of natural functions of the water course has grown since the 1990s.

While the United States have acted as a key actor in general dynamic towards dam demolition – with the removal of the 33-meter high Elwha Dam in Washington State in 2011 – Europe too is leading the way with the removal of a large number of small dams and weirs which formerly served as water mills. According to the latest report by the non-governmental organization European Rivers Network, at least 3450 in-stream barriers have been removed in Europe since the mid-1990s (Sneddon *et al*., 2017).

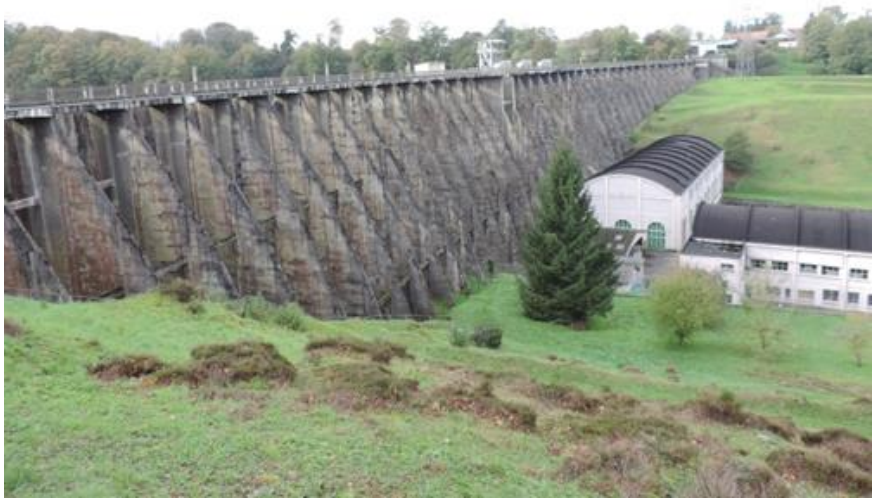

Figure 7.13 - The Vezins dam on the Sélune River, in the Seine-Normandy basin, France (Source: Seine-Normandy Water Agency).

[60] Based on information from the Seine-Normandy Water Agency and the French Water Partnership

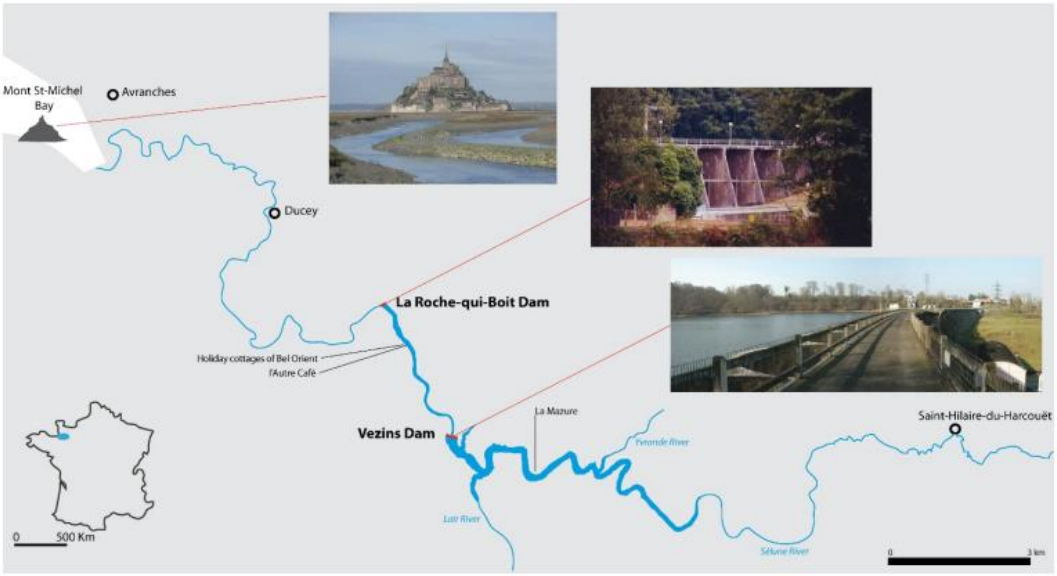

Figure 7.14. The Sélune river valley (source: Germaine and Lespez, 2017).

The Water Framework Directive (WFD) requires European Union countries to ensure that their water bodies attain good status. France included this objective in its national water policy, in particular in its 2006 law on water and aquatic habitats and the implementation of environment policy commitments.[61] French water policy has subsequently, as one of the Member States showing the way forward in this respect, moved ahead with the dismantling of a very large number of obstacles across the country and its various river basins.

While until now obstacles removed have been relatively small, in November 2017 the French government confirmed its choice to remove the 35 metre-high Vezins and the 15 metre-high “La Roche qui boit” dams from the Sélune River in Normandy. Since the beginning of this project in 2009 and the draining of its reservoir in 2017, a multi-disciplinary scientific expertise has been engaged, including an environmental and social impact assessment, supported and financed by the Seine-Normandy Water Agency. The decision to dismantle the dams was preceded by local consultations and dialogue with stakeholders at local, water basin, and regional level. It is carried out together with the State, EDF, the French biodiversity agency, the French National Institute for Agricultural research and the French national fishing federation.

The Vezins and “La Roche qui boit” dams are hydroelectric plants which have been operated by the French electric utility company EDF since 1946 (Germaine and Lespez, 2017). The Vezins and “La Roche qui boit” dams impact 17km and 4km respectively of the Sélune River’s upstream segment and have led to issues linked to sedimentation as well as loss of fish and other freshwater species. Furthermore, this case is important for international tourism and biodiversity because the river runs into the Mont-Saint-Michel bay (a UNESCO World Heritage Site).

The dismantling of the two dams especially targets rehabilitating sediment flow and facilitating the Atlantic salmon run by creating new spawning areas. It represents the largest dam removal project in Europe so far and a considerable step towards the restoration of river valleys in the Seine-Normandy river basin. Most importantly, it has environmental, ecological and socio-economic impacts on both landscape and territory as a whole because it concerns not only river dynamics and its microenvironment and habitats, but also the local touristic and economic activity, the leisure activity, the restoration of the river banks and the perceptions, values and representation of cultural

[61] In particular from the “Grenelle de l’environnement” environmental policy process.

landscapes. In this sense, this project goes beyond dam demolitions and is part of a specific territorial development project taking place at France's national level across all of its river basins.

Case study: Improving river continuity in the rivers Rhine and Danube, restoring salmon and sturgeon populations and biodiversity

Contact: Anne Schulte-Wülwer-Leidig, ICPR, and Ivan Zavadsky, ICPDR

By the end of the 1950s, pollution from sewage and industry had turned the transboundary river Rhine and many of its tributaries into open sewers, interrupted by multiple physical barriers. As a result, the salmon had become extinct in the Rhine Basin.

It was not until a fire in a major Swiss chemical factory in 1986 leading to massive pollution poisoning the river for hundreds of km, causing massive fish kills, that the International Commission for the Protection of the Rhine (ICPR) established a Rhine Action Programme to urgently implement measures to bring down radically pollution of the Rhine Basin and risks of accidental spills, and improving the status of Rhine Basin fauna. One of the objectives was to bring back the salmon to the basin by 2000.

By the year 2000 Rhine water was distinctly cleaner, accidents were less frequent, and salmon had again begun migrating upstream as far as the Upper Rhine, spawning in some of its tributaries. In 2001 the ICPR adopted a Rhine 2020 Programme to improve the sustainability of the river basin and reduce flood risks, including reactivation of floodplains and improvements of habitats, river continuity and biodiversity.

By 2009 a Master Plan Migratory Fish Rhine was adopted to promote self-sustaining, stable populations of migratory fish in the basin. The programme included removing all barriers to migration not only on the main river until Basel, but also in special tributaries in so-called programme waters to permit access to a wide range of spawning habitats. The plan entailed coordinated action by 7 countries, in more than 300 projects to be started before 2015, costing more than 200 million euros. In addition, Rhine Ministers decided in 2013 to enhance the application of new innovative techniques to limit the mortality at downstream fish migration at hydroelectric plants.

On the main river, specific measures are now planned to remove all but one of the major obstacles to autonomous fish migration upstream and downstream before 2020. The remaining obstacle for which there is yet no such plan is the Vogelgrun (together with two further obstacles in the Upper Rhine at Rhinau and Marckolsheim) hydroelectric power plant on the upper Rhine owned by the French State and operated by EDF.

Already by 2012, the river continuity for fish migration had been restored at 481 weirs in the Rhine and its upstream programme tributaries. The bar diagram shows the evolution of the number of measures to improve continuity and the map of the Rhine Basin shows the continuity of the river for migrating fish species as it was at the end of 2015.

Similarly, The International Commission for the Protection of the Danube River (ICPDR) has adopted as its flagship species the sturgeon which is an iconic anadromous fish species in the Danube, which is critically endangered and close to extinction.

At the end of 2017, the ICPDR has adopted a new Sturgeon Strategy, focusing ICPDR action on restoring river continuity of the main Danube river and tributaries through fish migration aids, ensuring the existence of appropriate habitats (spawning grounds), and appropriate ecology and water quality along migration routes for sturgeon and other fish. Apart from the issue of habitats much of the attention is currently focused on a feasibility study supported by the European Union on fish migration at the Iron Gates dam complex which is the only important obstacle in the first 1800 km from the sea of the main river as seen on the river continuity mapping for the Danube. In addition, several of the Danube States are undertaking ex-situ conservation measures, restocking and enforcing sturgeon fishing bans.

Both the ICPDR and the ICPR have won the Thiess International River Prize, in 2007 and 2014 respectively.

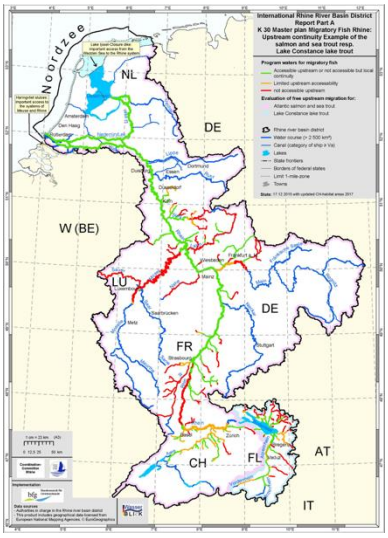

Figure 7.15. Map of Rhine River Continuity

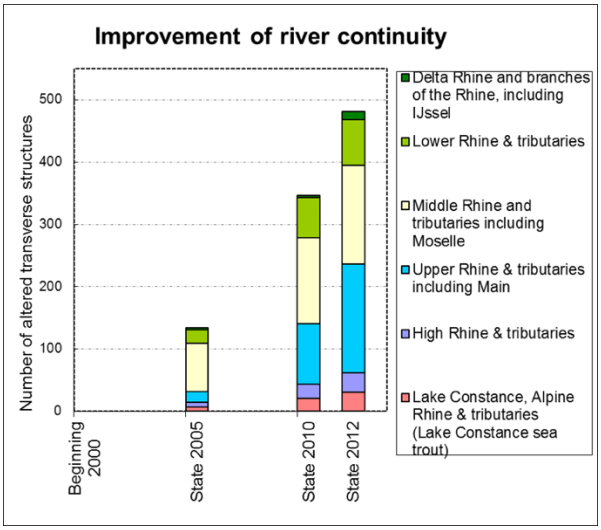

Figure 7.16. Evolution of Rhine River Continuity

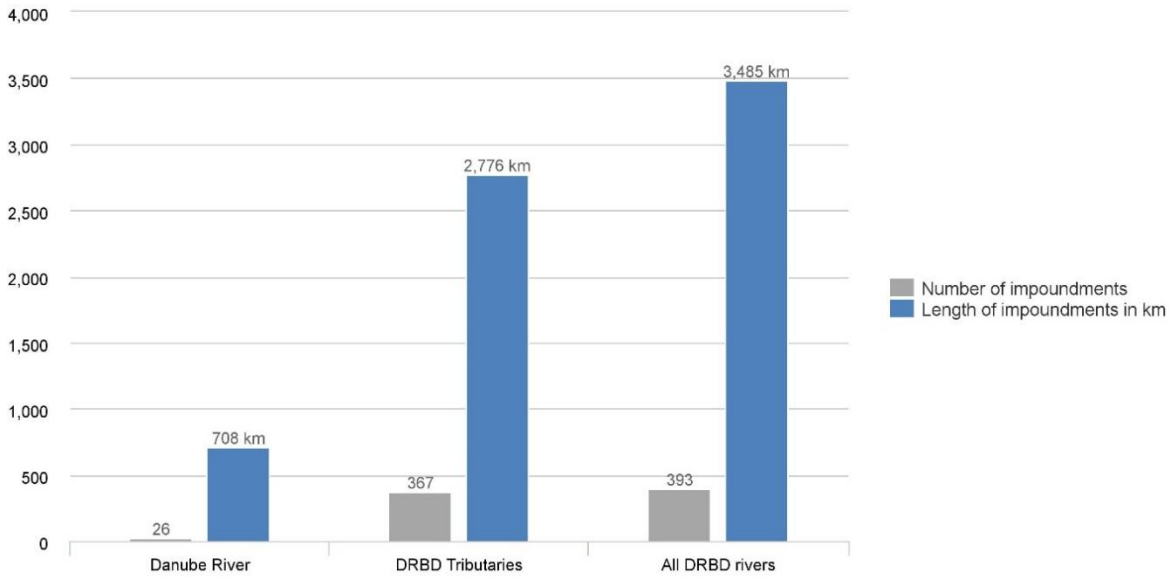

Figure 7.15. Danube River Impoundments – Main River and Tributarie (source: ICPDR, 2015b)

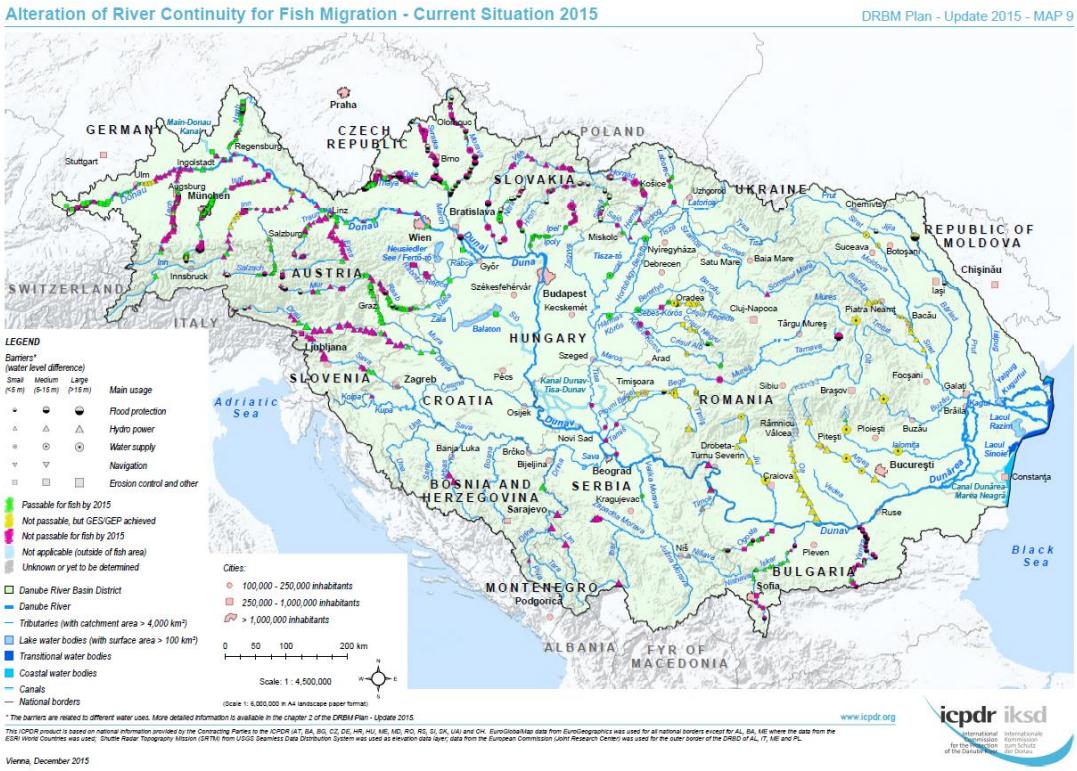

Figure 7.16. Danube River Continuity Map (source: ICPDR, 2015b)

7.8. Conclusions and recommendations

From the assessment presented in this section the following conclusions and recommendations emerged:

- Access to good quality water resources is a necessity for sustaining economic prosperity and jobs in the region. But ecosystems also need water to function and provide ecosystem services. However, man-made changes to the structure and functioning of our water bodies have undermined their resilience and the provision of several important water-related ecosystem services. Under these circumstances, and if no action is taken, impacts of pollution, water abstraction, and changes in land-use and climate risk threatening availability of water resources, and thus public health, welfare and jobs.
- In spite of very clear legal and policy frameworks for water, flood risk management, nature protection and biodiversity, implementation is lagging behind and needs to be reinforced. There is a need for increased integration into other related policy areas such as agriculture, land-use and energy which in some cases are pursuing other policy objectives where legal and implementation frameworks need to be better aligned with the Sustainable Development Goals and policy objectives for water and nature protection. There is also a need for improved arrangements to facilitate the mobilisation of the significant financial resources needed especially for innovation, establishment of green/blue infrastructure and re-establishing ecosystem connectivity.
- If these issues are not fully addressed, the United Nations' Sustainable Development Goals, and in particular the target to protect and restore water-related ecosystems by 2020- will be difficult to attain in the European Region. Failure to deliver on that target will inevitably have knock-on effects on the provision of ecosystem services and may create difficulties in attaining other Sustainable Development Goals than that related to water.

- In order to attain the Sustainable Development Goals and develop a sustainable, circular and climate-resilient economy and hydrological systems, authorities and stakeholders in the European region need to reinforce cooperation across jurisdictions, including transboundary cooperation.

They need also to develop step up efforts to control pollution by:

- Filling the gaps in efforts to treat sewage and industrial wastewater discharges, implementing more effective technologies for removing hazardous pollutants from discharges and ensuring that the parts of Eastern and South-East Europe and Central Asia that are lagging behind catch up.
- Stepping up efforts to control diffuse agricultural pollution and to use agricultural policies that guarantee that mainstream agriculture and livestock farming do not pollute or impair ecosystem services.
- Intensifying the preventive regulation of hazardous chemicals in products, tackling the issue of plastics and micropollutants, including pharmaceuticals, and phasing out inputs of endocrine disrupting substances

They need to assure balance sustainably water consumption and water availability by:

- Accelerating improvements in water efficiency, especially in agriculture
- Strengthening management of water demand, e.g. through more flexible arrangements for accessing water resources and conservation of the resource by preventing over-abstraction from groundwater bodies
- Implementing green, nature-based water retention land-use solutions to increase availability and stabilise water levels and flows
- Promoting and increasing safe re-use of water as part of the circular economy in ways that guarantee safety of the food chain and healthy ecosystems
- Replenishing depleted groundwater bodies by re-injection of treated wastewater free from hazardous chemicals

They need to implement nature-based solutions such as green/blue infrastructure and natural water retention measures to recuperate and guarantee future provision of water related ecosystem services by:

- Reactivating flood plains and reconnecting wetlands to water bodies to provide flood protection, flow regulation and re-establishing diverse ecosystems, re-meandering channelized rivers and re-establishing river bed habitats
- Restoring river connectivity to allow species migration and to maintain sustainable river hydrology and sediment transport by removing barriers or regulating their performance
- Implementing policies to ensure sustainable green and liveable cities, integrated into a circular economy
- Reinforcing governance support for green/blue infrastructure, especially mobilisation of stakeholders and finance for investment and innovation.

7.9. References

In the writing of this chapter the following bibliographic references have been used:

CDP (2017). Sector and Company Performance Insights.

Cimbritz, M. (2016) International “state of the art” of eliminating pharmaceutical residues by wastewater treatment, at http://www.svensktvatten.se/globalassets/utbildning/konferenser-och-seminarier/water-and-pharmaceuticals/26_cimbritz_state_of_the_art.pdf

Costanza, R.; de Groot, R.; Sutton, P.; van der Ploeg, S.; Anderson, S. J.; Kubiszewski, I.; Farber, S.; Turner, R. K. (2014). Changes in the global value of ecosystem services. *Global Environmental Change*, 26 (2014), 152-158.

COWI, DHI and ARUP (2014). Support Policy Development for Integration of Ecosystem Service Assessments into WFD and FD Implementation (https://circabc.europa.eu/sd/a/95c93149-0093-473c-bc27-1a69cface404/Ecosystem%20service_WFD_Main%20Report_Final.pdf).

EC (European Commission) (2012). A Blueprint to Safeguard Europe's Water Resources, Brussels, COM(2012) 673 final.

EC (European Commission) (2014). The Economic benefits of the Natura 2000 Network, Synthesis Report.

EC (European Commission) (2017a). Ninth Report on the implementation status and the programmes for implementation (as required by Article 17) of Council Directive 91/271/EEC concerning urban wastewater treatment, Brussels, COM(2017) 749 final.

EC (European Commission) (2017b). European Commission Staff Working Document: Agriculture and Sustainable Water Management in the EU, SWD(2017) 153 final, Brussels.

ECA (2016). Combating eutrophication in the Baltic Sea: further and more effective action needed. Special Report no. 3-2016.

Ecologic (2007). EU Water saving potential. Ecologic – Institute for International and European Environmental Policy report to the European Commission, available at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.603.4098&rep=rep1&type=pdf. It seems that no newer assessments are available.

EEA (2012). European waters – assessment of status and pressures, EEA Report no. 8/2012, European Environment Agency.

EEA (2016). Flood Risks and Environmental Vulnerability, EEA Report No 1/2016, European Environment Agency.

EEA (2017). Green Infrastructure and Flood management, EEA Report No 14/2017, European Environment Agency.

EEA (2018) Preliminary information from EEA, European waters –assessment of status and pressures 2018. State of Water report, Third complete draft 15 January 2018.

ETC/ICM (2017). Use of freshwater Resources in Europe 2002-2014, An assessment based on water quantity accounts. ETC/ICM Technical Report 1/2017.

EU (European Union) (2012). JRC Scientific and Policy Report: Evaluation of the effectiveness of Natural Water Retention Measures, Luxembourg.

Germaine, M.A. and Lespez, L. (2017). Le démantèlement des barrages de la Sélune (Manche). Des réseaux d'acteurs au projet de territoire? Développement durable et territoires, Vol. 5, n°3.

Grizzetti, B., Lanzanova, D., Liquete, C., Reynaud, A., Cardoso, A.C. (2016). *Assessing water ecosystem services for water resource management.* Environmental Science & Policy, 61 (2016), 194-203.

Grossmann, M., Hartje, V. (2012). Strategic cost-benefit analysis of an integrated flood plain management policy for the River Elbe, in: Grossmann, M. (2012), Economic valuation of wetland ecosystem services: Case studies from the Elbe River Basin, Technical University Berlin, Berlin, Germany.

ICPDR (2015). Joint Danube Survey 3 (JDS 3): a comprehensive analysis of Danube Water Quality, Scientific Report, Vienna.

ICPDR (2015b). The Danube River Basin District Management Plan, Update 2015

IKSR-CIPR-ICBR (2017). Mikroverunreinigungen im Rheineinzugsgebiet Bilanz 2017. CIPR report no. 246, see https://www.iksr.org/fileadmin/user_upload/Dokumente_de/Berichte/246d.pdf

Sneddon, C.S., Barraud, R., Germaine, M. A. (2017). Dam removals and river restoration in international perspective. Water Alternatives 10(3): 648-654.

Stagge, J. H., Kingston, D., Tallaksen,L., Hannah, D. (2017). Observed drought indices show increasing divergence across Europe. Scientific Reports 7, 14045 (2017), (available at https://www.nature.com/articles/s41598-017-14283-2).

WWAP (United Nations World Water Assessment Programme) (2016). The United Nations Water Development Report 2016: Water and Jobs. Paris, UNESCO.

8. Water and financing in Europe

8.1. Contents

This chapter details the assessment made in the European Regional Process about Europe and Financing: financing for water security. This text was prepared by José Veiga Frade (Portugal).

8.2. A brief overview

8.2.1. Relevance of the theme financing in the World Water Forums and Europe

Since the presentation in 2003 of the Report of the "World Panel on Financing Water Infrastructure" chaired by M. Camdessus in the 3rd World Water Forum in Kyoto, the theme "Finance" has attracted significant attention from the water sector community in the following World Water Forums. In 2006, the "Task Force on Financing Water for All" chaired by A. Gurría presented to the 4th World Water Forum in Mexico the report "Enhancing access to finance for local governments financing water for agriculture" that provided the support for the theme "Financing" but with an important focus at the local/municipal level and extending the debate to a wider scale by including agriculture. More recently, the World Water Council and the OECD created the High-Level Panel on Infrastructure Financing for a Water-Secure World" building on the legacy of the previous reports and output of the World Water Forums. This collaboration yielded the report "Water: Fit to Finance?" launched in 2015 during a High-Level Panel session at the 7th World Water Forum and a "Roundtable on Financing Water" was created under the initiative of an OECD-WWC-Netherlands partnership. The Panel and the Roundtable provide the opportunity for continuing the discussion and progress on relevant subjects concerning the theme "finance" worldwide.

The attention paid to the same theme in Europe, i.e. in the European regional process of the WWFs was substantially lower or not even included with the exception of the 5th World Water Forum in Istanbul when the European regional report emphasized the issues of financing, cost recovery and water efficiency jointly with the access to drinking water and sanitation as well as the issues of river basin management. At the last 7th WWF the theme "Finance" was not included in the European Regional process, the key messages do not mention the theme and in the Recommendations from the Final Session there is only a very general reference: "Promote adequate financing for the implementation of water related SDGs, through national budget when possible and through international development aid when necessary".

Under the 8th World Water Forum in Brasilia, "Financing" is back to the European regional process as one of the six main themes. Three topics were selected under the thematic process and replicated in the regional process as follows: 1) Economics and financing for innovative investments; 2) Financing implementation of water-related SDGs & adaptation to climate change; 3) Finance for sustainable development - supporting water-friendly business. The survey undertaken among 250 European focal points to assess the importance of the themes and topics of the European process has shown that the relevance, public perception and performance of the subject "financing" is not high but ranked between 7th and 14th among the 21 topics of the 6 European themes.

However, the three topics selected under the thematic process will likely not be the most relevant subjects of the European water sector. A survey undertaken at the end of 2017 among the same 250 focal points, although not representative of the European opinion due to the small number of responses, gave a higher relevance to the following topics: i) circular economy: financing wastewater and sludge reuse; ii) water prices, cost transparency, sustainable cost recovery; iii) the SDGs and adaptation to climate change. Concerning the most important investment needs with a financing gap in Europe, the

priority was given to: i) the asset renewal gap; ii) improving efficiency of the services; iii) innovative technology. The topics with a higher ranking regarding the water security challenges were: i) natural disasters; ii) infrastructure maintenance and renewal backlog; iii) availability and quality of water resources.

A short analysis of the most relevant topics mentioned above is presented in the section section 8.3 and the assessment of the investment and financial needs are described in the section 8.4. The bulk of the information was based on a literature review and data collected by the author[62]. The cross-cutting themes are mentioned in the section 8.5 and the main conclusions and recommendations in the section 8.7.

8.2.2. The status a decade ago

A reference to the status of the financing of the water sector a decade ago is important to enable a comparison with the current situation. For that purpose, it is used or quoted parts of the report presented to the European regional process in the 5th WWF in 2009, which was prepared by the author of this document/chapter 8.

Key issues, strategies to address them and Investment drivers

Water efficiency is a critical element of addressing water scarcity and potential climate risks as well as the long-term viability of water utilities. There is a de facto trade-off between financing new environmental infrastructure and addressing the inefficiency of existing infrastructure due to capital maintenance backlogs. Decision-makers with limited public funds are faced with a dilemma: do they focus on finding the money for new environmental infrastructure or on ensuring funds for maintaining and replacing existing infrastructure. Generally, money for new infrastructure can be raised where there is a visible outcome, effective enforcement and/or political will. However, for asset maintenance or replacement, deferral has often seemed the most expedient option, particularly since raising taxes or tariffs to cover such costs is politically difficult.

In many countries, average replacement rates of underground water supply and sanitation assets run into the hundreds of years and underinvestment for extended periods has left the sector with a substantial maintenance and replacement backlog. Positive action is needed to avoid a spiral of increasing operational costs and inefficiencies. Turning around inefficient systems in need of remedial investments is a long and even more capital-intensive process than maintaining an adequate, planned pace of renewal. The capital maintenance backlog is indicative of a general cost-recovery and tariff problem.

EU water legislation has been and remains a significant driver for a continued high level of new investment in the European water sector. An important element of the new generation of directives and policy proposals is recognition of the need to adapt systems in their widest sense to the effects and uncertainties caused by climate change. This calls for an even greater emphasis on creating a long-term economic and financial framework for the water sector. The Water Framework Directive (WFD) has brought in a number of innovations with the aim of promoting economically sound policies, including planning and economic analysis at river basin level, extensive stakeholder involvement and a move towards water pricing that reflects the true cost of water. The WFD, if implemented fully, will put focus on water efficiency and pollution avoidance and potentially reduce the investment cost of water infrastructure, with greater emphasis on economic instruments such as tariffs and metering. Public participation and river basin authorities, acting as facilitators, are key factors in synthetizing different national and local interests.

[62] An assessment of the investment needs was undertaken purposely for this document – (Owen, 2018)

There needs to be a greater focus on the cost side of the cost recovery equation. Poor investment decisions and inappropriate infrastructure design can potentially do more harm to financial sustainability than can be remedied through financial optimisation, good operational management or through sustainable tariff increases. It is therefore essential for financial sustainability, as well as for justifying and recovering costs from users and taxpayers, that utilities are run efficiently and that compliance with directives and other relevant legislation is achieved cost effectively and at a reasonable pace. Technological innovation needs to be pursued that will reduce the cost of maintenance, operation as well as exploit potential resource and energy recovery as sources of revenue.

The term “regionalisation” can cover a number of consolidation models for a fragmented water sector. Many countries in Europe have undergone this process. Generally, the move is accompanied by an effort to introduce a commercialised type of management and accountability. Regionalisation also necessarily implies a degree of cross-subsidisation and solidarity among the population. If adequate financial incentives are provided or substantial economies of scale in terms of costs can be achieved, win-win scenarios can be created. While decentralisation has the potential to bring political responsibility and accountability close to the consumer, it must be within an institutional setting that does not allow undue political interference in operational decisions or unrealistic.

Financial sources, cost recovery, tariffs, sector specific risks

The European water sector has traditionally relied on the use of public funds to extend coverage and there have been significant cross-subsidies between densely and sparsely populated areas and between groups with different affordability constraints. The water sector is capital intensive and dependent on long term borrowing against future tariffs and taxes, with the overall amount of debt per consumer to be serviced set to rise. The value of invested capital per consumer is very high as compared to other sectors; revenues, on the other hand, as a function of distributed volumes, are comparatively low. Revenues are unable to cover the immediate financing needs for either major enhancement works or significant replacement efforts. There is therefore a continuous need for debt financing and re-financing for a wide range of needs. Moreover, the overall amount of debt will rise as coverage and environmental obligations are extended, particularly where there is a major backlog in asset replacement. This debt will have to be serviced out of user fees or taxes, which constitute the ultimate sources of money.

Access to capital markets and debt financing is governed by the risk profile of the water sector and individual utilities. The ability of the water sector to obtain the right financing is a function both of utilities’ performance and the legal, institutional and financial environment that is created around them. The ability of individual utilities to borrow at a sustainable cost of capital is largely governed by their ability and willingness to repay the debt in a timely manner as well as mechanisms or regulation to reduce the financial risk to lenders or subsidise the cost of capital directly.

Cost recovery remains fiction without accounting and planning methods that provide reasonable projections of the necessary level of funding for maintenance and replacement or without tariff setting that reflects that level of funding. The reality in several countries in Europe is that tariffs, even when supplemented with national or local government transfers, are not high enough to ensure maintenance and replacement of existing assets at a long-term sustainable pace and to a modern standard, leaving the sector underfinanced.

Cost-recovery and prices need to “work” for water efficiency and vice versa. Awareness is increasing that incentive-based instruments like water pricing and metering are effective tools to promote efficient use of water. Water efficiency will also bring down costs in the long run and make cost recovery easier to achieve by reducing or deferring investments for new water resources. Such demand-side measures are generally low-

regret from a financial and environmental perspective. To cover the high level of compliance-driven investment in new infrastructure and the maintenance and replacement of an ageing existing infrastructure, tariffs will most likely have to be increased. However, this is difficult since increases are subject to a high degree of public scrutiny, significant inertia in the planning and political system and the need to take into account affordability issues, particularly in the less wealthy regions of Europe. Political pressure to keep tariff levels low and/or poor tariff collection rates often lead to poor cost recovery levels and little or no real surplus for debt repayment.

The fundamentals of a mature water sector are generally good, with a low-risk/low-return profile, given its monopolistic and essential nature. However, sustained or significantly increasing investment needs, political volatility in tariff setting, increasing affordability concerns, decreasing visibility of returns on investments and suboptimal institutional or legal arrangements have the potential to negatively affect the low-risk perception of the water sector, or the capacity to yield stable revenues over the long tenure of infrastructure loans. In addition, without adequate adaptation and system resilience, the water sector and utilities may become more exposed to operational and financial risk under extreme climatic events.

A particular challenge for service providers in medium and small-size municipalities or utilities is the lack of capacity to adequately provide public services or the scale to access financing at suitable terms. Consolidation of the sector – a process whereby smaller water service providers cooperate or are replaced by or associated with larger and stronger providers over a geographical area – is a logistical necessity for the implementation of the required investments and absorption of grants over the relatively short transition periods. A regulatory, economic and financial environment needs to be established that will enable the perception of the water sector as a stable, low-risk/low-reward sector that could facilitate access by utilities to suitable low-cost long-term debt served by stable cash flows.

8.2.3. Current situation. Progress made over the last decade in Europe

It is clear that the majority of the issues mentioned a decade ago and the recommendations to address them remain valid although some have been minimized. However, the current situation varies substantially from country to country and region to region. Moreover, different purposes - water supply, sanitation, water resources management, irrigation[63], flood protection and climate adaptation have reached different levels of progress and performance. There is a positive trend towards an integrated approach of all the purposes, but it is not yet visible in terms of financing. In Europe, there is a clear lack of national financial strategies with a mid or long-term vision from the supply side of money, which is still mainly driven by EU grants. Another characteristic of the European sector is the wide diversity of the institutional framework, namely on the provision of water and wastewater services still led mainly by a municipal fragmented approach. At central level, governance is still a major issue in some countries.

In the EU region, the diversity has been progressively reduced due the legal framework driven by the EU Directives. Member States (MS) have benefitted from new investment required to comply with the Directives coupled with substantial financial support of grants through the European Structural Investment Funds (ESIF) with a very positive impact on the quality of the drinking water and significant improvement on urban wastewater treatment, and the management of the water resources. In the countries under the enlargement process, there is still a substantial gap either on current status of water quality, management and SDGs with a much lower availability of funds required to support the investment needs, often due to poor quality of projects, lesser development

[63] The irrigation sub-sector is not assessed in this document due to a significance difference of approach related to financing

of domestic and commercial finance, and incipient management of water resources. However, there are several financial mechanisms to support the development of the sector towards the EU goals.

Investment on water infrastructure remains capital intensive and the investment needs over the next decade are still substantially high. Several factors and sector-specific characteristics contribute to the problem of underinvestment or lack of financial resources in the sector. These include:

- The long-term nature of investment. Water infrastructure is a long-term asset and its funding requires long maturity that does not attract or are less available at the banking sector;
- Poor management of assets, with aging infrastructure that is not renewed at an adequate pace due to cost recovery issue aggravated by pressure from urbanisation and insufficient investment in new technologies;
- Emerging challenges linked to climate change or emerging pollutants. Adaptation to a changing climate requires sub-optimal design of the infrastructure to ensure a higher resilience (higher peak factors, standby facilities, etc.) and/or cope with a higher probability of the extreme events/natural disasters (floods and droughts) and increasing scarcity of water resources. These challenges aggravate the capital intensive nature of the sector and require higher unit costs of the infrastructure for similar level of services;
- The low return on investment for the services due to the nature of the good provided by the services – economic, social and monopolistic thus having affordability constraints. Willingness to pay (Wtp) is below the economic and social value of the services provided, namely if compared with other basic services;
- High political exposure with services viewed as social good undermining cost recovery objectives. For similar reasons, it affects the policy makers' willingness to impose taxes necessary to fund investment to water security not generating direct revenues, e.g. IWRM, flood and drought prevention, and adaptation to climate change;
- Fragmentation of the service providers not benefitting from economies of scale that could reduce the unit investment costs and a higher capacity of the utilities to recruit skilled human resources and mobilise financial resources due to lower borrow constraints and more favourable borrowing conditions – lower risk;
- Complex and diverse institutional framework requiring management at national, regional and local level;
- Water projects compare unfavourably with other infrastructure projects (e.g. renewables) as regards allocation of risks and rewards for investors. They also often smaller increasing the transaction costs.

The current financing gap was aggravated by the recent austerity on public funds, the main source of funding for the water sector. However, the credit recovery in macro terms is picking up in many European countries and the coming years look more positive.

8.3. Diagnosis of current issues and challenges

8.3.1. Water security

Water security is defined (OECD, 2016) as achieving and maintaining acceptable levels for four inter-related water risks: i) too little water, including droughts to meet demand for beneficial uses; ii) too much water, including floods that overflow of the normal confines of water bodies or the destructive accumulation of water over areas not normally submerged; iii) too polluted water with lack of suitable quality for a particular purpose or use; and iv) degradation of freshwater ecosystems undermining its resilience by exceeding the coping capacity of the water bodies and their interactions. These risks to

water security can also increase the risk of inadequate access to safe water supply and sanitation. The report Securing Water, Sustaining Growth provides estimates of global economic losses per year from inadequate water supply and sanitation (US$260 bn) and urban property flood damages (US$120bn).

While investment in water security makes economic sense, it does not materialize due to the characteristics/constraints of the water sector and barriers – see section 8.2.3. Moreover, water climate-proof infrastructure does not generate additional financial revenues and returns thus highly dependent on public finance. In Europe, floods are the largest source of GDP losses from natural disasters (EIB, 2016) (EUR 150bn in 2002-13), while their frequency has increased with annual damages estimated at EUR 5.5bn under current conditions, but exceeding EUR 23bn by 2050 if climate and economic changes are considered (Jongman *et al*., 2014). At the other end of the spectrum, droughts have caused EUR 86bn in damages over the last 30 years and one fifth of Europe's population lives in water stressed countries (EEA, 2010).

8.3.2. Efficiency, asset renewal

In Europe and namely in the EU, the current rate of connection of the population to the water supply systems is high and population is not growing thus requiring neither significant extension of the network nor the expansion of the capacity of the existing facilities. Therefore, the focus is now and in the future on taking the best of the existing facilities in terms of installed capacity (quantity) and quality of the services. Efficiency gains should be the new paradigm and progressively predominate on the trade-off between financing new infrastructure and addressing the inefficiency of existing systems.

> The Strategy Plan for the water supply and sanitation in Portugal for the period 2014-20 (***PENSAAR 2020) – "A strategy at the service of the population – services of (good) quality at a sustainable price"*** has defined the following new paradigm for the sector: "A strategy less centered on infrastructure to increase the services coverage but more focused on the management of the assets and the quality of the services to the population within a wide sustainability – technical, environmental, economic, financial and social"

The improvement of the performance of the systems has multiple positive effects: it postpones investment needs and reduces O&M cost thus enhancing cost recovery and minimizing the increase of tariffs. It helps addressing major sector issues – cost recovery and affordability, and it also increases the resilience of the systems and improves the quality of the services provided to users as well as the water resources affected by pollution caused by underperforming wastewater facilities.

Efficiency gains have been achieved successfully in a large number of European countries and the EU legislation has currently a strong focus on that objective. The non-revenue water (NRW) has been substantially reduced due to investment made on the reduction of water leakages and commercial good practice - the mean values for losses are 23% and 2171 m^3/km/y in EurEau member countries. However, there is still a high number of utilities who don't know their assets due to lack of survey and have no asset management practice as a main purpose and tool to achieve higher efficiency. A further infrastructural challenge for developing Europe's water sector is the lack of metering that could induce excessive consumption and capital expenditure (capex) on system's capacity increase.

The water supply and wastewater infrastructure in many parts of Europe is ageing and need to be replaced. The renewal rate for infrastructure is generally around 1% per year, but it can be much lower, causing a major impact on the efficiency of the systems. This issue was clearly highlighted in the past (see section 8.2.2) and remain or will likely be aggravated by the substantial investment made on new water infrastructure in Europe over the last decades. The large majority of the utilities in European countries who report

their figures on investment on asset renewal have a ratio for drinking water infrastructure below 1.0 (EurEau, 2017) and some below 0.5, i.e. a renewal every 200 years whereas for wastewater infrastructure the renewal is even lower.

Generally, funding for new infrastructure is easier to raise and justify due to a visible outcome either for the population, politicians and utilities, as well as effective enforcement by the policy-makers. Instead, the benefits of efficiency gains are mainly visible only to the service providers but have a stronger economic justification with a short-term payback, less capital intensive thus often seen as a low-regret solution with a higher capacity to attract repayable financing. However, ensuring funds for constant asset management, maintenance and replacement does not have a visible and short-term outcome. The characteristics of the investment required for asset renewal are substantially different – a constant flow of steady and increasing investment generally self-funded by the utility through the revenues generated by the tariffs to ensure the cost recovery. Deferral has often seemed the most expedient option, particularly since raising taxes or tariffs to cover such costs is politically difficult. Therefore, the current asset renewal backlog leads to a funding gap. Moreover, it became an unfair inter-generation issue with the actual users of the system, often highly subsidised transferring costs to future generations who might not have access to the same level of grants.

8.3.3. Sustainable Development Goals

The UN's MDGs have been superseded in 2015 by 17 Sustainable Development Goals (SDGs) and 169 targets for attaining sustainable development by 2030 including a series of targets under the Goal 6 focused on all aspects of the water cycle and designed to provide water security which is a precondition for attaining sustainable development. They include, inter alia, targets for adequate sanitation and access to safe drinking water for all by 2030 and enhanced protection of water resources and related ecosystems, efficient use of water, resource efficient infrastructure and better use of nature's own capacity by using "green infrastructure" to retain water in order to attain similar water security objectives to those in the EU water policy. In addition to the dedicated goal for water, there are goals for a number of other issues such as energy and food security, health, ecosystems, cities, climate change and gender equality which are critically dependent on tackling water security.

In 2015 (UN ESC, 2017) and regarding the goal 6 worldwide, 6.6 billion people (over 90 per cent of the world's population) used improved drinking water sources and 4.9 billion people (over two thirds of the world's population) used improved sanitation facilities. In Europe, the achievement of the goal 6 is significantly more advanced than in other regions, namely on the provision of drinking water. The EC - Eurostat, SDG Indicator Set (April 2017) is structured along the 17 SDGs and includes 100 indicators used to produce regular EU SDG monitoring reports. A recent Eurostat report shows which of SDG goals the EU has progressed the most on, such as clean energy and others but it revealed that for certain goals, including clean water and sanitation, it is not possible to determine whether the trend is moving away or towards the achievement of the goal due to actually insufficient data.

The EU Parliament (EP) (EP, 2017) recently called on the EC and the MS to address the significant delays in achieving good water status under the WFD, and to ensure the attainment of SDG 6. The EP report notes that in the European Environment Agency's (EEA) assessment more than half of the river and lake water bodies in Europe have an ecological status that is classified as less than good. It also; i) calls the EC to support innovative approaches to sustainable water management, including by unlocking the full potential of wastewater, and applying the principles of circular economy in water management, by implementing measures to promote the safe reuse of wastewater; ii) emphasises that around 70 million Europeans experience water stress during the summer months; iii) recalls that the approximately 2 % of the EU population not having full access to drinking water is disproportionally affecting vulnerable, marginalised

groups; iv) and recalls, furthermore, that there are 10 deaths a day in Europe as a result of unsafe water and poor sanitation and hygiene. The EP report shows that achieving the SDGs in the EU is more demanding on the improvement of the quality of the water resources, which will benefit from the investment on wastewater treatment enforced by the Urban Waste Water Treatment Directive (UWWTD) with a strong financial aid from the ESIF grants.

8.3.4. Innovation, circular economy

Innovation (Suzenet, 2017) is key to support resource efficiency, economic growth, increase competitiveness and contribute with new technology for the circular economy and the adaptation of the water sector to climate change. The cycle of water innovation builds on basic knowledge, research and experience to develop new solutions or make improvements. Financial resources are needed to test their potential, the suitability under real-life conditions, and where appropriate demonstration plants and other measures to speed up diffusion and support commercialisation. Priority innovation areas have been identified, namely water reuse and recycling, water and wastewater treatment including recovery of resources contributing to the circular economy, water-energy nexus, flood and drought risk management. The importance of research and innovation for water has been already fully recognised in the Horizon 2020 EU funding programme. The European Innovation Partnership for Water (EIP) was created aiming to facilitate the development of innovative solutions and to create market opportunities, both inside and outside EU. The Water Supply and Sanitation Technology Platform (WssTP) was initiated by the EC in 2004 for research and technology development in the water industry.

Innovation in the water sector has progressed significantly in the supply of water for industry and regions suffering from water scarcity, e.g. desalination, efficiency use and recovery of energy by the water facilities and production of renewable energy, and on wastewater treatment enabling treated effluent and sludge reuse, or becoming carbon-neutral and/or energy-positive thus contributing to climate mitigation. These innovative technology is mainly driven by savings on capex and opex thus easier to justify in economic terms supporting higher margins and cost recovery that creates conditions for self-financing with own financial sources and attract external repayable funding. Investment on innovative IT and digital technologies and services, management and monitoring tools can also be facilitated as requires much lower capex and have shorter payback period. Financing innovative water technology requires an economic and business model using blended finance with the start-up based on public funds and grants provided for research and demonstration pilot projects, making the cases profitable and justifying private funds to support the commercialisation.

How the EIB supports water sector innovation[a]**:** It provides support for the development, implementation or commercialisation of novel water technologies through: • Long term loans for water R&D multi-annual programmes carried out by operators or water technology companies; • financing tools to specifically finance innovation such as the InnovFin – EU Finance for innovators under the H2020 programme. It consists of financing tools and advisory services offered by the EIB and the EC, covering the entire value chain of research and innovation to support investments from EUR 25 000 up to EUR 300m, directly or indirectly through banks or other financial institutions.

[a] *EIB water sector lending orientation: strengthening water security, December 2017*

8.4. Assessment of investment and financing needs

8.4.1. Investment needs

Investment drivers

The Report of the High-Level Panel on financing infrastructure for a water-secure world (WWC and OECD, 2015) makes a reference about future investment and water-related expenditures worldwide and acknowledges that projections in this area are particularly difficult. The Delphi survey indicates as the main drivers for future water infrastructure needs the following:

(i) Social perception of and responses to water-related risks (in particular droughts, floods, pollution); (ii) Increasing awareness of the value of ecosystems and biodiversity; (iii) Innovation in water services and infrastructure; and (iv) The impact of climate change on water availability and demand. However, in Europe, the EU water acquis and compliance with EU policy and directives are considered the principle drivers of investment in the MS and countries in the process of enlargement, and the primary consideration for decision-making on investment. For the other non-EU countries, the main driver is likely the need to serve the population with adequate drinking water supply followed by wastewater collection, treatment and sanitation.

Following compliance, maintenance of sustainable services and higher efficiency are major goals. Addressing Europe's investment gap, including the water sector, has also been central to the Juncker Plan (Investment Plan for Europe) and also the development of the European Fund for Strategic Investments (EFSI), which aims to leverage a total of €315bn of investment across the EU economy for all the sectors. In the "newer" (after 2004) MS EU-13 located in the Eastern part, investment on compliance is the most pressing requirement whereas in the Western part with fewer compliance issues, prioritisation of investment is more focused on new challenges such as efficiency, adaptation and circular economy.

It is estimated that the European water utilities reinvest about 50% of their turnover (EurEau, 2017), amounting to €45bn annually, i.e. on average, water services invest €93.5 per inhabitant per year assuming the extrapolated population of 499 million people served by the EurEau 29 member countries (EU-28 less Latvia and Lithuania plus Norway, Serbia and Switzerland) connected to a drinking water network, while 450 million inhabitants are connected to a wastewater collection network and 435 million to a wastewater treatment plant.

In conclusion, the current and future main investment drivers are: i) compliance with European and national regulatory requirements; ii) the need to increase the efficiency of the water systems and; iii) to expand drinking water and sanitation services and; iv) simply maintaining and renewing the water infrastructure. Climate change adds new challenges, such as flood protection and adaptation of existing infrastructure. Emerging pollutants (e.g. micro-plastics or pharmaceuticals) will require additional treatments.

Investment needs and gap

In the EU (EC, 2017a), investments to satisfy the requirements of the relevant directives are nearing completion. More than 99% of the large drinking water supplies comply with DWD and more than 90% of urban wastewater is being collected and undergoes secondary treatment as required by the UWWTD. On bathing waters, 96% of all sites meet the minimum quality requirements set out in the EU's Bathing Water Directive. However, important gaps still remain in some regions and further investment to comply with EU legislation will still be required in the short and medium term, especially in EU-13, for small water supply systems and in the application of tertiary wastewater treatment (85% compliance in 2014). The total remaining investment needed for the compliance with the UWWTD is estimated to be in the order EUR 22bn/year (EC, 2016). The

continued significant investment to replace, renovate or upgrade existing EU water facilities to improve their resource efficiency, provide water security in the future and remain compliant with the directives is estimated at EUR 25bn annually in the EU alone.

However, the current investment in this sector is considered low. Capex in utility and industrial water sector in 2016 estimated by country in the GWI (2015) is presented in Table 8.1.

Table 8.1 – Capex in utility and industrial water sector in 2016 (source: GWI, 2015).

EUR billion/per year	Utility water supply	Industrial water supply	Utility wastewater	Total
2016	17.6	3.8	29	50
Average 2016-20	18.3	4.5	31.1	54

The estimate includes also opex showing that the O&M costs in the sector could be the double of the capex.

The figures do not cover the investment needed in water security and flood risk management, as well as investment to make water infrastructure resilient to climate change. In the EU alone, flood frequency and flood risk are projected to rise significantly in the 21st century with annual average flood damage rising from EUR 5 bn per year in 2020 to EUR 20-40bn per year by 2050 and to EUR 30-100bn per year by 2080, depending on future economic growth.

As part of its engagement with the “Investment Plan for Europe”, the EIB carried out assessments of potential investment gaps which might hinder Europe’s competitiveness (EIB, 2016; EC DGENV, 2017) with the following results (Table 8.2).

Table 8.2 - Potential investment gaps in Europe (source: EIB, 2016; EC DGENV, 2017)

Investment need/objective	Annual investment (€bn)		
	Required	Current	Gap
R&D	4	3	7
Water security (including flood risk management)	15	2	13
Compliance and rehabilitation of Europe’s water infrastructure	75	30	45
Additional needs for resilient and efficient urban infrastructure	40	13	27
TOTAL:	134	48	92

The EIB acknowledges some of the limitations of this assessment. The estimates might be conservative as they do not include: i) the full impact of investment backlog for compliance with EU directives linked with freshwater quality, ii) investment required to meet new environmental requirements (e.g. elimination of pharmaceuticals) that are expected to be introduced shortly; iii) investment needed to increase resilience to climate change of water systems (e.g. improved drainage systems to reduce urban flooding and sewage spills). However, in view of the methodology and coverage of relevant geography as well as sub-sectors of the water sector, the estimates presented are considered most likely to reflect the true water sector investment needs in the study “Bridging the water investment gap”. The EIB assessment of investment gaps indicates that actual investment needs to upgrade and renew Europe’s water and wastewater systems are estimated at EUR 90bn a year for the period 2014 to 2020.

To complement the figures above, an estimate of the long-term investment needs till 2050 was undertaken specifically for this document (Owen, 2018). The estimate of annual investment in EUR bn covers each of the European countries with the following total figures by region and type of infrastructure, which are close to the GWI estimate mentioned before:

Table 8.3 – Annual investment needs in Europe (source: Owen, 2018)

	Water supply (€bn)			Wastewater (€bn)				
Europe	Urban	Rural	Total	Urban	Rural	Total	Meter&monitor	Total
Eastern	9.5	1.3	10.8	4.9	0.4	5.3	1.0	17.2
Western	12	1.2	13.2	20.9	0.2	21.2	2.3	36.7
Total	21.5	2.5	24	25.8	0.6	26.5	3.3	54

The average total annual investment just for water supply and wastewater infrastructure in the long run would not deviate from the actual capital expenditure, with a level of investment needs likely rising significantly over the next two decades till all the European population will have access to the basic services of the SDG goal 6. However, the huge and increasing needs on asset renewal estimated at EUR 90bn a year due to current backlog plus the new challenges such as climate adaptation would likely bring the average annual investment in the overall sector in Europe to well above EUR 100 billion.

Technical assistance and capacity building – the soft investment

Technical assistance (TA) for the preparation of projects and capacity building of public entities and utilities operating in the European water sector has a relevant role in the countries with less developed systems and still lacking experience and skilled human resources. It represents a significant contribution to its development through grants from the EC, European banks and bilateral aid. One example is the JASPERS (Joint Assistance to Support Projects in European Region) initiative helping new Member States prepare major infrastructure projects using EU Structural and Cohesion Funding. Another example is the Instrument for Pre-Accession Assistance (IPA), a “vehicle” that was used for the policy objectives of the EC in the field of enlargement to EU membership by supporting reforms with financial and technical help.

The Western Balkans Investment Framework (WBIF) is a regional blending facility established in 2009 under joint initiative of the EC, EBRD, EIB, CEDB and bilateral donors supporting EU enlargement to 6 countries in the region. The World Bank Group and the KFW subsequently joined the Framework. The WBIF provides financing and technical assistance to strategic investments in several sectors including environment.

The Eastern Partnership Technical Assistance Trust Fund (EPTATF) was established in December 2010 as a multi-donor, multi-sector trust fund designed to enhance the quality and development impact of the EIB’s operations in the Eastern Partnership Countries by providing well targeted technical assistance to several sectors including water, sanitation, environmental protection and climate adaptation. The factors driving the creation of the Fund were the slow uptake of financing, attributed to a lack of resources for project preparation, and the limited implementation capacity of promotors in the region. At end-2016, the EPTATF had received pledges from contributors totalling EUR 36.2m. Countries currently eligible for EPTATF support are Armenia, Azerbaijan, Georgia, Moldova and Ukraine. The Fund is also open to cross-border or regional projects. It supports preparatory studies, strengthening project management and operational skills, and it also provides support for capacity-building such as the training of officials in beneficiary countries.

8.4.2. Financial sources

The 3 Ts and repayable financing

Water utility infrastructure is financed in a variety of ways, including private, public, national and international sources of finance – often in combination – and via a range of different financial instruments. Generally, financing is based on a combination of three sources – tariffs, taxes and transfers (the '3Ts')[64]. This revenue stream is also used as a basis for attracting and repaying finance including loans – concessional from development agencies or market-based from commercial banks, bonds (debt) and equity, which is used to address financing gaps or meet short-term budgetary needs. The debt service is mostly supported by the cash flows generated by the users' fees whereas the transfers and taxes are normally used to subsidise part of the capex, which is complemented by the repayable financing and self-financing of the borrower

In Europe, the water sector is eligible for the cohesion policy funding from the European Regional Development Fund (ERDF) and, depending on the region[65], the Cohesion Fund (CF), i.e. transfers from the European taxpayers. The latter is a major source of financing for water investments, especially in EU-13 (25% of total funding) whereas in EU-15 countries it is much lower (4% in 2007-2013) – see Figure 8.1.

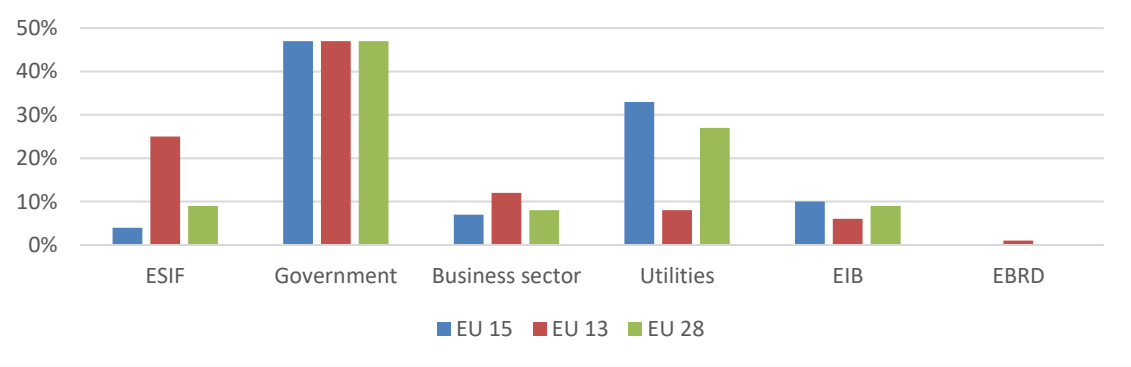

Figure 8.1 – Percentage of total funding from Cohesion Funds.

There is a decline in the current decade of the support from the Cohesion Policy funds, namely in the EU 15, as indicated in the table below, due to the good progress in meeting EU requirements for the DWD and the UWWTD (EC, 2017b). When considering different type of infrastructure or sub-sector, however, the proportion of allocations to drinking water projects compared to wastewater projects has remained fairly constant across the three financing periods whereas the allocations to wastewater investments were approximately two times higher. Overall, the majority of MS benefiting from the ESIF decreased their funding allocations to water projects since 2007 with the exception of a few countries. The totals by sub-region and type of infrastructure are the following:

Table 8.4 – Total amount of investment support from cohesion policy funds in Europe (source: EC, 2017b)

€ bn	2000-6	2007-2013	2014-20
EU15	14.3	7.6	4.2
EU13	6.3	13.9	10.4
Drinking water	6	7	5
Wastewater	14	14	10

[64] The 3Ts concept is a classification to analyse financial flows, developed by OECD's Horizontal Programme on Water in 2009 (OECD, 2009).

[65] The Cohesion Fund is aimed at Member States whose Gross National Income (GNI) per inhabitant is less than 90% of the EU average.

Associated with the decline, new types of investment are growing and represent for the period 2014-20 about 20%, e.g. 'water management and drinking water conservation'. Under this category, the national operational programmes (Ops) plan a broad range of investment aiming at :i) the reduction of leakages and losses in water networks; ii) the expansion and improvement of water metering systems; iii) studies to define ecological flows and to improve and complement the criteria for classifying water bodies and the acquisition of equipment for the mathematical modelling of water quality; iv) development or updating of the strategic documents related to water management.; v) climate change adaptation to climate measures preventing and management the related risks including awareness raising, civil protection and disaster management systems and infrastructures. Water sector investment in the EU is also supported by a number of programmes which provide funding, such as LIFE and the Danube Transnational Programme.

Tariffs/water prices, cost recovery, affordability

It was not possible to find reliable data about the cost recovery in Europe or in the EU. Figures presented by EurEau indicate a total annual investment by the utilities in the 29 member countries of about EUR 45bn and the amount of billing around EUR 85bn, which should cover both capex and opex. As the latter is estimated in the GWI (2015) at about the double of the capex, the annual revenues of the EurEau associated utilities generated by tariffs could be well below the total costs, around 65% but depending on the real O&M costs.

In the EU, the cost-recovery principle was introduced through the article 9 of the WFD establishing that: i) water prices must allow for the (adequate) recovery of water services costs, including environmental and resource costs; ii) the main water users (disaggregated for households, industry and agriculture) must adequately contribute to the recovery of costs of water services, proportionally to their contributions to the pressures imposed on aquatic ecosystems in line with the polluter pays principle; iii) water pricing policies must provide adequate incentives for users to use water resources efficiently and thereby contribute to the environmental objectives of the WFD. Those EU countries benefitting from the ESIF grants have to fulfil an ex ante condition for the 2014-2020 programme period meaning that the approval of the Ops was subject to the existence of an adequate contribution of the different water uses to the recovery of the costs of water services. No data was found on the compliance of the EU MS with the article 9.

In general, there is resistance from stakeholders and users to the rise of the water prices. This resistance may in some cases originate from the lack of information, while in others it is due to multiple social issues. Generally, customers have limited knowledge about the economic instruments which are set up by water utilities and river basin agencies. On the other hand, the general perception that household water demand is inelastic with respect to pricing, and the notion that water is a basic requirement for life both pose

Denmark has implemented the principle of full cost recovery for water and wastewater services including climate change adaption. The income from the water price is funding all activities related to the provision of the services with no subsidies and the revenues collected are fully used for funding running costs or to be reinvested in the sector. Utilities are owned by municipalities, organised as private entities managed as limited (shareholder) companies operating under a not-for-profit principle. Consumers pay for water supply and sanitation to the water and wastewater utilities and all revenue collected by payment for the water has to stay in the companies. A household Danish pays in average less than 750 € per year, of which 30 % goes to the State in the form of VAT and other taxes to for groundwater protection, climate adaptation and monitoring of drinking water quality. Consumption is 104 l/c/d and average NRW estimated at 7.6%. (*case study submitted by DANVA to the 8th WWF*).

political constraints to the establishment of the cost-recovery principle. Therefore, the water prices required to achieve cost recovery have been kept at low level in the majority of the European countries. When compared with the affordability limits recommended in the region and if investment on efficiency is adequately achieved, the full cost recovery prices would affect only a small number of households.

The more developed water sectors in the European countries have used the other two sources and some have reached full cost recovery through one single T – the tariffs.

Repayable financing. Supply of public and private lending

The role of the European public development banks (EIB, EBRD, NIB, CEB) remains fundamental. Some European countries are also eligible for borrowing through the World Bank. Public financing on the water sector has the advantage of having lower capital costs and/or better conditions such as longer maturities or lower interest as compared to private capital. However, the latter could complement the public funding gap by unlocking financial resources in a context of progressively reduced public budget applied in the sector, which is in competition with other highly demanding sectors as education, health or transport, and thus on a downward trend.

In June 2015, EIB and the European Commission launched the European Fund for Strategic Investments (EFSI), intended to mobilise private financing for strategic investment. EFSI has a capital of €33.5bn (€26.0bn from the European Commission and €7.5bn of EIB's own capital) and a ring-fenced budget for infrastructure and innovation, including water infrastructure. The target was to mobilise a total of €315bn over three years, and in 2016 alone EFSI-related total investment reached €163.9bn. Since the 2015 launch to the end of 2016, EFSI investment contributed to the construction or upgrade of almost 120km of water mains or distribution pipes with over 2 million people benefiting from safe drinking water. The EFSI provides also guarantees to loans provided to higher risk profile borrowers, often the case in the water municipal or regional sector.

Cooperation between the EC and the European development banks offers conditions for pooling resources and reduce funding gaps often faced by the promoters. Some large European cities have the financial capacity to fund urban water services by issuing municipal bonds as a debt security. There are also various schemes set up by individual EU MS, e.g. the Netherlands has established a public bank – the Netherlands Water Bank (NWB Bank) – which arranges short and long-term loans or issues green bonds for water authorities, municipalities, and provinces, promoting investment in the field of water supply.

Private repayable financial instruments to fund water industry investment include debt (various loans, including bonds and export credits), with fixed (and often interest) payments to the provider, and to a lesser extent equity. There is an increasing interest from non-traditional private financial sources to invest in European water infrastructure, including, for instance, various kinds of institutional investors such as pension funds, insurance companies, sovereign wealth funds or other specialised water funds, e.g. private equity funds. Venture capital, although marginal in Europe, could also progressively contribute more to the reduction of the water sector funding gap, namely trough innovative technology.

8.4.3. Financial needs, the funding gap, financial instruments

A strategic financial planning methodology for water supply and sanitation called FEASIBLE was developed jointly by the OECD/EAP Task Force and the Government of Denmark and designed to help countries improve their financial planning for the water supply and sanitation sector. The aim was to support the definition of financing strategies providing the necessary link between the general programmes on the one hand, and project pipelines and public budgets but it was not scaled-up up in Europe. Such an output could have been a good source of information for the estimate of financing needs and current funding gap.

Some stakeholders claim that the financial gap is due to shortage of money on the supply side whereas others blame the demand side for lack of bankable or sustainable projects/investment. The gap stems from major factors: i) the beneficiaries of water-related services do not usually pay the full cost of the provision of such services; ii) the risk profile of sector is high compared to other sectors as a result of the uncertainty on the cash flow generated by the users' fees; iii) borrowing capacity of a fragmented sector is low. Lack of bankable projects is considered a reason for the gap, i.e. lack of well justified and designed projects promoted by a service provider charging tariffs able to ensure a sustainable cost recovery and showing acceptable borrowing conditions. Without it, taxes and transfers are the only sources of financing the investment.

Two EU MS – Bulgaria and Portugal have adopted national sector strategies with estimate of investment needs comparable with available actual funds available. In the Bulgaria 2014-2023 National Strategy with the aim of improving the quality of water services and achieving the EU environmental standards, the investment needs for drinking water in that period have been estimated at about EUR 2.5 bn. In comparison[a], the EU funding allocated to drinking water related investments for the 2014-2020 period amount to about 145 million euro. This indicates an investment gap of around EUR 1.6 billion. In Portugal, in the sector national strategy plan for 2014-20 in Portugal[b], the investment needs for the water sector were estimated at EUR 3.7 bn. If the current available funding sources from ESIF and EIB are considered, the funding gap is about two thirds of the total estimate. [a] Court of Auditors report, [b] PENSAAR2020

Traditionally, infrastructure investments have been financed by public funds (OECD *et al.*, 2017a) and the majority of spending will likely continue to come from the public sector. In recent decades, however, the emergence of a neoliberal perspective has helped to support the opinion that alternative sources of public and private financing infrastructure are both necessary and desirable. This become more relevant with the fiscal austerity and balance sheet recapitalisation that has followed the credit crisis of 2008-9. However, in the aftermath of that crisis, the share of infrastructure spending by the public sector actually went up, due to the flight of risk-averse private sector capital. Therefore, the role of public funds needs to be rethought so they are used more effectively to leverage commercial finance. Public resources should be recognized for what they are: scarce, pivotal, and catalytic. Annual savings could be unlocked by improving infrastructure productivity through better project selection, improved implementation, operation and better asset management.

The city of Poznan in Poland was frequently damaged by floods leading to the decision to canalise the river Warta early 19th century. However, it led to the river becoming an isolated area with no connection to the historic city centre. The City of Poznan acknowledged the need for a strategy to increase water safety and to restore the river connection with the city. The development strategy, aiming to protect the city from flooding in combination with a high quality of life for its 600,000 population, consists of proposals of some 70 projects ranging from developing river islands, new river channels and a marina, and the revitalization of river fronts. Economic analysis has shown that the City of Poznan will have measurable benefits if all projects proposed in the strategy are completed. It is envisaged to set up a joint development company, the "JDC Warta" - The City will be majority owner, a public-private partnership providing resources and capital, and acting as the managing entity of the investment programme defined under the development strategy. %. (*case study submitted by NWP to the 8th WWF*).

Water financing needs should be estimated and made available in a better database (OECD *et al.*, 2017b) in order to provide a firmer benchmark from which to judge future financial requirements, and to monitor future progress. Further investigation on the level of current expenditure on water and the sources of its financing is needed.

Long-term liabilities of pensions and insurance plans match the long-term asset profile of infrastructure. As this has not happened partly reflects the heterogeneous attributes

of commercial lenders, insurers, institutional investors and others. Commercial banks, pension funds, insurance companies, mutual funds, sovereign wealth funds and others each have different performance objectives, risk tolerances, income preferences, time horizons, information resources, sector knowledge, etc. For instance, to protect against the impact of climate change, there is a need to develop drought-proof water resources such as desalination, water reuse infrastructure, and to develop green infrastructure in and around cities to reduce the impact of floods. However, climate change adaptation does not bring an increase in productivity and/or revenues, which can pay for the investment. In that sense, the financial model is more about insurance than investment. Building a desalination plant or preserving forest in upstream catchment areas could be viewed as the insurance premium that cities would have to pay in order to make sure that they can withstand climate change and the insurance industry would play a central role in financing such projects. Insurers would offer discounted premia to cities which invest in climate change adaptation measures and provide the finance municipalities need to build the necessary infrastructure. However, the insurance industry is not set up to provide a business model for climate change adaptation for several reasons (Gasson, 2016).

New types of financial contribution are being used and growing in importance worldwide. A list of potential financial sources and/or instruments is presented below although only a few are applied in Europe.

Table 8.5 – List of potential financial sources and/or instruments

3Ts and other contributions	Loan and bond finance (repayable)	Equity finance (repayable)
Tariffs and user charges	Public development banks, IFIs, OBA	Institutional investors, IFIs
Taxes (public budgets)	Commercial banks (incl. project finance)	Sovereign Wealth Funds
ODA	Institutional investors	Specialised water funds
Philanthropic funds	Sovereign, municipal, project and green bonds,	Private equity funds
Property taxes and other levies and contributions	Microfinance	Venture capital
Self-finance by users	Climate-related “green” finance	Public-Private Partnerships
	Export credits	Individual shareholders
	Revolving funds	Lease financing

The significant number of financial sources create favourable conditions for pooling and blending it (Leigland *et al.*, 2016), either public-public or public-private. As taxes and transfers will become scarce in the future, namely in Europe where compliance with basic services and environmental goals are progressively achieved, these two Ts could be used to leverage repayable funds or be dedicated/targeted to social purposes, e.g. support low-income households in accessing the water and wastewater services. They could also support guarantees to cover risks and enabling better repayable conditions, e.g. water investment programmes in EU-13 are currently benefitting from guarantees provided under EFSI to mitigate the risk of EIB loans. Moreover, the loans jointly with ESIF grants exceed the usual 90% cumulative EIB-EU financing threshold.

Revolving funds at national scale pooling all the available financial resources and lending it at concessional terms through the grant contribution and with a sovereign risk have also the potential to contribute to the reduction of the current funding gap. It is also important to ensure that concessional finance is not crowding out private finance and instead catalysing it to reduce the gap.

8.5. Crosscuttting themes

Sharing

The European policy regarding the water sector puts a strong emphasis on the involvement of the stakeholders due to the social nature of the sector, namely the population benefiting from the basic water services aiming at being universal. However, the theme finance is often split in two different parts concerning the stakeholders: i) on the demand side of money involving mainly utilities, national, regional and municipal organisations in charge of investing and/or operating water facilities, river basin and environmental agencies; ii) on the supply side of funds the main stakeholders are the national ministries of finance, international and regional entities, policy-makers, e.g. the EC providing transfers/grants, public and private banks. The expertise on each side is often substantially different, e.g. the banking sector often looks to borrowers focusing mainly on the basis of their risk with less emphasis on sectoral subjects. On the other side, borrowers could run the services with little attention to the risk associated with their business, e.g. imposing low tariffs not securing cost recovery.

The European water sector requires cooperation at several levels: international, national, basin/regional and local that renders the stakeholders' involvement and sharing more difficult. Moreover, the cross-cutting nature of the sector divided by a large number of compartments/silos is often and handicap in the decision-making process. These characteristics require a complex dialogue and difficulties in reaching consensus on the way forward to secure financing of the sector. At technical level, the cooperation and exchange of experiences has been always strong demonstrated by the World Water Forum and the high number of technical events but there is a strong need to achieve a closer cooperation on financing matters in the European sector. The High Level Panel and the Roundtable on Financing Water could set up the stage if accepting a regional approach.

Capacity

Insufficient financial resources and strong fragmentation of the sector concerning the service providers do not favour the recruitment of skilled human resources and/or the investment/purchase and use of hard and soft facilities, digital equipment and methodologies for asset management practice. The same applies to entities in charge of managing water resources and flood protection. The Netherlands claim the industry will be short of thousands of skilled labour in the coming decades. Therefore, the sector has important needs on capacity building. However, there are financial facilities and dedicated funds for the provision of technical assistance as mentioned in the section 8.4.1.

Governance

The governance framework of the sector in Europe plays a crucial role for financing related aspects as water pricing, cost recovery and internalisation of environmental and resource costs (EEA, 2013). It is also a major subject with relevant issues in the sector worldwide[66]. Being defined (Rogers and Hall, 2003) as the "range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society", it implies that the diversity of systems in Europe has led to different levels of performance and issues across the region.

Several reasons explain the complexity and difficulties of the water finance governance, namely the institutional framework and characteristics of the sector with a cross-cutting

[66] OECD Water Governance Initiative

nature (horizontally) and a complex decision-making process at 4 different levels: i) local as a municipal service provision sector generating revenues from end-users; ii) regional due to the importance of the river basin approach and allocation of funds for water management, floods protection, etc; iii) national in what concerns the mobilization of resources at ministry/national budget level; iv) international concerning the water policies and transfer of international funds for compliance with regional sector policies. The latter plays an important role in the EU on the water pricing and cost recovery, which is critical to the financing of the sector, by imposing compliance according with the requirements of the article 9 of the WFD, an instrument that is paramount in contributing to the reduction of the funding gap.

Another factor is the strong dependency of the financing of the sector on: i) repayable finance due to its capital intensive nature requiring the mobilization of up-front funds to cover short term capex supported by long term cash flows due to the long lifetime of the water assets; ii) the revenues generated by the end users with the general notion that water is a basic requirement for life and thus an arbitrary rise in the price of such a basic good is considered socially unjust despite its cost being substantially lower than other basic services. The latter leads to political decisions to keep tariffs below the levels required for sustainable cost recovery. The water sector is strongly politicised in a number of countries, where strong political and lobbying influences exist, and local utilities can operate as de-facto monopolies. Excessive political interests leading to mismanagement of services in the water sector are a major barrier for reform by introducing considerable uncertainty in the market and keeping the fragmentation of the services' organisational framework that block or render unattractive the financial resources required for the development of the sector.

8.6. Case studies

This section presents some case studies to illustrate the chapter, based on the collection and selection of proposals sent by different European organisations, as part of the European Regional Process approach described in chapter 3.

Case study: Implementation of full cost recovery in Denmark

Contact: Carl-Emil Larsen, CEO, DANVA: cel@danva.dk

Introduction

The case study describes how Denmark has implemented the principle of Full Cost Recovery (FCR) as a funding principle for water supply, handling and treatment of wastewater and water-related urban climate change adaption. The impact of this is that the income from the water price is funding all activities related to water supply and sanitation in Denmark. There are no subsidies and it is not possible to use revenues

collected in the sector for any other purpose. There are taxes and VAT included in the price of water, and some of the taxes stay in the sector to fund water resource mapping and monitoring, but part of the revenue collected goes directly to the national budget.

The Danish FCR-model is interesting in an international context as Denmark is one of the very few countries that have truly implemented the FCR-principle, and because this sustainable funding model is among the reasons that the water sector in Denmark has so many amazing results for instance in terms of non-revenue water and lowering water consumption. It has also had a significant impact on the opportunities to fund investments and new projects in the water sector.

The Danish water sector

All drinking water in Denmark is based solely on groundwater. The Danish drinking water sector is highly decentralised and consists of approx. 2,600 public waterworks. There are approx. 87 municipality-owned drinking water companies, who are running the large drinking water utilities. The rest, more than 2.000 small water works are owned and operated by local communities.

Wastewater treatment takes place primarily at the approx. 110 municipality-owned waste¬water companies. In 2015, there were a total of 780 treatment plants over 30 PE registered in Denmark, which collectively had a total load of 7 million PE and altogether discharged approx. 768 million m³ of treated wastewater. 93.2% of the wastewater discharged was treated at tertiary wastewater treatment plants, which is the most advanced type of wastewater treatment plant.

Water Sector regulation

The Danish Water Sector Act, which was adopted in 2009, applies to all drinking water and wastewater compa¬nies selling over 200,000 m³ water per year, which is ap¬prox. 220 drinking water companies.

The Danish Water Sector act requires the establishment of a financial frame¬work for each individual company and since 2009 the overall governing principle has been a separation of authority (municipalities) and operations (water utilities).

98 municipalities are the local water and environment authorities, and they are the owners of the large drinking water companies and all wastewater companies in Denmark. Even though the water companies are owned by municipalities, they are organised as private entities. They are managed as limited (shareholder) companies and governed by a board. Members of the board of the water utilities are to a large extent elected among members of the local city council, but they are still independent companies.

All water and wastewater utilities and community owned companies– small and large - are operating under a not-for-profit principle. Consumers pay for water supply and sanitation to the water and wastewater utilities and all revenue collected by payment for the water has to stay in the companies for funding running costs or to be reinvested in the sector.

Thus, the Danish water sector is built on the “break-even principle”, which means that there has to be a balance between the company’s expenses and income, measured over a number of years. Water companies are 100% financed by tariffs, and all measures, capital investments and operating expenses are to be paid by their consumers.

This is actually the full cost recovery principle implemented in practice. Not many other countries worldwide have taken the principle so far and it helps to secure funding for the sector and to keep focus on the core task of utilities.

Also with the new water act of 2009, we now have an independent national regulator. The regulator sets an individual revenue cap for utilities and individual goals to improve service efficiency in the utilities. There is a constant demand from the regulator to reduce prices and still provide services at the same service levels. Experience is that this is hard

to fulfil in practice, but it is however also a driver for innovation, when utilities have to be able to deliver same or better service with lower costs.

The Danish water price in comparison

This funding model where there is a balance between income and costs have resulted in water prices in Denmark that are relative high, but still not the highest in Europe as can be seen from this figure from 2014.

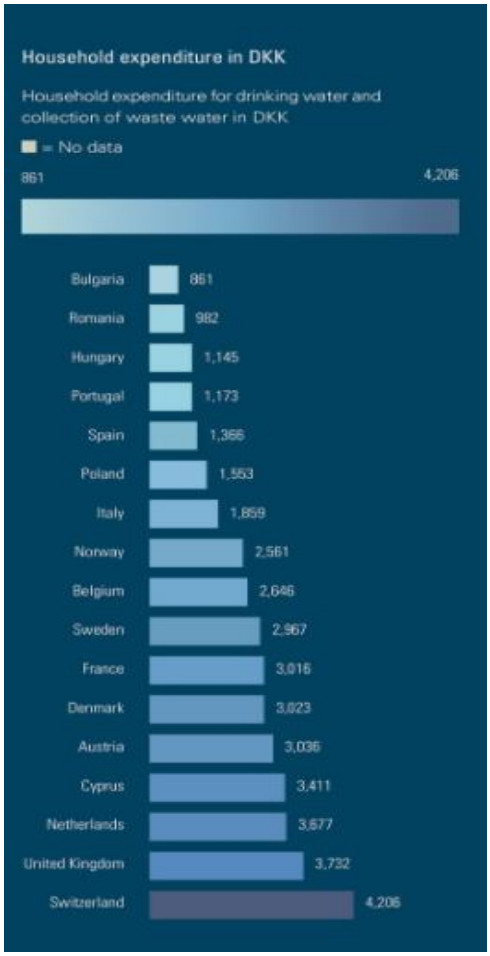

Figure 8.2 – Household expenditure in Denmark.

The Water Price

If we look further into the price of water it can be divided into the price of treatment and delivery of clean drinking water, plus the collection, treatment and discharge of wastewater. Out of the total water price, 18.2% go to the drinking water company, 51.6% to the wastewater company, while 30.2% go to the State in the form of VAT and other taxes.

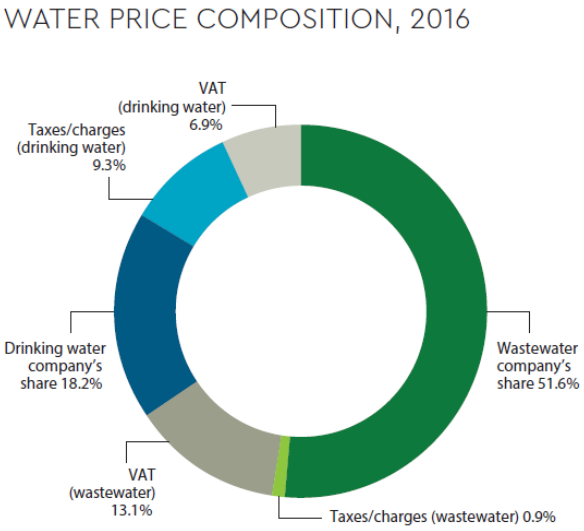

Figure 8.3 – Water price composition

Affordable water price

Even though the price of water at a global scale is relatively high, it is still affordable for the Danish population. An average Danish family needs to pay less than 750 € per year to have fresh, clean and regularly monitored drinking water delivered to the household. And it also covers getting rid of wastewater and making sure that it is properly treated before it is discharged into nature. In addition, the price of water also covers groundwater protection and climate change adaptation.

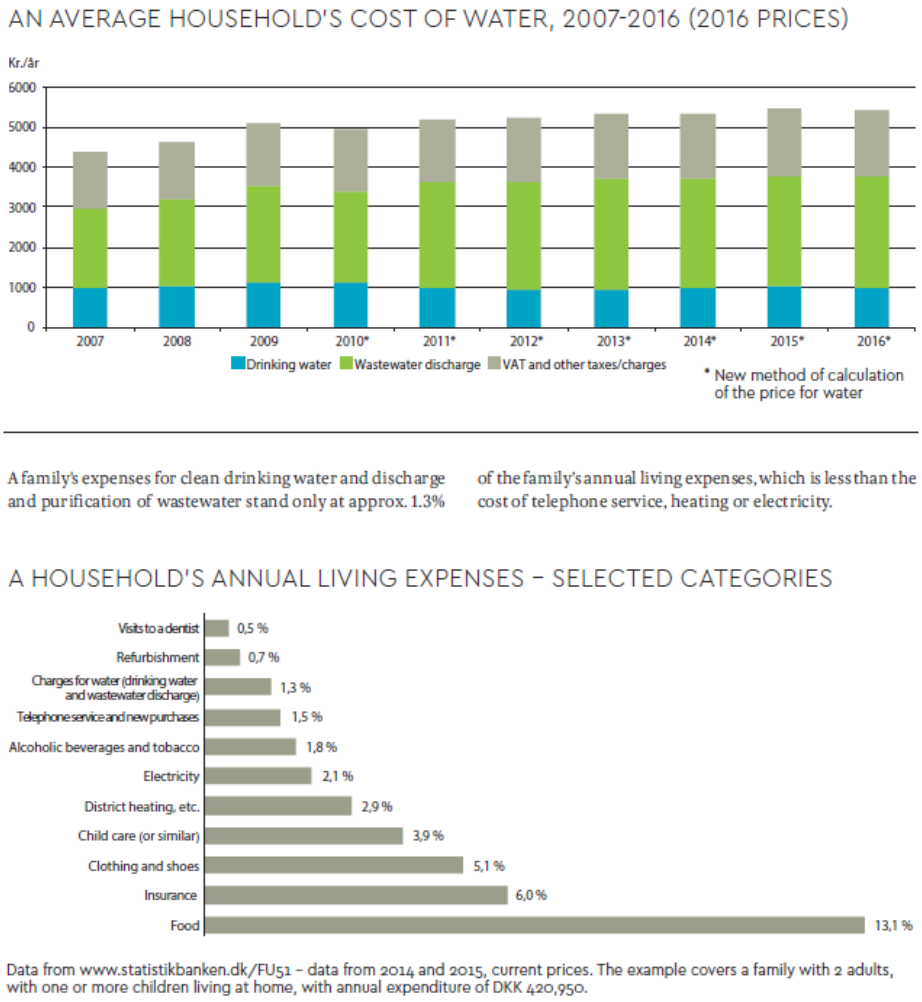

Figure 8.4 – i) average household's cost of water, 2017-2016; ii) a houholds's annual living expenses

In general, the public is happy to pay for clean and safe water and actually the price for an average family in 2016 fell by 1% compared to last year measured in constant prices, so the price is now only 1.3% of the average household expenditure.

Results of sustainable water pricing

Among the results of the funding model, where the population pays the actual cost for water provision is a high level of awareness about the use of water, how to save water and water-efficient solutions and appliances.

We also see now that water consumption in the sector now is at a historically low point. The average water consumption in 2016 measured at households, holiday homes, businesses, institutions and water losses is on average 62.67 m³ per person/per year. This is a decline of a full 0.7% compared to the level in 2015.

Households account for 65% of the total volume of water sold. An individual uses an average of 37.8 m3 per year, corresponding to 104 litres per person per day. Over the past 10 years, water consumption in households has fallen by almost 9%.

Another interesting fact is the low and declining level of water loss. It is among the lowest in the world and the average figure is 7.6%. This is caused by a combination of technologies and metering schemes, education, awareness and a penalty.

At the end of the 1990s, a general requirement for setting up water meters for all water users was introduced, and a penalty payment was imposed on companies experiencing a water loss of more than 10%, measured as the ratio between the volume of water pumped by the utility company for its own distribution network and the amount it has charged its customers for water.

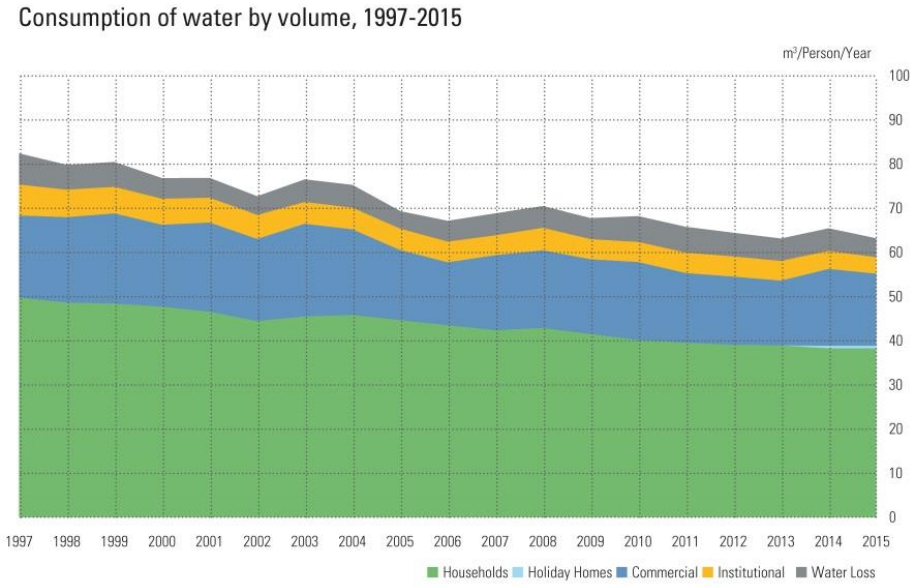

Figure 8.5 – Consumption of water by volume, 1997-2015

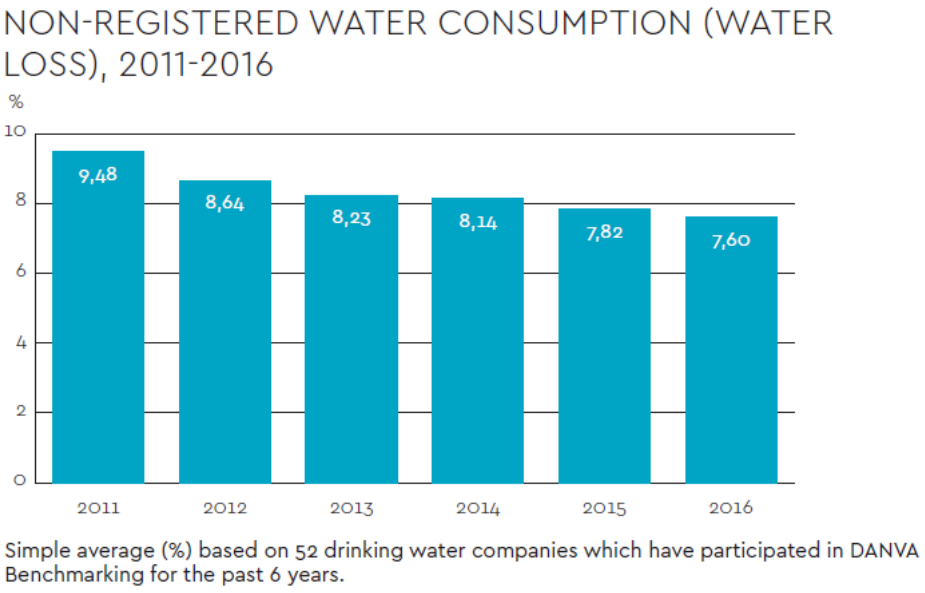

Figure 8.6 – Non-registered water consumption (water loss), 2011-2016

Framework within the scope of Sustainable Development Goals

Sustainable funding mechanisms are a precondition for sustainable water supply and sanitation and thus for implementation of the water goal 6. It is also important to related goas that depend on efficient handling of stormwater and wastewater such as goal 13 – Climate Action, goal 14 – Life below Water and goal 15 Life on Land.

Case Study ‘Development Strategy for River Warta in Poznan’

Contact: Poznan government and Netherlands Water Partnership (e.wisniewska@nwp.nl)

Background of the case study

Throughout history Poznan was frequently damaged by floods leading to the decision to canalise the Warta early 19th century. However, the canalisation led to the river becoming an isolated area with no connection to the historic city centre.

Recent years again dangerously high-water levels of the Warta occurred in Poznan. Some areas were flooded but luckily a large flooding did not take place.

The City of Poznan acknowledged the need for a strategy to increase water safety and to restore the river connection with the city, and entered into a partnership with KuiperCompagnons, Royal HaskoningDHV and SwedeCenter. The project was supported by the Dutch government.

Case study ‘Development Strategy for River Warta in Poznan’

The development strategy for the River Warta in Poznan 2012-2030 prepared by Polish -Dutch team represented by KuiperCompagnons, Royal HaskoningDHV, City of Poznan and residents of the city of Poznan is the first of its kind in Poland. The document is a long term vision to protect the city of Poznan from flooding in combination with a high quality of life for its 600,000 residents.

The development strategy consists of proposals of some 70 projects ranging from developing river islands, new river channels and a marina, the revitalization of river fronts and realizing a water bus, connecting neighbourhood playgrounds to the river.

The strategy is underpinned by six guiding themes: connectivity (traffic and pedestrian areas), river safety, living and working (residential areas and public space), tourism and recreation, historical heritage and landscape, and nature.

Socio-economic and financial aspects of the case study

Financial and economic analyses of the Development Strategy for The River Warta in Poznań were carried out. Both quantitative and qualitative, and also tangible and intangible impacts, were analysed. Investments do bring a lot of qualitative and intangible impacts, which have to be taken into account. These are, inter alia, the enhanced City’s prestige/branding, job creation, increases in tourism, new private capital inflow and the increased accessibility of the City.

The economic analysis (also called socio-economic analysis) includes the indirect benefits from the impact of the investment realisation (like the reduction of travelling time because of new bridge construction). Besides, in economic analyses every benefit generated in the area of impact is taken into account (for example, improving flood safety will bring benefits for the whole city). The economic feasibility of a project is positive if the benefits generated by the investment are greater than the costs and the opportunity cost of capital (interest generated by risk-free investments, i.e. treasury bonds) in the reference period (30 years). In such a situation, the project is efficient and acceptable from the socioeconomic point of view and can be implemented because of the high positive impact on the public.

The financial analysis (from the banker’s point of view) was carried out on a cash-flow basis (real flows of money, like the increase in the amount of local taxes). It deals with the investor in the Development Strategy perspective only. The financial analysis is used to check if the investment is profitable and if it is worth it to invest. The project is financially feasible when the new revenues generated by the implemented investments

are higher than the costs and the opportunity cost of capital in the reference period (30 years). Then, the investment is profitable.

Conclusions

The Development Strategy for River Warta is an ambitious and challenging project. Conducted financial and economic analysis showed that total cost of implementation may amount from 2 697,0 mln PLN to 3 151,0 mln PLN. However, it should be remembered that such a great investment would consist of dozens of sub-projects carried out at different times. Economic analysis has shown that the City of Poznan will have measurable benefits if all projects proposed in the strategy are completed. The total value of the benefits was estimated at 16 577 mln PLN. It should also be noted that the sources of funding for individual investments should be sought in the European Union funds. The analysis also showed that each 1 mln PLN allocated by the City on projects will result in private investment estimated at 2,8 - 3,0 mln PLN.

Impacts of the case study

The impacts of the measures proposed in the case study result in a varety of benefits for the City of Poznan as summarized below.

Environment

- Poznan's flood safety will increase (estimation: river flood decreases with 50%)
- Ecological values in the river zone will increase.
- The green spaces of Poznan will be connected to inner-city green areas.
- Urban parks and green areas will be linked to the Warta green zone

Economy

- The City of Poznan will be more competitive in attracting investors, businesses etc.
- Land values in the river zone will increase.
- The functionality of the river zone will increase, which will result in economic benefits (e.g. shorter travel times).
- Private investment in the river zone will increase.

Identity

- The identity of the long-neglected river transforms into a highly-attractive area.
- The identity of the City of Poznan as a whole will be strengthened.
- Poznan will be able to identity itself as a pioneer city in Poland in integrated water management.
- Many areas in the vicinity of the river area will be revitalised.

Society

- The strategy will result in increased public use of the river zone.
- Poznan population will benefit from increased flood safety.
- The city life and well-being of the citizens will be improved by improvement in urban quality.
- The citizens of Poznan will take pride in and commit themselves to the implementation of the strategy.

Connectivity

- An extensive communication project will result in the enthusiasm of the public, stakeholders and politicians.
- Many strategies, plans and projects on a variety of subjects will be connected in the integrated strategy.

- The momentum will be created to use the river for (public) transport.
- Several city districts have been connected to the river zone.

Partners

8.7. Conclusions and recommendations

Conclusions

The major issues affecting negatively the financing of the water sector identified a decade ago and reported in the European process of the 5th WWF remain actual, but some have been mitigated by the improvements progressively introduced by the EU policy goals and directives, and implemented with a strong support of grants. Despite the substantial subsidisation of the sector in the majority of the European countries, the tariffs are still kept low by a large number of water and wastewater service providers thus not recovering costs of services at a level necessary to attract and access repayable financing to complement taxes and transfers, two sources that will become scarce in the future.

The capital intensive and long lifetime nature of the investment in the sector makes the financing of new investment highly dependable on up-front repayable finance requiring long maturities – a scarce resource in the banking sector, serviced by the cash flows of the revenues generated by the end users' tariffs. Therefore, the stability and cost-recovery level of the latter are paramount and a pre-condition to ensure simultaneously an economic and financially mature low-risk sector for lenders, and a low-return profile with minimum financing costs to the sector and affordable service prices, satisfying its monopolistic and social nature.

The above goal - cost recovery with affordable prices - could not be achieved until the water services become efficient to minimise the investment and operating costs. With the current high level of compliance of relevant EU directives in the majority of the European countries as well the higher coverage rates contributing to the achievement of

the SDG 6 and provision of universal services, there is a progressive shift of attention to the efficiency of the systems supported by the EU policy on this matter. Investment on low-regret investment aiming at efficiency gains have the advantage of offering more attractive conditions due to its short payback nature and low intensive capital as compared to the financing of environmental infrastructure and does not require substantial grant support. However, there is also a pre-condition to make sustainable the investment on efficiency gains – a good knowledge of the extensive underground "invisible" network that would require its survey jointly with asset management tools. Innovative technology will also enhance efficiency gains.

Other factor that could contribute to the improvement of the services performance is the economy of scale from a less fragmented framework of service providers. The fragmentation has a negative effect on financing – borrowing limits with less favourable conditions for repayable finance resulting from a higher risk profile of the utilities. As utilities' consolidation often requires time, it would be advisable to look in the short term for financing options aiming at pooling and minimising the risk with available guarantees.

A major challenge facing the water sector in Europe, in particular concerning water security is the asset renewal backlog, which has also a detrimental effect on the performance of the services. Contrary to the low-regret short-term payback investment on efficiency gains, it requires huge investment and constant flow of cash flows. The capital maintenance backlog is indicative of the general cost-recovery and tariff problem. In parallel, promoters and lenders should consider a project life cycle funding approach.

The sector has been underinvested and will likely continue in the near future with a substantial gap that could be well above EUR 100 bn annually aggravated by more demanding compliance with drinking water and resources quality requirements threatened by pollution and climate change. Underinvestment is considered to be mainly associated with the demand side of money, e.g. lack of sustainable or bankable projects whereas on the supply side, e.g. unavailability of finance the main cause is the unavailability of promoters/utilities/borrowers to create the conditions, e.g. low risk and sufficient rewards to meet financiers' expectations. Regarding the latter, public funds are the main source and will remain but will never cover fully the gap thus justifying its use, e.g. grants, which will become a scarce financial resources to leverage other sources including private capital. Blended finance – which combines different sources of finance by appropriately allocating risks and rewards - or other financial mechanisms, e.g. revolving funds should be enhanced in the European sector.

In the majority of the EU MS benefiting from the ESIF, the grant support has been shifted progressively from investment on infrastructure to water resources management and drinking water conservation, e.g. definition of ecological flows, classification of water bodies, acquisition of equipment for the mathematical modelling of water quality, development or updating of the strategic documents related to water management, natural disaster management and climate change adaptation, prevention and mitigation of the related risks. This trend should be pursued and encouraged by the policy-makers as the main gap on the achievement of the SDG 6 in Europe is the quality of its water resources with an adverse effect on water security. Moreover, it does not generate revenues thus dependable on public funding, namely grants.

Last but not least, the European water sector needs to undertake studies and develop tools that will make available reliable data on investments in the sector and financial resources used with the flows of different sources. In parallel, carry out studies to estimate in a continuous way the investment and financial needs in the future. National regulators could have a role on this matter.

Recommendations

- Need to pursue with the cost recovery principle driven by the article 9 of the EU WFD making it universal to the EU countries in the short term and progressively in

the enlargement and other European countries with support of grants for the latter. This objective would enhance the financing of infrastructure contributing to the SDG 6;

- Focus investment on efficiency gains attractive to financing and lowering its cost, preceded by a good knowledge and management of the assets. Create conditions, e.g. technical assistance or grant support to accelerate the availability of the pre-condition knowledge and management tools;
- Develop the potential for more repayable financing to complement the public funding and reduce the gap, namely through the use of grants to leverage it, blending/pooling financial resources and risks coupled with available guarantees.
- Promote innovation, especially when it can minimise investment needs, or support innovative business models scale it to make innovative solutions competitive reflecting the full cost of supplying water, sanitation and flood protection services in pricing mechanisms;
- Promoters and lenders should develop project life cycle funding approach to help addressing the current asset renewal backlog jointly with the need to raise progressively the tariffs for that purpose;
- European policy-makers should support and encourage the current trend towards the use of ESIF on the improvement of the quality of the water resources and its management by dedicating a higher portion to these objectives in detriment of investment on infrastructure generating revenues; use ESIF wisely to attract and leverage other sources of finance, including domestic commercial finance;
- Statistics on investment and financing of the European water sector should be made available through database and assessment of futures needs in a continuous way by the national and EU entities benefiting from the information to judge future financial requirements, and to monitor future progress. National strategy plans should be incentivised and used with their monitoring tools to support this objective.

8.8. References

In the writing of this chapter the following bibliographic references have been used:

EC (2016). Eight Report on the Implementation Status and the Programmes for Implementation (as required by Article 17) of Council Directive 91/271/EEC concerning urban waste water treatment, COM(2016) 105 final, Brussels.

EC (2017a). Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Ninth Report on the implementation status and the programmes for implementation (as required by Article 17) of Council Directive 91/271/EEC concerning urban waste water treatment, SWD(2017) 445 final, Brussels.

EC (2017b) Integration of environmental concerns in Cohesion Policy Funds. Results, evolution and trends through three programming periods (2000-2006, 2007-2013, 2014-2020), Final report. EC, COWI/Milieu Ltd.

EC DGENV (2017). Bridging the water investment gap, EC DGENV, Cambridge Economics, Sept 2017.

EEA (2010). Use of freshwater resources (CSI 018). Based on the Water Exploitation Index EEA, 2010.

EEA (2013). Assessment of cost recovery through water pricing, EEA Technical report, No 16/2013

EIB (2016). Restoring EU competitiveness. 2016 updated version. European Investment Bank, Luxembourg.

EP (2017). Report on EU action for sustainability, European Parliament, 27 June 2017

EurEau (2017). Europe's water in figures. An overview of the European drinking water and wastewater sectors. 2017 edition. The European Federation of National Water Services.

Gasson, C. (2016). Making climate change adaptation water's big theme. Article from GWI published January 7th, 2016.

GWI (2015). Global Water Market 2015 Report, volume 3: Europe, Global Water Intelligence.

Jongman, B., Hochrainer-Stigler, S., Feyen, L., Aerts, J., Mechler, R., Botzen, W., Bouwer, L., Pflug, G., Rojas, R., Ward, P. (2014). Increasing stress on disaster-risk finance due to large floods. Nature Climate Change, 4

Leigland,J., Trémolet, S., Ikeda, J. (2016). Achieving universal access to water and sanitation by 2030. The role of blended finance. Water Global Practice, August 2016.

OECD (2009). Managing water for all. An OECD perspective on pricing and financing. OECD Publishing, Paris.

OECD (2016). Water, growth and finance. Policy perspectives. OECD Publishing, Paris, http://www.oecd.org/environment/resources/Water-Growth-and-Finance-policy-perspectives.pdf

OECD, WWC and Netherlands (2017a) Scaling-up financing through an attractive risk-return profile, background paper, Alex Money, OECD-WWC-Netherlands Roundtable on Financing Water, Inaugural meeting 12-13 April 2017, Paris.

OECD, WWC and Netherlands (2017b). Mapping financing flows: An inventory of data sources, OECD-WWC-Netherlands Roundtable on Financing Water, second meeting 13 September 2017, Tel Aviv

Owen, D. L. (2018). Costs for achieving universal and sustainable access to water and sanitation in Europe by 2050. Envisager Ltd.

Rogers, P. and Hall, A. (2003). Effective Water Governance, in TEC Background papers n 7, Global Water Partnership Technical Committee.

Suzenet, G. (2017). Prospects in Water-related Technological Innovation, OECD-WWC-Netherlands Roundtable on Financing Water, second meeting 13 September 2017, Tel Aviv

UN ESC (2017). Progress towards the SDGs. Report of the SG, E/2017/66, United Nations Economic and Social Council.

WWC and OECD (2015). Water: Fit to finance? Catalysing national growth through investment in water security. Report of the high level Panel on infrastructure financing for water-secure world. Marseille, France.

9. Water and governance in Europe

9.1. Contents

This chapter details the assessment made in the European Regional Process about Europe and Water governance. It is largely based on the framework proposed by OECD with respect to the principles for good water governance (OECD, 2015a). This text was prepared by Francisco Nunes Correia (Instituto Superior Técnico, University of Lisbon, Portugal).

9.2. Introduction

John Briscoe, the former responsible for water policy at the World Bank, used to say that "*Integrated Water Resources Management is like an animal walking on two legs: infrastructure and governance*" (Briscoe, 2011). In fact, infrastructure and technology without appropriate governance is "*like a hammer without a hand*" (Correia, 2012).

But what is governance and why is it so important? There are several approaches addressing this concept in the specific context of water resources management. One of the most comprehensive definitions is probably the one given by OECD (2015a), "*water governance formally refers to the range of political, institutional and administrative rules, practices and processes (formal and informal) through which decisions are taken and implemented, stakeholders can articulate their interests and have their concerns considered, and decision-makers are held accountable for water management*". Or in a very brief statement, governance determines "*who gets what water, when and how*" (OECD, 2011).

In fact, it is now commonly accepted that "*decisions that determine how water resources are used (or abused) are not made by water managers alone, but driven by various socio-economic development objectives and the operational decisions to achieve them*" (UNESCO, 2015). Ultimately, the question is by whom and how are decisions made, and how those responsible for the decisions are held accountable for them. In a democratic society, legitimacy is obviously a key issue. Therefore, the definition of governance given by the World Bank (2015) is particularly relevant and assertive: "*Governance is the process by which authority is conferred on rulers, by which they make the rules, and by which those rules are enforced and modified. Thus, understanding governance requires an identification of both the rulers and the rules, as well as the various processes by which they are selected, defined, and linked together and with the society generally*".

Other definitions and considerations on water governance can be found, among others, in Rogers and Hall (2003), Franks and Cleaver (2007), Plummer and Slaymaker (2007), Dixit (2009), Huitema *et al*. (2009), Moss and Newig (2010), Garcia Quesada (2011), Gupta and Pahl-Wostl (2013) and Gupta *et al*. (2013).

However, it should be noted and emphasized that "*governance is not an end in itself and should never be considered as such. It is a means to formulate and implement water policies that are considered appropriate and fair by those to whom they are intended and by society in general*" (Akhmouch and Correia, 2016).

Europe is a very diverse region, both from a climatic and a social-political point of view. Therefore, it does not come as a surprise that water governance changes substantially from country to country. In what concerns the European Union (EU), the numerous water-related directives, and particularly the Directive 2000/60/EC of the European Parliament and of the Council Establishing a Framework for Community Action in the Field of Water Policy, usually known as the Water Framework Directive (WFD), favour some degree of homogeneity and consistency across the territory of the EU. Nevertheless, even those numerous Directives recognize the specificities of each region and member-state, leaving plenty of room for adaptation to local circumstances, provided

that some common goals and targets are achieved. Hence, it is not accurate, or even possible, to talk about a model for water governance in Europe, although some common characteristics can certainly be identified and a common framework has matured over the past two decades.

Although this chapter deals with the entire European continent, it necessarily gives some emphasis on the EU. This is justified not only because this political entity is quite relevant in terms of area, population, GDP, among other indicators, but also because it sets an ambitious standard in what concerns water policies and environmental policies that is taken as a reference by other countries, especially those willing to join the EU.

In section 9.3, some features of water management and governance in Europe are briefly described, underlining the diversity of relevant issues and challenges. In 9.4, the most relevant aspects of the Water Framework Directive in terms of governance are identified. In section 9.5, the principles for good water governance, put forward by OECD, are presented and briefly discussed (OECD, 2015a; Akhmouch and Correia, 2016). In section 9.6, the WFD is revisited and discussed at the light of the Principles for Good Water Governance and in section 9.7 these principles are used in two case studies for assessing the evolution of water resources and water services management and governance in Portugal. Finally, in section 9.8, a few key messages are formulated. References are listed in section 9.9.

9.3. Brief review of water management and governance in Europe

It is much easier to compare climatic or hydro-morphological conditions in various countries than to compare the institutional set-up and governance models for water management. In fact, the former can be based on a simple quantitative comparison, with numbers clearly expressing similarities or differences, while the later are largely based on qualitative judgements that can never be dissociated from historical and cultural roots. Furthermore, the specificities of water governance are always part of a broader system of governance, and all its legal provisions stem from, or are based on, a broader juridical framework.

It is easier to establish goals and targets for water management rather than to define specific means to reach those targets, as they are largely determined by the specificities of each country in terms of its institutional and legal apparatus. This is recognized in many EU documents, such as EEA (2012): "*When it comes to water policy, the European Union can provide only general principles, guidance on implementation, and some funding. The concrete policy measures to implement this guidance and these principles can only be made by national and regional governments with knowledge of local conditions*".

The approach to governance must be holistic and contextual. A "map" of the policy formulation process is presented on Figure 9.1. At the core of the policy formulation process is the need to match in time and space the water needs and availability in a sustainable way. The needs to be considered are not only those that fulfil social and economic requirements, i. e. necessary for the well being of society and for all economic activities, but also the environmental requirements like the flows that sustain life and guarantee ecological diversity in water bodies. This process relies on appropriate technological instruments but goes much beyond that. In fact, decision processes and structures and relevant stakeholders, including economic actors and segments of the public are part of this process. To a large extent, governance is the way by which all these elements are organized and interact among themselves to produce water policies and subsequent management procedures.

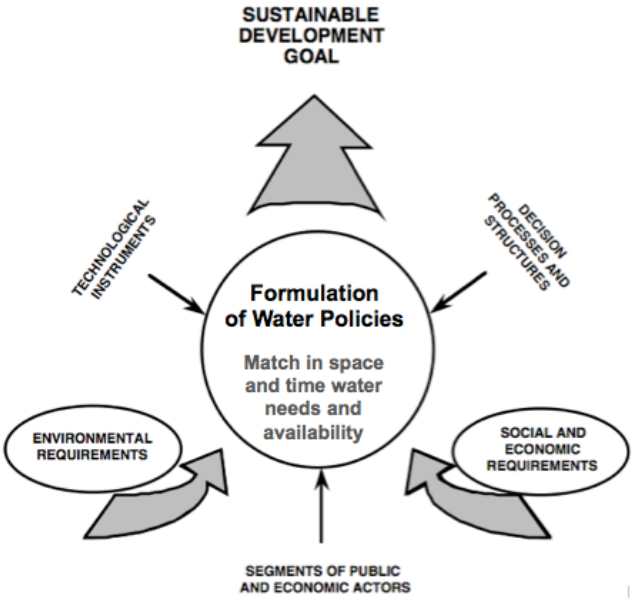

Figure 9.1 - Contextual analysis of water policy formulation processes (Correia *et al*., 1999)

Sustainable development is the overarching goal to be achieved by the water policy formulation process, and this cannot happen without a model of governance that promotes a balance among sectors, guarantees equity between current users and between generations, and contributes to the preservation of the sources.

EEA (2012) emphasizes that water governance needs to address integration in two dimensions. Vertical integration is necessary to attain a constructive articulation between levels of government, namely at the municipal, regional, river basin, national, and trans-boundary levels. Obviously, for the EU member states this supra-national level is also of paramount importance. Horizontal integration is necessary to achieve a balance between water users, namely the various economic sectors, and contribute to a sound territorial and regional development.

The dissemination of credible information and the participation of stakeholders and all vested interests related to water are very important for the transparency and effectiveness of water governance (EEA, 2012, 2014).

A comparative analysis of the governance models adopted by different countries is not an easy task because of the very specific characteristics of each case. As it was already noted, the cultural roots and the different legal systems lead to very misleading situations in which what seems similar is, in fact, quite distinct. Some pioneering work along these lines was carried out under the EU projects Eurowater and Water 21 (Correia 1997a, Correia 1997b, Correia et Al. 1999, and Correia 2000).

EEA (2014) points out three main types of complexity for analysing and comparing water management as a multilevel process, especially in what concerns participation (and governance in general): "*One level of complexity arises from the interplay between administrative boundaries, such as those* 1 SEP *for regional and local governments, and natural catchment boundaries... On a second level, public bodies at different administrative levels — such as national, regional and local — often have key roles for water management. On a third level, water management involves a range of economic and social sectors: and thus, different stakeholders need to be involved, as well as government bodies that set policies across the sectors*".

These difficulties, although quite general, are aggravated in the case of the European Union because the Water Framework Directive (correctly!) calls on European governments to set up River Basin Districts (RBD) based on the natural boundaries,

although water management always involves pre-existing governmental agencies that are often not territorially configured in this way.

The implications of the Water Framework Directive (WFD) in governance are further described in the following section.

9.4. Governance implications of the Water Framework Directive

The Water Framework Directive (WFD), approved by the European Council and the European Parliament in the year 2000, is clearly a benchmark and a turning point in European water resources management.

The EU currently comprises 28 member states, out of the 44 European countries, has a population of approximately 512 million inhabitants, out of slightly above 740 million in all Europe, and corresponds to an area close to 4.5 million km^2 in a total area of the European continent of approximately 10 million km^2.

Obviously the WFD is enforced only in the EU member-states, but it is followed on a voluntary basis in other European countries and even worldwide. In fact, it certainly is a basis for inspiration and benchmarking in many other countries in Europe, notably those that share transboundary rivers cutting across the borders of the Union. Therefore, its relevance and impact in the whole European continent is much larger than simply a law to be complied with in the EU territory.

Concerns with water management in the EU (previously the EEC and the EC) started a few decades before the WFD, although with a very different approach. The protection of human health was the key point, leading to legislation on the quality of water for various purposes and trying to keep away dangerous substances from the water bodies. The Directive 67/548/EEC dealing with hazardous substances in the aquatic environment, and the Directive 75/220/EEC, concerning the quality required of surface water intended for the abstraction of drinking water, are good examples of this first generation of Directives.

In the late 80's of the 20th century it became clear that it was necessary to go beyond the simple establishment of chemical parameters for specific uses of water. The water bodies should be protected if the EU wanted to have a long-term protection of its water sources. The concept of ecological quality of water bodies was put forward and the preparation of a Directive on this subject was initiated in the late 80's. However, the complexities of the ecological quality were soon understood. In fact, the definition of good environmental quality of a water body cannot be dissociated of its hydro-morphological, climatic, and environmental circumstances, and the purpose of managing water to attain that good quality status necessarily requires an integrated approach at the level of the river basin (or aquifer). A more "territorial" approach became the obvious consequence, as well as a better coordination among sectors using water resources. Integration became a key word, and river basin planning became a fundamental tool to be complemented and made operational by a plethora of actions integrated in a Program of Measures. This has led to opening the scope of the new Directive, that kept the main and original purpose of protecting the aquatic environment and achieving good ecological quality of the water bodies, but brought in many provisions concerning several dimensions of governance. This approach corresponds to a shift from a traditional water-use driven approach to an integrated approach reflected in a governance setting (EC, 2012).

It is then possible to say that the WFD is an implicit recognition that a long-term protection and use of the water sources is only possible if several measures at the level of governance are adopted. Obviously, this was already accepted and practiced in several member-states, but establishing it at the EU level expanded and consolidated those previous and dispersed procedures, giving a new and reinvigorated breath to governance issues in EU Member-States.

Coordination about sectors became essential, forcing that current and future availability of water resources is taken into account. A robust legal framework (that somehow incorporates previous legislation) and appropriate governance structures were advocated as pre-requisites for river basin management and, consequently, for water resources management (EC, 2012).

The implications of the WFD in water governance are very clear in several articles of this Directive. In fact, after stating the Purposes (article 1) and Definitions (article 2), the in article 3 explicitly addresses governance issues by establishing the "*Coordination of administrative arrangements within river basin districts*". All river basins must assigned to a River Basin District and a competent authority must be identified. These provisions also apply with the necessary adaptation to international river basins, even if they are partially located outside the EU. The cross-border cooperation and coordination of the implementation of the WFD is considered a key element for the satisfaction of the principle of management at the river basin scale, which is an important statement given that trans-boundary river basins cover most of the EU territory.

Article 5 establishes procedures and standards, not only for the characterization of the River Basin Districts and the review of the impact of human activity, but it also determines an economic analysis of water use. This analysis relates closely to the principle of the recovery of costs of water services, clearly formulated in article 9. The relation of these provisions with governance is very obvious given that the generation of financial resources, and the jurisdiction over its use, is a key element in the definition of the role and responsibilities of each water-related organization.

The obligation of preparing of a Programme of Measures, according to article 11, and a River Basin Management Plan, according to article 13, also has strong governance implications in spite of the many technical issues that it may raise. In fact, these are clearly instruments of integration, in which all water uses need to be considered, made compatible, and projected into the future, taking into account its characteristics in terms of quantity and quality.

In fact, land-use planning, domestic supply and wastewater treatment, irrigation, hydropower generation, navigation, and flood protection, all have important impacts on water resources. The River Basin Management Plans and the Programmes of Measures offer an excellent opportunity for bringing into the same picture all these sectors, and for interacting with the major actors responsible for them, ultimately developing a framework that fosters sustainable development and helps making it feasible.

The many issues related to stakeholder engagement and public consultation are addressed in article 14. This is another key element introduced by the WFD that is directly related to governance. Certainly, it not only enriches the final results achieved with the WFD, but it is also crucial for the transparency of the whole process. Common, credible, and transparent reporting aggregated by River Basin District, is also a flagship of the WFD, as noted by EWP (2009).

Finally, it should be noted that the importance of the WFD in terms of governance, relies not only on the efforts of each member-state to comply with the directive, but also in the very participated and fruitful process of the common implementation. This process leads to a much stronger interaction between the European Commission and the Member-States, which is also a contribution towards further integration of water policies and better understanding of what is specific of each Member-State and should be left to its discretionary decision, on behalf of the subsidiarity principle, and what is common among all Member-States and should be addresses at the level of the Union.

9.5. OECD Principles for Good Water Governance

The Organization for the Economic Cooperation and Development (OECD) has been dedicating attention to water and water resources management practically since its

creation and with more emphasis since the 80's of the last century. This multilateral organization, among other duties, plays the role of a think-tank promoting a reflection on important matters related to the development of western economies and approving recommendations on those matters. In the early days, a lot of attention was given to the implementation of good practices in integrated water resources management and in water services and its relationship with environmental policies, including the application of economic and financial regimes based on the polluter-pays principle and on the user-pays principle.

In the last decade, the emphasis has shifted from good practices in water resources and water services management to institutional issues, bringing the topic of governance into the front stage. The report "Water Governance in OECD Countries: A Multilevel Approach", OECD (2011), published under the assertive lemma that "*The water crisis is largely a governance crisis*", is a clear sign of this shift from management to governance. That report is largely based on a survey conducted in 17 OECD members, including 8 European countries.

This shift, paving the way for a new approach, is well explained in a document intended for the dissemination of the main results that have been achieved until now ("https://www.oecd.org/governance/regional-policy/48885867.pdf): "*There is enough water on Earth for all, even in areas where temporary shortages may exist. Managing water for all is not only a question of resources availability and money, but equally a matter of good governance... Key challenges are institutional and territorial fragmentation and badly managed multi-level governance, but also limited capacity at the local level, unclear allocation of roles and responsibilities and questionable resource allocation. As the 2009 OECD report Managing Water For All* [OECD, 2009] *stated, patchy financial management and the lack of long-term strategic planning are also to blame, together with poor economic regulation and poorly drafted legislation*".

The above-mentioned survey, and the 2011 report, brought to evidence the large diversity of institutional arrangements of the various OECD countries and even among the European members of this multi-lateral organization. This diversity is well summarized in Table 9.1. Seven major governance gaps were identified and the need to overcome those gaps inspired the subsequent work dedicated to the formulation of principles for good water governance. Those seven gaps are presented in Table 9.2.

To deepen this comparative analysis and formulate recommendations to improve water governance and policies, the OECD created in 2011 the Water Governance Initiative, as part of the Water Governance Programme (http://www.oecd.org/cfe/regional-policy/water-governance-initiative.htm). This programme, and its network of stakeholders and governmental organizations, has been producing important results that can be used, not only as recommendations for the improvement of water governance in quite distinct contexts, but also as a basis for benchmarking water governance performance in various regions and countries. The reports OECD (2014, 2015a, 2015b, 2015c, 2015d, 2015e, 2016) are good examples of this very relevant and prolific initiative. OECD (2015a) plays a central role for the topic of this chapter because it formulates the principles for good water governance that were approved by the Ministerial Council of this multi-lateral organization as a recommendation for the 35 OECD members, including 25 European countries.

Table 9.1 – Water policy making at central level in OECD countries (source: OECD, 2011). European countries are marked with an arrow

Country or region	Unitary, federal or quasi-federal country	Number of principal actors in design and implementation	Number of actors in regulation	Role of central government (dominant actor, joint role with local actors, none)	Means of defining roles	Specific water regulatory agency (yes/no)
Australia	Federal	4	4	Joint	Law	Yes
Belgium (Flanders)	Federal	7	–	None	Constitution Law Other	No
Belgium (Wallonia)	Federal	–	–	None	Constitution Law	No
Canada	Federal	9	3	Joint	Constitution Law	No
Chile	Unitary	15	10	Dominant	Law *Ad hoc* Other	No
France	Unitary	5	5	Joint	Law *Ad hoc* Other	No
Greece	Unitary	13	12	Dominant	Law	Yes
Israel	Unitary	4	4	Dominant	Law Other	
Italy	Quasi- federal	6	5	Joint	Law *Ad hoc*	Yes
Japan	Unitary	4	–	Dominant	Law	No
Korea	Unitary	6	4	Dominant	Law	No
Mexico	Federal	6	4	Dominant	Constitution Law *Ad hoc*	Yes
Netherlands	Unitary	2	2	Joint	Constitution Law	Yes
New Zealand	Unitary	14	7	Joint	Law *Ad hoc* Other	Yes
Portugal	Unitary	3	5	Dominant	Law *Ad hoc* Other	Yes
Spain	Quasi- federal	5	6	Joint	Constitution Law *Ad hoc* Other	No
United Kingdom	Unitary	11	5	Joint	Law	Yes
United States (Colorado)	Federal	11	7	Joint	Constitution Law	No

Table 9.2 – Major gaps in multi-level water governance (source: OECD, 2011)

Administrative gap	Geographical "mismatch" between hydrological and administrative boundaries. This can be at the origin of resource and supply gaps. ***=> Need for instruments to reach effective size and appropriate scale.***
Information gap	Asymmetries of information (quantity, quality, type) between different stakeholders involved in water policy, either voluntary or not. ***=> Need for instruments for revealing and sharing information.***
Policy gap	Sectoral fragmentation of water-related tasks across ministries and agencies. ***=> Need for mechanisms to create multidimensional/systemic approaches, and to exercise political leadership and commitment.***
Capacity gap	Insufficient scientific, technical, infrastructural capacity of local actors to design and implement water policies (size and quality of infrastructure, etc.) as well as relevant strategies. ***=> Need for instruments to build local capacity.***
Funding gap	Unstable or insufficient revenues undermining effective implementation of water responsibilities at subnational level, cross-sectoral policies, and investments requested. ***=> Need for shared financing mechanisms.***
Objective gap	Different rationales creating obstacles for adopting convergent targets, especially in case of motivational gap (referring to the problems reducing the political will to engage substantially in organising the water sector). ***=> Need for instruments to align objectives.***
Accountability gap	Difficulty ensuring the transparency of practices across the different constituencies, mainly due to insufficient users' commitment' lack of concern, awareness and participation. ***=> Need for institutional quality instruments.*** ***=> Need for instruments to strengthen the integrity framework at the local level.*** ***=> Need for instruments to enhance citizen involvement.***

Those principles aim at achieving three main goals: effectiveness, efficiency, and trust and engagement. OECD (2015a) formulates these goals as follows:

- "Effectiveness relates to the contribution of governance to define clear sustainable water policy goals and targets at all levels of government, to implement those policy goals, and to meet expected targets.
- Efficiency relates to the contribution of governance to maximise the benefits of sustainable water management and welfare at the least cost to society.
- Trust and Engagement relate to the contribution of governance to building public confidence and ensuring inclusiveness of stake- holders through democratic legitimacy and fairness for society at large".

For each one of these three main goals, four principles are put forward leading to a total of twelve principles. Those principles are summarised in Table 9.3. A synoptic view of

these goals and principles, with the corresponding key words, are displayed on Figure 9.2.

As previously mentioned, among other considerations, these principles aim at overcoming the seven gaps identified in the survey conducted in 2011. The direct relationship between the principles and the gaps is presented in Table 9.4.

Naturally, each principle may contribute to overcome more than one gap or even be relevant for several of them. In Table 9.3 only the most relevant and the second more relevant gap related to each principle are identified.

9.6. The Water Framework Directive in View of the OECD Principles of Water Governance

As mentioned in section 3, the Water Framework Directive (Directive (2000/60/EC) has very clear implications in terms of water governance. Although it aims at establishing (Article 1) *"...a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater..."*, several institutional precepts are considered necessary and instrumental to achieve this goal.

Table 9.3 - The twelve OECD Principles on water governance (sources: OECD, 2015a, Akhmouch and Correia, 2016)

	Enhancing the **effectiveness** of water governance
Principle 1	Clearly allocate and distinguish *roles and responsibilities* for water policymaking, policy implementation, operational management and regulation, and foster co-ordination across these responsible authorities
Principle 2	Manage water at the *appropriate scale(s)* within integrated basin governance systems to reflect local conditions, and foster co-ordination between the different scales
Principle 3	Encourage policy coherence through effective *cross-sectoral co-ordination*, especially between policies for water and the environment, health, energy, agriculture, industry, spatial planning and land use
Principle 4	Adapt the level of *capacity* of responsible authorities to the complexity of water challenges to be met, and to the set of competencies required to carry out their duties
	Enhancing the **efficiency** of water governance
Principle 5	Produce, update, and share timely, consistent, comparable and policy-relevant water and water-related *data and information*, and use it to guide, assess and improve water policy
Principle 6	Ensure that governance arrangements help mobilise water finance and allocate *financial resources* in an efficient, transparent and timely manner
Principle 7	Ensure that sound water management *regulatory frameworks* are effectively implemented and enforced in pursuit of the public interest
Principle 8	Promote the adoption and implementation of *innovative water governance practices* across responsible authorities, levels of government and relevant stakeholders
	Enhancing **trust and engagement** in water governance
Principle 9	Mainstream *integrity and transparency* practices across water policies, water institutions and water governance frameworks for greater accountability and trust in decision-making
Principle 10	*Promote stakeholder engagement* for informed and outcome-oriented contributions to water policy design and implementation
Principle 11	Encourage water governance frameworks that help manage *trade-offs* across water users, rural and urban areas, and generations
Principle 12	Promote regular *monitoring and evaluation* of water policy and governance where appropriate, share the results with the public and make adjustments when needed

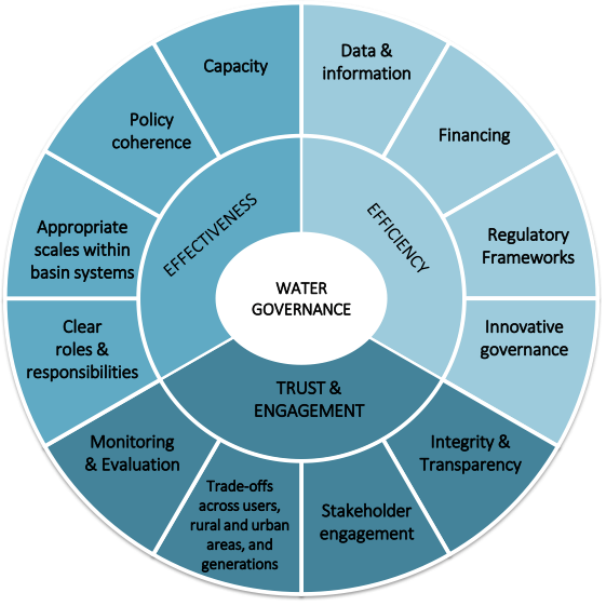

Figure 9.2 - Synoptic view of the 12 OECD Principles (source: OECD, 2915a, and Akhmouch and Correia, 2016)

Table 9.4 - Main contributions of the principles to overcome the gaps, with black representing the most direct relationship and grey the second more direct relationship

	Gap 1 Administrative	**Gap 2** Information	**Gap 3** Policy	**Gap 4** Capacity	**Gap 5** Funding	**Gap 6** Objective	**Gap 7** Accountability	
Principle 1 Clear roles & responsibilities	■					▒		**Effectiveness**
Principle 2 Appropriate scales within basin systems	■					▒		
Principle 3 Policy coherence			■			▒		
Principle 4 Capacity	▒			■				
Principle 5 Data & information		■						**Efficiency**
Principle 6 Financing	▒				■			
Principle 7 Regulatory frameworks	■					▒		
Principle 8 Innovative governance				■		▒		
Principle 9 Integrity & transparency		▒					■	**Trust & Engagement**
Principle 10 Stakeholder engagement		▒					■	
Principle 11 Trade-offs across users & generations						■	▒	
Principle 12 Monitoring & evaluation		■					▒	

As it was previously noted, the diversity of physiographic, climatic, legal and cultural circumstances and background are very pronounced in the EU, making it impossible to

establish very strict guidelines on governance. On behalf of the subsidiarity principle, only some key dispositions are put forward and made obligatory, leaving to the Member-States a lot of freedom to tailor the specific details that make it fit for each society, provided that common goals are achieved.

In spite of this diversity and degrees of freedom, it is possible to look at the WFD provisions at the light of the OECD Principles for Water Governance (Table 9.5). This exercise reveals clearly the governance implications of this important directive and demonstrates how it contributes to somehow harmonized governance in all EU Member-States. This exercise also demonstrates how and why the WFD has been inspiring in countries other than the EU Member-States.

The close relationship of the WFD provisions and the key dimensions of the OECD Principles is summarized in Table 9.5 and hereafter presented.

Effectiveness

With respect to the "Effectiveness" dimension of the OECD Principles, Principles 1, 2, and 3, can be considered as fully contemplated by the Directive, and principle 4, although not directly targeted, is also significantly taken into consideration.

In fact, Article 3 calls for the identification of the individual river basins and its assignment to river basin districts directly responsible for implementation of the Directive. In the annex I the characteristics of the competent authorities has to be clarified and declared, namely its legal status, responsibilities, and international relationships when the river basin is shared with other countries. These provisions imply that river basins and groundwater bodies are taken as the appropriate scale throughout the Directive, as advocated in Principle 2.

The identification and assignment mentioned above, is the operational basis for the elaborations of River Basin Management Plans (Article 13 and annex VII) and Plans of Measures (Article 11 and annex VI), that by its own nature aim at integrating sectoral policies and increasing coherence of water resources management.

Principle 4, dealing with institutional capacities, is not explicitly addressed but, indeed, all the procedures for sharing experience and information among Member-States and with the European Commission (Articles 18, 19 and 20) in a joint implementation process, contributes clearly for the capacity building of Member-States' institutions.

Table 9.5 – Degree of consideration of the OECD Principles for Good Water Governance in the provisions of the Water Framework Directive

	Degree of Consideration In the WFD	Most Relevant Provisions of the Water Framework Directive	Description and Comments	
Principle 1 Clear roles & responsibilities		Article 3, annex I	All river basins are integrated in River Basin Districts (RBD) and a competent authority with jurisdiction over the RBD is identified	**Effectiveness**
Principle 2 Appropriate scales within		Article 3, annex I	River basins and groundwater bodies are taken as the appropriate scale throughout the Directive.	
Principle 3 Policy coherence		Articles 11 and 13, annex VI, VII and XI	Programmes of Measures and River Basin Plans ensure policy coherence. Requirements are linked to the Eco-regions	
Principle 4 Capacity		*...Articles 18, 19 and 20 (not explicitly)...*	Not explicitly addressed, but joint implementation is largely a capacity building process in which information is shared and procedures compared	
Principle 5 Data & information		Articles 7, 8 and 15 annexes II and V	Monitoring and reporting are key requirements of the WFD. This is done at a harmonized way at the EU level	

Principle 6 Financing		Article 5 and 9 annex III	Economic analysis of the water uses and the recovery of costs are considered crucial and procedures are gradually harmonized in the EU	**Efficiency**
Principle 7 Regulatory frameworks		Article 11 and 24 annex V	The implementation of the WFD, especially the Programmes of Measures, requires regulatory instruments. The Directive itself has not that nature	
Principle 8 Innovative governance		*...to some extent, the entire Water Framework Directive...*	Implementation will bring innovation in several areas. This is not explicitly addressed in the WFD, but Horizon 2020 will play a complementary role	
Principle 9 Integrity & transparency		Article 14 and 15 annex ii and V	Public consultation, involvement of the stakeholders, and reporting procedures will strongly contribute to integrity and transparency	**Trust & Engagement**
Principle 10 Stakeholder engagement		Article 14 and 15 annex II and V	The consultation provisions assure stakeholder engagement. Reporting by the member-states and the EC also facilitates participation	
Principle 11 Trade-offs across users &		Article 1, 11 and 13	This is the main purpose of the WFD. The Programmes of Measures and the River Basin Plans are instrumental for achieving that goal	
Principle 12 Monitoring & evaluation		Articles 15, 18, 19 and 20	The WFD provides mechanisms for the successive revision and improvement of its implementation in predetermined cycles	

Legend:

Full consideration | Significant consideration | Little consideration | No consideration

Efficiency

Without adequate data and information it is not possible to manage water and, above all, it is not possible to manage water efficiently. Thus, it is no surprise that the WFD gives a lot of attention to monitoring and reporting of water availability and uses, very much in line with the OECD Principle 5. In fact, Article 8 deals explicitly with "*Monitoring of surface water status, groundwater status and protected areas*". For this purpose, monitoring programs are mandatory, in accordance with the very strict requirements established in annexes II and V. Given the implications to human health, special attention is given to water used for the abstraction of drinking water (Article 8) and to reporting (Article 15) to the European Commission and other concerned Member-States of the relevant information and also the River Basin Plans and the Programmes of Measures.

Articles 5 and 9 relate directly with Principle 6 dealing with financing. Article 5 includes the economic analysis of water use, and Article 9 established in a very clear way the "*Recovery of costs for water services*". The concept is considered in a quite broader sense "*including environmental and resource costs*". Annex III provides further details on how the economic analysis must be performed.

The implementation of the Directive (Article 24), notably through the Programmes of Measures (Article 11), requires the adoption of some regulatory provisions in order to ensure compliance with the lengthy and detailed dispositions of annex V.

Finally, governance innovation, the key point of OECD Principle 8, is not explicitly addressed in the text of the Directive but, after all, it is all about it. Not only all the institutional provisions of the Directive require a new approach, especially in Member-States that have somehow overlooked this dimension of water management, but also the intense process of sharing information and learning from each other that is implicit in the concept of "joint implementation" provides a fertile ground for putting forward new approaches and new solutions.

Trust and engagement

It comes as no surprise that this group of OECD Principles (9 through 12) is the most directly related with the WFD. Integrity and transparency (Principle 9) and stakeholder engagement (Principle 10) are at the core of the Directive. In fact, Article 14 establishes very clear requirements for "*Public Information and Consultation*" and Article 15 requires a publicly known and transparent reporting, very much in line with OECD proposals. Annexes II and V present very clearly how this report must be done, making it the subject of open public scrutiny.

Principle 11 establishes the need for trade offs across users and generations. In some sense this is the main purpose of the WFD, as it can be understood in Article 1 (Purpose). This purpose is operationalized in many ways, but the Programmes of Measures (Article 11) and the River Basin Management Plans (Article 13) are at the core of the process.

Principle 12 underlines the need for a continuous improvement of water governance based on the monitoring and evaluation of the steps previously made. This is clearly accomplished by several provisions of the Directive, especially the already mention Article 15 on reporting, and also Article 18 (Commission report), Article 19 (Plans for future Community measures), and Article 20 (Technical adaptation to the Directive). A process is set in motion that will lead to a permanent improvement, or at least non-deterioration, of the water bodies across the territory of the European Union.

Therefore, it is very clear that, although coming from very different veins, the EU Water Framework Directive is very much in line with the direction recommended by the OECD Principles for Good Water Governance.

9.7. Case studies

This section presents some case studies to illustrate the chapter, based on the collection and selection of proposals sent by different European organizations, as part of the European Regional Process approach described in chapter 3. The case studies on Ireland and on the Danube River were taken from the inventory of case studies organized and disseminated by the OECD under the Water Governance Initiative.

Case study: Assessment of the water resources management and its evolution in Portugal

Contact: Francisco Nunes Correia, Instituto Superior Técnico, University of Lisbon, Portugal

As mentioned in section 4, the OECD Principles of Water Governance can be used as a general guide to improve water governance in each country, never neglecting the specificities of that country and its global system of governance in which water is simply a component. These principles and the degree of its achievement can be used as a basis for evaluating the evolution registered in a given context and in a given period of time.

In 2018 OECD is developing a set of indicators that will certainly help this evaluation process (http://www.riob.org/IMG/pdf/OECD_scoping_note_on_indicators_13June.pdf). While this still an on-going process, several preliminary attempts have been done that clearly demonstrate the usefulness of this approach.

One possible procedure is to gather a group of experts that are familiar with the evolution of water governance in a country and ask them to try and reach an agreement on the evolution experienced by that country throughout a period of time. The assessment of this evolution can be based on a justified and documented expert judgement on how the implementation of each principle is being accomplished, grading it from 0 to 5, if the evolution has been positive, or from 0 to -5 if the evolution has been negative. A more simplified approach is grading it with + or ++, if the evolution has been positive or very positive, respectively, and – or – –, if it has been negative or very negative, respectively.

If no significant change has occurred during the period under consideration, a + – grade may be used to represent the situation. This approach has been applied to Portugal for the 5-year period 2011 – 2015 (Correia, 2016).

From 2005 to 2010 Portugal went through a period of very important reforms in the water sector, leading to a new model of water resources governance. In 2005, the Parliament approved a new water law (Law no. 58/2005), which preparation had started in 2000 with the objective of transposing the Water Framework Directive, but going beyond it in the sense that it had also the objective of modernizing and streamlining legislation that was in some cases a few decades old but had a very relevant merit in terms of bringing into water legislation several environmental concerns. The previous Water Law was from 1919 but it was surprisingly "modern" in establishing rules so that the private sector could have access to the provision of public services and the use of the so-called "water domain". In the 70's and 80's of the 20th century several pieces of legislation were approved, clarifying the concepts of public and private waters and "water domain" (including the river beds and margins) and establishing several measures for the protection of the rivers, especially in what concerns the management of the flood plain. These pieces of legislation were still in force, but had become somewhat inconsistent with a "new layer" of legislation derived from the EU Directives transposed in the late eighties and nineties. Briefly, the legislative framework was a bit messed up and required coherence, tuning up with EU obligations, but making it compatible with concepts and tools deeply rooted in Portuguese legislation.

The 2005 Water Law was preceded by the Law of Water Resources Entitlements (Law no. 54/2005) that established the various types of authorizations for any user to have access to public waters, namely permits, licenses, and concessions. These two laws, approved by the Parliament, were followed by 15 Decree-Laws, approved by the Government, that operationalize the provisions that were established by those two framework laws. Among other matters, this extensive legislation creates or clarifies the role of the National Water Institute and five River Basin Agencies, clarifies the roles of the National Water Council and the River Basin Councils, creates the User Associations (that include the already existing Irrigators Associations) to share responsibility in the management of water, revises and updates the Economic and Financial Regime of Water Use and creates the Water Resources Taxes (implementing the Polluter-Pays-Principle and the User-Pays-Principle), creates the Water Resources Protection Fund establishing rules for the use of the funds raised by the Water Resources Taxes, updates the legislation that allow for the possibility of establishing contractual-programmes with water users for the benefit of water systems, approves a framework for the protection of groundwater, and approves a framework for the protection of public reservoirs. All these initiatives brought a new era in the Portuguese water governance: "a tranquil revolution!" as a foreign journalist called it in a report on this whole process.

All these reforms were implemented in the period from 2015 to 2010. However, the financial crisis and the subsequent bail out of the country after 2011 was the justification for restrictions that reversed this process quite significantly, especially in what concerns the institutional set up. The National Water Institute, the five River Basin Administrations, and also a strategic unit of the Ministry of Environment were merged with the previously existing Portuguese Environmental Agency (although they were largely self-sustained in financial terms), the Water Resources Protection Fund was diluted in the Environmental Intervention Fund dealing with all areas of environment, the River Basin Councils practically failed to meet, a step backward was made in the creation of decentralized organizations such as the Users Associations, in some cases the water resources tax stopped being collected or was used in areas that had nothing to do with water.

This evolution, that took place mainly from 2011 to 2015, has led to some sort of dismantling of the institutions responsible for water that were diluted and merged in much broader organizations. Such a process had consequences beyond the institutional dimensions. The interaction between water authorities and water users declined, the

stakeholder involvement and commitment was negatively affected, and even the governmental agencies tend have lost motivated staff that migrated to other areas or felt restricted in their daily activities.

One obvious conclusion is that financial crisis and bailout is not a good background for the expansion and consolidation of any sector, including the water sector, regardless of the advantages that that expansion and consolidation might bring. Now, that the country is overcoming the financial crisis and recovering from heavy restrictions is time for a prudent re-evaluation of the path that must be adopted for the future.

The starting point of this recovery process is an assessment of the damage caused by the previous period (Correia, 2016). The 12 OECD Principles of Water Governance provide a very good grid for this evaluation. This was done and is used herein as a case study for the application of the concepts and methodology presented in the previous sections.

A group of experts was gathered and asked to discuss and try to agree on the evolution of the Portuguese water governance during the critical period of 2011-2015. The 12 OECD principles were used as the basis for this assessment. The results of this collective exercise of expert judgement are presented on Table 9.6. The principles marked in grey are considered the most relevant in each group for the specific case under analysis.

The results presented in Table 9.5 can be represented in a way that provides a synoptic view of the improvements or setbacks with respect to the 12 principles. This is done on Figure 9.2 that is based on the following assumptions in order to simplify this graphic representation: i) the situation in 2011 is taken as the reference situation with the positive or negative evolution in the period 2011-2015 considered in relation to that reference situation; ii) a "–" evaluation is represented at the point corresponding to 75% of the radius; a "– –" evaluation is represented at 50% of the radius; ii) a "+" evaluation is represented at 125% of the radius; iii) if there was no significant evolution (+ –), the point on the reference situation (100% of the radius) is considered.

In this case, no judgement was made on how good the situation was at the reference point (2011). Therefore, only the evolution since then was considered and displayed on Figure 9.2. However, in a more detailed analysis an expert judgement on the situation in 2011, represented also by an irregular polygon, could be considered as the reference situation.

From the analysis of Figure 9.2, it is very clear that the most negatively affected dimension of governance was its "Effectiveness". In fact, all principles related to this dimension were negatively affected with the definition of "Clear roles and responsibilities" and the use of "Appropriate scales within basin systems" severely damaged. Also, the "Policy coherence and coordination among actors" and the "Capacity for performing duties" were negatively affected. The four principles relevant for "Effectiveness" add up to 2.50 (0.50+0.50+ 0.75+0.75) in a total of 4.00 that would occur if no significant change had occurred.

The "Trust and Engagement" dimension is the second more affected. A "Systematic monitoring and evaluation of policies" was severely hurt, the "Stakeholder engagement" was also hurt, but the other two principles, namely "Integrity and transparency" and "Equity across users, territories, and generations" suffered no significant change. Adding up the values given to each one of the four principles in relation to the reference situation, a value of 3.25/4.00 is obtained (1.00+0.75+1.00+0.50).

Table 9.6 – Evolution of water governance in Portugal in the period 2011-2015 with respect to the 12 principles proposed by OECD (from Correia, 2016)

		Principles of Governance (abbreviated)	Recent Evolution	Comments
Effectiveness	**1**	Clear allocation of roles and responsibilities	**- -**	Fading of the concept and presence of a "National Water Authority" (INAG); Poorly defined interfaces with user sectors, namely water services.
	2	Appropriate scales within basin systems	**- -**	Fading of the River Basin Organizations as entities responsible for interfacing with users; Centralist drift and equivocal interfaces with municipalities and regional administrations.
	3	Coherence of policies and coordination among sectors	**-**	Some fading of the water resources policy as a transversal policy and some fading of structures relevant to the inter-sectorial articulation at the national and basin levels.
	4	Capacities for performing the allocated responsibilities	**-**	Decrease in human resources allocated to the management of water resources at the central and regional levels and some deterioration of the know-how of the country in several areas.
Efficiency	**5**	Consistent data and information	**- -**	Serious situation in terms of basic information, namely the national data bank and the network feeding it. Persistent announcements of improvement still awaiting implementation.
	6	Efficient use of financial resources	**+**	Crisis and bail out have brought greater awareness of the need to use resources more effectively. However, the crisis was an excuse for restrictions that had nothing to do with it.
	7	Solid regulatory frameworks	**+ -**	The regulatory framework for water services has been improved. Other regulatory frameworks relevant for water resources remain basically unchanged.
	8	Innovative governance practices	**-**	Some e-government practices were lost, and the only innovations consisted in regressing the advances of the Water Law and other legislation using the false pretext of the crisis.
Trust and Engagement	**9**	Integrity and transparency	**+ -**	There were no significant changes.
	10	Stakeholder engagement and commitment	**-**	The fading of entities responsible for the management of water resources, namely at the basin level, did not contribute to a greater commitment or involvement of the stakeholders.
	11	Fair balance between rural and urban areas, users, and generations	**+ -**	The issues of inter-sectorial, regional and intergenerational equity are rarely made explicit in policy formulation, but there have been no significant changes.
	12	Regular monitoring and evaluation of water policies	**- -**	Water resources policies and governance models in Portugal tend to be changed and discarded without any a careful evaluation of their performance and relevance.

Legend
Recent evolution: ++ very positive, + positive, + - no significant change, - negative, - - very negative

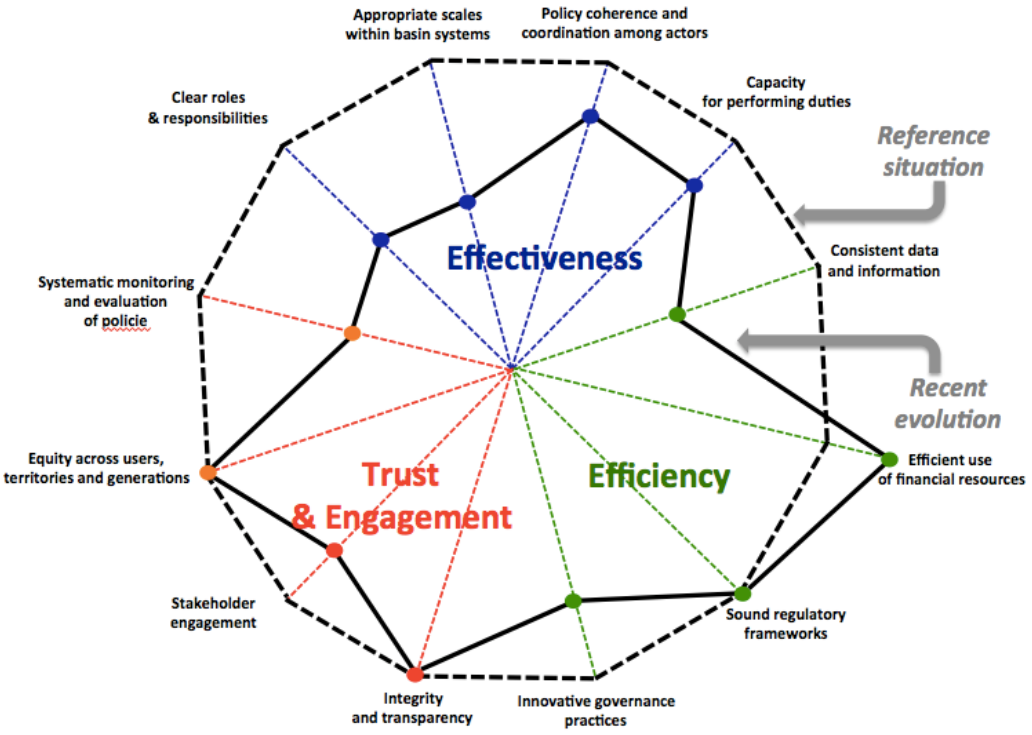

Figure 9.3 - Graphic representation of the evolution of water governance in the period 2011-2015 for the demonstration case under consideration (source: Correia, 2016)

Finally, the “Efficiency” dimension was the least damaged, as one could expect given the financial restrictions that were used to justify the steps backward. However, the “Consistent data and information” had a quite significant negative evolution, and the “Innovative governance practices” also registered a negative change. The “Sound regulatory frameworks” were not significantly sensitive to the restrictions, and the “Efficient use of financial resources” was even considered as having a positive evolution because the severe financial restriction forced a more stringent and conscious use of the resources. Altogether this dimension adds up to 3.50/4.00 showing the smallest deviation from the reference situation, i.e. the situation before the 2011.

This demonstration case shows clearly that the OECD Principles for Water Governance can be used not only as an inspiration for streamlining new water policies, but also as a basis to assess the evolution of water governance in a given period of time, providing a better understanding of what may have gone wrong and, still more important, helping to formulate adequate recovery policies.

Case study: Assessment of the water supply and wastewater services reform in Portugal

Contact: Jaime Baptista, Lisbon International Centre for Water (LIS-Water), Portugal

The OECD Water Governance Principles provide the 12 must-do for governments to design and implement effective, efficient, and inclusive water policies in a shared responsibility with the broader range of stakeholders. They were approved at the OECD Ministerial Council Meeting in 2015.

Since their adoption, the Principles have been endorsed by almost fifty countries and more than one hundred major stakeholder groups. The first signatures from public, private and non-profit organisations were gathered at the 7th World Water Forum in 2015 in Korea through the Daegu Declaration. One the signatures was the Portuguese Water and Waste Services Regulation Authority (ERSAR).

Two years later, if we analyse the current public policy developed in Portugal for water services (drinking water supply and wastewater management services) we can understand that it has in average a good degree of alignment with the OECD water governance principles, but with some disparity between the principles. We can say that the alignment of Portugal is good regarding half of the OECD principles, even extremely good regarding one third. However, the alignment of Portugal is still insufficient regarding the two remaining OECD principles. Note that the following analysis was made from the viewpoint of drinking water supply, and wastewater management services only, not from the view point of water resources management.

In detail, we can say that the alignment of Portugal is good regarding OECD principles 1, 4, 6, 9, 10 and 11. Let´s evaluate each one in detail.

Regarding the OECD principle 1 of clearly, allocate and distinguish roles and responsibilities for water policymaking, policy implementation, operational management and regulation, and foster co-ordination across these responsible authorities, Portugal has established an appropriate institutional framework, with a clear assignment of responsibilities for the public entities involved, especially the regulatory authority for water services and the environmental, water resources, waste management, public health, consumer protection and competition authorities. From the strict water services point of view, allocation of responsibilities and institutional links between authorities only need some minor adjustments.

Regarding the OECD principle 4 of adapt the level of capacity of responsible authorities to the complexity of water challenges to be met, and to the set of competencies required to carry out their duties, a major effort regarding human resources capacity building has been carried out in Portugal in terms of number and competencies. There has been a strengthening of advanced, technological and traditional technical courses to overcome shortages of personnel with relevant academic qualifications to carry out the existing roles in the sector. There are training and updating courses for specific human resources in the sector, involving training activities for managers and technicians at various levels, with significant involvement of the universities and water associations. There has been a considerable increase in technical publications and various other educational tools, of a practical character, covering all areas of the sector, aimed at the different professional levels involved.

Regarding the OECD principle 6 of ensure that governance arrangements help mobilise water finance and allocate financial resources in an efficient, transparent and timely manner, to implement a new public policy and carry out coverage of services goals in Portugal it was necessary to ensure the availability of important financial resources, both national resources and those originating from European funds. Indeed, in the last twenty years there has been and continues to be a significantly higher level of investment in infrastructure for water. It was also created internal capacity for the efficient management of the so important financial resources, deciding how to apply where they could provide greater profits and benefits for society.

Regarding the OECD principle 9 of mainstream integrity and transparency practices across water policies, water institutions and water governance frameworks for greater accountability and trust in decision-making, a very complete information system has been established in Portugal for the water services, making use of reliable information, both to support the definition of public policies and business strategies and to evaluate the service that is actually provided to society, so as to be able to convey an overview of the sector in a reliable and regularly updated manner. Additionally, according the legislation all the water administration and water utilities must have internal integrity programs, to avoid or minimise corruption events.

Regarding the OECD principle 10 of promote stakeholder engagement for informed and outcome-oriented contributions to water policy design and implementation, the users in Portugal now have rights reinforced through specific legislation and increasingly

involvement about water services, particularly regarding their participation in decisions. The involvement of the population in the decision-making processes has gradually been promoted through environmental education activities, for example regarding the efficient use of water, and with the growing availability of information, has allowed users to make more well-founded decision regarding their preferences, particularly regarding the levels of coverage to be attained and the quality of services to be provided, with regard to what they are willing to pay. This is however a slow transition of behaviours.

Regarding the OECD principle 11 of encourage water governance frameworks that help manage trade-offs across water users, rural and urban areas, and generations, Portugal has set out a tariff policy for public water services with the goal of promoting a gradual trend towards cost recovery, consistent with the economic capacity of the population. Although somewhat distant from a full application, the recovery of the costs of these services has gradually been carried out through tariffs paid by the users, supplemented where possible through transfers of European funding and, if necessary, through rates from the levying of taxes. At the same time an attempt has been made to trade-offs across water users, rural and urban areas, based on regional tariffs. Also between generations an attempt has been made based on the coverage of the full opex and capex costs to guaranty good services in the future.

The alignment of Portugal even is extremely good regarding OECD principles 5, 7, 8 and 12. Let´s evaluate each one in detail.

Concerning the OECD principle 5 of produce, update, and share timely, consistent, comparable and policy-relevant water and water-related data and information, and use it to guide, assess and improve water policy, a very complete and sophisticated information system has been established in Portugal for the water services, making use of reliable information, publicly disseminated in an annual report of five volumes. Information is disseminated on two levels. The first is at an essentially national level, which is most useful for defining policies and development strategies, and a second essentially at the level of each utility, mostly useful for the operation of the systems. It is also made available to consumers in a more accessible and friendly format, namely in the smartphones.

Concerning the OECD principle 7 of ensure that sound water management regulatory frameworks are effectively implemented and enforced in pursuit of the public interest, Portugal has established an appropriate institutional framework, with a clear assignment of responsibilities for the public entities involved, especially the regulatory authority for water services and the environmental, water resources, solid waste management, public health, consumer protection and competition authorities. This definition was absolutely fundamental and essential for a good performance by the sector, since it has enabled the responsibilities of stakeholders to be specified, along with clear rules of operation and the articulation between the close and complementary sector mentioned above, without overlaps or important gaps.

Concerning the OECD principle 8 of promote the adoption and implementation of innovative water governance practices across responsible authorities, levels of government and relevant stakeholders, Portugal decided on the governance models that could be used in the sector, in accordance with current political options. They are direct management, delegated management and concessions for water services, with provision by State-owned, municipal and private entities. Legislation to be followed is very strict and clear. Currently there are around 80% of cases involving direct management, 10% of cases involving delegated management and another 10% involving concessions. In 15% of these situations private management is involved. The introduction of these different models of governance, all of them having clear cases of success, has meant that there is a comparative analysis of their performance and thus the stimulus to improve services.

Concerning the OECD principle 12 of promote regular monitoring and evaluation of water policy and governance where appropriate, share the results with the public and make adjustments when needed, the Portuguese regulator has ensured the regulation of the service provided to users by the utilities, assessing their performance and comparing the utilities among themselves, through the application of a suitable selection of performance indicators, so as to promote effectiveness and efficiency. Monitoring and evaluation of water policy is also done by a working group of different stakeholders.

However, the alignment of Portugal is still insufficient regarding OECD principles 2 and 3. Let´s evaluate each one in detail.

About the OECD principle 2 of manage water at the appropriate scale(s) within integrated basin governance systems to reflect local conditions, and foster co-ordination between the different scales, Portugal decided on the governance models that could be used in the sector, in accordance with current political options. They are direct management, delegated management and concessions for water services, with provision by State-owned, municipal and private entities. The introduction of these different models of governance has meant that the option adopted varies from municipality to municipality and from region to region. Bulk services are in general provided by State owned utilities, with optimal scale economies. Retail services are in general provided by Municipal owns utilities, but still under a complex process of aggregation to improve scale economies.

About the OECD principle 3 of encourage policy coherence through effective cross-sectoral co-ordination, especially between policies for water and the environment, health, energy, agriculture, industry, spatial planning and land use, the Portuguese strategic plan for the sector for drinking water supply and wastewater management, nationwide in scope and for the medium term, reinforces this cross-sectoral co-ordination. But in practice the institutional links between other sectorial authorities and the water services authority still have large space for development.

From the analysis carried out, it can be seen that the public policy instituted in 1993 for the water services was implemented in a global and integrated manner, with greater stability over time. Success required continuity of government pursuing a well-defined public policy implemented through long-term planning.

It brought together institutional, governance, management, planning, technical, economic, legal and environmental, public health, social and ethical instruments to ensure the suitable provision of these services.

That public policy reveals in average a good degree of alignment with the OECD water governance principles, approved two decades later.

As a consequence, a very positive evolution in the provision of these essential public services can be noted, particularly in terms of the evolution of the public services of drinking water supply and wastewater management, and the impact on environmental quality and on public health and also the impact of compliance with human rights in access to water and sanitation.

Case study: Reform of National Water Governance in Ireland

Contact: Matt Crowe, Environmental Protection Agency, Wexford, Republic of Ireland

Introduction and brief description

Ireland is in the process of completing a fundamental reform of water governance in tandem with its planning for the second and third cycles of the Water Framework Directive. Following a number of reviews of the governance structures that were in place for the period of 2003 - 2014, new structures were developed and provided for in legislation in 2014. A key change is the move from several river basin management districts (including three cross-border RBDs) to a single national approach incorporating the cross-border areas. A new collaborative three tier governance structure has been put

in place bringing much greater clarity to who does what, why, at what level and how. Tier 1 is led by the Government Department with responsibility for water policy and legislation, tier 2 by the Environmental Protection Agency which leads on science, evidence and reporting and Tier 3 by Irish local authorities who lead on local area implementation and public engagement. The communication, engagement, collaboration, networking, implementation and management structures and staff resourcing are being put in place to support this new approach which is aimed at achieving better outcomes for water by targeting resources (people and money) at the right problems in the right places by the right actors. This has included additional staffing for both the EPA and local authorities. The new approach also builds on the principles of Integrated Catchment Management and is a real and live attempt at implementing Integrated Catchment Management at national, regional and local levels.

Socio-economic context

The overall governance approach taken for the first WFD cycle didn't work. The target, which was over ambitious and insufficiently grounded in hard science and evidence, was to achieve a 14% improvement in water quality between 2009 and 2015. The results show a slight dis-improvement overall. While there was much excellent preparatory work done between 2003 and 2009 on characterisation, monitoring and draft river basin management planning (the what), the governance and public engagement structures (the who, the how and at what level) simply were not there to oversee and drive implementation. Resourcing was also inadequate and the 2009-2012 period coincided with a severe national financial crisis which included a strict embargo on the hiring of public sector staff. Staff numbers therefore declined during this period. The policy debate at that time was also focused on the establishment of a new water utility and the introduction of water charging so there was less focus on the implementation of the Water Framework Directive. A key governance issue that needed to be fixed was that national actors were insufficiently engaged at national level, there was no identifiable leader for implementation and too much responsibility without the necessary authority and resources was delegated to local authorities.

Key-milestones

- Getting the new governance structures (for communication, engagement, collaboration, networking, implementation and management) in place and operational at the three tiers (or levels).
- Ensuring that these structures are truly collaborative and that all state actors are clear as to their own roles and responsibilities.
- Establishing robust mechanisms for real and meaningful public/citizen engagement at both national and local levels.
- Developing a strong, reliable and scientifically defensible evidence base to support better and more targeted decision making.
- Developing web-based tools for improving the dissemination and sharing of data, information and knowledge with relevant actors and the public/citizenry.
- Agreeing a realistic and achievable national river basin plan for the period 2018-2021 and being able to prove that this plan is being implemented.

Key stakeholders and partners involved

- All Irish citizens that rely on clean, fresh and well protected water supplies;
- Department of Housing, Planning and Local Government: lead Government Department;
- Environmental Protection Agency: lead for science, evidence, monitoring, assessment and reporting;
- Local authorities (31): lead for regional and local implementation;

- Local Authority Water and Communities Office: new office established to coordinate public engagement;
- Other government departments and agencies: (agriculture, fisheries, nature, flooding, health, forestry, marine): leads for national implementation in areas of responsibility;
- Irish Water: national water utility responsible for drinking water and wastewater;
- Civic society representative organizations: Environmental NGOs, industry associations, civic society associations with an interest in water;
- Farmers and the farm industry: a very important stakeholder group in Ireland
- Recreational water users: fishermen and women, bathers, walkers, nature lovers, boaters,
- Industry: both as a user of water and a potential pressure on water

The reform process as an illustration of the OECD Principles on Water Governance

Principle 1 - Clear roles and responsibilities

This is a work in progress. The three governance tiers are now in place and operational but at different levels of maturity. Tiers 1 and 2 are well established (water policymaking, operational management and regulation, fostering coordination across responsible authorities, national level implementation). Tier 3 (which is driving local implementation) is still in construction but quite well advanced. The committees, networks and structures at Tiers 1 and 2 are in place and operational. A key set of regional coordination committees, led by local authorities, are under construction.

Principle 2 - Appropriate scales within basin systems

The reform programme is specifically aimed at managing water at the appropriate scale. Ireland has been divided into 46 catchments, 583 sub-catchments and over 4,000 water bodies all within one national administrative unit. A tiered approach to characterization has been taken which has resulted in structured data and evidence at water body, sub-catchment, catchment and national levels. The data is all contained in one application called the WFD Application and all public bodies involved in water management and protection in Ireland. have access to this as a shared service. Much of this data is also available to the public through the website catchments.ie. The committees at the three tiers are also designed to facilitate decision making at the right level by the right people and organizations.

Principle 3 - Policy coherence

This is mainly achieved through the work of the Water Policy Advisory Committee, established by law in 2014 and chaired by the Government Department with responsibility for water (the Department of Housing, Planning, Community and Local Government). This provides a policy framework for coordinating implementation of the WFD, Floods Directive and the Marine Framework Directive as well as the other key water related Directives such as the Urban Waste Water Directive, Bathing Water Directive, Shellfish Directive and Drinking Water Directive and associated environmental Directives such as the Habitats Directive. Of particular relevance in the Irish context is the active participation in WPAC of the government department with responsibility for agriculture (the Department of Agriculture, Food and Marine) which provides for cross-sectoral coordination between water issues and the Rural Development Programme. Sub-committees of this committee have also been formed to deal with specific issues, for example, abstractions controls and the preparation of programmes of measures. Policy coherence is also facilitated at national level at tier 2 (led by the EPA) through various committees and networks with all the relevant actors involved, and at regional and local level at tier 3 (led by local authorities) through a dedicated office (Local Authority Water and Communities Office) and five regional committees, each chaired by a local authority Chief Executive.

Principle 4 – Capacity

This has been a very challenging area for Ireland as there was a strict embargo of staff replacement and hiring between 2008 and 2014 which led to loss of staff and expertise at all levels of water management. Since 2014, public sector hiring has commenced, albeit at very controlled levels, and both the EPA and local authorities have been provided with additional but very targeted resources since then. Catchment science has been strengthened in the EPA through the creation of a small but highly skilled Catchment Management and Science Unit and this unit has carried out the bulk of the science and evidence work since 2014 that underpins the draft National River Basin Management Plan. The new Local Authority Water and Community Office (LAWCO), established in 2015/2016 is providing a whole new skill set through the hiring of community water officers (14 in all) strategically located around the country. Their job is to drive better engagement at regional and local level, supporting by the science and evidence produced by the EPA and others such as Teagasc, the State Agricultural Advisory Service. A business case for specific skill sets at local authority level is also under consideration which is seeking in the region of 50 additional specialist staff to be dedicated to water management and protection work.

Principle 5 - Data and information

Ireland has performed very strongly in this area through the recent development of web-based and map-based tools for data collection, assessment, reporting and communication. This work is being carried out by the EPA with funding from the Department of Housing, Planning, Community and Local Government. The two main products from this are: the WFD Application, accessible through the EPA's Environmental Data Exchange Network (EDEN) to all public bodies involved in water management and protection; and Catchments.ie which provides access to most of this information but in a format more accessible to members of the public and other interested parties. The EPA also operates the national WFD monitoring programme so it has been designing its laboratory systems to link in with the WFD Application to facilitate easier access to up to date information. A new quarterly newsletter is also now being produced by the EPA (the Catchments Newsletter) as a collaborative effort between the various stakeholders where people and organizations are encouraged to tell their water management and protection stories in an engaging and interesting way.

Principle 6 - Financing

The two largest sources of finance for water management and protection in Ireland are the Irish Water Capital Investment Programme, mainly aimed at modernising water and wastewater infrastructure from collection to treatment to discharge, and the Rural Development Programme, mainly aimed at the agricultural sector and which includes European funding through the Common Agricultural Policy. The improved evidence and information base created over the past three years is starting to make it easier to plan for targeting investment in the places that will give greatest environmental return. This is also being helped through the committee and supporting engagement structures, particularly at national level involving government departments and agencies which is leading to more frequent multi-lateral and bi-lateral engagements across sectors by the people that are in a position to make decisions.

Principle 7 - Regulatory frameworks

As with many countries, the regulatory framework in Ireland is quite complex and involving many actors at different levels. The most valuable consequence of the recent reform programme is that it has brought much greater clarity as to who is responsible for what and at what level but has also provided a framework for much better collaboration between these actors and across these levels and ensuring that new staff and structures are supporting the new integrated catchment management approach. Economic regulation of water issues has also been introduced in tandem with the establishment of

Irish Water, the national water utility. The Commission for Energy Regulation is the economic regulator. Ireland is planning a fundamental reform of its water management and protection legislation which will seek to codify many of the administrative changes that have taken place in the past three years. This will provide an opportunity for a national conversation on how best to design the regulatory framework to make it fit for purpose for the next twenty to thirty years.

Principle 8 - Innovative governance

The entire reform programme is built on a re-design of the water governance practice through the creation of an interlocking three tier structure with supporting committees, networks, IT systems, communications systems and engagement processes. These new structures though are still being tested and those at tier 3 just being formed so it will be some time before it will be possible to evaluate their relative success.

Principle 9 - Integrity and transparency

There has been considerable engagement with the environmental NGO sector over the past three years as the new governance arrangements have evolved. This was particularly so in the area of stakeholder engagement and the idea of a national water forum came originally from the environmental NGO sector. The approach taken by the three governance leads (Department of Housing, Planning, Community and Local Government, the EPA and local authorities, has been to be as open and transparent as possible as the science, evidence and policy has developed. The National Stakeholder Event, established in 2015, has helped with this as well as does the National Water Event run each year by the EPA as both of these events provide an opportunity for interested parties to get updates and to discuss and debate the issues. The Department of Agriculture has also set up a water forum to engage better with other public bodies and stakeholders in the private, representative, voluntary and civic society sectors. These initiatives are helping create an atmosphere of greater collaboration, integrity and transparency and can be further evolved in the coming years as new initiatives such as the National Water Forum take hold.

Principle 10 - Stakeholder engagement

There are three new initiatives of relevance to this principle. 1. A new independent National Water Forum has just been launched which will provide for citizen engagement and discussion at national level. The first task of this forum will be to review and comment on the draft River Basin Management Plan. The Forum has been provided with administrative support to assist it with its work. 2. A National Annual Stakeholder Event was established in 2015 to which all national stakeholders are invited to take stock of progress to date and to discuss and debate next steps. Ireland is a relatively small country and Events like this are very productive as people on the same and opposing sides of the argument tend to know each other quite well and this tends to encourage open and honest debate. 3. LAWCO, the new Local Authority Water and Community Office has, as part of its operations, 14 water community officers strategically located around the country whose job is to engage with local communities and to encourage them to become more involved in water management and protection projects.

Principle 11 - Trade-offs across users and generations

There will be a number of trade-offs required as we move towards full implementation of the draft River Basin Management Plan. The main trade-offs arise from the simple fact that there is limited public money available to do all the things we would like to do and therefore prioritizing the most important actions that will deliver best environmental benefit is of huge importance. Also, the principle that public or private monies should not be invested in actions unless there is a reasonable likelihood that the actions will deliver good environmental outcomes. The improved evidence base together with the new tiered governance structures are helping better management of these trade-offs, particularly in areas such as agriculture, forestry, other land use, hydro-morphology and wastewater

treatment. Many of the 'at risk' water bodies in Ireland have multiple pressures and unravelling these pressures to get to the right actions in the right place at the right time is complicated. We are therefore working to the principle that the science and evidence must support the decision making about measures, particularly those that require significant time and money.

Principle 12 - Monitoring and evaluation

Ireland conducted a comprehensive review of water policy and governance in the period from 2010 -2014 involving mainly the lead Department with responsibility for water protection and management (the Department of Housing, Planning, Community and Local Government), the EPA and the local authorities. Out of this came the creation of a new three tier interlocking governance structure described in earlier sections of this form with a much stronger focus on collaboration, role clarity, hard science and evidence, integrated catchment management and public engagement. There is a commitment to continue to evaluate these structures as they evolve and to make changes where they make sense from a policy and operational viewpoint.

Case study: The International Commission for the Protection of the Danube and the elaboration of the River Basin Management Plan

Contact: Ivan Zavadsky, International Commission for the Protection of the Danube River, Vienna, Austria

Introduction and brief description

The Danube River Basin covers more than 800,000 square kilometres – 10% of continental Europe – and extends into the territories of 19 countries. This makes it the most international river basin in the world. Over 80 million people live in this basin, with many depending on the Danube for drinking water, energy production, agriculture, and transport. Its ecological diversity, from plant and animal species to critical habitats, is also highly valued. In 2000, the EU Water Framework Directive (WFD) came into force, establishing a legal framework to protect and enhance the status of aquatic ecosystems, prevent their deterioration, and ensure the long-term, sustainable use of water resources throughout the EU. In response, the ICPDR countries, including non-EU Member States (MS), agreed to implement the WFD throughout the entire basin. The contracting parties made the International Commission for the Protection of the Danube River (ICPDR) the facilitating platform to coordinate WFD-related work. The objective of the WFD is to achieve for all inland surface waters, transitional and coastal waters 'good chemical and ecological status (or potential)' – and for all groundwater to achieve 'good chemical' and 'quantitative status'. For a set of selected hazardous substances called priority substances, limit values were set on the European level which are defining "good chemical status". 'Clean water', not polluted by organic substances, nutrients and dangerous substances is essential. However, it is not enough in case the natural ecosystem including its flora and fauna is significantly damaged or dysfunctional. That is why a holistic approach requires surface waters to be as well in 'good ecological status': River bed and banks have to be well structured and enough water has to be ensured so that migration routes and natural habitats are provided for aquatic animals and plants. To meet these objectives, the ICPDR developed its first "Danube River Basin Management Plan" (DRBM Plan) in 2009, including assessments and measures towards the achievement of 'good status' by 2015. Aware of the fact that not all waters would hit the target in six years, the WFD requires to update the DRBM Plan in 2015 and 2021. The management plan defines the framework for water management in the Danube River Basin for the next six years. The DRBM Plan – Update 2015 includes updated assessments on the main pressures impacting the Danube basin's waters, updated information on water status and progress achieved, as well as the joint further actions agreed by the Danube countries to be undertaken until 2021.

Socio-economic context

The Danube is the most international river in the world and the diversity in landscapes is matched by a high diversity of languages, administrative traditions, religions and cultures. The Danube links some of the richest regions in Europe with some of the poorest. The GDP per capita in the richest Danube country is 14 times higher than in the poorest. For millennia, the Danube has acted as a barrier and navigation route, both dividing people and connecting them. Several geopolitical fault-lines have run through the Danube Basin, with the Danube itself often as the centre of conflicts among the dozens of peoples living along its banks. In the decades that followed World War 2, water quality in many European rivers including the Danube deteriorated as they were subject to pollution from increased industrialisation, growing populations, and more intense farming practices. Hydropower was developed, inland navigation increased, wetlands were drained and dams built. The fall of the Iron Curtain, marked a new era, when transboundary cooperation became more dynamic, but also more complex with a higher number of countries in the Basin – up to the current 19. In the spirit of these three trends or developments, the countries of the Danube Basin decided to coordinate their water management in a more formal way and in 1994, they signed the Danube River Protection Convention (DRPC). First tasked as implementation body of the DRPC, the ICPDR is now also tasked with the coordination of the implementation of the Water Framework Directive (WFD) in the Danube River Basin.

Key milestones

The Plan is developed in line with the requirements of the EU Water Framework Directive (WFD) and defines the framework for water management in the Danube River Basin for the next six years until 2021. It aims to protect the Danube and to ensure the sustainable, long-term use of its water resources. The plan includes the latest assessments on significant pressures facing the river, the status of its water and a joint programme of measures. Developed as a work program for 6-year periods, it is updated at the end of each cycle. The management plans provide a basin-wide umbrella supported by national and sub-basin management plans. Half-way through the production of the plan update, an Interim Report is produced which provides an overview on the state of play regarding the implementation of the Joint Programme of Measures that is being included in the plan and agreed by the Danube countries. The reference date for the assessment is the situation by the end of 2012. The report also addresses the activities which were undertaken towards financing the Joint Programme of Measures, what is key for measures implementation.

The plans are endorsed at the end of the six-year cycle in the framework of Ministerial Meetings, the last in date, the 3rd Ministerial Meeting held in Vienna on 9 February 2016.

Key stakeholders and partners involved

The 15 ICPDR contracting parties are the main actors involved in the practice. They have committed themselves to implement the Danube River Protection Convention. They co-operate on fundamental water management issues and take all appropriate legal, administrative and technical measures to maintain and improve the quality of the Danube River and its environment. The 23 ICPDR observers are main stakeholders who cooperate actively from across sectors with the ICPDR. They are informed on ICPDR activities and meetings, have the possibility to express their views and position and contribute to projects initiated under the auspices of the Convention in which they are invited to participate or make any other voluntary contribution. Apart from the 15 contracting parties to the ICPDR, the following countries also co-operate with the ICPDR under the EU Water Framework Directive: Italy, Switzerland, Poland, Albania and the Former Yugoslav Republic of Macedonia.

The reform process as an illustration of the OECD Principles on Water Governance

Principle 1 - Clear roles and responsibilities

The backbone of the operation and the success of the ICPDR is the Expert Groups (EG). They are formed by national experts from the Contracting Parties and representatives of ICPDR observer organisations. Eight Expert Groups deal with a variety of issues and make recommendations to the ICPDR. The technical work within the ICPDR relies very heavily on the work of these EGs. These panels of specialists are not only essential to the operation of the ICPDR they also EGs link the work of the commission to the national administration of its contracting parties. Indeed, they comprise national experts and - although with no formal vote - delegates from observers. Currently, the ICPDR has 7 regular Expert Groups (River Basin Management, Flood Protection, Pressures and Measures, Accident Prevention and Control, Monitoring and Assessment, Information Management and Geographic Information Systems, Public Participation) and 1 ad-hoc Expert Group for legal and administrative questions.

Principle 2 - Appropriate scales within basin systems

For efficiency and proportionality purposes, and also to be in line with one of the governing principles of the ICPDR, the principle of subsidiarity, the management of the DRBD is based on 3 levels of coordination:

Part A: International, basin-wide level – the Roof Level;

Part B: National level (managed through the competent authorities) and/or the international coordinated sub-basin level for selected sub-basins (Tisza, Sava, Prut, and Danube Delta);

Part C: Sub-unit level, defined as management units within the national territory

Principle 3 - Policy coherence

The ICPDR acts as a platform for its contracting parties to coordinate responses to various environmental threats. Economic activities often have needs that conflict with the environment. Inland navigation can contribute to making transport more environmentally sustainable, particularly where it substitutes for road transport. It can, however, also have significant influence on river ecosystems, jeopardizing the goals of the EU Water Framework Directive, which aims for the “good ecological status” of all waters by 2015.Thus, in 2007 The "Joint Statement on Guiding Principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin" was launched, summarizing principles and criteria for environmentally sustainable inland navigation on the Danube and its tributaries, including the maintenance of existing waterways and the development of future waterway infrastructure.

In 2010, the ICPDR became active in initiating a dialogue with representatives from the hydropower sector. As an essential step in this process, "Guiding Principles on Sustainable Hydropower Development in the Danube Basin" were developed by an interdisciplinary team and were finalised and adopted in June 2013.

Principle 4 – Capacity

Technical work within the ICPDR relies heavily on the ICPDR Expert Groups (EGs). These panels of specialists are essential to the operation of the ICPDR. They link the work of the commission to the national administration of its contracting parties who are appointed and delegated by the countries. Technical decisions by the ICPDR are prepared through the Expert Group bodies, which draw from over 200 people who are specialists in their respective countries or organisations.

Principle 5 - Data and information

Data and information are monitored and assessed in the ICPDR's TransNational Monitoring Network (TNMN). It is an important tool under the DRPC, whose Contracting

Parties are committed to co-operate in the field of monitoring and assessment. Formally launched in 1996, it aims to provide a well-balanced overall view of pollution and long-term trends in water quality and pollution loads in the major rivers in the Danube River Basin. The main objective of the TNMN is to provide a structured and well-balanced overall view of pollution and long-term trends in water quality and pollution loads in the major rivers in the Danube River Basin.

The Danube River Basin Geographic Information System (DanubeGIS) supports the ICPDR in its tasks related to spatial data. It is open to public users as well – providing access to data and maps for the whole Danube Basin.

Principle 6 - Financing

EU legislation with the "polluter pays principle" set out in the EC treaty ensures that environmental damage in the EU is prevented or remedied, and that those who cause it are held responsible. Thus, environmental damage including damage to water resources, natural habitats, animals and plants as well as contamination of land which causes significant harm to human health will follow the polluter pays principle.

The EU Water Framework Directive (WFD) calls for accounting related to the recovery of costs of water services and information on who pays, how much and what for. Cost recovery for specific water services is defined as the ratio between the revenues paid for a specific service and the costs of providing the service. In most countries, the assessment of cost recovery focuses mainly on water supply as well as sewerage services for industry and households. Costs include management costs, depreciation, interests, taxes and fees, and the environment and resources costs. Environmental and resource costs are not taken directly into account in most countries as part of the economic analysis, due to both a lack of methodology and information. In some countries, existing economic instruments that are intended to partly internalise environmental and resource costs are considered separately in the cost recovery assessment. The issue of cost recovery is primarily an issue of national importance.

Principle 7 - Regulatory frameworks

The ICPDR is the implementation body of the Water Framework Directive. This regulatory framework foresees the following:

Expanding the scope of water protection to all surface waters, including transitional and coastal waters, and groundwater.

Water management based on river basins including necessary administrative arrangements.

Achieving “good status” for all waters by a set deadline.

“Combined approach” of emission limit values and quality standards.

Economic instruments and adequate water pricing for water services.

Public participation and information through a better involvement of citizens and regular implementation reports (EU-MS and COM).

Streamlining legislation by repealing seven old Directives.

Principle 8 - Innovative governance

The ICPDR acts as a platform for its contracting parties to coordinate responses to various environmental threats. Economic activities often have needs that conflict with the environment. Inland navigation can contribute to making transport more environmentally sustainable, particularly where it substitutes for road transport. It can, however, also have significant influence on river ecosystems, jeopardizing the goals of the EU Water Framework Directive, which aims for the “good ecological status” of all waters by 2015.Thus, in 2007 The "Joint Statement on Guiding Principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin" was

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In 2010, the ICPDR became active in initiating a dialogue with representatives from the hydropower sector. As an essential step in this process, "Guiding Principles on Sustainable Hydropower Development in the Danube Basin" were developed by an interdisciplinary team and were finalised and adopted in June 2013. Since then the Guiding Principle have been utilised in number of Danube countries at in development and/or revision of their national hydropower strategies.

Principle 9 - Integrity and transparency

The ICPDR sees integrity and transparency practices across water policies, institutions and water governance frameworks for greater accountability and trust in decision-making as a core value. Thus, the ICPDR rules of procedure define the framework in which we operate. They range from fundamental treaties to organisational rules for staff members of the permanent secretariat. Furthermore, the ICPDR supports the active involvement of stakeholders and civil society on all levels of its work. This is pursued through observer organisations, as well as through public consultation activities for the development of management plans. To ensure a high level of public information, educational and outreach initiatives support the public participation work of the ICPDR.

Principle 10 - Stakeholder engagement

Public Participation is a requirement of Article 14 of the Water Framework Directive. he ICPDR engages in public participation through primarily two means: firstly, through the active involvement of observer organisations on the level of both expert group meetings and plenary meeting; and secondly, through activities that ensure a high level of public consultation in the development of the plans - such as stakeholder workshops, online surveys or public calls for the submission of comments on draft documents. As civil society can be more meaningfully involved in the work of the ICPDR if representatives are well-informed about the objectives and structure of it, public information, educational initiatives and outreach activities support the public participation of the ICPDR. These include Danube Day, the Danube Box or the publication of the magazine Danube Watch. An additional line of stakeholder involvement is the cooperation with the private sector, in particular the Coca-Cola system. This line of activities is formalised through the "Business Friends of the Danube" initiative. The ICPDR is one of the only River Commissions to have a dedicated expert for Public participation issues.

Principle 11 - Trade-offs across users and generations

The ICPDR has done pioneering work on cross-sectoral issues such as navigation, hydropower and adaptation to climate change underpinning the first management plan needs to be further expanded at both technical and political levels. The practical use of the joint statement on navigation and environment and the ‘Guiding Principles on Sustainable Hydropower Development in the Danube Basin’ helped the CPs to the DRPC to conduct a structured dialogue on strategic planning and development of projects impacting the status of the waters in the DRB. Both tools established a mechanism for regular review of the progress and achievements on both basin-wide and national levels.

Principle 12 - Monitoring and evaluation

The ICPDR Monitoring & Assessment Expert Group (MA EG) coordinates the joint operation of TransNational Monitoring Network (TNMN) by all Contracting Parties. The work includes collection, processing and evaluation of the monitoring data as well as the maintenance and necessary upgrades of the TNMN database. This task also includes an ongoing review and update of monitoring methodologies and analytical procedures for the determinants monitored within TNMN as required for the assessment of the water status according to the EU WFD. The MA EG ensures high credibility and reliability of

the TNMN data produced annually in the Danube River Basin. The regular performance tests of analytical methods, which are used by the laboratories participating in the TNMN, are carried out using appropriate quality assurance procedures (ISO/EN compatible). The MA EG coordinates the actions towards improving the quality assurance procedures of TNMN laboratories in order to improve the comparability of data. The current AQC program (QualcoDanube) is based on the tender “Organization of a proficiency testing scheme for the TNMN laboratories under the ICPDR in years 2014 – 2018”.

9.8. Key messages

From the assessment presented and discussed in this section, the following key messages can be formulated:

- Infrastructure and technology is not enough to guarantee an adequate management of water resources and to pursue effective water policies. Good governance is a key element for the success in achieving these goals.
- Europe has a rich and diversified experience in this area, especially because of the diversity of conditions, both in terms of water availability and water needs. From Norway to Malta, from Scotland to Sicily, just to mention extreme cases, the profile of water uses, and the characteristics of the hydrological regimes, couldn’t be more far apart.
- On the top of all those economic and physical differences, there are also quite distinct cultures and traditions deeply embedded in the legal and institutional systems of the various European societies. Many countries in southern Europe are direct heirs of the Roman law, often mixed with Moorish influence, in which “public property” of water is essential. In many northern European countries, the Celtic tradition prevails with a deeply rooted concept of “common property”.
- As a result of the above-mentioned circumstances, it comes as no surprise that Europe can be seen as some sort of “laboratory” in which different systems coexist side by side. There is much to be learnt by comparing those governance systems, understanding how they evolved in time, what are the strong and the weak points, and what makes them fit for each society. This comparative analysis has been done at several occasions, such as Correia (1997a), Correia et al. (1999), OECD (2011) or Garcia Quesada (2011), inter alia.
- In the European Union, the Water Framework Directive (Directive 2000/60/EC) has played a very important role in relation to water governance. This is a legal document with obligatory compliance in the 28 Member-States of the EU, but with an impact that goes much beyond, because it establishes a standard and provides inspiration for many other countries in Europe and in the world.
- That Directive establishes the ultimate purpose of achieving a good ecological quality in all water bodies of the EU, while recognizing that several measures in the area of governance need to be adopted to achieve this goal. This is addressed, however, in a way that assumes that there are enormous differences in the institutional set-up of the various EU Member-States and that a reasonable degree of freedom should be left to the discretion of those Member-States in shaping their systems of governance, provided that reach the ultimate goals and comply with some key provisions established by the Directive.
- Some of those key provisions of the WFD having significant governance implications, are the need for assigning a competent authority to each River Basin District, the obligation of preparing River Basin Management Plans and Programs of Measures. Also, the need for coordinating those plans and programs of measures at the scale of the entire river basin even when it is contained in more than one Member-State, or even when it includes countries beyond the EU territory, has important governance consequences. Another relevant dimension in

terms of governance, is the obligation of engaging stakeholders, disseminating information, and going through extensive consultation procedures.

- In recent years, the OECD has developed a very relevant effort for the establishment of principles and indicators of good water governance (OECD, 2015a). This exercise was largely based on the comparative analysis of 17 countries, with 8 of them located in Europe. The 12 principles that were formulated, can be adopted, not only as an inspiration for the formulation of water policies, but also as a basis for an assessment and benchmarking of every system of water governance.
- Although inter-comparison and benchmarking of institutions, policies, and models of governance is always very inspiring and instructive, one should not forget that those arrangements are never an end by itself, but rather a mean to an end. Historical, cultural, social, and political contexts and backgrounds determine, to a large measure, the configuration of institutions relevant for water resources management in each specific country. Having recognized this, and thus paying due respect to the specificities of each society, those contexts and backgrounds should not be seen as an "inescapable prison" that blocks any possible progress. On the contrary, it is important to make a continuous effort to improve governance because the challenges are always increasing throughout the world and also in Europe. If it is a good thing that future generations grow with the memory of the past and with a strong sense of identity, they should not, however, be prisoners of atavisms that have lost meaning and block their development and progress.
- It is then clear that governance plays an important role to achieve a successful water resources management, aiming at providing water for all needs in a sustainable manner. Governance, considered as that "*second leg*", is complementary to infrastructure and technology, preventing water management from "*stumbling and falling*" (Briscoe, 2011). As it was mentioned at the beginning of this chapter, one should never forget that infrastructure and technology without appropriate governance is "*like a hammer without a hand*" (Correia, 2012). Future generations deserve that we "hit the nail".

9.9. References

In the writing of this chapter the following bibliographic references have been used:

Akhmouch, A., Correia, F. N. (2016). The 12 OECD principles on water governance: When science meets policy. Utilities Policy 43 (2016) 14-20

Briscoe, J. (2011). Making Reform Happen in Water Policy: Reflections from a Practitioner. Background Paper, OECD Global Forum on Environment: making Water Reform Happen, 25-26 October. Organization for Economic Cooperation and Development, Paris.

Canali, G. V., Correia, F.N., Lobato, F., Machado, E. S., 2000 - Water Resources Management - Brazilian and European Trends and Approaches. International Water Resources Association and Brazilian Water Resources Association, Porto Alegre, Brazil.

Correia, F.N. (Ed.) (1997a). Institutions for Water Resources Management in Europe. Balkema Publishers, Rotterdam. ISBN 90 5410 439 2. Also translated in German: Institutionen der Wasserwirtschaft in Europa - Landerbericht. Springer-Verlag, Berlin.

Correia, F.N. (Ed.) (1997b). Selected Issues in Water Resources Management in Europe. Balkema Publishers, Rotterdam. ISBN 90 5410 440 6. Also translated in German: Dimensionen Europa€ischer Wasserpolitik - Themenberichtt. Springer- Verlag, Berlin.

Correia, F.N., Barraqué, B., Zabel, T., Mostert, E. (1999). WATER 21-Towards Sustainable European Water Management: Appraisal of Current Water Policies and Required Action. European Commission, Brussels. Contract no.: ENV4 e CT96 e 0196.

Correia, F.N. (2000). Water resources management in Europe: institutions, issues and dilemmas e a brief presentation of EUROWATER project. In: Canali, et al. (Eds.), Water Resources Management - Brazilian and European Trends and Approaches. International Water Resources Association and Brazilian Water Re- sources Association, Porto Alegre.

Correia, F. N. (2012). The Role of Good Governance as a Basis for Achieving Water Security. High Level Event “The Way Towards Rio+20”, 6th World Water Forum, Marseille, 12 March 2012

Correia, F. N. (2016). Public Water Policies and Governance – Recent (In)volution in Portugal, [In Portuguese: Governança e Políticas Públicas da Água – (In)volução Recente em Portugal], in Serra, P. (Ed.) Public Water Policies, [In Portuguese: Políticas Públicas da Água], Portuguese Water Resources Association, Lisbon, Portugal, ISBN 978-989-8509-16-1

EC (2012). River Basin Management Plans – Report on the Implementation of the Water Framework Directive (2000/60/EC), European Commission, COM(2012) 670 final, Brussels, Belgium

EEA (2014). Public participation: contributing to better water management. Experiences from eight case studies across Europe. EEA Report No. 3/2014, European Environmental Agency, Copenhagen. ISSN 1977-8449

EWP (2009). European Regional Document, 5th World Water Forum, European Water Partnership, Brussels, Belgium

Franks, T. R., Cleaver, F. D. (2007). Water governance and poverty: a framework for analysis. Progress in Development Studies 7 (4), 291-306.

Garcia Quesada (2011). Water and Sanitation Services in Europe – Do Legal Frameworks provide for “Good Governance”. UNESCO, Center for Water Law, Policy and Science, University of Dundee, Dundee.Gupta, J., Akhmouch, A., Cosgrove, W., Hurwitz, Z., Maestu, J., Unver, O., 2013 - Policymakers' reflections on water governance issues. Ecology and Socierty 18 (1), 35.

Gupta, J., Akhmouch, A., Cosgrove, W., Hurwitz, Z., Maestu, J., Unver, O. (2013). Policymakers' reflections on water governance issues. Ecology and Socierty 18 (1), 35.

Gupta, J., Pahl-Wostl, C. (2013). Editorial on global water governance. Special feature on global water governance: challenges and future scope. Ecology and Socierty 18 (4), 54.

Huitema, D., Mostert, E., Egas, W., Moellenkamp, S., Pahl-Wostl, C., Yalcin, R. (2009). Adaptive water governance: assessing the institutional prescriptions of adaptive (co)management from a governance perspective and defining a research agenda. Ecology and Society 14 (1), 26.

Moss, T., Newig, J. (2010). Multi-level water governance and problems of scale: setting the stage for a broader debate. Environmental Management 46 (1), 1-6.

Neto, S., Camkin, J., Fenemor, A., Tan, P.L., Baptista, J.M., Ribeiro, M., Schulze, R.l, Stuart-Hill, S., Spray, C., Rahmah, E. (2017). OECD Principles on Water Governance in practice: An assessment of existing frameworks in Europe, Asia-Pacific, Africa and South America, ORCID Id - 0000-0001-5231-8633.

OECD (2009). Managing Water for All: An OECD Perspective on Pricing and Financing, OECD Publishing. Organization for Economic Cooperation and Development, Paris. ISSN 2224-5073. http://doi: 10.1787/9789264059498-en

OECD (2011). Water Governance in OECD Countries: A Multilevel Approach. Organization for Economic Cooperation and Development, Paris. ISBN: 9789264119277, http://dx.doi.org/10.1787/9789264119284-en

OECD (2014). Water Governance in the Netherlands e Fit for the Future? OECD Studies on Water, OECD Publishing, Organization for Economic Cooperation and Development, Paris.

OECD (2015a). OECD Principles on Water Governance Welcomed by Ministers at the OECD Ministerial Council Meeting on 4 June 2015. Directorate for Public Governance and Territorial Development, Organization for Economic Cooperation and Development, Paris. http://www.oecd.org/gov/regional-policy/OECD- Principles-on-Water-Governance-brochure.pdf.

OECD (2015b). Water and Cities - Ensuring Sustainable Futures. OECD Studies on Water, OECD Publishing, Organization for Economic Cooperation and Development, Paris.

OECD (2015c). Stakeholder Engagement for Inclusive Water Management. OECD Publishing, Organization for Economic Cooperation and Development, Paris.

OECD (2015d). Water Resources Allocation. OECD Publishing, Organization for Economic Cooperation and Development, Paris.

OECD (2015e). The Governance of Water Regulators. OECD Studies on Water, OECD Publishing, Organization for Economic Cooperation and Development, Paris.

OECD (2016). Water Governance in Cities. OECD Publishing, Organization for Economic Cooperation and Development, Paris. ISBN 9789264251090.

Plummer, J., Slaymaker, T. (2007). Rethinking Governance in Water Services. Working Paper 284. Overseas Development Institute, London.

Rogers, P., Hall, A. W. (2003). Effective Water Governance. TEC Background Papers No. 7. Global Water Partnership, Printed by Elanders Novum, Sweden.

Serra, P. (2016). (Ed.) Public Water Policies [In Portuguese: Políticas Públicas da Água], Portuguese Water Resources Association, Lisbon, Portugal, ISBN 978-989-8509-16-1

UNESCO (2015). Water for a Sustainable World. In UN World Water Assessment Programme 2015, UNESCO, Paris.

World Bank (2012). Arriving at a Common Understanding of Governance. http://go.worldbank.org/G2CHLXX0Q0

10. Integration with the other Processes

10.1. Contents

This chapter presents the integration of the European Regional Process with the other processes, namely the thematic, the political, the sustainability focus group, the citizens; and describes the established partnerships.

10.2. Integration with the Thematic Process

The 8th World Water Forum in 2018 takes place in the early phase of the implementation of 2030 Agenda for Sustainable Development (2015-2030), shaped primarily by the milestone events of 2015: the Global Risks Report of the World Economic Forum, the Sendai Disaster Risk Reduction Summit, the 7thWorld Water Forum in Korea, the Addis Ababa Summit on Financing for Development, the 70thSession of the UN General Assembly that adopted the Sustainable Development Goals (SDG's) and the COP 21 Paris Agreement.

Several linkages are particularly relevant for the thematic framework of the Forum, allowing it to bridge, analyise backwards and forwards to other initiatives and events, as well as the expected SDG implementation mechanisms:

The theme of the Forum "Sharing water" call for the identification of common questions regarding water resources that shall lead to the recognition of solutions and good practices that can be shared between governments (countries and regions), academics, civil society, enterprises, sectors and user groups. Such an initiative, and resulting joint efforts, is an important way forward on sharing the benefits of water with all.

In addition, dialogues and actions related to water use and management must focus on long-term sustainability, which comprises environmental, technological, financial and political aspects. A group, the Sustainability Focal Group, has been formed to address sustainability as both a separate and an underlying matter, which should provide guidelines for all the Forum processes and groups, to guarantee that sustainability concepts and principles appear into every theme being discussed during the Forum, and for the event itself, leaving a legacy of sustainable practices for future events.

Those guidelines shall be the link to the Thematic Process and will be present when developing topics, sessions, content, etc.

The Thematic Process will attempt to contribute to the implementation and monitoring of water-related SDG's, particularly the 8 targets of the water goal SDG 6, but also to other relevant water-related goals. The exact nature of this contribution still needs to be discussed and agreed upon. Specific reference to relevant SDG goals and targets were made at the theme level for each of the 6 Themes and 3 Crosscutting Issues described below.

For each of the 16 themes presented at 7th World Water Forum in Korea an Implementation Roadmap (IR) was adopted, each with an international organisation as Champion and a number of Core Group Members. The IR's translate efforts across the global water community into specific sets of action, which are monitored through the on-line Action Monitoring System (AMS). The six main themes and three crosscutting issues presented here are committed to ensure continuity of the Implementation Roadmaps, comprising all of its 16 themes. The 7th World Water Forum also launched the Science & Technology Process, the outcome and follow-up of which will be addressed as part of the cross-cutting issue "Capacity" – see below.

Attempts was made to coordinate across the various Forum processes, in particular between the Thematic and the Regional Processes, as was started at the 7th World Water Forum in Korea. For this linkage to be effective six main themes have been

identified for the Thematic Process, each of which will be addressed by all regions. In addition 3 crosscutting issues have been identified that will be addressed in their own right as themes, while being addressed throughout as crosscutting. Whilst addressing the same overall themes, each region will focus on topics of particular relevance to it.

Linking to SDGs/2030 Agenda and 7th World Water Forum Implementation Roadmaps (IR), the principal themes and topics adopted by the Thematic Process and followed by the European regional process are the following:

CLIMATE – Water security and climate change

(SDG links: SDG 13, SDG 11.5, COP 21-22, Sendai DRR Summit)

- Managing risk and uncertainty for resilience and disaster preparedness – IR 1.3
- Water and adaptation to climate change
- Water and climate change mitigation
- Climate science and water management: the communication between science and decision/policy making

PEOPLE - Water, sanitation and health

(SDG links: Water targets 6.1, 6.2, 6.3, 6.B and SDG's 1 and 3)

- Enough safe water for all – IR 1.1
- Integrated sanitation for all – IR 1.2
- Water and public health

DEVELOPMENT - Water for sustainable development

(SDG links: Water target 6.4 and SDG's 2, 7, 8, 11 and 12)

- Water for Food - IR 2.1
- Water for Energy - IR 2.2
- Inclusive and sustainable growth, water stewardship and industry – IR 3.1
- Efficient use of surface water and groundwater - urban and rural
- Infrastructure for sustainable water resource management and services – IR 1.4

URBAN – Integrated urban water and waste management

(SDG links: Water target 6.3 and SDG's 11 and 14, HABITAT 3)

- Water and cities – IR 2.3
- The circular economy – reduce, reuse, recycle
- Treatment and reuse technologies

ECOSYSTEMS - Water quality, ecosystem livelihoods and biodiversity

(SDG links: Water targets 6.3, 6.6 and SDG 15)

- Managing and restoring ecosystems for water services and biodiversity – IR 3.2
- Natural and engineered hydrological systems
- Water and land use
- Ensuring water quality from ridge to reef – IR 3.3

FINANCE – Financing for water security

(SDG link: SDG's 6 and 17)

- Economics and financing for innovative investments – IR 4.1
- Financing implementation of water-related Sustainable Development Goals and adaptation to climate change
- Finance for sustainable development – supporting water-friendly business

The crosscutting issues adopted by the Thematic Process and followed by the European regional process are the following:

SHARING – Sustainability through stakeholder involvement

(SDG link: Water target 6.b and SDG's 3, 15 and 17)

- Sharing solutions and good practices
- Involving all: public, private, civil society – women and men – young and old - in bottom up and top down approaches
- Water cultural diversity, justice and equity – IR 4.4

CAPACITY - Education, capacity building and technology exchange

(SDG link: Water target 6.a and SDG's 4 and 17)

- Enhancing education and capacity building – IR 4.5
- Science and technology – 7th World Water Forum S&T Process
- ICT and monitoring
- International cooperation

GOVERNANCE - Water governance for the 2030 Development Agenda

(SDG link: Water target 6.5, SDG 17)

- SMART implementation of IWRM - IR 3.4
- Cooperation for reducing conflict and improving transboundary water management – IR 4.3
- Effective governance: Enhanced political decisions, stakeholder participation and technical information – IR 4.2

The European Regional Process promoted the integration with the Thematic Process following this matrix regarding both the six themes and three crosscutting issues, and a final coordination meeting was held in February 2018 in Lisbon. Chapters 4 to 9 assess in detail six from the nine Themes of the World Water Forum.

10.3. Integration with the Political Process

The Political Process Commission provides guidance on the political program and connection among official authorities at a global level. In this way, it ensures relationships with the various bodies representing elected officials and with leading elected individuals engaged in water.

The main objective of the Political Process is to encourage the engagement of local/regional political authorities, such as parliamentarians, mayors and governors, to participate in meetings focused on water, since it understands that solutions in water management can only be implemented via political decisions and leadership.

The Commission is responsible for preparing the content and process for the 8th World Water Forum political program, in such a way that it offers a creative way for Ministers, Parliamentarians and Local Authorities to interact dynamically with one another and with other stakeholders involved in the Forum.

Specific events are planned for each level of the Political Process in the run-up to the Forum and are closely linked to the Thematic and Regional Processes and the Sustainability Focus Group.

The European Regional Process promoted the integration with the Political Process sending its main conclusions and recommendations to the Coordinators of this last process before the 8th World Water Forum.

10.4. Integration with the Sustainability Focus Group

The Sustainability Focus Group is crosscutting to all other processes of the 8th World Water Forum. The Group seeks to ensure that sustainability issues are incorporated into the processes of other Forum commissions, mapping the opportunities to develop an even more sustainable event.

This innovation on the agenda of the main event aims to attract contributions and suggestions on water-related themes and their social, economic and environmental importance, from the standpoints of different stakeholders and institutional sectors, so that the actions proposed by this group can contribute in an effective way to develop more sustainable water management models and practices.

The Group will promote debate on the various aspects of sustainable use of water resources, in the light of existing multilateral commitments, and examination of current challenges, especially in countries with fragile sectoral institutions or that suffer significant shortfall, including difficulties of access to drinking water.

The European Regional Process promoted the integration with the Sustainability Focus Group sending its main conclusions and recommendations to the Coordinators of this Group before the 8th World Water Forum.

10.5. Integration with the Citizens Process

The Citizen's Forum is a process that aims at encouraging creative and effective participation of civil society, organised or otherwise, by which is meant NGOs, local communities, farmers, business people and indigenous movements, gender and youth, among others. Thus, it is a way of involving citizens in the discussions who generally cannot be informed about water issues.

The Citizen's Forum purpose is to raise public awareness and attention to issues related to water and to provide innovative solutions to the problems that citizens face in their personal, social and professional lives, bearing in mind the concept of "Sharing Water".

The organisation of the Citizen's Forum, therefore, is flexible and is receptive to creative proposals to reach citizens in different ways. The proposed activities have educational value, generating ample enthusiasm for these civic issues.

This can also take the form of an open platform that allows for the exchange of new partnerships, initiatives, cooperation and innovation, encouraging social and democratic responsibility for water issues.

The work of the Citizen's Forum Commission shall be comprised of two distinct and autonomous work areas: actions in Brazil and Latin America; and actions in the other countries.

The European Regional Process promoted the integration with the Citizens Process sending its main conclusions and recommendation to the Coordinators of this Process before the 8th World Water Forum.

10.6. Partnerships

About 254 organisations of the 52 European countries have been invited to be involved in the European Regional process, which are listed in annex 1. A significant part of them had some form of participation, according the Acknowledgements. They cover water resources administration, water services administration, water industry, European CSOs/ NGOs on water, European regional water networks and international organisations.

Outside Europe, the European Regional process identified common topics to discuss with other regions, Africa, Americas, Arab, Mediterranean, and Asia-Pacific.

11. Sessions organised by Europe

11.1. Contents

This chapter details the sessions that have been organised by the European Regional Process and included in the World Water Forum program.

11.2. Water and climate change in Europe: the tip of the iceberg?

The European Regional Process proposed the regional session R-EUR-Cli-32 with the title “Water and climate change: the tip of the iceberg?”, coordinated by Rodrigo Oliveira from the Instituto Superior Técnico – Universidade de Lisboa, Portugal.

Climate change impacts manifest first and more strongly through water. Changes in climate mean changes in the water cycle, in rainfall and runoff distribution patterns, in river water flows, and in the severity and magnitude of extreme hydrological events, such as drought, flooding, storms, ice melting, etc. The expected changes affect the water availability for human activities and increase exposure to more frequent water related critical events. Its cross-sector nature make water the clear centre of adaptation – which requires articulated policy, planning and action, involving governments at all levels, sectors and society. Europe faces multiple challenges in adaptation to climate change. In this session the topics of water and adaptation to climate change and managing risk and uncertainty for resilience and disaster preparedness, besides climate science and water management priority: the communication between science and decision/policy making and water and climate change mitigation in Europe will be discussed. A comprehensive and multidisciplinary perspective of these topics will be provided, including public policy, technology, economic, environmental, and social components. The diagnosis reported in the Europe report will be discussed. Issues such as relevance, perception, level of engagement and performance and examples of good case studies will be addressed. The outcomes from the session will be key lessons, messages and recommendations to enrich the report and to disseminate around the world.

The key questions for the session are:

- How do you to manage uncertainty and risk when designing an adaptation strategy?
- How do you build an adaptation strategy that bridges policy sectors, government levels and national boundaries (within transboundary basins and aquifers)?
- How do you ensure a good communication between science and policy and decision making?

The main conclusions of this session will be included in the final version of this European Report on Water after the 8th World Water Forum.

11.3. Water services in Europe: long-term sustainability at what price?

The European Regional Process proposed the regional session R-EUR-Peo-33 with the title “Water services in Europe: long-term sustainability at what price?”, coordinated by Jaime Melo Baptista from the Lisbon International Centre for Water (LIS-Water), Portugal.

Public drinking water supply and wastewater services are essential to the well-being of citizens, public health and economic activities. Governments shall be able to provide universal access of citizens, with suitable quality, at socially acceptable price and with an adequate level of risk. The stages of development of water services in European countries are quite different. Three different stages coexist, the quantity stage, in which the main task is to satisfy the basic quantitative needs of the population, the quality stage, where the water quality objectives are jointed to the previous stage, and the excellence

stage, which seeks to add the strand of good asset management and financial sustainability. One big challenge is how to ensure long-term sustainability of those services and at what price in all Europe. A multidisciplinary assessment of this challenge will be provided, including public policy, economic, technical, legal, environmental, and social components.

The key questions for the session are:

- What is the situation in your country(ies) of the public drinking water supply and wastewater services regarding the universal access of citizens, the quality of service, and the price?
- What is the degree of asset management practice and financial sustainability in medium and long term in your country(ies)?
- What you propose to increases the degree of asset management practice and financial sustainability in medium and long term in your country(ies)?

The main conclusions of this session will be included in the final version of this European Report on Water after the 8th World Water Forum.

11.4. European Cities: why wastewater and energy?

The European Regional Process proposed the regional session R-EUR-Urb-35 with the title “Cities: why wastewater and energy?” coordinated by Corinne Trommsdorff from the International Water Association.

Cities require the adoption of sustainable and integrated processes for urban waste and water management. Despite the increasing investments in promoting its rational use, the use of water in urban environments generates significant and increasing volumes of effluents, whose treatment and final destination is of paramount importance. In this scenario, methodologies to reduce water usage, reuse water in cities, and recycle waste are gaining importance to improve life conditions in cities. In this session the topics of circular economy for water in cities and associated technologies, business models, and risk analysis, will be discussed. A comprehensive and multidisciplinary perspective of these topics will be provided, namely including public policy, technology, economic, environmental, and social components. The diagnosis reported in the Europe report will be discussed and the outcomes from the session will be key messages to enrich the European report disseminated around the world.

The key questions for the session are:

- Why are we not taking more rapid action towards “regenerative” urban water services in Europe? How can regulations help and what is planned for Europe?
- Why are we not taking more rapid action towards “regenerative” urban water services in Europe? How can technology and innovation support this transition?
- Why are we not taking more rapid action towards “regenerative” urban water services in Europe? How can political will be strengthened in European cities to support this transition?

The main conclusions of this session will be included in the final version of this European Report on Water after the 8th World Water Forum.

11.5. Ecosystems in Europe: how to bridge systems and services?

The European Regional Process proposed the regional session R-EUR-Eco-36 with the title “Ecosystems: how to bridge systems and services?”, coordinated by Peter Gammeltoft from the International Commission for the Protection of the Danube River.

Natural ecosystems are strongly dependent of the presence of adequate amounts of water of proper quality. The ecological services provided by the natural dynamics of

aquatic systems promote the physical, biological and chemistry processes that generate, sustain and guarantee most forms of life. Also, human beings depend directly on these water ecological services. Water policy and management need to ensure the provision of water related environmental services. Managing and restoring ecosystems for water services and biodiversity, water and land use, ensuring water quality from ridge to reef, and natural and engineered hydrological systems in Europe will be discussed. A comprehensive perspective will be provided, including public policy, technology, economic, environmental, and social components. The diagnosis reported in the Europe report will be discussed in terms of relevance, perception, level of engagement and performance and good case study examples. The outcomes from the session will be key lessons, messages and recommendations.

The key question for the session is:

- Do we need to sacrifice economic gains in certain sectors in order to preserve and restore ecosystems and the services they provide?

The main conclusions of this session will be included in the final version of this European Report on Water after the 8th World Water Forum.

11.6. Water services financing in Europe: how to bank it and blend it?

The European Regional Process proposed the regional session R-EUR-Fin-37 with the title “Water financing in Europe: How to bank it and blend it?”, coordinated by José Veiga Frade from Portugal.

The provision of water services and water security in Europe require significant investment, to enhance efficiency of service delivery, renew assets before they decay, comply with more stringent regulations or deal with emerging issues, such as a changing climate or contaminants of emerging concern.

While some public finance is available in some countries, investment is hampered by the capital-intensive nature of water services and infrastructures, insufficient cost-recovery levels and the inability to attract other sources of finance at scale. As a consequence, issues affecting the sector a decade ago remain despite efforts made on compliance with the European Union directives.

It is key to address the current issues and find innovative ways and new sources of funds that can meet the new challenges. In Europe, as in other parts of the world, there are hopes that blended finance can leverage domestic commercial finance.

These topics will be discussed in the session with the presentation of case studies, opinions from experts and audience participation to help finding ways to catalyse more, new, innovative financial resources.

The key questions for the session are:

- Why the issues conditioning the availability and access to financial resources highlighted a decade ago still remain? What is the progress made? How to address and minimize them? How to reach full cost recovery?
- What are the main borrowing constraints? How could the borrowing capacity of utilities be strengthened and facilitate access to funds with long maturities and low interest rates?
- Could the European Union grants leverage better other sources – repayable loans, bonds, private finance, and risks? What are the innovative ways to boost funds in Europe – private & blended finance, revolving funds?
- How to finance adaptation, WRM, flood and drought control, and innovative technology?
- Assessment of investment and funding needs – drivers, relevance, available data, gap

The main conclusions of this session will be included in the final version of this European Report on Water after the 8th World Water Forum.

11.7. Water governance in Europe: how to add value, block by block?

The European Regional Process proposed the regional session R-EUR-Gov-38 with the title “Water governance in Europe: How to add value, block by block?”, coordinated by Francisco Nunes Correia from the Instituto Superior Técnico – Universidade de Lisboa, Portugal.

Europe is a particularly interesting region to compare and discuss different systems for water governance. From a water abundant continental country, like Sweden, to a water scarce island country, like Malta, differences are immense. However, all are bound by a Framework Directive that is quite specific in terms of water governance. In any case, the implementation of an appropriate development model requires participation of different actors, political push, capacity building and, above all, effective and efficient water governance, largely based on the trust and engagement of all stakeholders. In this session, emphasis will be put on effective and efficient governance, including enhanced political decisions and stakeholder participation. A comprehensive and multidisciplinary perspective will be provided, including public policy, management instruments, economic, environmental and social components, and governance reforms to improve these dimensions. The content of the European report will be discussed, especially in what concerns water governance and related issues.

The key questions for the session are:

- How do you perceive compliance with the OECD Principles for Water Governance in your own country and at the European level?
- How do you ensure multi-level governance, engage stakeholders and assess the results of policies in the European context?
- What do you suggest for designing and implementing IWRM-wise policies in this region?
- How do you foster transboundary co-operation in water management in Europe?
- Which steps and measures should be adopted by the European Union to improve water governance in Europe?

The main conclusions of this session will be included in the final version of this European Report on Water after the 8th World Water Forum.

11.8. AcquAwareness

The European Regional Process proposed the special regional session SS-J-CF+RP 02 with the title “AcquAwareness”, coordinated by Lesha Witmer from the Women for Water Partnership.

In Europe and beyond turning on the kitchen tap or running a bath seems an effortless decision. However, in Europe people face water shortages, lack of sanitation, and floods. In the Pan-European region 62 million people lack access to adequate sanitation facilities: functioning toilets and safe means to dispose of human faeces.

Are we aware of the actual state of affairs of access to and use of water for all kind of purposes, do we think our infrastructure is sustainable, future proof?

A questionnaire amongst European organisations and young people in Europe and Africa, revealed low awareness of the situation of water and its impacts. Believing there is always sufficient water for multiple uses, not aware of the changing situation, leading to little long term investments coping with the O&M of water infrastructure and meeting quality standards.

Examples are shared during the interactive session aimed at collecting ideas to become AquAware.

The main conclusions of this session will be included in the final version of this European Report on Water after the 8th World Water Forum.

11.9. How regulatory authorities must promote Human Rights?

The European Regional Process proposed the special regional session IR-Peo-72 with the title “How regulatory South America and European authorities could promote the Human Rights to water and sanitation?”, coordinated by Jaime Melo Baptista from the Lisbon International Centre for Water (LIS-Water), Portugal. This session includes Europe and South America.

UN resolution recognized the right to safe and clean drinking water and sanitation as a human right. Those services should be physically accessible, available in proportion to a number of users, with quality, affordable, and acceptable according to cultural demands. As all human rights, it must be guaranteed: no-discriminatory access, participation of citizens in the decision-making processes, and accountability mechanisms. Last September 2017, a Report submitted by the Special Rapporteur on the rights to water and sanitation focuses on the role of regulatory frameworks. It describes the obligations and responsibilities, the regulation in water and sanitation services, and recommends the responsibilities of Governments and regulatory actors. It concludes that the regulatory frameworks are essential for the implementation of the Human Rights to water and sanitation. As public bodies, regulators are bound by States’ international human rights obligations.

The key questions for the session are:

- How do you comment the Report A/HRC/36/45 submitted by the Special Rapporteur last September on the rights to water and sanitation to the Human Rights Council, focused on the role of regulatory frameworks?
- How do you comment the possibility or the legal impossibility of disconnecting the water services due to the lack of payment, and alternative solutions?
- How regulatory authorities should monitor the implementation of human rights to water and sanitation?

The main conclusions of this session will be included in the final version of this European Report on Water after the 8th World Water Forum.

11.10. Water and migration: how to face the challenge?

The European Regional Process proposed the interregional session IR-Peo-34 with the title “Water and migrations, how to face the challenge?”, coordinated by Lesha Witmer from Women for water.

The world is witnessing some of the largest refugee flows since the Second World War. Meanwhile, water crises are highlighted as one of the most pressing global challenges. In this context, migration and refugee flows are increasingly explained in terms of water scarcity – perpetuated by climate change. A comprehensive and multidisciplinary perspective of these topics will be provided, namely including public policy, technology, economic, environmental, and social components. The diagnosis reported in the Europe report will be discussed, namely in terms of relevance, perception, level of engagement and performance and examples of good case studies. The outcomes from the session will be key lessons, messages and recommendations to enrich the European report and to disseminate around the world.

The main conclusions of this session will be included in the final version of this European Report on Water after the 8th World Water Forum.

11.11. Which public policies for water services to comply with the SDG and Human Rights?

The European Regional Process proposed the interregional session SS-RP-14 with the title “Which public policies for water services to comply with the SDG and Human Rights?”, coordinated by Jaime Melo Baptista from the Lisbon International Centre for Water (LIS-Water), Portugal. This session includes Europe, South America, Africa and Asia.

With the new United Nations Sustainable Development Goals, countries are now sharing a common concern with the water challenges. SDG 6 refers to drinking water and sanitation, water resources and ecosystems. But the other SDG always have a greater or lesser articulation with water. On the other hand, a few years before the United Nations has declared access to water and sanitation as Human Rights.

How can countries ensure the compliance with SDG 6, Human Rights and other international guidelines? The answer is certainly good public policy on water, which requires a holistic and multidisciplinary approach to several components that are critical to the success of this policy and to the sustainability of investments. A strong commitment of policy makers, a sound institutional organization, adequate tools and the necessary human and financial resources are essential.

The key questions for the session are:

- An adequate public policy, with a holistic and multidisciplinary approach, strong political commitment, institutional organization, adequate instruments and human and financial resources, are needed for countries to achieve the Sustainable Development Goals and to accomplish the Human Rights to water and sanitation?
- What is the situation of water services in your country in relation to the Sustainable Development Objective 6 and to the Human Rights of the United Nations to access water and sanitation?
- Which public policy on water services is your country adopting to faster fulfilment of the United Nations Sustainable Development Objective 6 and Human Rights to access water and sanitation?

The main conclusions of this session will be included in the final version of this European Report on Water after the 8th World Water Forum.

12. Key messages

12.1. Contents

This last chapter details the European key messages resulting from the work developed in the European Regional Process of the 8th World Water Forum, where an extensive list of 254 focal points in the 52 European countries have been invited to participate, covering representatives from public administration, academia, water utilities, NGO and European based-organizations.

These European key messages must be transmitted to the decision makers, namely at ministerial, parliamentarian, mayors, judges and prosecutors levels. They must be incorporated by the water professionals to influence their day-to-day activity. They must be a challenge for the private sector to promote entrepreneurship and the development of new products and services. They must be spread to the citizens and the society at large as they are the final beneficiaries of those recommendations.

12.2. Relevance of the themes and topics in Europe

The 8th World Water Forum selected 9 Themes and 32 Topics, linking them with the Sustainable Development Goals/2030 Agenda and the Implementation Roadmaps.

The Theme Climate (Water security and climate change) was divided in four Topics: managing risk and uncertainty for resilience and disaster preparedness; water and adaptation to climate change; water and climate change mitigation; and climate science and water management – the communication between science and decision/policy making.

The Theme People (Water, sanitation and health) was divided in three Topics: enough safe water for all; integrated sanitation for all; and water and public health.

The Theme Development (Water for sustainable development) was divided in five Topics: water for food; water for energy; inclusive and sustainable growth, water stewardship and industry; efficient use of surface water and groundwater – urban and rural; and infrastructure for sustainable water resource management and services.

The Theme Urban (Integrated urban water and waste management) was divided in three Topics: water and cities; the circular economy – reduce, reuse, and recycle; and treatment and reuse technologies

The Theme Ecosystems (Water quality, ecosystem livelihoods and biodiversity) was divided in four Topics: managing and restoring ecosystems for water services and biodiversity; natural and engineered hydrological systems; water and land use; and ensuring water quality from ridge to reef.

The Theme Financing (Financing for water security) was divided in three Topics: economics and financing for innovative investments; financing implementation of water-related sustainable development goals and adaptation to climate change; and finance for sustainable development – supporting water-friendly business.

The Theme Sharing (Sustainability through stakeholder involvement) was divided in three Topics: sharing solutions and good practices; involving all: public, private, civil society – women and men – young and old – in bottom up and top down approaches; and water, cultural diversity, justice and equity.

The Theme Capacity (Education, capacity building and technology exchange) was divided in four Topics: enhancing education and capacity building; science and technology and decision/ policy making – 7th World Water Forum S&T Process; ICT and monitoring; and International cooperation.

The Theme Governance (Water governance for the 2030 Development Agenda) was divided in three Topics: SMART implementation of integrated water resources management; cooperation for reducing conflict and improving transboundary water management; and effective governance – Enhanced political decisions, stakeholder participation and technical information.

The prioritization of topics in terms of relevance in Europe, relevance in country/region, public perception, performance, level of engagement and existence of case studies, both at European level and sub-regional level has led to the following key messages:

- Almost every topic is considered very relevant both for Europe and for countries; however, the level of engagement and, particularly, public perception are still low.
- In general, topics are considered more relevant for Europe than for countries themselves. This can represent a perception that water problems are more global than national.
- The circular economy is the most relevant topic in Europe. Enough safe water for all and integrated sanitation for all are the least relevant topics. However, Europe presents significant asymmetries in different sub-regions, which were detailed in chapter 3.
- Water and public health is the topic with the highest public perception. On the opposite, the communication between science and decision/policy making is the topic with the least public perception.
- Enough safe water for all and water and public health are the topics with the best performance and the highest level of engagement. On the contrary, finance for sustainable development is the topic with the worst current performance and lower of engagement.
- Relevant cases studies have been proposed for all topics. Financing issues are those with the fewest case studies.

The results of the **analysis by theme** have shown that:

- In the theme Climate, water and adaptation to climate change is at the top of the concerns. Managing risk and uncertainty for resilience and disaster preparedness is also at the top of the countries / regions' priorities. Water and adaptation to climate change is also the topic with greater public perception. Managing risk and uncertainty for resilience and disaster preparedness presents better performance and higher level of engagement. On the other hand, the communication between science and decision/policy making is where there is still a greater way to go.
- In the theme People, water and public health issues are the highest priority and those who gather greater public perception. Enough safe water for all and water and public health are the topics with the best performance and the highest level of engagement. By contrast, the major challenges respect to integrated sanitation for all.
- Regarding the theme Development, the issues of efficient use of surface water and groundwater are the highest priority, with greater public perception and level of engagement. Infrastructure for sustainable water resource management and services is the top performing topic. These two topics are also the ones that have the highest level of engagement. On the contrary, infrastructure for sustainable water resource management and services present the worst relevance and topic inclusive and sustainable growth, water stewardship and industry the worst performance and levels of public perception and engagement.
- In the Urban theme, circular economy is the major concern and the focus of public perception. Topics water and cities and treatment and reuse technologies are the best performers. Water and cities is the topic with the highest level of engagement. Treatment and reuse technologies issues present less public perception and level of engagement. Circular economy is the topic with the lowest performance.

- In the theme Ecosystems, topic managing and restoring ecosystems for water services and biodiversity stands out as the most relevant, with greater public perception, better performance and level of engagement. On the other hand, natural and engineered hydrological systems is the least relevant topic, while water and land use is the one that presents less public perception, worse performance and lower level of engagement.
- With regard to the Financing theme, economics and financing for innovative investments is the most relevant, with greater public perception and level of engagement. Financing implementation of water-related Sustainable Development Goals and adaptation to climate change is the one that performs best. On the contrary, finance for sustainable development issues present the greatest challenges in terms of relevance, public perception current performance and level of engagement.

12.3. Key messages on water and climate

The key messages from the assessment presented in the chapter on water and climate in Europe are the following:

- Climate change affects Europe in many ways, although the nature and dimension of impacts varying throughout Europe. All regions are affected, thus making climate change one of the continent's most important challenge.
- If not properly addressed, climate change impacts to health, ecosystems and biodiversity, property and economic activity are likely to become more severe in the coming decades and could become very costly. Most OECD countries have serious concerns over the impacts of climate change and report that changes are already occurring.
- Water plays a vital role on how society feels climate change impacts and this fact is recognized by European countries and individual stakeholders. The areas of highest concern are extreme events and water shortage.
- Europe is at the forefront of greenhouse gases emission reduction efforts, but mitigation can only lead to a meaningful reduction of climate change risk if concerted efforts, joining all nations in the world, significantly reduce global greenhouse gases emissions.
- Adaptation is inevitable. It seeks to reduce the vulnerability to climate change by enhancing the society preparedness and capacity to respond to the unavoidable impacts. Since 2013, the European Union has a strategy on adaptation to climate change, as well as most European countries.
- Climate change adaptation is a decision-making process under significant uncertainty. A risk-based approach that explicitly identifies the range of possible future scenarios and considers the available options to manage the associated risks is a useful tool.
- An adaptation strategy on water resources needs to cover a number of policy areas, such as land planning, agriculture, energy, infrastructures, biodiversity and health, among others. The adaptation strategy also needs to distribute the planned activities to different levels of government, from a local municipality to regional or national institutions or even supra-national entities, ensuring effective action by selecting the most appropriate government level to manage each issue.
- An effective water management practice, supported by a sound water governance arrangement, is a key success factor to reduce the vulnerability to climate change. Mainstreaming adaptation efforts into the existing governance frameworks and management tools following the principles of integrated water resources management can support adaptation efforts.

- The challenges of climate adaptation are amplified within transboundary basins and aquifers as the coordination efforts among policy sectors and government levels needs to be achieved also across the border, which requires a strong cooperation between riparian countries and the involvement of a larger number of stakeholders.
- To date, most adaptation strategies focus on the development of information-based instruments directed to knowing the risks, raising awareness and disseminating information. The emphasis on information-based instruments within the national adaptation strategies puts in evidence the difficulties in designing and implementing other types of actions that require an active attitude to address specific threats.
- The key challenges to adaptation are: how to develop effective integrated policies to promote change; how to overcome uncertainties and start effective adaptation action; how to strengthen the links between national, regional and local planning and actions; how to adapt the legal and regulatory framework; and how to ensure funding and what financial mechanisms are needed.

12.4. Key messages on water and people

The key messages from the assessment presented in the chapter on water and people in Europe are the following:

- Although many people take water and sanitation for granted in Europe, there are still many actions needed to ensure water and safe sanitation for all by 2030 and to fulfil the human right to water.
- The aging infrastructures of Europe, some more than one century old, may even deteriorate more because the investments are far from sufficient for operation, maintenance and rehabilitation, let alone to cope with demographic changes.
- The impacts of climate change are becoming more apparent across Europe. Large areas of continental European Union suffered severe drought in several years, due to the combination of rain shortages and very high temperatures. In recent years, on average 17% of Europe's territory and at least 11% of Europe's population have been affected by water scarcity. If temperatures keep rising, the water situation in Europe is expected to deteriorate further. Due to climate change, water is no longer a problem for a few regions, but became a concern for all 500 million Europeans.
- Therefore, it is recommendable to pay attention to: rural dwellers, disadvantaged people and people with low incomes as well as migrants; the role women can play as actors, experts and partners in ensuring water and safe sanitation for all; investments not only to big scale systems but also to small scale systems, an important component of supplying water in Europe; improving water, sanitation and hygiene practices in schools all over Europe, including menstrual hygiene management and attention for healthy behaviour; assessment and data collection to get up-to-date information about the situation, disaggregated in terms of women, men, and age.

12.5. Key messages on water and urban

The key messages from the assessment presented in the chapter on water and urban in Europe are the following:

- For the development of water-wise communities in Europe, it is essential to: create a sense of urgency, bottom-up approaches (community engagement) and strong political leadership on sustainable water management; improve soft skills to achieve better collaboration between institutions, departments; improve intra

institutional cooperation for addressing water challenges beyond improving soft skills: it also requires long-term funding security, stakeholder engagement, common goals and strategy formulation, and clear benefits for the involved stakeholders and institutions; create adaptive regulations that encourage a water cycle approach, closing the loop on resources, and water sensitive urban design; identify cost-sharing for co-benefiters of multi-purpose infrastructures (where water is one component) at the basin, city or utility level; define the problem to be solved using a holistic approach rather than sub-systems approach, i.e., when governments assign missions to an institution, or define a new investment project, there is an opportunity to apply a more integrated approach, which will then bring up new ways for solving the individual problems; and accelerate these processes by creating alliances of cities, which are urgently needed as the time window to address the challenges of water, waste and climate change in cities is rapidly closing.

- In order for cities to take action, establishing a baseline is a key step. The baseline assessment provides the diagnosis and can lead to clear steps for improvement. Currently, there are no standardized assessments of European cities and the only attempt until now is the publication of the Urban Water Atlas for Europe, which covers about 40 cities, mainly in Western Europe. Promoting the importance of assessment frameworks is essential, while at the same time continuously improving these frameworks, so that they best guide cities to identify progression pathways to water-wise urban development. The assessment of the challenges in cities and the options for improvement should be shared actively at regional or European level. The creation of city-to-city learning or learning alliances of cities will greatly benefit the transition to water-wise cities (European Commission 2017). Probably, the biggest barrier in solving the diverse water challenges in Europe is a lack of sufficient governance capacity.
- Principles for water-wise governance of Smart Cities can be summarized by seven C's: citizen-centred – create adaptive, healthy and liveable cities for people; children and grandchildren first – focus on anticipatory long-term strategies; collaboration – involve stakeholders right from the start; comprehensive and coherent planning – integrate water and other sectorial agendas; co-benefits or win-wins must be explored; cost-effective and cost-efficient solutions; and collaborative learning: enhance city-to-city learning.

12.6. Key messages on water and ecosystems

The key messages from the assessment presented in the chapter on water and ecosystems in Europe are the following:

- Access to good quality water resources is indispensable for sustaining economic prosperity and jobs in the region. But water is also needed for the healthy functioning of ecosystems and the provisioning of ecosystem services. However, man-made changes to the structure and functioning of European water bodies have undermined their resilience and the provision of several important water-related ecosystem services. Under these circumstances, and if no action is taken, impacts of pollution, water abstraction, and changes in land-use and climate risk threaten availability of water resources, and thus public health, welfare and jobs.
- In spite of very clear legal and policy frameworks for water, flood risk management, nature protection and biodiversity, implementation is lagging behind and needs to be reinforced. There is a need for increased integration into other related policy areas, such as agriculture, land-use and energy, which in some cases are pursuing different policy objectives and where legal and implementation frameworks need to be better aligned with the Sustainable Development Goals and policy objectives for water and nature protection. There is also a need for improved arrangements

to facilitate the mobilisation of the significant financial resources needed especially for innovation, establishment of green/blue infrastructure and re-establishing ecosystem connectivity.

- If these issues are not fully addressed, the United Nations' Sustainable Development Goals, and in particular the target to protect and restore water-related ecosystems by 2020, will be difficult to attain in the European Region. Failure to deliver on that target will inevitably have knock-on effects on the provision of ecosystem services and may create difficulties in attaining other Sustainable Development Goals than that related to water.
- In order to attain the Sustainable Development Goals and develop a sustainable, circular and climate-resilient economy and hydrological systems, authorities and stakeholders in the European region need to reinforce cooperation across jurisdictions, including transboundary cooperation.

European stakeholders need to step up efforts to control pollution by:

- Filling the gaps in efforts to treat sewage and industrial wastewater discharges, implementing more effective technologies for removing hazardous pollutants from discharges and ensuring that the regions of Eastern and South-East Europe and Central Asia that are lagging behind catch up.
- Stepping up efforts to control diffuse agricultural pollution and to use agricultural policies that guarantee that mainstream agriculture and livestock farming do not pollute or impair ecosystem services.
- Intensifying the preventive regulation of hazardous chemicals in products, tackling the issue of plastics and micro pollutants, including pharmaceuticals, and phasing out inputs of endocrine disrupting substances.

European stakeholders need to assure the balance between sustainability of water consumption and water availability by:

- Accelerating improvements in water efficiency, especially in agriculture.
- Strengthening management of water demand, e.g. through more flexible arrangements for accessing water resources and resource conservation by preventing over-abstraction from groundwater bodies.
- Implementing green, nature-based water retention land-use solutions to increase availability and stabilise water levels and flows.
- Promoting and increasing safe re-use of water as part of the circular economy in ways that guarantee safety of the food chain and healthy ecosystems.
- Replenishing depleted groundwater bodies by re-injection of treated wastewater free from hazardous chemicals.

European stakeholders need to implement nature-based solutions such as green/blue infrastructure and natural water retention measures to recuperate and guarantee future provision of water related ecosystem services by:

- Reactivating flood plains and reconnecting wetlands to water bodies to provide flood protection, flow regulation and to re-establish diverse ecosystems, re-meander channelized rivers, and re-establish riverbed habitats.
- Restoring river connectivity to allow species migration and to maintain sustainable river hydrology and sediment transport by removing barriers or regulating their performance.
- Implementing policies to ensure sustainable green and liveable cities, integrated into a circular economy.

- Reinforcing governance support for green/blue infrastructure, especially mobilisation of stakeholders and finance for investment and innovation.

12.7. Key messages on water and financing

The key messages from the assessment presented in the chapter on water and finance in Europe are the following:

- There is a need to improve the application of the cost-recovery principle defined in the article 9 of the European Union Water Framework Directive, making it universal in the European Union countries, in the short term, and progressively in the enlargement countries and other European countries, with the concession of grants for the latter. This objective would enhance the financing of infrastructure contributing to the SDG 6.
- It is important to focus investment on efficiency gains to attract financing at lower costs. For this, knowledge and management of assets should be improved, and conditions, e.g. technical assistance or grant support, should be created to accelerate the availability of expertise and management tools.
- There is a need to develop the potential for more repayable financing to complement the public funding and reduce the existing gap, namely through the use of grants to leverage it, blending/pooling financial resources and risks, coupled with available guarantees.
- Innovation promotion is essential, especially when it can minimise investment needs, or support innovative business models that can scale to make innovative solutions competitive, reflecting the full cost of supplying water, sanitation and flood protection services in pricing mechanisms;
- Promoters and lenders should develop project life cycle funding approaches to help addressing the current asset renewal backlog and the need to raise progressively the tariffs for that purpose;
- European policy-makers should support and encourage the current trend towards the use of European Structural Investment Funds for the improvement of the quality and management of water resources by dedicating them a higher portion of the funds in detriment of investment on infrastructure generating revenues; it is important to use European Structural Investment Funds wisely to attract and leverage other sources of financing, including domestic commercial finance;
- Investment and financing statistics of the European water sector should be made available through a database and the assessment of future needs by the national and European Union entities should be continuous, to estimate future financial requirements and to monitor progress. The creation of national strategy plans should be encouraged and also the use monitoring tools.

12.8. Key messages on water and governance

The key messages from the assessment presented and discussed in the chapter of water and governance are the following:

- Infrastructure and technology is not enough to guarantee an adequate management of water resources and to pursue effective water policies. Good governance is a key element for the success in achieving these goals.
- Europe has a rich and diversified experience in this area, especially because of the diversity of conditions, both in terms of water availability and water needs.
- On the top of all those economic and physical differences, there are also quite distinct cultures and traditions deeply embedded in the legal and institutional

systems of the various European societies. Many countries in Southern Europe are direct heirs of the Roman law, often mixed with Moorish influence, in which “public property” of water is essential. In many Northern European countries, the Celtic tradition prevails with a deeply rooted concept of “common property”. As a result of the above-mentioned circumstances, it comes as no surprise that Europe can be seen as some sort of “laboratory” in which different systems coexist side by side. There is much to be learned by comparing those governance systems, understanding how they evolved in time, what are the strong and the weak points, and what makes them fit for each society.

- In the European Union, the Water Framework Directive has played a very important role in relation to water governance. This is a legal document with obligatory compliance in the 28 Member States of the European Union, but with an impact that goes much beyond, because it establishes a standard and provides inspiration for many other countries in Europe and in the world.
- That Directive establishes the ultimate purpose of achieving a good ecological quality in all water bodies of the European Union, while recognizing that several measures in the area of governance need to be adopted to achieve this goal. This is addressed, however, in a way that assumes that there are enormous differences in the institutional set-up of the various European Union Member States and that a reasonable degree of freedom should be left to the discretion of those Member States in shaping their systems of governance, provided that they reach the ultimate goals and comply with some key provisions established by the Directive.
- Some of those key provisions of the Water Framework Directive having significant governance implications are the need for assigning a competent authority to each River Basin District, the obligation of preparing River Basin Management Plans and Programs of Measures. Also, the need for coordinating those plans and programs of measures at the scale of the entire river basin even when it is contained in more than one Member State, or even when it includes countries beyond the European Union territory, has important governance consequences. Another relevant dimension in terms of governance is the obligation of engaging stakeholders, disseminating information, and going through extensive consultation procedures.
- In recent years, a very relevant effort for the establishment of principles and indicators of good water governance was developed by OECD. This exercise was largely based on the comparative analysis of 17 countries, with 8 of them located in Europe. The 12 principles that were formulated can be adopted, not only as an inspiration for the formulation of water policies, but also as a basis for an assessment and benchmarking of every system of water governance.
- Although inter-comparison and benchmarking of institutions, policies, and models of governance is always very inspiring and instructive, one should not forget that those arrangements are never an end by itself, but rather a mean to an end. Historical, cultural, social, and political contexts and backgrounds determine, to a large measure, the configuration of institutions relevant for water resources management in each specific country. Having recognized this, and thus paying due respect to the specificities of each society, those contexts and backgrounds should not be seen as an “inescapable prison” that blocks any possible progress. On the contrary, it is important to make a continuous effort to improve governance because the challenges are always increasing throughout the world and also in Europe. If it is a good thing that future generations grow with the memory of the past and with a strong sense of identity, they should not, however, be prisoners of atavisms that have lost meaning and block their development and progress.
- It is then clear that governance plays an important role to achieve a successful water resources management, aiming at providing water for all needs in a

sustainable manner. Governance, considered as that “second leg”, is complementary to infrastructure and technology, preventing water management from “stumbling and falling”. One should never forget that infrastructure and technology without appropriate governance is “like a hammer without a hand”. Future generations deserve that we “hit the nail”.

Annex 1. European national focal points invited to participate

Within the European Regional Process focal points of the 52 European countries have been identified and invited to be involved in the process, covering water resources administration, water services administration, water industry, European CSOs/ NGOs on water, European regional water networks and international organisations. The participation reched 254 organisations (March 2017).

Civil Society

UNSGAB - Sustainable Development Knowledge Platform
ACF - Action contre la Faim
Akvo Foundation
Aqua Publica Europea
AquaFed – The International Federation of Private Water Operators
AWHH - Armenian Women for Health and Healthy Environment
Beyond 2015
BORDA - Overseas Research & Development Association, Germany
Both Ends
BSWC - Black Sea Women's Club
Business & Professional Women International
CDP
Cercle Français de l'eau
Coalition Eau
Concord - European confederation of Relief and Development NGOs
COR - European Committee of the Regions
Donaufluss, Germany
Eastern PA Animal Alliance, Working Group 3
Earth Foreever
Water Right Makers
EEB - European Environmental Bureau
End Water Poverty
EU Parliament
EC - EEAS - European Commission - European External Action Service
EWP - European Water Partnership
European Works Council, EPSU secretariat
Dbluec – Deep Blue Consultants
FNCA - Fundacion Nueva Cultura del Aqua
OWG UN – United Nations Opening Working Group
Friends of the Earth
German WASH network
Good Planet Belgium
Green Cross International
GWP - Global Water Partnership
Helvetas
ISENIM, Republic in Uzbekistan
IUCN - International Union for Conservation of Nature
Lvia - LVIA Solidarity and International Cooperation, Italy
M&S - Medium and Sanitas, Romania
MAEDI- MEEM – The Ministry of Foreign Affairs French Ministry, French Ministry of Environment, France
Nabu – Nature and Biodiversity Conservation, Germany
Natuurmonumenten, Netherlands
NBvP Vrouwen van Nu, Netherlands
Oasis, Serbia
Oxfam Germany, Germany
Oxfam NOVIB, Netherlands
Oxfam UK, United Kingdom
Protos
pS-Eau – Programme Solidarité Eau, France
SDC - Swiss Agency for Development and Cooperation, Swizterland
Seas At risk
Simavi, Netherlands
SLL- Luonnonsuojeluliitto, Finland
SEI - Soroptimist International Europe
Spanish NGO coordination, Water Working Group

Umweltdachverband, Austria
WASH United
WASTE, Netherlands
Wateraid
Waterfootprint network
Waterlex
WFD - Weltfriedensdienst e.V., Germany
WfWP - Women for Water Partnership
WECF - Women of Europe for a common future
World Council of Churches
World Youth Parliament for Water
WWC – World Water Council
WWF - World Wide Fund for Nature Europe
WYN - Water Youth Network
Office International de l'Eau, France
Koninklijke BLN Schuttevaer, Netherlands

European Organisations

EC - European Commission
OECD - Organisation for Economic Co-operation and Development
UNECE Water Convention
European Environmental Agency

Industry Representatives

CCNR - Central Commission for Navigation on the Rhine
CEEP - European Centre of Employers and Enterprises providing Public services
CEFIC - European Chemical Industry Council
CEMR - Council of European Municipalities and Regions
CIM – La Commission internationale de la Meuse
CONCAWE – CONservation of Clean Air and Water in Europe
COPA-COGECA – Committee of Agricultural Organisations in the European Union – General Committee for Agricultural Co-operation
EAA - European Anglers Alliance
EBU - European Barge Union
ECPA - European Crop Protection Association
EEB – European Environmental Bureau
EIC-FENACORE – Euromediterranean Irrigators Community
EMPA – European Mollusc Producers Association
EREF - European Renewable Energies Federation
EURAQUA - European Network of Freshwater Research Organisations
EUREAU –European Union of National Associations of Water Suppliers
EURELECTRIC-Union of the Electricity Industry
EUROMETAUX - European Association of Metals
EUWMA – European Union of Water Management Associations
EWA - European Water Association
FEAP – Federation of European Aquaculture Producers
HEA - Hydropower Equipment Association
ICPDR – International Commission for the Protection of the Danube River
ICPR – International Commission for the Protection of the Rhine
INBO - International Network of Basin Organisations
NTG - European Union Water Framework Directive Navigation Task Group
Wetlands International
WMO- World Meteorological Organisation
WWF – The World Wild Fund For Nature

Water Authorities and Water Regulators

Ministry of Agriculture, Rural Development and Water Administration, Directory of Water Souces Policy, Albania
Technical Secretariat of the National Water Council, Albania
ERRU - Enti Rregullator i Ujrave, Albania
Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, Germany
Deputy Chairman of State Committee of Water Economy Ministry of Agriculture of the Republic of Armenia, Armenia
PSRC - Public Services Regulatory Commission of the Republic of Armenia, Armenia
Federal Ministry of Agriculture, Forestry, Environment and Water Management, Austria
Head of International Cooperation Department, Azerbaijan
BIME - Brussels Institute of Management of the Environment, Belgium

FODVVVL - Federal Public Service Health, DG Leefmilieu / Environment, Belgium
VMM - Vlaamse Milieumaatschappij - Flemish Environment Agency, Belgium
SPW - DGO3 - Service Public de Wallonie- Directorate General O3, Belgium
VMM - Vlaamse Milieumaatschappij, Belgium
Deputy head of the International Cooperation Department Ministry of Natural Resources and Environmental Protection, Byelorussia
Ministry of Environment and Physical Planning, Bosnia Herzegovina
Ministry of Environment and Water, East Aegean River Basin Directorate, Bulgaria
SEWRC - State Energy and Water Regulatory Commission, Bulgaria
Head of Division for International Water Relations of Transboundary Rivers Department, Ministry of Agriculture of the Republic of Kazakhstan, Kazakhstan
AREM - Agency of the Republic of Kazakhstan on Regulation of Natural Monopolies, Kazakhstan
Ministry of the Environment, Czech Republic
Ministry of Agriculture, Rural Development and Environment, Water Development Department, Cyprus
Ministry of Agriculture, Croatia
Croatian Energy Regulatory Agency, Croatia
Ministry of the Environment, Nature Agency, Denmark
KFST - Danish Competition and Consumer Authority, Denmark
WICS - Water Industry Commission for Scotland, Scotland
Ministry of Environment of Slovakia, Slovakia
URSO - Regulatory Office for Network Industries, Slovakia
Ministry of the Environment and Spatial Planning, Slovene
Water Directorate Spanish Ministry of Agriculture, Food and Environment, Spain
Ministry of the Environment, Estonia
Estonia Competition Authority, Estonia
Ministry of the Environment, Finland
DGALN/DEB/CI - Ministère de l'écologie, du développement durable et de l'énergie, France
Ministry of the Environment and Natural Resources Protection, Georgia
GNERC - Georgian National Energy and Water Supply Regulatory Commission, Georgia
Special Secretariat for Water, Ministry of Environment & Energy, Greece
Ministry of Interior, Hungary
Hungarian Energy and Public Utility Regulatory Authority, Hungary
OFWAT - Water Services Regulation Authority, United Kingdom
Department of Housing, Planning, Community and Local Government, Ireland
NIAUR - Commission for Energy Regulation; Northern Ireland Authority for Utility Regulation, Ireland
Environment Agency of Iceland, Iceland
MATTM - Ministry of the Environment and Protection of Land and Sea, Italy
Autorità per l'energia elettrica il gas ed il sistema idrico, Italy
Water and Waste Regulatory Office, Kosovo
Ministry of Environmental Protection and Regional Development, Latvia
PUC - Public Utilities Commission, Latvia
Ministry of Environment of the Republic of Lithuania, Lithuania
NCC - National Control Commission for prices and energy, Lithuania
Administration de la gestion de l'eau, Luxemburg
Sustainable Energy and Water Conservation Unit, Malta
Malta Resources Authority, Malta
Regulator for Energy and Water Services, Malta
Deputy Head of the Water Management Department Water Management Division Ministry of Environment, Moldavia
Ministry of Agriculture and Rural Development, Montenegro
Norwegian Environment Agency, Norway
RWS - WVL - Dutch Ministry for Infrastructure and the Environment, Netherlands
Ministry of Environment, Poland
APA - Agência Portuguesa do Ambiente, Portugal
ERSAR - Entidade Reguladora dos Serviços de Águas e Resíduos, Portugal
Department for Environment, Food and Rural Affairs, United Kingdom
Ministry of Environment and Climate Change, Romania
ANRSC - National Regulatory Authority for Municipal Services, Romania
Head of the Federal Agency of Water Resources Federal Agency of Water Resources of Russian Federation, Russia
Ministry of Agriculture, Forestry and Water Management, Directorate for Water, Serbia
Swedish Water Agency for Marine and Water Management, Sweden
Swiss Federal Office for the Environment, Switzerland
Ministry of Forestry and Water Affairs, Responsible for European Union affairs, Turkey
Head of Division on the Protection of Water Resources and Marine Ecosystems - Ministry of Ecology and Natural Resources, Ukraine
SCWRM - State Committee for Water Management of Ukraine, Ukraine
WSRC - Water Sector Regulatory Council, Ukraine

WAREG - European Water Regulators, Europe

Water Partnerships

GWP - German Water Partnership, Germany
DWF - Danish Water Forum, Denmark
PTEA - Plataforma Tecnologica Española del Agua, Spain
FWF - Finnish Water Forum, Finland
FWP - French Water Partnership, France
NWP - Netherlands Water Partnership, Netherlands
PWP - Portuguese Water Partnership, Portugal
UKWP - UK Water Partnership, United Kingdom
SWH - The Swedish Water House, Sweden
SWP - Swiss Water Partnership, Switzerland
TWI - Turkish Water Institute, Turkey

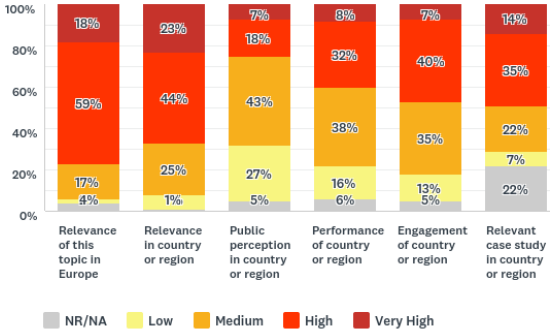
Water Operation Associations

DVGW - German Technical and Scientific Association for Gas and Water, Germany
OVGW - Austrian Association for Gas and Water, Austrian
ÖWAV - Austrian Water and Waste Management Association, Austrian
CELABOR - Centre de services scientifiques et techniques, Belgium
IMIEU - Institute for Infrastructure, Environment and Innovation, Belgium
WSSTP - Water Supply and Sanitation Technology Platform, Belgium
Vlakwa - Flanders Knowledge Center Water, Belgium
BWA - Bulgarian Water Association, Bulgaria
SOVAK - Water Supply and Sewerage Association of the Czech Republic, Czech Republic
Water Board of Nicosia, Cyprus
DANVA - Danish Water and Waste Water Association, Denmark
DHI - Danish Hydraulic Institute, Denmark
GEUS - Geological Survey of Denmark and Greenland, Denmark
AVS - Association of Water Companies, Slovakia
Chamber of Commerce and Industry of Slovenia, Chamber of Public Utilities, Slovenia
PTEA - Plataforma Tecnologica Española del Agua, Spain
Aeas - Spanish Water and Wastewater Association, Spain
Ceit-IK4, Spain
CETAQUA - Centro Tecnologico del Agua, Spain
FEUGA - Fundación Empresa Universidad Gallega, Spain
IMDEA - Water Institute Imdea Water, Spain
EVEL - Estonian Water Works Association, Estonia
FIWA - Finnish Water Utilities Association, Finland
IRSTEA - Institut National de recherche en sciences et technologies pour l'environnement et l'agriculture, France
Office International de l'eau, France
UIE - Union Nationale Des Industries Et Entreprises De L'eau Et De L'environnement, France
EAEYA - Hellenic Union of Municipal Enterprises for Water Supply and Sewage, Greece
EMVIS - Water Resources & Environment Management, Greece
E.D.E.Y.A. - Hellenic Association of Municipal Enterprises for Water Supply and Sewerage, Greece
MaVíz - Hungarian Water Utility Association, Hungary
CCMA - The County and City Management Association, Ireland
WSSIC - Water Systems and Services Innovation Centre, Ireland
DTC - The Development Technology in the Community Research Group, Ireland
UTILITALIA - Federation of energy, water and environmental services, Italy
WSC - Water Services Corporation, Malta
Norsk Vann, Norway
NIVA - The Norwegian Institute for Water Research, Norway
Dutch Water Authorities, Netherlands
Vewin - Association of Dutch Water Companies, Netherlands
ISPT - Institute for Sustainable Process Technology, Netherlands
IRC Netherlands, Netherlands
IHE – Delft - IHE Delft Institute for Water Education, Netherlands
SPHERE - Systemic Physiological and Ecotoxicological Research, Netherlands
Vewin - Association of Dutch Water Companies, Netherlands
Wetsus - European centre of excellence for sustainable water technology, Netherlands
Polish Waterworks Chamber of Commerce, Poland
PGI - The Polish Geological Institute, Poland
APDA - Associaçâo Portuguesa de Distribuiçâo e Drenagem de Águas, Portugal
Centre for Ecology & Hydrology, United Kingdom
Cranfield University, United Kingdom
Isle Utilities, United Kingdom

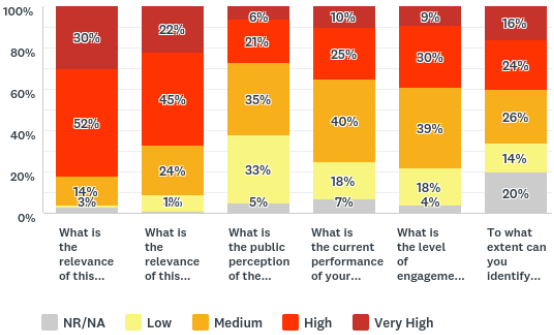
The James Hutton Institute, United Kingdom
WIRC - Water Innovation & Research Centre, United Kingdom
ARA - Romanian Water Association, Romania
CCIS - Chamber of Commerce and Industry of Serbia, Serbia
SWWA - The Swedish Water & Wastewater Association, Sweden
IVL - Swedish Environmental Research Institute, Sweden
RISE - Research Institutes of Sweden, Sweden
SWR - Sweden Water Research, Sweden
SVGW SSIGE - Swiss Gas and Water Industry Association, Switzerland
TWI - Turkish Water Institute, Turkey
TUBITAK MAM - Environment and Cleaner Production, Institute of the TUBITAK Marmara Research Center, Turkey
IWA - International Water Association

Annex 2. Survey about European relevance of themes & topics

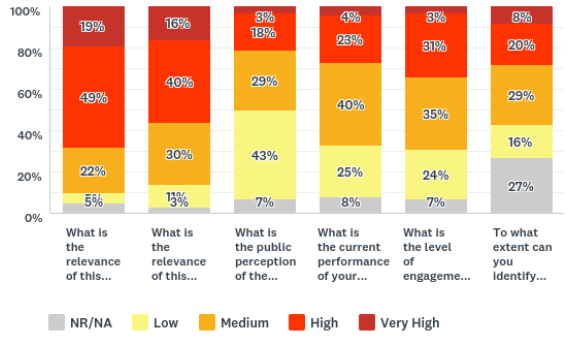
Theme CLIMATE - Water security and climate change



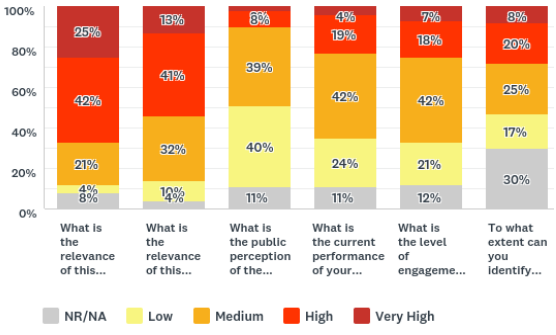
Climate – Topic a. Managing risk and uncertainty for resilience and disaster preparedness



Climate – Topic b. Water and adaptation to climate change

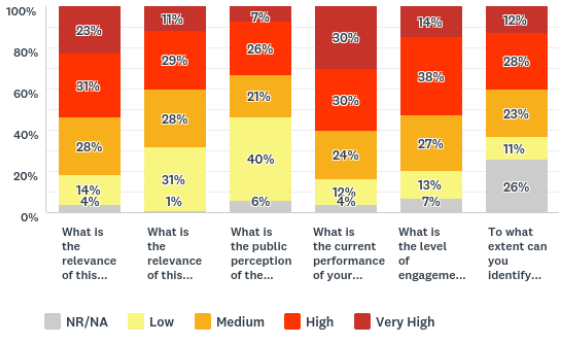


Climate – Topic c. Water and climate change mitigation

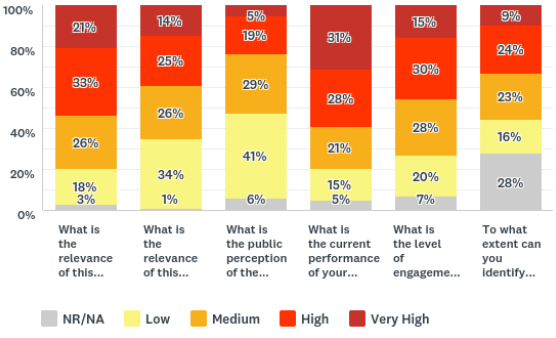


Climate – Topic d. Climate science and water management: the communication between science and decision/policy making

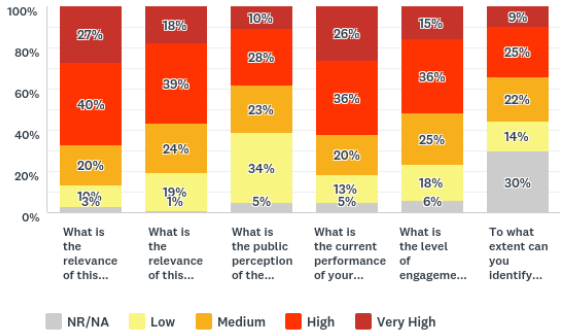
Theme PEOPLE: Water, sanitation and health



People – Topic a. Enough safe water for all

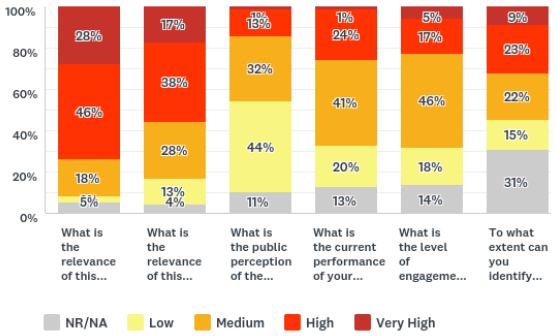


People – Topic b. Integrated sanitation for all

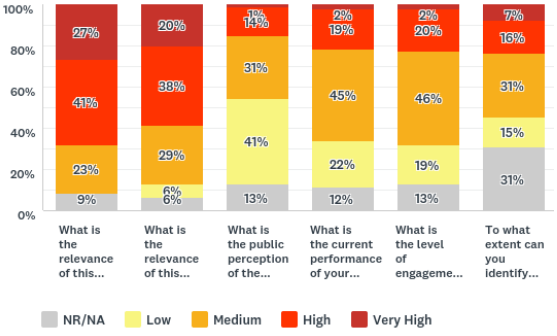


People – Topic c. Water and public health

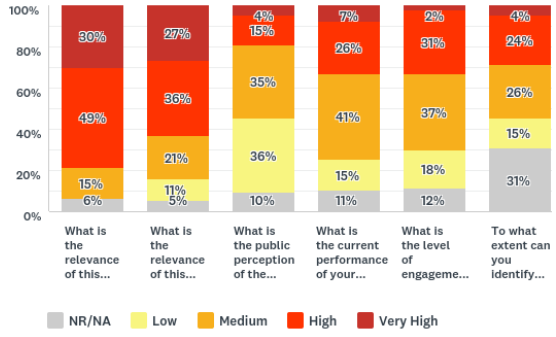
Theme DEVELOPMENT: Water for sustainable development



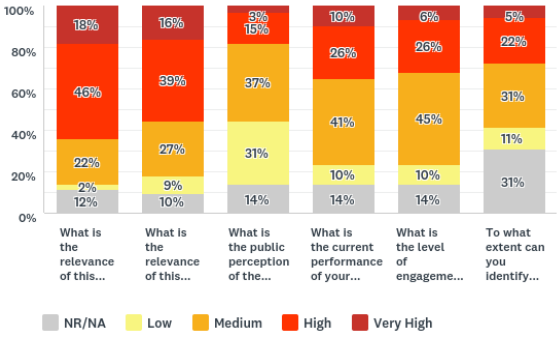
Development – Topic a. Water, energy and food security



Development – Topic b. Inclusive and sustainable growth, water stewardship and industry

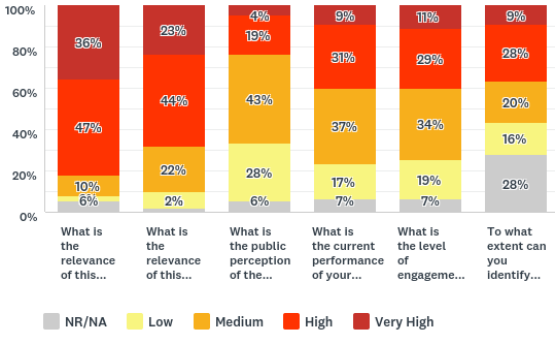


Development – Topic c. Efficient use surface water and groundwater – urban and rural



Development – Topic d. Infrastructure for sustainable water resource management and services

Theme URBAN: Integrated urban water and waste management



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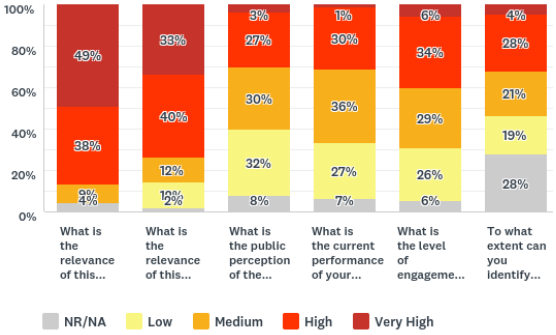

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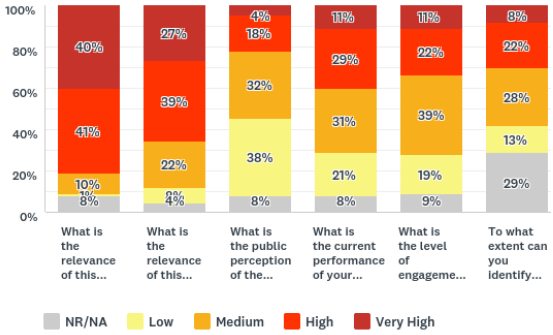
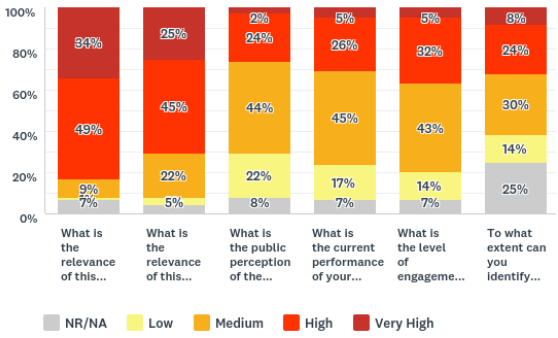
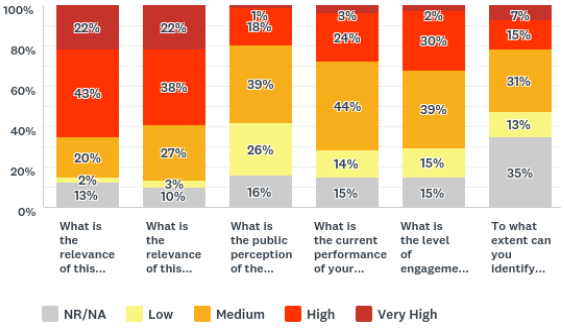


Urban – Topic c. Treatmernt and reuse technologies

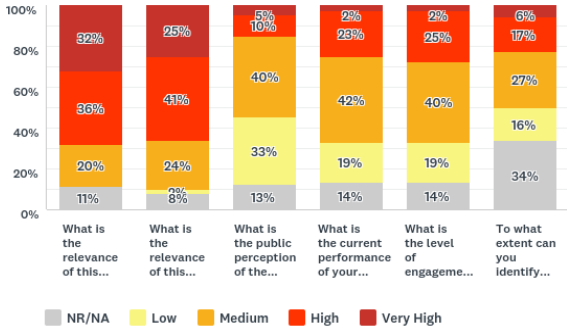
Theme ECOSYSTEMS: Water quality, ecosystem livelihoods and biodiversity



Ecosystems – Topic a. Managing and restoring ecosystems for water services and biodiversity



Ecosystems – Topic b. Natural and engineered hydrological systems



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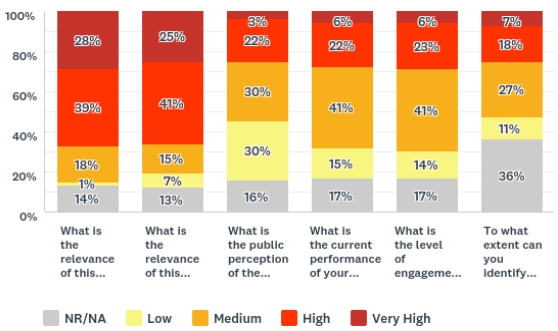
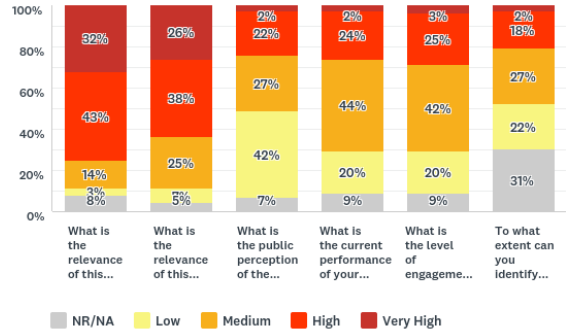


Ecosystems – Topic d. Ensuring water quality from ridge to reef

Theme Financing: Water quality, ecosystem livelihoods and biodiversity



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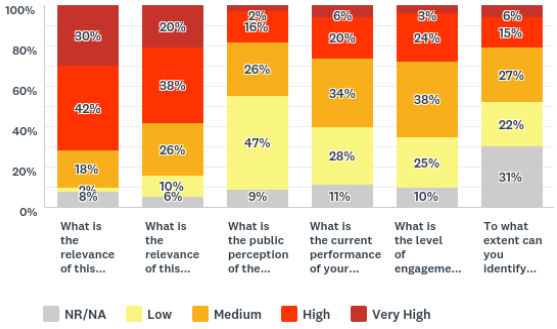

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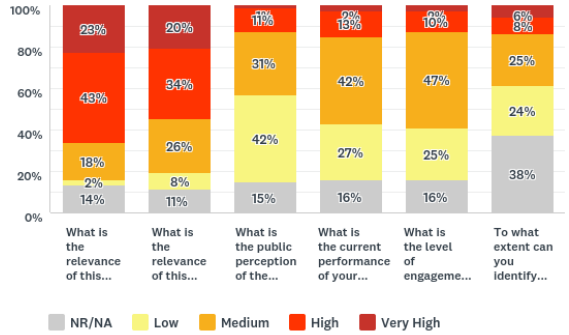

Financing – Topic c. Finance for sustainable development – supporting water-friendly business

Results of the relevance of the topics in Europe – analysis by sub-regions

Themes and topics	Mediterranean	North Europe and UK	Central Europe	Southeast Europe
Climate				
a. Managing risk and uncertainty for resilience and disaster preparedness	57	81	45	67
b. Water and adaptation to climate change	69	86	54	67
c. Water and climate change mitigation	52	62	53	67
d. Climate science and water management	40	69	51	58
People				
a. Enough safe water for all	45	60	28	71
b. Integrated sanitation for all	48	62	23	75
c. Water and public health	45	74	40	67
Development				
a. Water, energy and food security nexus	43	71	54	58
b. Inclusive and sustainable growth, water stewardship and industry	50	57	54	46
c. Efficient use of surface water and groundwater - urban and rural	57	83	56	46
d. Infrastructure for sustainable water resource management and services	43	67	40	63
Urban				
a. Water and cities	60	86	60	58
b. The circular economy - reduce, reuse, recycle	67	83	79	67
c. Treatment and reuse technologies	62	81	71	50
Ecosystems				
a. Managing and restoring ecosystems for water services and biodiversity	64	74	75	58
b. Natural and engineered hydrological systems	38	60	49	46
c. Water and land use	43	74	56	46
d. Ensuring water quality from ridge to reef	69	67	54	25
Finance				
a. Economics and financing for innovative investments	50	79	56	58
b. Financing implementation of water-related SDGs and adaptation to climate change	40	74	53	58
c. Finance for sustainable development - supporting water-friendly business	43	64	54	46

* The results correspond to the weighted sum of ‘very high’ and ‘high’ responses to the question “What is the relevance of this topic in Europe?” (‘very high’ = 1.5 ‘high’).

Results of the relevance of the topics in European sub-regions.

Themes and topics	Mediterranean	North Europe and UK	Central Europe	Southeast Europe
Climate				
a. Managing risk and uncertainty for resilience and disaster preparedness	64	57	51	50
b. Water and adaptation to climate change	62	50	53	29
c. Water and climate change mitigation	50	33	47	38
d. Climate science and water management	36	57	39	25
People				
a. Enough safe water for all	50	33	16	33
b. Integrated sanitation for all	52	38	16	38
c. Water and public health	52	43	34	50
Development				
a. Water, energy and food security nexus	50	33	38	8
b. Inclusive and sustainable growth, water stewardship and industry	43	57	40	21
c. Efficient use of surface water and groundwater - urban and rural	62	52	44	21
d. Infrastructure for sustainable water resource management and services	55	57	31	29
Urban				
a. Water and cities	57	57	48	50
b. The circular economy - reduce, reuse, recycle	62	71	63	21
c. Treatment and reuse technologies	62	50	57	13
Ecosystems				
a. Managing and restoring ecosystems for water services and biodiversity	48	57	69	21
b. Natural and engineered hydrological systems	36	60	51	13
c. Water and land use	38	57	62	21
d. Ensuring water quality from ridge to reef	71	50	56	17
Finance				
a. Economics and financing for innovative investments	38	50	57	25
b. Financing implementation of water-related SDGs and adaptation to climate change	48	45	46	21
c. Finance for sustainable development - supporting water-friendly business	36	50	45	21

* The results correspond to the weighted sum of ‘very high’ and ‘high’ responses to the question “What is the relevance of this topic in your country or region?” (‘very high’ = 1.5 ‘high’).

Results of the public perception of the topics in European sub-regions.

Themes and topics	Mediterranean	North Europe and UK	Central Europe	Southeast Europe
Climate				
a. Managing risk and uncertainty for resilience and disaster preparedness	7	33	21	33
b. Water and adaptation to climate change	14	26	23	8
c. Water and climate change mitigation	10	5	24	25
d. Climate science and water management	0	5	16	8
People				
a. Enough safe water for all	40	38	14	21
b. Integrated sanitation for all	33	33	6	13
c. Water and public health	45	52	16	38
Development				
a. Water, energy and food security nexus	19	5	10	8
b. Inclusive and sustainable growth, water stewardship and industry	14	10	8	8
c. Efficient use of surface water and groundwater - urban and rural	24	29	7	17
d. Infrastructure for sustainable water resource management and services	17	26	8	8
Urban				
a. Water and cities	29	17	14	21
b. The circular economy - reduce, reuse, recycle	21	29	21	8
c. Treatment and reuse technologies	21	21	16	0
Ecosystems				
a. Managing and restoring ecosystems for water services and biodiversity	19	21	24	0
b. Natural and engineered hydrological systems	0	19	20	8
c. Water and land use	5	12	14	0
d. Ensuring water quality from ridge to reef	24	19	21	8
Finance				
a. Economics and financing for innovative investments	19	21	16	13
b. Financing implementation of water-related SDGs and adaptation to climate change	14	21	11	8
c. Finance for sustainable development - supporting water-friendly business	10	5	11	8

* The results correspond to the weighted sum of ‘very high’ and ‘high’ responses to the question “What is the public perception of the relevance of this topic in your country or region?” (‘very high’ = 1.5 ‘high’).

Results of the current performance of the European sub-regions regarding each topic.

Themes and topics	Mediterranean	North Europe and UK	Central Europe	Southeast Europe
Climate				
a. Managing risk and uncertainty for resilience and disaster preparedness	19	33	47	21
b. Water and adaptation to climate change	14	36	43	8
c. Water and climate change mitigation	19	24	28	17
d. Climate science and water management	24	14	30	8
People				
a. Enough safe water for all	76	60	54	42
b. Integrated sanitation for all	76	74	60	0
c. Water and public health	79	67	54	33
Development				
a. Water, energy and food security nexus	19	19	24	8
b. Inclusive and sustainable growth, water stewardship and industry	29	29	14	8
c. Efficient use of surface water and groundwater - urban and rural	31	36	24	17
d. Infrastructure for sustainable water resource management and services	43	38	31	8
Urban				
a. Water and cities	45	52	31	13
b. The circular economy - reduce, reuse, recycle	21	43	21	8
c. Treatment and reuse technologies	36	40	44	0
Ecosystems				
a. Managing and restoring ecosystems for water services and biodiversity	33	21	29	0
b. Natural and engineered hydrological systems	14	19	31	8
c. Water and land use	14	14	25	8
d. Ensuring water quality from ridge to reef	36	14	30	8
Finance				
a. Economics and financing for innovative investments	24	24	24	13
b. Financing implementation of water-related SDGs and adaptation to climate change	21	19	26	8
c. Finance for sustainable development - supporting water-friendly business	17	14	13	8

* The results correspond to the weighted sum of 'very high' and 'high' responses to the question "What is the current performance of your country or region regarding this topic?" ('very high' = 1.5 'high').

Results of the level of engagement of European sub-regions on each topic.

Themes and topics	Mediterranean	North Europe and UK	Central Europe	Southeast Europe
Climate				
a. Managing risk and uncertainty for resilience and disaster preparedness	45	45	38	38
b. Water and adaptation to climate change	29	38	37	8
c. Water and climate change mitigation	38	24	33	8
d. Climate science and water management	10	24	32	17
People				
a. Enough safe water for all	71	52	37	46
b. Integrated sanitation for all	64	57	34	21
c. Water and public health	74	62	31	54
Development				
a. Water, energy and food security nexus	33	10	20	8
b. Inclusive and sustainable growth, water stewardship and industry	36	29	10	8
c. Efficient use of surface water and groundwater - urban and rural	38	31	20	17
d. Infrastructure for sustainable water resource management and services	52	31	17	17
Urban				
a. Water and cities	45	57	26	21
b. The circular economy - reduce, reuse, recycle	36	45	33	17
c. Treatment and reuse technologies	36	31	37	8
Ecosystems				
a. Managing and restoring ecosystems for water services and biodiversity	36	33	33	8
b. Natural and engineered hydrological systems	17	33	29	8
c. Water and land use	26	24	25	0
d. Ensuring water quality from ridge to reef	38	24	26	8
Finance				
a. Economics and financing for innovative investments	36	26	24	17
b. Financing implementation of water-related SDGs and adaptation to climate change	40	14	23	17
c. Finance for sustainable development - supporting water-friendly business	21	10	13	0

* The results correspond to the weighted sum of ‘very high’ and ‘high’ responses to the question “What is the level of engagement of your country or region on this topic?” (‘very high’ = 1.5 ‘high’).

Annex 3. Indicators of the City Blueprint® Framework

Indicator 1 – Secondary WWT Waste Water Treatment (WWT): This indicator shows the percentage of the city population that is connected to secondary wastewater treatment. Primary WWT removes the sludge, oil and grease from sewage. Secondary WWT combines physical removal of sediments and a biological process to remove suspended organic material.

Indicator 2 – Tertiary Waste Water Treatment (WWT): This indicator shows the percentage of the city population that is connected to tertiary WWT. Tertiary WWT provides a final treatment stage to further improve water quality by removing nutrients and pollutants, thereby avoiding the proliferation of algae in water bodies to which it is discharged (sea, rivers, lakes, wetlands, etc.).

Indicator 3 - Groundwater quality: This indicator represents the percentage of groundwater analyses showing 'good chemical status'. Groundwater is the water present under the Earth's surface. It discharges from springs, into wetlands and the beds of streams, rivers and lakes. In urban areas, it is sensitive to industrial pollution, and can transfer pollution to surface water by the routes mentioned.

Indicator 4 - Solid waste collected: This indicator reflects the amount of solid municipal waste produced in kilos, per person, per year compared to a benchmark of the best and worst collection rates. It takes into account households, small commercial activities, office buildings and institutions such as schools and government buildings and small businesses. Apart from the obvious reasons of health and the need to limit excessive plastic waste in cities, city drainage systems, rivers and oceans, solid waste is also a valuable resource if collected and processed properly. Benefits include the improvement of economic efficiency by good resource recovery, and the development of a market for the production and consumption of products from recycled materials. This in turn supports the development of sustainable employment and new business opportunities. The indicator reflects the amount of municipal waste collected/produced in kilos, per person, per year.

Indicator 5 - Solid waste recycled: This indicator represents the percentage of solid municipal waste collected and recycled or composted, but excluding waste incinerated for energy, as this is also a sustainable activity. The recycling of solid waste reduces or eliminates some adverse environmental impacts. For example, it can help improve air and water quality and reduce greenhouse gas emissions. The long-term result is a more sustainable economy and a healthier natural environment.

Indicator 6 - Solid waste energy recovered: This indicator represents the percentage of solid municipal waste incinerated for energy production. Incineration is the process whereby solid organic wastes are burned to significantly reduce volume, create gaseous products and recover useful energy. The reduction in volume of solid waste by 20 to 30 percent is especially beneficial in countries with limited land available for landfill disposal. In a process called Waste-to-Energy (WtE), waste is also burned in furnaces or boilers to generate heat, steam or electricity, which helps reduce greenhouse gas emissions. However, as is the case with most fossil fuels, it is a controversial issue as the resulting emissions may contain organic compounds such as dioxins which may have negative environmental impacts.

Indicator 7 - Access to drinking water: This indicator shows the percentage of the urban population with access to safe drinking water. Access to drinking water is a basic human right recognised by the UN Millennium Development Goals. However, more than 780 million people still do not have access to safe and sufficient drinking water (UN, 2014).

Indicator 8 - Access to sanitation: This indicator shows the percentage of the population with access to proper sanitation. Sanitation is the system for taking dirty water and other waste products away from buildings in order to protect people's health. Poor or absent

sanitation infrastructure is a serious problem in many cities, especially in developing countries. The UN estimates that more than 2.5 billion people lack access to adequate sanitation (UN, 2014). This, combined with a lack of safe drinking water, results in millions of deaths each year from water-related illnesses.

Indicator 9 - Drinking water quality: This indicator represents the percentage of drinking water samples that comply with water quality regulations. Drinking water quality is usually controlled by local, regional or national legislation.

Indicator 10 - Nutrient recovery (from Wastewater Treatment): This indicator represents the percentage of the total wastewater which undergoes nutrient recovery. Nutrients are minerals and compounds which living things need to survive and grow. Nutrients such as nitrogen, potassium and phosphorus (essential components of fertilisers, and which are becoming increasingly scarce) are present in wastewater. If not removed or reduced by treatment, they can cause serious pollution in receiving water bodies. Therefore, it is beneficial to recover them from wastewater and sewage sludge (the solid waste component), to be used in fertilisers and to reduce water pollution.

Indicator 11 - Energy recovery: This Indicator represents the percentage of wastewater treated to recover energy. Wastewater sludge contains elements which can be converted into energy as burnable solids or gas (biomass). At least secondary wastewater treatment is necessary in order to obtain the sludge for energy recovery.

Indicator 12 - Sewage sludge recycling: This indicator represents the proportion of sewage sludge recycled to recover nutrients and/or energy. As mentioned for Indicators 10 and 11, sewage sludge can be used in agriculture or be converted into biomass to be burned in power plants for electricity generation. However, not all sludge is recycled. If it is heavily polluted with high levels of organic and inorganic contaminants, many countries prohibit its use in farming. This sludge may be converted into biomass or simply be incinerated in waste destruction installations.

Indicator 13 - Energy efficiency Waste Water Treatment (WWT): This indicator is a measure of the energy efficiency of the wastewater treatment in the city. An enormous amount of energy is used to sanitise, supply and treat water and wastewater. One of the principle subjects of any sustainable urban policy is the energy-water nexus, which highlights the connection between these two sectors. It has been calculated that the demand for energy to adequately treat water will have risen by 44% between the years 2006 and 2030. (IEA, 2009). Therefore, the question of energy efficiency is just as vital as the production of renewable energies.

Indicator 14 – Average age sewer: This indicator compares the average age to an ideal maximum of 60 years. The older the system, the lower the score. There exists, at present, a serious situation concerning the lack of investment in renewal of sewer infrastructure. This is important because future projected climatic conditions will place greater pressure on drainage systems. The average age of the infrastructure is an indication of the financial commitment to regular system maintenance and replacement.

Indicator 15 - Operating cost recovery (which here is concerned exclusively with drinking water and sanitation services) is the total operational revenue divided by the annual operational costs. A higher profit margin gives a higher indicator score, because this signifies that the municipality has a stronger capability to improve its water infrastructure or react effectively to unforeseen circumstances such as water quality or pipe failure.

Indicator 16 - Water system leakages: This indicator compares the average leakage rate with a realistic, but undesirable maximum rate of 50% of water supplied. Leakage is defined as the difference between the volume of water put into thenetwork at the drinking water plant and the total volume reaching customers' taps. Insufficient maintenance of the drinking water distribution network results in substantial water loss due to the poor physical conditions of the pipes in many municipalities.

Indicator 17 - Stormwater separation: This indicator shows the proportion of the wastewater system in which sanitary sewage and storm water flows are separated. There always exists a serious threat from extreme weather conditions, including storms. Often, the same drainage infrastructure carries both sewage and storm water, especially in the older parts of cities. A separate system is much preferred. In a combined system, extreme weather events can result in infrastructure overload, and sewer overflows into surface water, representing a major source of water pollution. Furthermore, the possibility of flooding is greater if storm water is not evacuated via a separate storm drainage network with adequately designed capacity.

Indicator 18 - Green space: This indicator reflects the percentage of the green area within a municipality. As defined by the EEA in 2012, a Green Space is an area of land within a municipality which consists of sports and leisure facilities, agricultural areas, semi-natural areas and wetlands, forests, gardens and parks. These areas are a vital component of any urban community as they counteract the heat which can be generated in cities (up to 10ºC higher than in surrounding areas), and air pollution, and are a social advantage and beneficial to the general wellbeing of citizens.

Indicator 19 - Climate adaptation: The indicator reflects the general activity with regards to urban climate issues including climate change adaptation measures.

Indicator 20 - Drinking water consumption: This indicator reflects the average drinking water consumption per person per year, comparing it to the best and worst examples in European cities. A higher water use per capita gives a lower score.

Indicator 21 - Climate-robust buildings: A measure of actions and policies for the creation of energy-efficient buildings, including those buildings which have been restored or reconverted in order to respond more adequately to such energy mechanisms as green roof creation, insulation, solar and geothermic technologies.

Indicator 22 – Management and action plans (of integrated water resources management): A measure of the application of the concept of Integrated Water Resources Management (IWRM) in the city. IWRM is a process which promotes the coordinated development of the management of water, land and related resources in order to maximise the economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (GWP).

Indicator 23 - Public participation (in voluntary organisations and societies of all types): This indicator is an estimate of how many citizens of the municipality participate voluntarily in organisations, societies and clubs of all description. This serves as an indication of a community's willingness to become actively involved in social issues such as those related to water and climate change adaptation. It cannot, however, be considered as a definitive measurement.

Indicator 24 - Water-efficiency measures: An indication of the application of water-efficiency measures by the range of water users across the city. The measures in question include plans, procedures and their implementation to improve the efficiency of water usage by, for example, water-saving measures in taps, toilets, showers and baths, water-efficient design, or attempts to raise awareness.

Indicator 25 – Attractiveness (the use of water elements in the creation of the urban landscape): A measure of how surface-water features are contributing tothe urban landscape of the city and wellbeing of its inhabitants. Water is, without question, an added value to any city's physical appearance. For example, water is a dominant feature in some cities that attract large numbers of tourists, such as Venice, Hamburg and Amsterdam. The property prices in the vicinity of rivers, canals and harbours are often much higher than in other parts of the city.

References:

Koop, SHA, & Van Leeuwen CJ (2015a). Assessment of the sustainability of water resources management: A critical review of the City Blueprint approach. Water Resources Management, 29(15), 5649–5670.

Koop SHA, Van Leeuwen CJ (2015b) Application of the Improved City Blueprint Framework in 45 Municipalities and regions. Water Res Manag, 29(13), 4629–4647Koop S.H.A., Van Leeuwen C.J., 2015a. Application of the Improved City Blueprint Framework in 45 municipalities and regions. Water Resources Management, 29, 4629-4647

Gawlik BM, Easton P, Koop S, Van Leeuwen K, Elelman R (eds) (2017). Urban Water Atlas for Europe. European Commission, Publication Office of the European Union, Luxembourg

European Commission (2017). European Innovation Partnership on Water. Brussels, Belgium. http://www.eip-water.eu/City_Blueprints. Accessed 12 March 2017.

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