DELIVERABLE D.T3.4.7

Transnational CWC strategy & policy recommendations for boosting circular water use in the CE region

Version 1
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1. INTRODUCTION

1.1. Urgency to Act

Water is essential for human life, nature and the economy. It is permanently renewed but it is also finite and cannot be made or replaced with other resources.[1]

While Europe is by large considered as having adequate water resources, water scarcity and drought is an increasingly frequent and widespread phenomenon in the European Union. Studies estimate, through the world's first global survey of large cities' water sources, that 1 in 4 cities already is seriously water stressed[2], with different cities facing various problems. Urban growth has a large impact on the liveability of cities and is putting huge pressure on the availability of water, food, energy and materials. Climate change will put even more pressure on cities, as it leads to increased risks of flooding, droughts and heat waves[3]. Soil sealing is a prevalent problem, since from mid 1950s the total surface area of cities in the EU has increased by 78 %, simultaneously increasing the degradation rate of aquatic environment. With increased periodic precipitation in some parts of EU, stormwater buffer capacity that has been depleted due to urbanisation now needs to be increased. Sealed surfaces direct the rainfall to the sewer networks, where it is merges with wastewater, causes problems at the WWT facilities, and prevents the rainfall from infiltrating into the soil to renew groundwater reserves.

About 30 % of the total European population was exposed to water scarcity conditions in summer 2015 compared to 20% in 2014. Water scarcity prevails in several European river basins, with different water stress levels, affecting about 15-25 % of total European territory[4]. According to EEA, approximately one fifth of the total freshwater abstracted in Europe supplies public water systems, but only 20 % of water used by the sectors receiving a public water supply is actually consumed. The hot spots are metropoles, high population density areas and popular tourist destinations. Underperforming supply systems considerably contribute to water losses; e.g. in Croatia nearly 40 % of the total water supply is lost in the water transportation network[5]. Direct reuse of water after treatment represents only about 1 billion cubic metres of treated urban wastewater annually, which corresponds to approximately 2.4 % of the treated urban wastewater effluent or to less than 0.5 % of annual EU freshwater withdrawals. The multitude of interconnected water problems faced by cities demands a structural and systemic approach to address and resolve as many issues as possible and put cities at the European forefront as circular water centres.

Rethinking urban water through the circular economy and resilience lenses offers an opportunity to tackle urban water challenges by providing a systemic and transformative approach to delivering water supply and sanitation services in a more sustainable, inclusive, efficient, and resilient way, recognizing and capturing the full value of water - as a service, an input to processes, a source of energy and a carrier of nutrients and other materials. Circular economy recognizes water as the finite resource it is. By adopting a systems perspective and mimicking the natural water cycle, circular economy avoids using water when possible and closes loops at several levels by improving water (and other resources) efficiency, minimizing waste, and focusing on the behavioral Rs—reduce, reuse, recycle, replenish, recover, and retain.[6]

[1] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A Blueprint to Safeguard Europe's Water Resources

[2] McDonald, R.I., Weber, K., Padowski, J., Flörke, M., Schneider, C., Green, P.A., Gleeson, T., Eckman, S., Lehner, B., Balk, D., Boucher, T., Grill, G, and Montgomery, M. (2014). Water on an urban planet: Urbanization and the reach of urban water infrastructure. Global Environmental Change, 27, pp.96-105

[3] Van Hattum T. et.al., Towards Water Smart Cities, Climate adaptation is a huge opportunity to improve the quality of life in cities, report number 2787 of Wageningen Environmental Research, 2016

[4] Use of freshwater resources, European Environmental Agency, 10.10.2018

[5] Close up — Water in the city, European Environmental Agency, 30.08.2018

[6] Delgado, Anna, Diego J. Rodriguez, Carlo A. Amadei and Midori Makino. 2021. "Water in Circular Economy and Resilience (WICER)." World Bank, Washington, DC

In a circular economy, water reuse plays a key role, bringing significant environmental, social and economic benefits. Water reuse in the EU today is far below its potential, therefore initiatives to address the problem of a too limited application of water reuse in EU are needed, in order to contribute significantly to alleviating water scarcity. The EU's Circular Economy Action Plan[7] adopted in 2020 includes the implementation of the new Regulation on minimum requirements for water reuse for agricultural irrigation amongst Europe's priorities for the circular economy. The Action Plan also announces that the Commission will facilitate water reuse and efficiency in other sectors, including in industrial processes.

The Transnational CWC strategy "D.T3.4.7 Transnational CWC strategy & policy recommendations for boosting circular water use in the CE region" aims to contribute to EU's efforts to stimulate and facilitate water reuse and rainwater use. It should serve to guide the cities and practitioners who are incorporating the principles in policies and strategies, planning, investment prioritization, and design and operations to achieve a fully circular and resilient water system.

1.2. Aim of this Document

Policy instruments are statements of intent to change behavior in a positive way with the means or a specific measure to translate that intent into action. Governance as the process whereby societies or organizations make important decisions, determine whom they involve and how they render an account. Execution of the policy instruments is through effective governance. Policies and efficient governance are crucial in determining and improving the state of our environment, material sufficiency, socio-economic outlooks connected to wider implementation of circular economy in a pre-determined space in time. Also, legislations can have a strong influence on innovation. They can act as barriers for innovation and, like in the field of environmental protection, foster innovation for new technologies and services. Particular emphasis has to be put on the aspect of "web of constraints": In many cases, regulatory obstacles are not created by a single policy, but also by an aggregation of rules that thus cannot be easily "removed" but will require balanced policy mixes[8].

The Transnational CWC strategy is therefore introducing elaborated national level regulatory & non-regulatory policy options on CE level to close identified gaps hindering circular water use, incorporated in three content sets:

- Legislative policy measures: upon the need to improve existing bottlenecks.
- Knowledge capacity and awareness raising policy measures: to improve knowledge and awareness deficit.
- Governance policy measure: to improve existing governance principle (to tailor governance to the needs of circular economy approach).

1.3. Methodology of Document Elaboration

When identifying and elaborating best (regulatory & non-regulatory) policy options for promoting urban circular water management in the CE region a bottom-up methodological approach was used. Throughout the project implementation, the individual base elements and characteristics of the existing systems of urban water management, with emphasis on identifying the problems and gaps hindering its circularity,

[7] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A new Circular Economy Action Plan For a cleaner and more competitive Europe

[8] Technopolis Group, Fraunhofer ISI, thinkstep and Wuppertal Institute, Regulatory barriers for the Circular Economy, Lessons from ten case studies, 2016

were first identified on local levels, in each of the involved FUAs.[9] In the second phase, within the Activity „A.T3.3 Building FUA-level visions, concepts and strategies on CUW management“, FUA-level CWC strategies on integrated circular urban water management were elaborated, incorporating chosen actions and policy recommendations deriving from diverse practical know-how on appropriate measures for rainwater management and water reuse with the various components to preserve, improve and strengthen the blue-green infrastructure at property and district levels in cities and municipalities. In the final phase, within the Activity “A.T3.4 Elaborating policy recommendations on national level and feeding them to a CE level CUW strategy“, project partners prepared a comprehensive assessment of laws, strategies, regulatory and non-regulatory measures applied in the 6 CE countries involved (Germany, Hungary, Italy, Slovenia, Poland and Croatia), with the aim of elaborating national level policy recommendations comprising of all of the previously explored elements and further discussed on national roundtables discussions in order to form a complexed and complete top-level system.[10]

[9] Detailed information on status quo in involved FUAs can be found in Deliverable „D.T3.1.5 Comprehensive FUA-level status quo studies“ and Deliverable „D.T3.1.6 Synthesis of the FUA level status quo analyses“

[10] Detailed information on methodological approach used in elaboration of national level policy recommendations can be found in Deliverable “D.T3.4.6 Blueprint of the transnational CWC strategy“

2. LEGISLATIVE POLICY MEASURES: UPON THE NEED TO IMPROVE EXISTING BOTTLENECKS

2.1. Relevance of Legislative and Regulatory Measures

Legislation and regulation provide a general framework for finance and funding conditions as well as for intellectual property rights, which set important principles for, and grease the wheels of innovation. Regulation also imparts clarity, stability and certainty on the operating environment experienced by entrepreneurs and investors. Standards deliver a design and performance benchmark for producers and confidence for the consumer, often helping to boost trust in an unfamiliar product or service. Perhaps most importantly, regulation and standards underpin legal obligations and thereby bound liability for all parties.[11] Legislation and regulation can play an essential role in shaping markets, influencing behavior, and removing barriers that inhibit progress. Legislating and regulating is an impactful policy lever that is often used in conjunction with other policy levers such as public procurement, urban planning, and fiscal measures.

Coherent, symbiotic and planned management of all interventions in water and use of water, coastal land and water infrastructure is crucial in maintaining the quality, quantity and safety of water resources for the life and health of people and the environment, which requires **appropriate regulation and effective administration for implementation and control.**[12]

2.2. EU-level Regulatory Measures in Support of Circular Water Use

The EU has developed a portfolio of directives[13] to protect the environment, human health and regulate the water cycle. However, there are **gaps in implementation that prevent the existing legislation from achieving its objectives.** Stronger implementation support and enforcement is required.

On 25.6.2020 the new Regulation on minimum requirements for water reuse for agricultural irrigation[14] has entered into force. The new rules will apply from 26 June 2023. The purpose of this Regulation is to facilitate the uptake of water reuse whenever it is appropriate and cost-efficient, thereby creating an enabling framework for those Member States who wish or need to practice water reuse**. Any decision not to practice water reuse should be duly justified based on the criteria laid down in this Regulation and reviewed regularly.** The EU's Circular Economy Action Plan adopted in 2020 includes the implementation of the new Regulation on minimum requirements for water reuse for agricultural irrigation amongst Europe's priorities for the circular economy. The Action Plan also announces that the Commission will facilitate water reuse and efficiency in other sectors, including in industrial processes.

The challenges of common regulation in EU arise from the fact that activities being regulated are often novel, we are facing geographical heterogeneity and different, already existing legal regimes in EU countries. **Effective EU legal regulation of recycled water would provide potential for its reuse, it would accelerate the overall reuse of water, not only in agriculture, but in many more areas, where substituting fresh water for recycled would be adequate.**[15]

[11] "D.T1.2.1 Analysis of the EU level policy and legislative framework linked to circular urban water management"

[12] "D.T1.2.1 Analysis of the EU level policy and legislative framework linked to circular urban water management"

[13] Water Framework Directive (2000/60/EC), Groundwater Directive (2006/118/EC), Drinking Water Directive (98/83/EC), Bathing Water Directive (2006/7/EC), Urban Waste Water Treatment Directive (91/271/EEC), Nitrates Directive (91/676/EEC), Floods Directive (2007/60/EC)

[14] Regulation (EU) 2020/741 of the European Parliament and of the Council of 25 May 2020 on minimum requirements for water reuse

[15] "D.T1.2.1 Analysis of the EU level policy and legislative framework linked to circular urban water management"

2.3. Determination of Bottlenecks

2.3.1. Lack of Concrete Rules, Regulations and Standards

Despite increasing levels of water stress across the EU and a large potential to reuse treated wastewater, the water reuse remains limited and unregulated in the different Member States.[16] In other countries, regulatory frameworks are available but limited to reuse for irrigation.[17] Current **legal frameworks with no national regulations, guidelines and obligatory standards for non-potable water quality limit water reuse.** In addition, the lacking legal and organizational frameworks **open questions about environmental and health risks as well as the costs for suppliers and users,** which also act as a barrier for water reuse in industry and agriculture.

Moreover, a comparative analysis of national level legislative frameworks assessments in 6 CE countries (Germany, Hungary, Italy, Slovenia, Poland and Croatia)[18] showed that **there are no specific, independent national level laws with wholesome approach on rainwater management.** Regulations in most cases address the setting of requirements for the discharge of wastewater (rainwater) into water bodies (surface water or groundwater), in some cases (e.g. Germany, Poland) requirements for the installation of a rainwater harvesting system, while in Italy rules and guidelines that govern rainwater harvesting and use were issued on regional level by some regions.

In general, **there is a lack of regulations on municipal stormwater management and water scarcity** (monitoring of rainwater management such as infiltration and prevention of municipal water damage is usually the responsibility of local governments). In most examined countries there are currently no definite legal requirements for dealing with lengthening water scarcity periods related to climate change and the use of runoff reduction tools; the provisions essentially outline principles but do not provide clear guidance. This legislation, if interpreted in a permissive way, gives local municipalities more freedom in the local regulation and adoption of sustainable stormwater management solutions. On the other hand, **the actors see in the undescribed possibilities rather the danger of liability, on which investments or measures cannot be based.** In addition**, inexistent specific regulation on green roofs infrastructure hinders facilitation and boost of green roof implementation and development.** Consequently, most commonly identified policy recommendations refer to the **adjustment of laws and technical regulations in line with principles of circular economy** to give priority instead to avoiding, reducing and recycling of wastewater.

Modernized legislation on water recycling should be **supplemented by rules on water reuse and rainwater management.** Development of national regulations and standards regarding water reuse and rainwater collection would enable water reuse for irrigation and industrial purposes that will reduce overall water consumption.

In order to remove legal barriers, **legal frameworks should be created for the integration of rainwater cisterns into the property drainage** and **the dual-pipe network for the separate collection of greywater and black water should be incorporated in the building codes** for CE countries and municipalities to have the appropriate instruments at their disposal.

[16] Currently only five countries have compulsory standards on water reuse enforced through specific water reuse legislation – Cyprus, France, Greece, Italy and Spain. Water reuse standards exist also in Portugal but they become binding only when included in water reuse permits ("D.T1.2.1 Analysis of the EU level policy and legislative framework linked to circular urban water management")

[17] Detailed information on the Water Law frameworks in 6 examined countries (Germany, Hungary, Italy, Slovenia, Poland and Croatia) can be found in "D.T3.4.2 Country report on the assessments of the national level legislative and policy frameworks"

[18] Detailed comparative analysis of national legislations pertaining to water resources management in 6 examined countries can be found in " D.T3.4.6 Blueprint of the transnational CWC strategy"

2.3.2. Lack of Regenerative, Inclusive and Climate Adaptive Spatial Planning

During spatial planning determining urban land-use local rainwater management and water recycling with their various modules should be basically taken into account during the planning process. Cisterns, retention systems, and water recycling facilities should be laid down in the development plans at municipal level. Spatial planning has the task to coordinate competing land uses and conflicting objectives and to identify and promote multifunctional land use potentials. Also climate change, such as the increase in heavy rainfall events, has an impact on spatial structures and uses. Adaptation to climate change and hence heavy rain risk reduction is therefore a central issue in spatial planning. By integrating goals for heavy rain risk reduction in spatial planning, heavy rain risks can be reduced at the local and regional level. Especially on the basis of hazard and risk maps, heavy rain risk reduction strategies can be designed with the help of spatial planning instruments[19]. The national urban planning legislation is the main tool on national level that can have encouraging and symbiotic effects on the local governments' plans for climate adaptive spatial planning on local levels.

Therefore, inclusive and regenerative spatial planning should create a mechanism for protecting the resources of geographical space against excessive appropriation, enabling their ecological, climate adaptive and mitigating functions. It should include at least the following criteria:

(i) rate of inclusion of sustainability and urban regeneration as basic principles of spatial planning;

(ii) inclusion of the "regenerative" into policies and strategies for spatial development;

(iii) functional specialization through coordinated development of urban areas;

(iv) disaffecting/avoiding green gentrification potentially caused by renaturation of neighborhoods;

(v) advancement and protection of the environment, natural and cultural heritage;

(vi) regenerative repurposing of degraded, derelict, unused and underused areas;

(vii) existence and rate of participatory inclusion in regenerative spatial planning process;

(viii) mobilizing other public and private actors through spatial policy to mobilize urban renaturation;

(ix) consideration of other spatial planning influencing factors (social, gender, minorities, empowerment etc.).

2.3.3. Lack of Tax-based Incentives and Deterrents

The **current tax and price policies are not motivating to invest in circular water management.** The tax and price policies of local and national authorities **need revisions in aspect of water sustainability.** Discounts for circular water management, nature-based solutions, water retention and reuse, low consumption solutions etc. and economic sanctions of non-sustainable water management e.g. penalty pricing of high consumption, sanctions of overbuilding are also necessary elements of the regulations.

Adjusting water tariffs is necessary to support the investments needed to improve the water distribution network and treatment systems. Tariffs for stormwater discharges into the sewer system should be anchored in the wastewater fees regulations according to the polluter-pays principle.

[19] Tool risk reduction measures, ADAPT SPATIAL PLANNING, Interreg Central Europe - RAINMAN

2.4. Key Legislative Policy Recommendations for Boosting Circular Water Use in the CE Region:

Recommendation 1: Complete necessary projects to ensure full compliance with Urban Wastewater Treatment Directive as soon as possible.

Rationale: Slovenia, for instance has, not met the deadline of 31 December 2015 for the implementation of the Urban Wastewater Treatment Directive. An investment of around EUR 420 million is needed to ensure that wastewater in the remaining agglomerations is properly collected and treated.

Recommendation 2: The adaptation of new EU Regulation (REGULATION (EU) 2020/741 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 May 2020 on minimum requirements for water reuse) and creation of national legal frameworks on water reuse and rainwater/stormwater collection/reuse.

Rationale: The new rules will apply from 26 June 2023 and are expected to stimulate and facilitate water reuse in the EU. The purpose of this Regulation is to facilitate the uptake of water reuse whenever it is appropriate and cost-efficient, thereby creating an enabling framework for those Member States who wish or need to practice water reuse. This Regulation should be flexible enough to allow the continuation of the practice of water reuse and at the same time to ensure that it is possible for other Member States to apply those rules when they decide to introduce this practice at a later stage. Any decision not to practice water reuse should be duly justified based on the criteria laid down in this Regulation and reviewed regularly. Moreover, the development of national regulations and standards regarding water reuse and rainwater collection will enable water reuse for irrigation and industrial purposes that will reduce overall water consumption. Thus, it will reduce water costs and positively impact the preservation of current water resources.

Recommendation 3: Legislation on water recycling needs to be modernized and it should be supplemented by detailed rules on the way greywater and rainwater are used.

Rationale: If there is no legal regulation on technical solutions and their discharge limits, there is uncertainty in decisionmakers and officials, who apply the rules, which hinders their development. If the use of drinking water is not replaced in areas (industries and local utilizations) where the water used below the drinking water standard would be appropriate, the community will be damaged obviously. Therefore, it is necessary to support the recycling of used waters and the proper utilization of rainwater at the legislative level.

Recommendation 4: Developed standards for the quality of grey and rainwater for use in residential and public buildings and watering and drainage

Rationale: According to the European Environment Agency, an average of 144 litres of fresh water per person per day is supplied for domestic use in Europe. This value is almost three times higher than the demand for water, determined to meet basic needs. In a traditional household, 50-80% of the waste water can be reused as greywater. Greywater recycling systems are used wherever there is a large production of grey wastewater with a high demand for water. Therefore, its use in hotels, multi-family housing estates, large office complexes and public buildings is most profitable. Rain can also be used for non-potable purposes. The growing popularity of systems for the management of "rainwater" is associated with several aspects. The practical motivation is the inability to drain rainwater from the plot. The rainwater management system is then the only solution that allows you to start the investment.

Technologies for the reuse of greywater and rainwater management systems that can replace tap water already exist, although they are not widely used and can be used in residential and office buildings, in commercial and industrial facilities, in hotels and schools.

Recommendation 5: Development of a national strategic framework on green roofs

Rationale: Urban areas are highly affected by growing population, over-construction, reduction of green areas and increasing noise pollution. This causes buildings to heat up faster during the summer season, increases energy consumption, reduced biodiversity, etc. Green roofs, on the other hand, can help mitigate the problems that cities create by bringing natural cooling, water catchment and natural treatment, and air filtration properties that vegetated landscapes provided to the urban environment. Architects and planners can use green roofs to help solve environmental problems by bringing nature back to the city. The nationwide and strategic framework on green roofs in form of regulations, standards and measures would facilitate and boost green roof implementation and development.

Recommendation 6: Innovative urban spatial planning and building design

Rationale: In Italy, for example, some regions have adopted regional regulations or technical guidelines to promote innovation in the sector of rain collection and, rarely, the separation between grey and black waters. The results are still very limited. The (regional) urban spatial planning legislation is the main tool that can have effects on the government plans of the municipal territory.

At a national level, we signal the example of Germany, were in 2000 an administrative court prohibited the practice to discharge rainwater in the sewer (as a consequence of sealing soils) without paying for it. German municipalities are updating their rules for sealed soils (e.g. by introducing a fee proportional to the sealed area), and as a consequence they are achieving a widespread use of green roofs and rain collection systems.

Recommendation 7: Strengthening spatial planning as an instrument for integrated water management

Rationale: Water management is present in spatial planning, but focuses mainly on water and sewage management and the risk of flooding, which results from the diagnosis of local problems that need to be solved. Drought risk management and reduction should also be taken into account. The type of land cover and the method of land development have a decisive impact on the retention capacity of the catchment area, and thus on counteracting the negative effects of flooding and drought. The priority should be to decentralize rainwater management and recommend its retention at or near the places of precipitation, the creation of many dispersed points of local rainwater retention combined with greenery and multifunctional use of such places, e.g. for recreation of residents.

Recommendation 8:

- In national legislations the present path of wastewater disposal should be abandoned in line with principles of circular economy to give priority instead to avoiding, reducing and recycling of wastewater;
- During urban land-use planning, local rainwater management and water recycling with their various modules should be basically taken into account during the planning process;
- A legal framework should be created for the integration of rainwater cisterns into the property drainage in order for states and municipalities to have the appropriate instruments at their disposal;

- Tariffs for stormwater discharges into the sewer system should be anchored in the wastewater fees regulations according to the polluter-pays principle;
- The dual-pipe network for the separate collection of greywater and blackwater should be incorporated in the building codes.

Rationale*:* It is imperative to set the right course for the water resources management, which is one of the largest energy consumer and significant CO_2 emitter in a municipality, to achieve a greater resource efficiency. Cisterns, retention systems, and water recycling facilities should be laid down in the development plans at municipal level. The adaptation measures of the water infrastructure require a sufficient and secured financing for the construction and operation of these systems. For the implementation of different solutions, monetary incentives (subsidy systems, fee adjustments) should also be developed to realise the measures at municipal or property level (private investors).

Recommendation 9: Tax and price policies of water management should reward sustainable solutions and sanction the non-sustainable ones.

Rationale:

The current tax and price policies are not motivating to invest in circular water management. The tax and price policies of local and national authorities need revisions in aspect of water sustainability. Discounts for circular water management, nature-based solutions, water retention and reuse, low consumption solutions etc. Economic sanctions of non-sustainable water management e.g. penalty pricing of high consumption, sanctions of overbuilding are also necessary elements of the regulations.

Recommendation 10: Innovating economic tools: giving value to water.

Rationale: A strategy to promote rational water consumption and encouraging the use of technological innovation must also intervene on the price. Adjusting water tariffs is also necessary to support the huge investments needed to improve the water distribution network and treatment systems. However, it is necessary that this adjustment takes into account the equity and social sustainability of the tariffs. The ideal tariff scheme should strongly discourage water consumption above the target value.

It is also necessary to provide financial mechanisms that allow water service operators to access credit at reasonable rates, to finance new infrastructure and maintenance.

For example, funds could be built by reshaping and allocating for this purpose existing taxes or an amortization rate of the infrastructures previously financed with non-repayable contributions inserted in the tariff.

Recommendation 11: It is necessary to amend the legal framework for the operation of water utility systems so that rainwater drainage systems are also considered to be water utilities.

Rationale: Separate system stormwater drainage ditches and their facilities do not fall into the category of water utilities under current legislation. The financing of the stormwater drainage system was solved only in cases when the rainfall was discharged into the combined sewerage system. As is well known, despite of the advantages of a combined system, it has a number of disadvantages, such as the management of overloads. In the case of such systems, the rainwater mixed with the wastewater can cause a significant overload in the wastewater treatment plant, so that through the overflows and bypasses, the contaminated water enters the natural water bodies without treatment after extreme showers. In the case of extreme showers, the overload results in flooding at pumping stations or

hydraulically narrow parts of the sewerage system, faecal contaminated water can flood the inhabited settlements in the case of the combined canals, which poses a threat to public health. In the case of separated systems, this danger does not pose a threat (only in the case of illegal stormwater connection). The current regulation has resulted in sewers always having a designated operator with the necessary professional experience and equipment to carry out their task, providing a basis for the residential sewage treatment fee to cover the costs incurred. In the case of stormwater drainage channels, the "consumer" is typically the municipality, there are no other fee payers, so the maintenance of the system depends on the actual budget of the local government. As these financial resources have dwindled in the last decade, the amount of money that can be spent on the operation and development of stormwater drainage has also decreased.

The classification of the storm sewer as a public utility could make it possible to collect the costs of maintenance and development of the systems in a similarly to the sewage system and would provide the municipalities with the professional background already established by the water utility companies for the sewerage systems.

Recommendation 12: Updating the legal regulation for spatial limitations and update the technical regulation

Rationale: Complicated and long procedures for investors to obtain the necessary spatial permits and out-of-date technical regulation that is not adjusted to innovative tools should be alleviated with special provision that enable quick approval and enactment of state-of-the-art water retention, conservation and circulation solutions on single-house, street- and neighbourhood-level.

3. KNOWLEDGE CAPACITY AND AWARENESS RAISING POLICY MEASURES: TO IMPROVE KNOWLEDGE AND AWARENESS DEFICITS

Water security has become an imperative for economic prosperity, environmental sustainability and social inclusion. Climate change, rising demands for water and increasing pollution are leading to ever more insecure water resources, threatening sustainable development. These trends challenge water resources management and require strong human, organizational and institutional capacity to understand and address them.

Water management cuts across many sectors and is highly distributed – everyone contributes to it, one way or another, by consciously or not so consciously taking decisions to use, pollute, save or waste water, on a daily basis. Yet everyone's health and wealth and very survival depend on water security. This is intrinsically different from, for example, our dependency on transport or energy. Water management is therefore **particularly dependent on strong capacity, a solid knowledge base and awareness at all levels,** including those of the individual, the organization, the sector institutions and the 'enabling environment'.[20]

3.1. Decision Makers' Knowledge and Awareness Gaps

The decision makers are aware of climate change, however, **the link to urban water management and solutions is still not evident.** The public sector is a major contributor to the circular transition in all areas, not only as a policy-maker, regulator and supervisor, but also as a significant purchaser, consumer, and user of goods and services. Even though there has been many projects and activities in the past years targeting "increased water circularisation potential" in various sectors and stakeholders, the circularization of the public sector itself, however, has received very little attention. One of the other functions of the public sector has been, as put forward by authors, the importance of the public sector as a role model, where the public sector must serve as an example of good practice. This is because the public sector has influence over all other sectors, designing the policies and regulations as well as setting the overarching governance direction for how organizations are implementing the idea of circular water use in practice. Consequently, given the significance and potential of the public sector in the implementation of sustainable transition, it is imperative that the public sector embraces circular water principles into their management of resources at the organizational level, their day-to-day operations in relation to citizens and companies serving as the enabler not bottleneck.

Innovative technical solutions for sustainable water management are nowadays well known in the scientific world and it is necessary that all these scientific outcomes become also part of the higher education and university programs (mainly surveyors, engineers, and architects) and of the retraining of the professionals as technicians, private and public managers, urban planners. **Designers and engineers of the future need innovative approaches and practical knowledge to be able to respond to the challenges of climate change.**

3.2. Defining Knowledge and Awareness Gaps within the General Public

General public acceptance and awareness on water issues is of major importance. The most challenging is the development of the resource recovery market as **negative perceptions of reclaimed water and reuse products are widespread.** Preconceptions about wastewater and reuse are, for example, the notion that

[20] U. Wehn de Montalvo and G. Alaerts. Leadership in knowledge and capacity development in the water sector: a status review. Water Policy 15 (2013) 1–14

reuse of water inevitably entails health risks, irrespective of its prior treatment; greywater, on the contrary, is often considered "clean" and safe to use, whatever contaminated it may be - hence, while in public opinion water quality and health are strongly related, there is **a common lack of knowledge of wastewater treatment processes and their results.**[21]

Conducted public perception surveys indicated that the citizens of the CWC FUAs are fairly aware of the methods of reusing rainwater, whilst the awareness about the reuse of greywater is lower. Even though not everybody knew of the solutions regarding rainwater use, greywater reuse and green roofs, when the respondents were informed, they showed extreme interest and positive attitude towards their spreading, with a percentage above 90% in every FUA and close to 100% in some cases.[22] This shows a clear **need for an information strategy and communication campaigns** to capture the attention of citizens and raise awareness in order to achieve higher level of adoption of water/wastewater reuse practices and implementation of green roofs. There have to be promotion and education actions and campaigns to show that water reuse solutions are safe. It is important to implement pilots and **present good, implemented examples of activities / projects** as well as to **create a network of cooperation between stakeholders**: science, business, administration, non-governmental organizations.

However, if individual behaviours and traditions need to be changed, it will not be sufficient to merely disseminate information or to share knowledge. Experience shows that water reuse projects will obtain the best results when communities are actively involved early in project planning and implementation to avoid the NIMBY (*not in my back yard*) and BANANA (*build absolutely nothing anywhere near anything*) effects.

Model projects and participatory approaches play a key role in influencing behaviours. Moreover, stakeholders involved early in the process will feel that they can shape the project and, thus, have some control of its outcome. This alleviates fears or unease and promotes a sense of ownership.[23] It is best practice to have **as wide as possible engagement with the public, as well as with the relevant stakeholders on an equal footing (water industry, farmers, etc.), from the earliest stages of planning.**[24]

3.3. Key Knowledge Capacity And Awareness Raising Policy Recommendations for Boosting Circular Water Use in the CE Region:

Recommendation 14: Extended local and national awareness raising programs for citizens; training programs for municipalities decision makers, business sector etc.; upgraded educational programmes in public and university education.

Rationale:

However, general public and decision makers are aware on climate change, the links to urban water management and solutions are still not evident. The raised level of knowledge on water problems, sustainable solutions and its benefits ensures broad social support for implementation of circular urban water management in the public and private sector.

[21] Kramer, Annika; Petta, Luigi; Post, Julika; Wendland, Claudia (2007): EMWater Guide: Improving wastewater treatment and reuse practices in the Mediterranean countries - A Practical Guide for Decision-Makers. Prepared within the EMWater Project, InWEnt – Capacity Building International, http://www.emwater.org

[22] „D.T3.1.6 Synthesis of the FUA level status quo analyses"; detailed information on the results of the questionnaire surveys conducted in each involved FUA and their analysis can be found in Deliverable „ D.T3.1.4 FUA-level water efficiency and reuse related public perception assessments "

[23] Kramer, Annika; Petta, Luigi; Post, Julika; Wendland, Claudia (2007): EMWater Guide: Improving wastewater treatment and reuse practices in the Mediterranean countries - A Practical Guide for Decision-Makers. Prepared within the EMWater Project, InWEnt – Capacity Building International, http://www.emwater.org

[24] WFD Common Implementation Strategy – Progress and Work Programme 2003/2004

The circular water management is a “must have principle” in the educational programme of relevant universities and faculties. Designers and engineers of the future need innovative approaches and practical knowledge to be able to respond the challenges of climate change.

Recommendation 15: Promote innovative knowledge.

Rationale: Innovative technical solutions for sustainable water management are nowadays well known in the scientific world. These include management of distribution networks, remote control, systems for leak detection, collection and use of rainwater, separation, treatment and reuse of greywater, natural purification techniques for decentralized treatment, dry “sanitation” systems and separate urine collection, sustainable drainage systems.

It is necessary that all these scientific outcomes become part of the higher education and university programs (mainly surveyors, engineers, and architects) and of the retraining of the professionals as technicians, private and public managers, urban planners.

Recommendation 16: Innovating the culture of water by correctly informing citizens.

Rationale: In order to apply all other recommendations, it is essential to involve and educate on water issues citizens, public administration operators, the environmental world, and water service professionals.

There is a clear need for an information strategy to increase attention and awareness on water issues, through long-term national education, culture and information programs targeting all categories of stakeholders.

A large investment is needed to improve organization and culture on water issues and to replicate virtuous case studies already existing. Major communication campaigns are needed to capture the attention of citizens and raise awareness. Campaigns must have national coordination and many different local implementations integrated with technical actions and intervention. In particular, it is essential to integrate information campaigns with changes to the regulatory framework and with the use of economic tools.

Recommendation 17: The creation of a closed-loop water system, guidelines, requirements, catalogues of good practices for water reuse and promoting actions for its reuse.

Rationale: The goal of circular water management is to use wastewater as a resource (water, energy and nutrients) in accordance with the concept of the circular economy and based on priorities: • Avoid (if possible) • Reduce (demand) • Recycle (recover) • Reuse • Dispose of (as a last resort).

One of the barriers facing the reuse of water is the public perception of such a solution. There are treatment technologies that, according to the intended use, ensure the safety of recycled water. There needs to be promotion and education to show that water reuse solutions are safe. It is important to implement pilots and present good, implemented examples of activities / projects and cooperation of stakeholders: science, business, administration, non-governmental organizations (creating a network of cooperation between stakeholders).

Building responsibility for water: for saving drinking water, appropriate use of sewage (sewerage is not a garbage can), retention and reuse of rainwater and greywater, as well as protection of ecosystems.

Recommendation 18: Introduction of advisory and information services for companies and the general public, start-ups, customers, professional training, qualifications and skills courses.

Rationale: There is a lack of awareness of citizens and companies/entrepreneurs about the benefits of reusing water and wastewater and green roofs. Water/wastewater can be reused for industrial purposes, irrigation or non-potable home use. Sludge from wastewater treatment can be used for agricultural purposes or in construction for production of secondary raw material-based products. The use of a green roof reduces overheating of buildings and increases air filtration. All the benefits lead to a reduction in energy and water consumption which ultimately reduces costs. The introduction of these benefits in the form of advisory and information services for companies and the general public, start-ups, customers, vocational training, qualification and skills courses could lead to increased awareness, and thus a higher level of adoption of water/wastewater reuse practices and implementation of green roofs.

Recommendation 19: The framework for a successful and water-conscious urban land-use should be developed jointly with the stakeholders and communicated to citizens (inclusive, citizen-oriented). Simplicity, transparency and practicality are recommended instead of over-regulation.

Rationale: Water-conscious urban land-use needs good cooperation between all involved parties. The interests of the municipal enterprises, politicians, investors, interest groups and citizens should be involved early on and comprehensively. Integrative planning, communication and decision-making structures are very suitable to jointly develop goals, boundary conditions and solutions.

4. GOVERNANCE POLICY MEASURES: TO IMPROVE EXISTING GOVERNANCE PRINCIPLE (TO TAILOR GOVERNANCE TO THE NEEDS OF CIRCULAR ECONOMY APPROACH)

Cities are laboratories for innovation, where experiments and pilot projects can take place. The circular economy can provide technically innovative solutions for facing and overcoming water risks (i.e. technical innovations for water reuse, wastewater recycling and reduced water consumption, aiming to keep the value of water at its highest for as long as possible, generate new inputs and material, while optimising production costs (e.g. at industry level) and closing loops). Nonetheless, the potential of the circular economy can be unlocked only if the necessary economic and governance conditions will be in place.[25]

Although in most of the examined CE countries there are several strategic documents for water conservation available to decision-makers, they only address the set goal partially, at the level of mention, so they are able to perform their function with low efficiency.[26] **More detailed (national and local) strategies for more efficient water use and circular water management for all water-consuming sectors, outlining objectives in the short and medium term,** were therefore recognized as overall essential. These goals are the milestones that ensure that the goal is achieved through legislation and standards, aids, and awareness-raising work.

4.1. De-Siloing and Strengthening Environmental Governance

Current approaches to urban water management remain sector-specific, lacking the necessary scope to adequately address cross-cutting, water-related challenges in developing world cities. Watershed approaches to urban water management, where they exist, are often fragmented and not well coordinated with urban planning and with the provision of other urban services. Local authorities may also lack information and experience on the technical options available for a more sustainable approach to urban water management. As a consequence, variations in the quantity and quality of water available to cities for drinking water, agriculture, energy, industry and the environment, exacerbate water insecurity, as competition for water between sectors increases, both within the city and between the city and other actors in the watershed, particularly when the quality of water is compromised.[27]

In many cities decision-making on urban development remains to take place in silos, while circular economy requires a more multi-dimensional and integrated way of administration. Trans-departmental cooperation as well as continuously driven innovation and coordination of circular economy efforts in the city are crucial. As the city is a partner in the urban transition to the circular economy, not the director, non-municipal stakeholders should be identified, addressed and included early on in the transition process (e.g. businesses, knowledge institutes, citizens) - in order to craft the process to come to circularity within an urban context, together.[28] The **administrations of urban and open space planning, water resources management, urban drainage and green space maintenance are well advised to coordinate closely at management and**

[25] UNESCO and UNESCO i-WSSM. 2020. Water Reuse within a Circular Economy Context (Series II). Global Water Security Issues (GWSI) Series – No.2, UNESCO Publishing, Paris.

[26] Detailed information on the existing strategies and policy instruments in 6 examined countries (Germany, Hungary, Italy, Slovenia, Poland and Croatia) can be found in "D.T3.4.2 Country report on the assessments of the national level legislative and policy frameworks"

[27] World Bank. 2016c. Mainstreaming Water Resources Management in Urban Projects: Taking an Integrated Urban Water Management Approach. Washington, DC: World Bank. http://hdl.handle.net/10986/29613

[28] Jonker, J. and N. Montenegro Navarro (2018), "Circular city governance - An explorative research study into current barriers and governance practices in circular city transitions in Europe"

technical levels. The **interests of the municipal enterprises, politicians, investors, interest groups and citizens should be involved early and comprehensively.** Governments should adapt the **legal framework for urban, infrastructure and project planning to ensure effective and transparent participation processes** and cities and municipalities provide for **appropriate administrative and decision-making structures, qualified personnel and suitable communication formats** (e.g. round tables, zero-phase concepts.

4.2. Integrating Rainwater Harvesting and Greywater Recycling in the Overall Water Resources Management

The water infrastructure in CE countries is in need of rehabilitation and renewal. Within the context of climate change and climate adaptation, the infrastructure should be preferably transformed into a flexible, efficient, economical and resource-conserving infrastructure. This requires the establishment of an interdisciplinary, integrated water resources management. Traditional approaches cannot be simply further perpetuated in the future, but have to be improved, complemented or replaced by new, climate-resilient solutions and combination of measures. A re-orientation in the water resources management should take place. The goal should be to ensure the availability, quality and quantity of water for all sectors in an ecologically, economically and socially compatible manner, in addition to protecting our environment from the adverse impacts of climate change.

Hardly any city can supply itself with high-quality drinking water for all use purposes merely from own local water resources. In view of the increasing incidence of droughts (water shortages), the "water supply" as a public service becomes particularly important. There is a significant potential to supplement the water supply by using rainwater and recycled greywater. **Rainwater harvesting and greywater recycling (service water use) should be integrated in the overall water resources management.** For construction sites, rainwater cisterns should be stipulated as part of the onsite property drainage, to store and reuse rainwater in the building. At district level in cities and municipalities, rainwater retention options should be considered and integrated. Particularly in multi-storey residential buildings and dense urban centers, greywater reuse is an ideal measure to reduce water consumption. **For non-potable water applications in multi-storey residential constructions or in municipalities, trade and industry, priority should be given to service water systems (rainwater/greywater).**

The existing water infrastructure in buildings should be made available for the integration of service water (Water Efficiency Ready). For new constructions or complete renovations of existing buildings, the legal basis for the (mandatory) construction of a dual-pipe system for service water use in buildings (rainwater and greywater) should be laid down. Toilets and urinals as well as washing machines in buildings should basically be operated with service water. As a significant amount of thermal energy can be recovered from wastewater, **heat recovery from service water systems should be exploited.** Additionally, **service water systems should be used for cooling and air conditioning.** An effective, so far largely unused potential for air conditioning in buildings, are water-based cooling systems, which are operated with rainwater (adiabatic cooling). The use of the soft rainwater eliminates the need for softening or desalination processes. Rainwater-fed cooling and air-conditioning systems can significantly reduce energy consumption compared to the conventional air-conditioning. In addition, investment costs as well as material and maintenance expenditure are reduced. Wastewater also contains **essential nutrients (nitrogen, phosphorus), which can be recycled and reused.** Technologies to be used to improve resource efficiency have been successfully tested and introduced in the technical regulations as resource-oriented sanitation systems (NASS)[29].

[29] DWA Working Paper **DWA-A 272E (2014)** "Principles for the planning and implementation of New Alternative Sanitation Systems (NASS)". The German Association for Water, Wastewater and Waste (DWA), Hennef. https://webshop.dwa.de/de/dwa-a-272-neuartige-sanitarsysteme-6-2014.html

Heavy rainfall events in urban areas can quickly lead to overloading of the existing water infrastructure in cities and municipalities. Sealed surfaces aggravate the problem and increase flood risks. Rainwater storage systems used throughout the year reduce rainwater flow and runoff peaks (flood protection) and help protect surface and groundwater reserves during dry periods. Retaining rainwater in urban areas, instead of its discharge into the sewer or water bodies offers more environmental benefits and protection. Implementation of blue – green infrastructure can provide ecosystem services consisting in restoring water circulation processes in the urban landscape, mitigating floods and flooding, supporting the functioning of rainwater drainage, reducing the effects of drought and urban heat island and reducing the costs associated with the occurrence of the above disturbances. The **retention and storage of rainwater should be implemented as a priority measure of rainwater management on properties**. Where possible, underground storage facilities should be constructed on public properties and use applications examined. The provision of water for firefighting should be supplemented by rainwater retention systems.

For a focused future implementation of rainwater harvesting or greywater recycling, other management instruments may be necessary and useful. **Introduction of "Water Certificate", similar to the energy certificate (pass), is proposed for new private and public buildings and labelling of existing buildings.** The Energy Performance of Building Directive shows a good example of the market impact of technical requirements. Labelling is a clear and easy to understand market tool with long term impact on the new and existing building stock. Buildings with sustainable water management represent a higher market value, thus it is a motivation factor for the private owners to invest in sustainable solutions, e.g. greywater reuse, green roof, rainwater tanks etc.

Nowadays the management of urban networks is assessed based on the quality of the service offered to citizens (regularity of service, quality of water, response time in the event of breakdowns, etc.). To encourage managers to adopt more sustainable techniques and approaches, it is necessary to provide **reward and penalty mechanisms based on the "environmental performance"** such as water losses (per Km of network) and ILI (Infrastructure Leakage Index), energy efficiency of water supply networks (e.g. Water Supply Energy Efficiency – WSEE), untreated polluting load, environmental status of the water bodies, in particular upstream and downstream of the discharges of public treatment plants.

In order for the system to work properly, subsidiarity can be an effective solution, as enshrined also in European Union documents, as a way of tackling problems on the ground. There is a need to **establish a public administration framework that addresses the issue of water recyclability at the local level** by delegating authorization, control and sanctioning powers to the responsible local governments, shortening decision-making pathways.

4.3. Systemically Adapting Infrastructure in Support of Circular Water Use

4.3.1. Support Programmes

The adaptation measures of the water infrastructure require a sufficient and secured financing for the construction and operation of these systems. Beyond the tax and price policies, specific sectors, like residential and municipal, need direct **financial incentives to speed up investments.** In order for the developed technologies / installations to become widespread, **support programmes for up-take of best pilot projects to systemic practice are needed.** If there is financial support, there will surely be a group that will accept solutions for the use of rainwater or treated gray water and that can also be part of the promotion of such solutions, but it needs to be precisely defined what needs to be done, how much it will cost, at what time (after how many years) and how the investment will payback and what these benefits will look like.

4.3.2. Data Collection and Open Source Data Access

A range of information and communication technologies such as affordable, innovative sensor technologies, smartphones and social media provide the means for instant data collection, sharing and broadcasting. The diffusion of these technologies is accompanied by the post-positivist view of science that now pertains, which has given rise to the realization that there is a broader range of valid and relevant information than that observed, selected and generated by scientists alone. Together, these trends pave the way for citizen observatories whereby the observations of ordinary citizens – and not just those of scientists – are included in earth observation, environmental conservation and management as well as in development efforts. By drawing on the collective intelligence and knowledge of citizens, these trends have the potential to improve water services (e.g. reporting infrastructure failures) and the management of water resources (e.g. reporting on water levels). They also imply changes for water governance processes and may fundamentally change existing institutional structures These trends are accompanied by a move towards open data by many governments as well as donor organizations.[30] **Engaging the general public through citizen science can increase knowledge about the environment and help the authorities in their work.**

For a sustainable water resources management, it is indispensable that **existing data with regard to water resources and their quality, as well as to discharges from wastewater treatment plants and rainwater discharges are made transparent for the public without any barriers.** Transparency also applies to costs and environmental impacts.

The water system management can gain significant improvement by **adopting monitoring systems.** Monitoring can be applied in several contexts related to water: users' behaviour in water use can be monitored, as well as the results of facilities installation. The monitoring can regard the use of fresh water, the waste water and also the harvesting of rain water or the reuse of greywater. A better availability of data about the water cycle can help in taking correct decisions and specially to address a smarter use of water that allows a better water saving.

4.3.3. Spatial Governance in Support of Circular Water Use

Water-conscious urban land-use requires a long-term and complex transformation process whereby personal, financial, institutional, professional and legal barriers may be encountered. These require a **joint, long-term and strategic approach.**

A good example could be drawn from the INSPIRE Directive[31] that created an online portal to enable geospatial data on the environment to be shared among public authorities in Europe. This includes common standards for collecting data on e.g. groundwater, transport networks, land use, air temperatures. In every municipality, special measures are put in place for every intervention in space. "Space" in this instance means grey infrastructure, whereas no particular datasets are held by geospatial authorities in municipalities to keep records on green infrastructure, be it on private or public properties. Consequentially, no consents are needed in order for private (or public) investors to intervene into green space, thus no benefits or shortcomings of said interventions are considered and no records are kept. This mismanagement, or rather non-management, of green infrastructure culminating in abhorrent spatial intervention practices for several decades causing spatial decay on municipal level is one of the leading problems hindering systemic circular water use. Thus, systemic following, recording-keeping and public consent requirements for all green infrastructure in a city, particularly the parts affecting circular water use in any way (rainwater retention & collection surfaces, green roofs and green surfaces and nature-based

[30] U. Wehn de Montalvo and G. Alaerts. Leadership in knowledge and capacity development in the water sector: a status review. Water Policy 15 (2013) 1–14

[31] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

solutions, alternative pipelines, overall house-level discharge practices particularly of stormwater etc.) should be integrated into existing geo-information systems of municipalities and also included into spatial planning policies and implementation documents.

4.4. Key Governance Policy Recommendations for Boosting Circular Water Use in the CE Region:

Recommendation 20: Construction of municipal water structures and restoration of water supply networks that are obsolete due to the deterioration of water pipes.

Rationale: In some CE countries (e.g. Croatia) high percentage of citizens are not connected to the sewage system, and areas such as islands often do not have a built sewage system, instead the wastewater is collected in septic tanks or discharged directly into the sea. Construction of municipal water structures will contribute to increasing the amount of treated wastewater, as well as increasing the potential amount of water for reuse and ultimately environmental protection.

Water losses pose a major challenge for system improvements, better management and maintenance. The problem of water losses is an indication that municipalities in some CE countries (e.g. Slovenia) do not invest the funds raised in the purpose of renovating the water supply system in order to provide consumers with a quality standard of water supply. Dilapidated pipelines that have not been renovated cause, in addition to water losses, also high costs of current maintenance, which increases price of water or causes higher operating costs.

Recommendation 21:

- Incorporate decentralised water sources, such as rainwater and recycled water (service water) into the efficient water supply system;
- Incorporate retention, storage and utilisation of rainwater in the existing water supply as an integral part of the future water policy strategy.

For construction sites, rainwater cisterns should be stipulated as part of the onsite property drainage, to store and reuse rainwater in the building. At district level in cities and municipalities, rainwater retention options should be considered and integrated.

The existing water infrastructure in buildings should be made available for the integration of service water (Water Efficiency Ready). For new constructions or complete renovations of existing buildings, the legal basis for the (mandatory) construction of a dual-pipe system for service water use in buildings (rainwater and greywater) should be laid down. Toilets and urinals as well as washing machines in buildings should basically be operated with service water.

Rationale: Hardly any city can supply itself with high-quality drinking water for all use purposes merely from own local water resources. In view of the increasing incidence of droughts (water shortages), the "water supply" as a public service becomes particularly important. In this context, rainwater has become one of the most important alternative resources. Rainwater must be retained and stored where it falls and integrated into the water supply of cities and municipalities. There is a significant potential to supplement the water supply by using rainwater and recycled greywater. This is particularly true for months with high amounts of precipitation, which often occur in the dry months, during which rainwater can be stockpiled and used over the year. This will conserve the groundwater resources and buffer and store rainwater during heavy rain events.

Particularly in multi-story residential buildings and dense urban centers, greywater reuse is also a viable option. Greywater is recycled and safely reused throughout the year for different applications such as

toilet flushing, washing machines, irrigation, cleaning and firefighting. This can save 30 - 50% of the water used in buildings.

Recommendation 22: In cities and municipalities:

- the retention and storage of rainwater should be implemented as a priority measure of rainwater management on properties;
- where possible, underground storage facilities should be constructed on public properties and use applications examined;
- the provision of water for firefighting should be supplemented by rainwater retention systems.

Rationale: Heavy rainfall events in urban areas can quickly lead to overloading of the existing water infrastructure in cities and municipalities. Sealed surfaces aggravate the problem and increase flood risks. Rainwater retention, combined with other measures of rainwater management such as infiltration, evapotranspiration or utilization significantly contribute to reducing the impacts of heavy rainfall and floods. Since heavy rain events often occur during the summer months, valuable rainwater can be buffered locally and made available during dry periods, thus mitigating water scarcity as part of the climate change adaptation. The mere discharge of rainwater into surface water or the sewer deprives the area from this precious resource. A well-combined rainwater retention system with its flexible components, in combination with the existing systems, promotes the blue-green infrastructure in cities and municipalities (sponge city effect).

Rainwater storage systems used throughout the year reduce rainwater flow and runoff peaks (flood protection) and help protect surface and groundwater reserves during dry periods. Retaining rainwater in urban areas, instead of its discharge into the sewer or water bodies offers more environmental benefits and protection.

Recommendation 23:

- For non-potable water applications in multi-storey residential constructions or in municipalities, trade and industry, priority should be given to service water systems (rainwater/greywater);
- Heat recovery from service water systems should be exploited;
- Service water systems should be used for cooling and air conditioning;
- Potential synergies between water and energy should be identified and implemented in the urban and building planning.

Rationale: The drinking water demand as well as the amounts of generated wastewater in buildings can be significantly reduced through greywater recycling. This also results in continuous savings in the drinking water of approx. 30 - 50%, independent of the season. At the same time, wastewater is equivalently reduced. Combined with heat recovery, a significant amount of thermal energy can be recovered from wastewater. An effective, so far largely unused potential for air conditioning in buildings, are water-based cooling systems, which are operated with rainwater (adiabatic cooling). The use of the soft rainwater eliminates the need for softening or desalination processes. Rainwater-fed cooling and air-conditioning systems can significantly reduce energy consumption compared to the conventional air-conditioning. In addition, investment costs as well as material and maintenance expenditure are reduced.

Wastewater also contains essential nutrients (nitrogen, phosphorus), which can be recycled and reused. Technologies to improve resource efficiency have been successfully tested and introduced in the technical

regulations as resource-oriented sanitation systems (NASS)[32]. The use of these resources also requires new organizational and planning cooperation as well as financial support to further develop and introduce these technologies, above all against the background of global demand for resource-efficient cities of the future.

Recommendation 24: Creating formal, legal and administrative conditions for the implementation of green and blue infrastructure aimed at proper water management in urban space.

Rationale: Although cities recognize the issues of rainwater and meltwater management and include it in strategic and planning documents, it is mainly in the context of protecting local grey infrastructure against the negative effects of floods and floods resulting from heavy precipitation. However, they did not refer to the current and targeted level of use of rainwater and meltwater in cities. The activities undertaken by the self-governments mainly include the expansion of the rainwater sewerage network, including its separation from general sewage system. To a lesser extent, they concerned the construction of retention reservoirs, infiltration wells, blue-green infrastructure solutions, despite the fact that the retention and infiltration of rainwater and meltwater are in fact additional tools to protect urban infrastructure against the effects of violent weather phenomena in relation to overloaded rainwater sewer networks. In addition, BGI (blue – green infrastructure) can provide ecosystem services consisting in restoring water circulation processes in the urban landscape, mitigating floods and flooding, supporting the functioning of rainwater drainage, reducing the effects of drought and urban heat island and reducing the costs associated with the occurrence of the above disturbances.

Recommendation 25: Elaborating technical standards of water management for new buildings and a water labelling system for existing and new buildings - "Water Certificate"

Rationale: There is a huge potential in water consumption and water management of existing and new buildings. The private and public buildings play key role in the urban water management. The Energy Performance of Building Directive shows a good example of the market impact of technical requirements. Mandatory standards of water consumption, water reuse and rainwater management improve the sustainability of new building stock from the introduction point of new regulations. Labelling is a clear and easy to understand market tool with long term impact on the new and existing building stock. Buildings with sustainable water management represent a higher market value, thus it is a motivation factor for the private owners to invest in sustainable solutions, e.g. greywater reuse, green roof, rainwater tanks etc.

Recommendation 26: Innovate the management of urban networks

Rationale: Nowadays the management of urban networks is assessed based on the quality of the service offered to citizens (regularity of service, quality of water, response time in the event of breakdowns …). To encourage managers to adopt more sustainable techniques and approaches, it is necessary to provide reward and penalty mechanisms based on the "environmental performance" such as:

- Water losses (per Km of network) and ILI (Infrastructure Leakage Index)
- Energy efficiency of water supply networks (eg. Water Supply Energy Efficiency – WSEE)
- Untreated polluting load

[32] DWA Working Paper **DWA-A 272E (2014)** "Principles for the planning and implementation of New Alternative Sanitation Systems (NASS)". The German Association for Water, Wastewater and Waste (DWA), Hennef. https://webshop.dwa.de/de/dwa-a-272-neuartige-sanitarsysteme-6-2014.html

- Environmental status of the water bodies, in particular upstream and downstream of the discharges of public treatment plants.

On the basis of these parameters it would be possible to:
- define standards of "environmental performance" of the Integrated Water Service
- disseminate the comparison of these performances
- develop administrative mechanisms that reward or penalise managers according to the environmental performance achieved, taking into account the specific territorial characteristics.

Recommendation 27: There is a need to establish a public administration framework that addresses the issue of water recyclability at the local level by delegating authorization, control and sanctioning powers to the responsible local governments, shortening decision-making pathways.

Rationale: The issue of water recycling is a matter of national importance, which, however, can typically take place at local level. Economical and efficient water management can be ensured for utilities and end users. From the point of view of circular economy, the end user, the consumer, is a relevant participant in this process. The consumer is typically an individual, or a group of individuals (e.g., condominium owners), or business entities; all of these can be achieved directly within a given community, and community goals can obviously be managed at a hierarchical level appropriate to the community. The provision of piped water supply, although implemented through public utility companies, is basically the responsibility of the municipalities according to most national legal systems. This also means that saving water is also a local interest and thus obviously a local task, even if the protection of water resources is often a national matter. Share of tasks and competences needs particular care in the system.

Tasks related to water damage are also the responsibility of municipalities; this applies in particular to water damage (inundation) in connection with precipitation. Efficient water management at the building or consumer level can best be ensured by the building permit procedure and the related authority powers. Examples include dealing with damage in connection with the illegal disposal of rainwater, locating the person responsible and sanctioning it. In some systems (e.g. in Hungary), the building permit is issued at a higher administrative level, moved from the local governments, and in some cases, only a notification is required for the construction. Higher administrative units have little understanding of local problems, so local interests are not necessarily visible, although these are necessary for sustainable water management, and so these aspects are not adequately reflected in their decisions. The situation is similar with sanctions; if, for example, someone causes damage by dumping illegal rainwater, it could be remedied through a government office process instead of a faster local procedure. At the same time, the essence of the problem is lost in the government office, because it is handled together with hundreds of cases directed to concentrated administration. This procedure results in a prolongation of the process, becoming impersonal and a loss of substance. The result of the procedure is not efficient enough in this system. In order for the system to work properly, subsidiarity can be an effective solution, as enshrined also in European Union documents, as a way of tackling problems on the ground.

Recommendation 28: Sectors specific direct incentives to speed up investments.

Rationale:

In specific sectors, like residential and municipal, the long financial return period and the lack of financial resources hinder the investments. These sectors need direct financial subsidies to speed up interventions.

Recommendation 29: To increase the level of incentives and subsidies for eco-innovations (water management, eco-labelling, waste management, etc.)

Rationale: To make the transition to a circular economy easier, an increase in innovations in each area such as water reuse, eco-labelling, waste management, and renewables is needed. Such a boost can be achieved by promoting and increasing the level of incentives and subsidies for eco-innovation and green public procurement enacted by the public authorities.

Recommendation 30:

- Networking, targets and concepts should be developed and the right course should be set in order to drive forward the planning processes for new constructions and refurbishment projects quickly and productively. A crucial success factor is the early coordination and close and permanent cooperation from the framework to object planning;
- The federal and state governments should adapt the legal framework for urban, infrastructure and project planning to ensure effective and transparent participation processes. Cities and municipalities are called upon to provide for appropriate administrative and decision-making structures, qualified personnel and suitable communication formats (e.g. round tables, zero-phase concepts), which have proven very successful in practice;

Rationale: Water-conscious urban land-use needs a good cooperation between all involved parties. The administrations of urban and open space planning, water resources management, urban drainage and green space maintenance are well advised to coordinate closely at management and technical levels. The interests of the municipal enterprises, politicians, investors, interest groups and citizens should be involved early and comprehensively. Integrative planning, communication and decision-making structures are very suitable to jointly develop goals, boundary conditions and solutions.

Recommendation 31: Engaging citizens, businesses and farmers in the "citizens" science. Engaging the general public through citizen science can increase knowledge about the environment and help the authorities in their work.

Rationale: In Slovenia, for example, there is no website providing information to businesses and farmers on information how to comply with their environmental obligations. The provision and the quality of such information in Member States is an indicator of how actively authorities promote compliance in areas with serious implementation gaps.

Recommendation 32:

1. Improve access to spatial data and services by making stronger linkages between the country INSPIRE portals, identify, and document all spatial datasets required to implement environmental law, and make the data and documentation at least accessible 'as is' to other public authorities and the public through the digital services envisaged in the INSPIRE Directive[33].
2. Improve the legal framework and/or the practical application access to information to facilitate public participation across the implementation of EU legislation with impact on the environment in line with the Aarhus Convention.

Rationale: In some countries (e.g. Slovenia) implementation of the INSPIRE Directive leaves room for improvement. The accessibility of spatial data through 'view and download' services is poor. Greater

[33] DIRECTIVE 2007/2/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCILof 14 March 2007 Establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

efforts to make the data accessible through services, to improve the conditions for data reuse and to prioritise environmental datasets in the implementation of environmental legislation are needed.

Recommendation 33: Monitoring the water cycle

Rationale: The water system management can gain significant improvement by adopting monitoring systems. In water management, data are fundamental for a proper monitoring and to build models for a better planning. A better availability of data about the water cycle can help in taking correct decisions and specially to address a smarter use of water that allows a better water saving.

Monitoring can be applied in several contexts related to water: users' behaviour in water use can be monitored, as well as the results of facilities installation. The monitoring can regard the use of fresh water, the waste water and also the harvesting of rain water or the reuse of greywater. For each context specific devices for data collection must be installed to allow monitoring. The monitoring process can aim at increasing knowledge about the urban water cycle, but can also aim at testing the ability of an implemented set of interventions to achieve their goals, and at promptly recognising potential unwanted effects and adopt corrective measures, eventually including mitigation and compensation measures. As an example, if smart water meters were installed in each household, water utility companies could collect data from individual users and develop predictive models to forecast domestic water use and, consequently, adapt their development and management plans.

Recommendation 34: In order to remove barriers, legal, financial and administrative measures often contribute to this, such as:

- the adjustment of laws and technical regulations;
- the establishment of necessary working methods such as agility, participation, communication or new planning instruments;
- the provision of sufficient, easily accessible human and financial resources;
- the building of suitable and flexible organisational structures for interdisciplinary and cross-sectoral integrated work.

Rationale: In practice, administrative structures and planning processes are still often unilaterally oriented towards conventional rainwater drainage and wastewater disposal. Therefore, the necessary local targets, administrative processes and rules, as well as human resources in the technical field are often lacking, in order to realise a water-conscious urban land-use in accordance with the applicable planning rules.

Water-conscious urban land-use requires a long-term and complex transformation process which must be supported by a wide range of actors and stakeholders, whereby personal, financial, institutional, professional and legal barriers may be encountered. Barriers can often be easily reduced through early discussions and networking among stakeholders. However, there are also barriers that require a joint, long-term and strategic approach.

Recommendation 35: Development of a National Water Conservation Strategy

Rationale: In many CE countries the protection of water and the aquatic environment as well as the protection against adverse effects of water is partially regulated by different acts and strategic documents. However, there is no single document/strategy that governs water conservation on a national level. The creation of such a strategy will contribute to the harmonization of water protection throughout the country as well as to the change of water charges adapted to individual service areas.

Recommendation 36: Compilation of a detailed strategy for the reuse of water - water uses that require non-potable drinking water quality should be reduced in order to avoid overexploitation of natural water resources and to reduce the energy demand for water treatment and supply to consumers.

Rationale: During the development of water supply, the primary goal has been to provide consumers with healthy drinking water. This goal has been achieved in most CE countries (e.g. in Hungary, almost 100% of the population receives piped water supply, the quality of piped water meets the requirements of the standards in most of the country, and improvements are only needed to meet the stricter health protection regulations). However, purifying water and delivering it to consumers is an energy-intensive process. Reducing the energy demand of water supply is a reasonable goal. The energy demand for water treatment also depends on the quality of the naturally available water resources. If, due to the overexploitation of natural water resources, it is also necessary to include less good quality water bodies in drinking water production, the amount of energy spent on treatment should also be higher. If the amount of water supplied to consumers on the pipeline can be reduced, the use of natural water resources will also be less necessary. Thus, the reduction in consumption demand results in a reduction in energy demand and a better management of water resources.

One way to reduce consumption needs is to promote the safe reuse of water that is already used by the consumer for activities that do not require drinking water quality. This can also be helped by providing the necessary amount of water from alternative sources for such activities, such as collected rainwater. This is particularly important if the drainage of rainwater in the area is not solved and, for example, through illegal discharges, they cause overloading of the separated sewage system and thus material damage.

A strategy needs to be formulated on this issue, outlining objectives in the short and medium term. These goals are the milestones that ensure that the goal is achieved through legislation and standards, aids, and awareness-raising work.

Currently, several strategic documents are available to decision-makers, but they only address the set goal at the level of mention, so they are able to perform their function with low efficiency. A more detailed strategy, which also identifies milestones on the road to the goal, is essential.

Recommendation 37: Developing a national strategy and local strategies for integrated water management that treats rainwater, surface and groundwater resources and the quality of the urban environment together in order to ensure resource renewableness, water recirculation and increase the resilience of cities to extreme phenomena and develop recommendations/guidelines for their implementation in practice.

Rationale: Despite the observed climate changes and the systematic decrease in the level of groundwater, in many CE countries no uniform strategy has been developed regarding the issue of water management from precipitation, which would specify, in particular, goals, actions aimed at their implementation and target indicators for the management of these waters. The development and subsequent implementation of such a document is of key importance for counteracting the effects of human activity, especially in urban areas, where the sealed area is systematically increasing, preventing rainwater from soaking in. The result of the rapid flow of water to the receiver is a lowered level in groundwater.

Climate change is making long rainless periods interrupted by heavy rains more frequent. It grows with flash floods and urban floods. The sealing and increasing impermeability of the catchment area exacerbate the problem of rapid runoff of high-volume rainwater. Stormwater drainage systems are

designed for too little capacity compared to the increasing frequency and intensity of heavy rains. The result is the loss of local governments, business and citizens.

5. CONCLUSIONS – HOW TO CONTINUE

The proposed Transnational Strategy presents an all-encompassing overview of CE circular use of water recommendations elaborated in a bottom-up manner by the Stakeholders, Target Groups and Partners involved in the CWC project. Many recommendations have arisen by determining that several CE countries and cities suffer from the same bottlenecks and hindrances in achieving circular use of water. This Strategy is structuring its recommendations within three core groups that altogether present a comprehensive policy overhaul: legislative, capacity building and awareness raising, and governance. Self-reflection of different government levels and actors is pertinent before implementing (any) recommendations, thus the Strategy furthermore offers a way to actually implement said recommendations in the sub-sections below.

5.1. Implementing Legislative Recommendations

The majority of regulatory capacity in most CE countries resides with all three levels of governments: national, regional and/or local. There is an obvious need for an improved standard for assessing the impact of legislation on circular use of water opportunities and identifying barriers along the way. In order to generate opportunities for water use, recycling and reuse, this actions should develop regulations based on the recommendations described above, including promoting re-use and recovery of wastewater, capturing, storing rainwater and replacing potable water for non-potable uses with it, setting minimum fit-for-use standard, inclusion of circular water use into green public procurement, proposing tax incentives, and disincentives, etc. At the same time, the role of the revised regulation is also to ensure clearer rules on how best to stimulate the safe use of different water types for various purposes. Since defining problems and proposing legislative solutions for the entire circular water transition is a complex and lengthy process, a particular internal tool for policy-makers to conduct an assessment of this process that is based on the OECD's Regulatory Impact Assessment should be taken-up. The assessments steps should be comprised of:

I. Defining regulatory problems. This phase is the preliminary point partially defined already in the recommendations in this Strategy.
II. Collecting data should be based on positive experience from best practices.
III. Identifying different regulatory options - the need for regulatory intervention identified in phase 1 is herein translated into concrete options.
IV. Assessing alternative options. A cost-effectiveness analysis or a risk analysis should be done for proposal received and created. Options assessed should include the "no change", "minor change", "major change" or "complete overhaul" scenarios.
V. Selecting preferred regulatory option/s. Once the different options are identified and scrutinized, the comparison of the different assessment leads to the identification of the most efficient option.
VI. Communicating results. Proposal of changes is to be publicized for public scrutiny to allow for further exchange with stakeholders and improve the general transparency of the regulatory process.
VII. Adopting the proposal(s) and enforcement.

5.2. Raising Awareness and Building Capacities

Similarly, to the concept of welfare state, the environmentally-protective state should pursue "circular flexicurity" that is protective of environment and resources and at the same time enabling for innovative circular water solutions. The circular flexicurity of state comprising all public actors results as the contribution of public actors to sustainability equilibria, including the economic, environmental, and social dimensions of today, as well as their interrelations within and throughout the time dimension (i.e., the short-, long-, and longer-term). To efficiently increase knowledge, build capacities and raise awareness

among public and private actors, the following interrelated subject areas should be addressed in order to ensure the organizations' transition into a circular enabler:

I. Internal Organisation and Operation of the Public Sector. The internal processes and operations are one of the crucial areas for the examination and integration of circular water practices. This area of activity in the public administration sector represents a large variety of different activities ranging from policy making, to revenue collection and budgeting, human resource management, and the delivery of municipal services (e.g. waste management, nature protection, housing, transport, education etc.). While acknowledging the diversity of processes and operations, public actors are commonly and for the most part dealing with managers and employees working in office buildings undertaking office-level tasks. It is of utmost importance to enshrine the circular water use as the cornerstone of operational aims of public bodies, which could be achieved through internal organisation through several means, such as internal instructions, internal objectives, priority areas addressed by the organisation, memoranda distributed among public employees etc. Public sector in this regard can serve as the best example for private organisations and citizens encouraging them to take-up similar practices through positive impacting.

II. Public Service Delivery. This aspect of the public sector is related to its output and outcomes of primary importance, as integrating circular water practices and strategies has the potential to improve the efficiency and to transform the way that public services and the development of public policies are provided, having thus a considerable potential positive impact on citizens, their collective and individual behaviour, their well-being, and on society and its overall sustainability. This aspect widely addresses not only state actors, but also local authorities and local utility companies since they are usually implementing services of general interest and are thus at the forefront of bringing circular practices into reality.

III. Human resources and social-related dimensions are dealing with the issues of the lack of people's knowledge and the need for appropriate skills and innovative training and education initiatives to bring awareness and build the capabilities of individuals to take on circular water practices, change their daily behaviors, and change the culture thereafter. These human-centered aspects are crucial to complement the circular water practices and strategies. It is imperative to include strategies that encourage people to rethink and change their current unsustainable practices, thus broadening the scope of circular integration to human aspects with more potential for a transformative societal shift towards sustainability.

IV. Collaboration and interaction with other citizens, their groupings and organizations and their involvement in the redesign of public processes towards circular economy are one of the main hindrances for circular economy, especially in the circular water sub-sector. Lack of interaction within public institutions, with markets and a need for more cooperation mechanisms, dialogue, and information exchange, but also engagement with diverse external stakeholders such as suppliers, universities, associations, companies, and citizens to allow for the co-creation of appropriate and adapted circular water solutions in all its areas of action and activity is required.

5.3. Achieving Circular Governance Transition

The development of a new governance model is critical to the implementation of circular water solutions, as they require changing multi-stakeholder perspectives and collaborations to achieve optimal implementation of circular water use. These activities in public domain build trust as role models for businesses and citizens, provide clear information and set targets, promote circular water culture, and establish circular water practices as prerequisites for motivating the private sector in its circular transformation. This leads to the implementation of an effective multi-level governance approach to align priorities and incentives across sectors, levels of government, and stakeholders, promote systemic thinking

to achieve policy coherence, integrate siloed policies, facilitate collaboration between public, non-profit actors and businesses, and adopt a functional approach that transcends administrative boundaries and promotes linkages and partnerships.

Governance measures in support of circular water use include:

- Establishing clear roles and responsibilities if different national, regional and local actors.
- Applying circular water models within the government according to the "practice what you preach" principle.
- Allocating necessary financial and human resources.
- Linking the governance model with various sectoral strategies.
- Providing a systemic approach to regularly monitor and evaluate results.
- Developing clear communication approaches for circular and sustainable transition.
- Strengthening co-ordination across levels of governments.
- Foreseeing ad hoc co-ordination bodies, such as committees, commissions, agencies or working groups.
- Promoting the use of recycled water, rainwater, recovery technologies, rainwater catchment solutions based on nature-based solutions etc.
- Strengthening co-ordination across policies and governmental departments (horizontal co-ordination).
- Stimulating a dialogue among the governmental departments and areas involved in promoting the circular water transition.
- Monitoring and evaluating targets and goals of a circular water strategy in the short, medium and long terms.
- Proposing a monitoring framework to identify how water circular the country/region/city is and what works, what does not work and what can be improved.

Governance measures to enable circular water use include:

- Promoting business models shifting from using potable water for non-potable uses with proposals of alternative water sources that are fit-for-purpose.
- Implementing green public procurement including circular water principles.
- Sharing and co-creating with stakeholders to build consensus and vision.
- Promoting certificates, labels and awards that can enhance trust and lead to more conscious production and consumption choices.
- Identifying synergies across policies and plans (e.g. climate adaptation, land use, infrastructure)
- Proposing adjustments throughout the policy cycle, with implications on how institutions, processes, skills and actors are organised.
- Facilitating territorial linkages between urban and rural areas, and transnational where appropriate.
- Facilitating neighbourhood or community-based plans and initiatives.
- Evaluating partnerships with local service operators to apply circular water practices at all levels.
- Identifying cases in which it is possible to adapt the regulation (e.g. land use, permits) at the local level.
- Establishing clear requirements in tenders to foster circular water use principles.
- Proposing the establishment of a single window for the information on circular water use for businesses and citizens.
- Make relevant data publicly accessible, understandable and updated regularly.