Political and sOcial awareness on Water EnviRonmental challenges
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Abstract	The user-driven POWER project aims to share knowledge of and experience concerning local water challenges in different municipalities in the EU and beyond. The project has created a tool, a Digital Social Platforms (DSP), which facilitate new forms of knowledge sharing and communication. This report aims to propose a step-by-step process which enables cities to engage in a sustainability transition to become water-wise through the considered use of DSPs. This step-by-step guide consists of six parts. The first three steps are related to assessment methods which constitute the principal objective of this report: 1) to determine water management priorities, 2) to establish the governance baseline; and 3) to assess public awareness and engagement. These are supported by three further steps developed within Work Package 4 but summarised here which together ensure transitions towards further sustainability and form a basis for the successful implementation of long-term visions (Deliverable 4.4). The latter include 4) to stimulate public engagement 5) to secure long-term political and social continuity and 6) to main-stream city-to-city learning. We conclude this report with six suggestions to enable cities to foster sustainable transitions through the use of DSPs.

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Executive Summary

Urban dwellers are increasingly threatened by the combined impacts of sea-level rise, river flooding and urban expansion in flood-prone areas, while storm events are expected to increase in frequency and magnitude. In addition, the world is projected to experience an estimated 40% freshwater shortage by 2030, along with heatwaves that increase in frequency, length and severity. The pressure exerted on cities is projected to increase in the 21st century, thus emphasizing the importance of strategic efforts towards sustainability transitions of cities. Information and Communication Technology facilitated interactions between politicians, professionals and citizens may provide an important contribution to develop the enabling capacity of cities to address their water challenges, and ultimately apply water-wise management. Water-wisdom is understood as an ideal state of preparedness achieved through an optimised integration of institutions, scopes and short-term targets and long-term goals that intertwine with water.

The POWER project is a user-driven project that aims to share knowledge of and experience concerning water scarcity, security, quality, and water consumption-related issues in different local authorities in the EU and beyond. In this way cities can be enabled to become water-wise. As such, the project has created a tool, a Digital Social Platform (DSP), which facilitates new forms of knowledge sharing and communication, as they can be used to gather and disseminate detailed place-based information, citizens and expert knowledge and facilitate dialogue between varieties of stakeholders. Building on the knowledge of current water challenges that cities face, trajectories to overcome them and above all the project's developed knowledge and experiences to address water challenges in the Key Demonstration Cities (KDCs), this deliverable aims to propose a step-by-step guide to enable cities to engage in a sustainability transition to become water-wise through the considered use of DSPs. In total, six steps are proposed:

I. Determining water management priorities for sustainable transitions;
II. Establish the water governance baseline;
III. Assessment of public awareness and engagement;
IV. Stimulate public engagement;
V. Secure long-term political and social continuity;
VI. Mainstreaming city-to-city learning.

First and foremost, what is proposed in this report is an assessment approach for sustainable transitions (steps 1, 2 and 3). Since a sustainability transition is a long-term process of environmental, political and social change, it is also necessary here to summarise three key actions in order to achieve sustainable transitions that cities should take into account (steps 4, 5 and 6) which have been developed and are described in far greater detail in other POWER deliverables, such as , for example, a methodology for the implementation of long-term visions and political continuity which is described in Deliverable 4.4. In this report, we build on key lessons learnt in implementing the tasks and drafting the deliverables of primarily Work Packages (WP) 3 and 4. The main tasks of these WPs concern public engagement, governance assessment, DSP-evaluation, and further development of the DSP's to enhance their environmental, political and social impact.

In the first two steps, we propose a structured way to consistently assess urban water governance priorities and the key conditions that together determine the overall capacity to govern municipal water-related challenges. The conditions include 1) awareness, 2) useful knowledge, 3) continuous learning, 4) stakeholder engagement process, 5) management ambition, 6) agents of change, 7) financial viability and 8) implementing capacity. The third step provides a more in-depth approach to assess public awareness and engagement. Following this, the fourth step concerns the stimulation of public engagement. This is considered crucial to initiate and promote collaborative processes for change and innovation in the water sector. The fifth step of the POWER approach is to secure long-term political and social continuity through a Council of Citizen ENgagement in Sustainable Urban Strategies or ConCensus. The last step is to mainstreaming city-to-city learning, as this may help cities to better address water challenges. We conclude this report with some suggestions for cities that consider using DSPs for improving their urban water governance.

List of acronyms

CS	Citizen Science
ConCensus	Council of Citizen engagement in sustainable urban strategies
DSPs	Digital Social Platforms
ICT	Information and Communication Technology
KDCs	Key Demonstration Cities
KPIs	Key Performance Indicators
SDGs	Sustainable Development Goals
TMNs	Transnational Municipal Networks
WP	Work Package
WWT	Wastewater Treatment

1 Introduction

1.1 Towards water-wise cities

It is expected that by 2050 approximately 6.4 billion people will live in a city. These urban dwellers will be living in an increasingly water scarce world at a time when demand for water is projected to increase by 55% by 2050 (UN 2015). Already about 15% of the global population is threatened by the combined impacts of sea-level rise, river flooding and urban expansion in flood-prone areas, while storm events are expected to increase in frequency and magnitude (e.g. Ligtvoet et al. 2014). In addition, the world is projected to experience an estimated 40% freshwater shortage by 2030, along with heatwaves that increase in frequency, length and severity (EEA 2012, 2016). Cities are the largest water polluters through the emissions of solid waste, poor or untreated sewage and polluted storm water runoff that lead to biodiversity loss, and threaten drinking water, fisheries and economic output (UNESCO 2017). The pressure exerted on cities is projected to increase in the 21st century, thus emphasizing the intensifying urban challenges of water, waste and climate change, which in turn make strategic efforts towards sustainability ever more important (Koop and Van Leeuwen 2017). This message is emphasized by all 17 Sustainable Development Goals (SDGs) of the United Nations and in particular by SDGs 6 *Ensure access to water and sanitation for all* and 11 *Making cities inclusive, safe, resilient and sustainable* (UN SDGs 2019; UN-Water 2019). Specific targets have been formulated as well. These targets include reducing water pollution, halving the proportion of untreated wastewater, increasing water efficiency, water recycling and safe water reuse. Moreover, the reduction of water scarcity, improving mitigation and adaptation to climate change, and risk reduction of water-related disasters such as floods are also important goals. Importantly, the SDGs also specify how these goals have to be achieved. This is through an inter-sectorial, participatory and inclusive approach with an important role for multi-stakeholder cooperation to share knowledge, expertise, technology and financial resources (UN-Water 2019). Accordingly, the role of capacity development is considered as pivotal in enabling cities to address these water-related challenges. The role of Information and Communication Technology (ICT) facilitated interaction between politicians, professionals and citizens may provide an important contribution to develop the enabling capacity of cities to address their water challenges, and ultimately apply water-wise management.

Water-wisdom is understood as an ideal state of preparedness achieved through an optimised integration of institutions, scopes and short-term targets and long-term goals that intertwine with water. Accordingly, a key attribute of water-wisdom in cities is a high management performance in all relevant aspects of the urban water cycle as part of their integrated urban design. Hence, POWER project's Deliverable 4.5 applies an integrated indicator framework (Figure 1) which provides information about, and describes the current state of the urban water cycle, with a significance that extends beyond what is directly associated with the indicator scores. The framework – the City Blueprint – has been applied in 80 cities situated in 35 countries and provides a significant empirical contribution to our understanding of how cities develop towards water-wisdom. Although none of the assessed cities scored high on all components of the water cycle, their combined hypothetical achievement may be classified as water-wisdom (Figure 1). Water-wise cities are cities that fully integrate the element of water into urban planning with multi-functional and adaptive infrastructure. These cities are largely water self-sufficient, attractive, innovative and circular, by applying multiple centralised and decentralised solutions together with engaged local communities. Beyond the scientific goal formulation, this holistic indicator approach also provides a clear 'mental image' for cities to help them to envision goals related to water-wisdom. As such, a water-wise city is a city that scores high on all the water cycle management performance indicators.

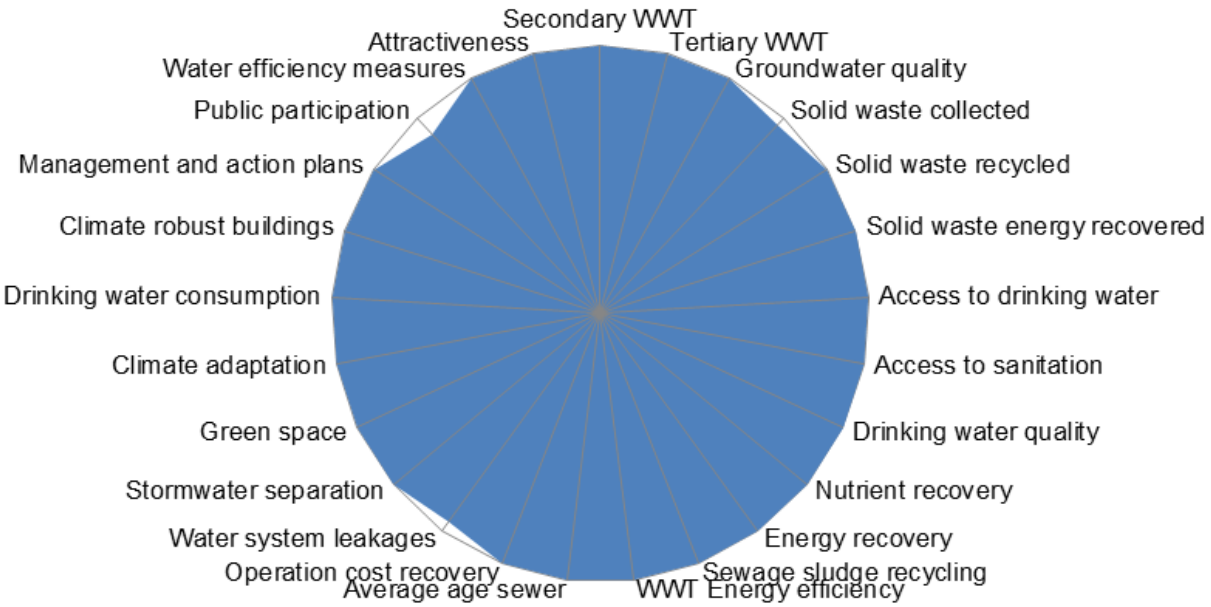

Figure 1 Conceptualisation of water-wisdom by combining the highest City Blueprint indicator scores of the urban water cycle in 80 cities in 35 countries. No individual city is already water-wise (Deliverable 4.5)

1.2 Aim of this deliverable

The POWER project has the objective to share the knowledge of and experience on water-related issues in local authorities in the EU and beyond. In this way, cities can be enabled to become water-wise. As such, the project has created a tool, a Digital Social Platform (DSP), which facilitate the sharing of progress, knowledge, opinions and best practices. DSPs can facilitate new forms of knowledge sharing and communication, as they can be used to gather and disseminate detailed place-based information, citizens and expert knowledge and facilitate dialogue between varieties of stakeholders. In order to do so, cities first need to understand their key water-related challenges. Based on 80 urban water management assessments, four key water-related challenges have been identified that can form the focus for DSPs to enable cities to become water-wise (Deliverable 4.5):

1. The untapped potential of urban wastewater;
2. Improving solid waste treatment: a criticality of sustainable urban growth;
3. Water use inefficiencies;
4. Water and climate adaptation in cities.

Building on this knowledge of current water challenges that cities face, trajectories to overcome them and above all the project's developed knowledge and experiences to address water challenges in the Key Demonstration Cities (KDCs), this deliverable aims to propose a step-by-step guide to enable cities to engage in a sustainability transition to become water-wise through the considered use of DSPs. First and most importantly, we propose an assessment approach for sustainable transitions (steps 1, 2 and 3). Since a sustainability transition is a long-term process of environmental, political and social change, we go one step further by describing briefly three key actions for sustainable transitions that cities should take into account (steps 4, 5 and 6). These three elements developed and described in other POWER deliverables, such as D4.4 contribute to the creation of a complete methodology for the implementation of long-term visions and political continuity.

The step-by-step method proposed in this deliverable builds on the experiences with transition processes in the KDCs. The DSPs of the four demonstration cities Sabadell (Spain), Leicester and Milton Keynes (United Kingdom) and Jerusalem (Israel) focus on specific water challenges, namely:

- water quality of non-potable reuse of treated wastewater (Sabadell);
- flood risk management (Leicester);
- reduction of drinking water consumption (Milton Keynes);
- water conservation (Jerusalem, Israel).

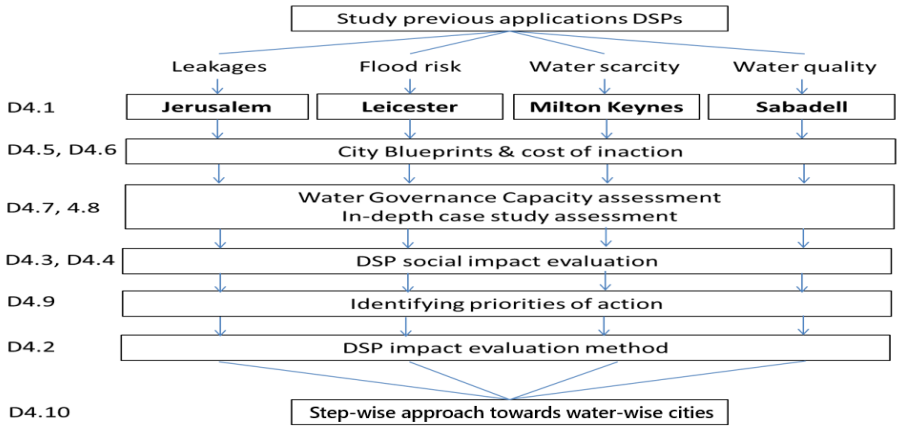

Figure 2 Overview of the deliverables of Work Package 4

The assessment, evaluation and further development of the DSPs environmental, political and social impact has been the main task of Work Package (WP) 4. This guiding deliverable is the result of the lessons learnt in the tasks and deliverables of primarily WP4 (Figure 2). First, an *ex-ante* analyses of previous applications of ICT tools in environmental decision-making was performed (Deliverable 4.1). Second, *in situ* City Blueprint assessment, governance analyses and DSP social impact evaluations provided insights in 1) the current state of urban water management and cost-benefits of best practices (Deliverable 4.5 and 4.6), 2) barriers and opportunities to govern the water challenges (Deliverable 4.7 and 4.8), and 3) social engagement through workshops (Deliverable 4.3) and through the development of a model for citizen-based political continuation (Deliverable 4.4). Third, *ex post* studies of the impact of DSPs (Deliverable 4.2) and the identification of priorities of action for cities (Deliverable 4.9) provides knowledge on lessons and critical conditions for high-impact application of DSPs. Together with the lessons learned in WP3, these studies proved to be crucial to propose methodological assessment steps and identify actions for sustainability transitions that can enable cities to become water-wise. Even more so, the identified actions for sustainable transitions are a prelude for development of an applicable methodology for the implementation of the long-term visions (deliverable 4.4). The step proposed in this deliverable might be relevant for the KDCs, follower cities and other cities beyond those involved in the POWER project. The step-wise guidance that is proposed in this deliverable consists of six steps. Steps I, II and III are assessment methods that can enhance sustainable transitions whereas steps IV, V and VI are proposed to further actions this transition:

I. Determining water management priorities for sustainable transitions;
II. Establish the water governance baseline;
III. Assessment of public awareness and engagement;
IV. Stimulate public engagement;
V. Secure long-term political and social continuity;
VI. Mainstreaming city-to-city learning

1.3 Outline of the report

The outline of this deliverable follows the steps of the POWER approach. In the next chapter, the first step will be elaborated. This step consists of the identification of the most important water-related challenges that can form the foci for the next steps (Section 2.1). This is carried out through the City Blueprint methodology which is a holistic assessment of the urban water management. Next, the governance baseline is determined (Section 2.2), which can be assessed according to the governance capacity framework. Section

2.3 proposes a method to assess public awareness and engagement. This section will also emphasize the need to assess DSPs though Key Performance Indicators (KPIs). The next step will provide guidelines for public participation in urban water governance (Section 3.1). Following from this a model to ensure political continuation through a Council of Citizen ENgagement in Sustainable Urban Strategies or ConCensus, will be briefly explained (Section 3.2). In Section 3.3, city-to-city learning is discussed as the last step which further enables cities to become water-wise. We conclude with providing six suggestions for applying tailor-made DSPs based on the experiences the POWER projects four KDCs.

2 Assessment methods for sustainable transitions

Sustainability transitions are in many cases not well monitored. This may lead to poorly-informed decisions, uncoordinated actions and limited evaluation and actual learning. In order to become water-wise, three assessment steps are proposed targeting, cross-disciplinary management (step 1), governance capacity development (step 2) and awareness and public engagement (step 3).

2.1 Step 1: Determining priorities for sustainable transitions

In order to enable a sustainable transition towards water-wise cities, a key first step is that city planners, water managers, asset owners and other local authorities develop a common understanding of where they are within the overarching sustainability transition of their water system. In order to achieve such a shared understanding, an empirically-based assessment of the current state of the urban water system is indispensable. In such, assessment indicators are key. These indicators must be able to point to information about the current state, with a significance that extends beyond what is directly associated with the parameter value (OECD 2003). Although different water indicator frameworks exist, most of them are part of a more generic set of national indicators. In addition, frameworks at the cities level often include water-related indicators but these are often limited to service delivery of drinking water and sanitation (e.g. IBNET 2019). The City Blueprint provides a more holistic indicator assessment of urban water management performance. At present, the methodology has been applied in 80 cities, published in over 20 peer-reviewed scientific papers and is recognized by the European Commission through its publication of "The Urban Water Atlas for Europe", which provides detailed info graphs of 40 European cities that have been assessed according to the City Blueprint (Gawlik et al. 2017). Moreover, many of these City Blueprint cities form an action group within the European Innovation Partnership on Water: https://www.eip-water.eu/City_Blueprints. The methodology consists of 25 indicators divided over seven categories (Table 1).

Table 1 Overview of the City Blueprint methodology to holistically assess the current state of water management performances and thereby facilitating cities in determining foci for sustainable transitions

I. Water quality	1. Secondary WWT 2. Tertiary WWT 3. Groundwater quality
II. Solid waste treatment	4. Solid waste collected 5. Solid waste recycled 6. Solid waste energy recovered
III. Basic water services	7. Access to drinking water 8. Access to sanitation 9. Drinking water quality
IV. Wastewater treatment	10. Nutrient recovery 11. Energy recovery 12. Sewage sludge recycling 13. WWT energy efficiency
V. Infrastructure	14. Stormwater separation 15. Average age sewer 16. Water system leakages 17. Operation cost recovery
VI. Climate robustness	18. Green space 19. Climate adaptation 20. Drinking water consumption 21. Climate-robust buildings
VII. Governance	22. Management and action plans 23. Public participation 24. Water efficiency measures 25. Attractiveness

The 25 performance indicators are scored from 0 (much room for improvement) and 10 (high score). The indicator's scoring methods are simple and publicly available through (amongst others) the EIP Water City Blueprint action group. The assessment can be considered a co-production process since indicators are scored by collaborating researchers and local authorities. Local experts and the City Council are asked to improve the accuracy of the data and approve the final assessment results. Researchers have the role of filling in as much information as possible through their own desk study and by performing the final data quality assurance. The indicators scores are based on simple calculation methods. In order to illustrate this, we provide three examples of indicator calculations (Van Leeuwen and Elelman 2019):

1. **Indicator 1**: Secondary WWT (Waste Water Treatment)
    - **Principle**: Measure of the urban population connected to secondary waste water treatment plants. Secondary treatment: process generally involving biological treatment with a secondary settlement or other process, with a biological oxygen demand reduction of at least 70% and a chemical oxygen demand reduction of at least 75%
    - **Calculation method**: Score = **X** / 10
      X = Percentage of population connected to secondary sewage treatment.
    - **Example**: The city of Amsterdam has 99% of secondary treatment. The score for the coverage of secondary WWT becomes: [1% + 98%] / 10 = 9.9 points.
2. **Indicator 4**: Solid waste collected
    - **Principle**: Represents waste collected from households, small commercial activities, office buildings, institutions such as schools and government buildings, and small businesses
    - **Calculation method**: Score = $\left[1 - \frac{X - 1.364}{689.2 - 136.2}\right] * 10$
      X = kg/cap/year of collected solid waste. The lowest and highest 10% produced solid waste of all countries that are available is taken as boundary values. These are respectively 136.4 kg/cap/year and 689.2 kg/cap/year
    - **Example:** Malmö's average municipal waste production is 460 kg/cap/year. The score for solid waste collected becomes: $\left[1 - \frac{460 - 1.364}{689.2 - 136.2}\right] * 10 = 4.2$ points.
3. **Indicator 14**: Stormwater separation
    - **Principle**: A separate drainage system for stormwater is better than a system that collects both stormwater and sewerage because the drainage capacity of combined systems can be exceeded by rainwater from storm events. In this way, the sewerage enters local surface water. A lower Indicator score is given where the proportion of combined sewers is greater
    - **Calculation method**: Score = $\frac{B+C}{A+B+C} * 10$
      A = Total length of combined sewers managed by the utility (km)
      B = Total length of stormwater sewers managed by the utility (km)
      C = Total length of sanitary sewers managed by the utility (km)
    - **Example**: Amsterdam has in total 523 km (**A**) of combined sewers, 1669 km of stormwater sewers (**B**) and 866 of sanitary sewers = 866 km (**C**).The score for stormwater separation becomes: $\frac{1669+866}{523+1669+866} * 10 = 8.3$ points.

The 25 indicators are reported in a spider web in order to provide a holistic overview of the current status of an urban water system. Such a representation helps decision-makers in formulating key foci for transitioning their water system and become water-wise. Figure 3 provides an example for the city of Leicester. The key message is "the bluer the better". Leicester's focus on improving flood risk is clearly connected to its lower performance with respect to stormwater separation and its limited share of green space. Limited separation of stormwater drainage increases the risk of flooding during storm events and a lower share of green space limits rainwater from infiltration in the ground or the (temporary) storage of excessive rainwater (in local ponds, green roofs). In addition, neighbourhoods in Leicester are situated in areas prone to flooding from

the river “Soar”. Leicester in fact is actively addressing and attempts to reduce its flood vulnerability. Many more historic cities like Leicester experience similar challenges (Strzelecka et al. 2017).

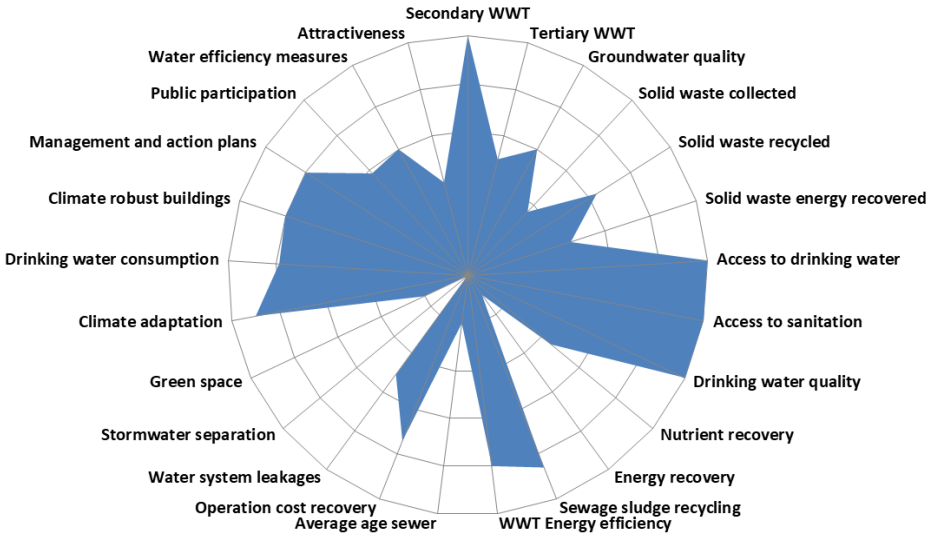

Figure 3 Example of City Blueprint results for the city of Leicester. The basic message is “the bluer the better”. Decision-makers can use this assessment to determining water management priorities for enabling a sustainable transitions towards water-wise cities

2.2 Step 2: Establish the water governance baseline

The second step of the POWER approach is to establish a water governance baseline. Governance analyses can provide a baseline for formulating and sharpening the role and polices of local authorities, stakeholders and citizens in addressing common water-related challenges. Deliverable 4.7 formed the guideline for the governance analyses which were subsequently conducted in Deliverable 4.8. In this section, the lessons learnt in these deliverables concerning the second step 'establish the governance baseline' will be discussed.

Today cities are facing major challenges such as freshwater shortage, rising sea levels, extreme weather events and depletion of natural resources (EC 2014; Cordell and White 2011). Despite numerous potential solutions – available from existing scientific knowledge and practical experiences – many cities have yet to find adequate responses to these water-related challenges (Koop et al. 2018a). Part of the problem is that most water-related challenges today transcend administrative boundaries and challenge us to go beyond traditional short-term and sectorial ways of governing water. The overall governance capacity of different organisations to effectively govern a common challenge, seems now more important than ever. The governance capacity concept needs a further specification. The governance literature on water and climate adaptation provides three key insights in what *Governance Capacity* exactly means (Koop et al. 2017). Governance capacity is

1. about the ability of actors to continuously identify and jointly act on collective problems;
2. determined by actors' interactions formed by social-institutional settings and allocation of resources
3. the results of actors' frame of reference, including their interests, values and culture, shape interactions and influence collective problem-solving.

Consequently, no single governance condition is decisive. On the contrary, governance capacity is determined by a balanced set of conditions that need to be well developed. Accordingly, we define water governance capacity as the key set of governance conditions that should be developed to enable change that will be effective in finding dynamic solutions for water-related governance challenges (Koop 2019).

Scientists have identified a plethora of social factors and conditions that either impede or enhance our ability to govern environmental challenges (e.g. Biesbroek et al. 2013; Eisenack et al. 2014; OECD 2015; Plummer et al. 2012). However, most of these studies focus on specific case studies or have a conceptual nature (Pahl-Wostl 2009; Van Rijswick et al. 2014), which limits their usefulness and learning value beyond the individual context or scientific discipline. The POWER project has therefore developed a framework that integrates existing knowledge into a practical tool that can assess water governance capacity which provides two important contributions. First, it facilitates the accumulation of coherent and empirical research that can enable the comparison among cases, provide conceptual clarity and coherence that provides the necessary empirically-based knowledge for a better (scientific) understanding. Second, because the analysis is coordinated by independent researchers, an outside perspective or diagnosis is provided that may enable local actors to critically reflect their current practices. It provides a mediating frame that is flexible enough to co-produce context-specific narratives that merge different viewpoints, backgrounds and types of knowledge into a common shared understanding of the water governance challenge at hand.

The Governance Capacity Framework (figure 4) consists of nine conditions and 27 indicators. Each indicator can be scored on a five-point scale ranging from very encouraging (++) too very limiting (--). The method is designed to be intelligible for everyone who takes an interest. Hence, people with various backgrounds are enabled to understand, evaluate and find solutions to improve the overall capacity to govern water-related challenges in their city. Therefore, the essence of the Governance Capacity analysis is to identify joint capacity-development priorities, or to evaluate progress on early set priorities. Citizen engagement can provide key contributions to the conditions listed in Figure 4, in particular with respect to the first four conditions.

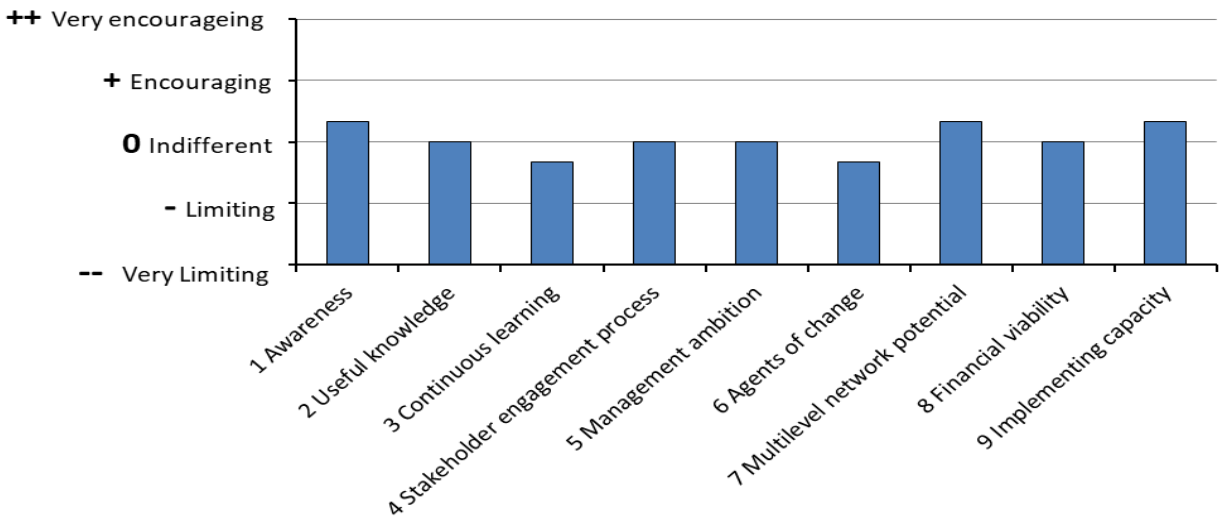

Figure 4 Nine conditions of the water Governance Capacity Framework, illustrated by the scores of the city of Sabadell (Steflova et al. 2017)

Figure 5 provides for a more detailed overview of the governance capacity of Amsterdam. The message is again a simple one: the bluer, the better. If Sabadell wants to improve, it should focus on the most limiting indicators (see Steflova et al. 2018 for more information). By comparing water management performances (as measured by the City Blueprint) and governance capacity profiles (see for more detail on related scientific papers of Deliverable 4.8) we could identify a clear correlation between implementing capacity (condition 9) and the ability to continuously monitor, evaluate and learn (condition 3). Evidently, Digital Social Platforms have the potential to strengthen the governance conditions listed in Figure 4, most particularly condition 3, continuous learning, which seems to be key addressing water challenges in cities.

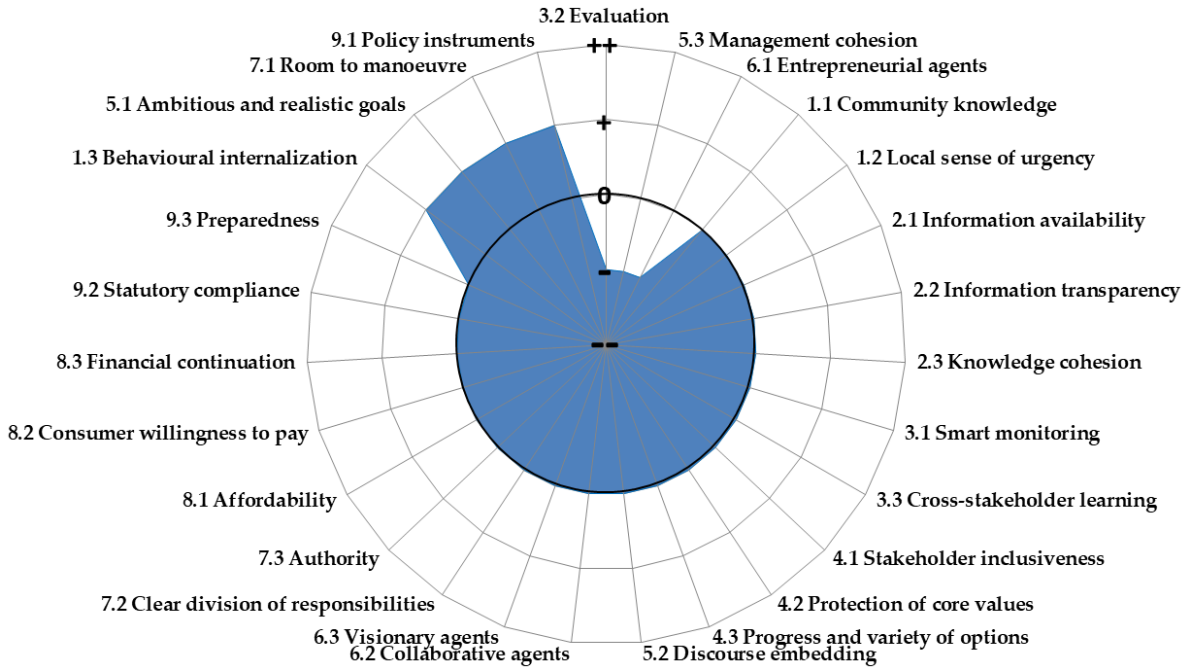

Figure 5 A spider diagram of the 27 indicators of the Governance Capacity Framework.

2.3 Step 3: Assessment of public awareness and engagement towards water-wise cities

With the essential information of assessment steps 1 and 2, a Digital Social Platform (DSP) can be established in order to share the knowledge of and experience on water scarcity, security, quality, and water consumption-related issues in different local authorities in the EU and beyond. The key aim is to raise public awareness and engagement which is key in achieving a sustainability transition towards water-wise cities.

A third important assessment step that enables monitoring, evaluation and learning in order to optimise the process of public awareness and engagement is the development of Key Performance Indicators (KPIs) for the DSPs and activities that cities carry out. Such a social impact evaluation integrates a specifically adapted combination of qualitative and quantitative items for social impact assessment. It is important to start with defining city-specific KPIs according to the city's focus area. Next, target values for these KPIs provide a basis for monitoring and evaluation, not only as a measure of success but also as an instrument to better steer targeted interventions (Deliverable 4.2). The following sections provide a step-by-step guide on how a city can develop their city-specific impact indicators, monitor the progress and derive measures to adjust and tailor instruments. In doing so, key elements of public awareness, public engagement and online gamification elements will be discussed respectively.

2.3.1 KPI assessment for monitoring and steering awareness and engagement

In order to develop KPIs for monitoring and steering awareness and engagement, four steps are proposed.

1. Define Key Performance Indicators

First cities identify their main areas of envisioned impact by selecting one or more of the following categories:

- Impact on community building and empowerment;
- Impact on information;
- Impact on ways of thinking, values and behaviours;
- Impact on education and human capital;
- Impact on environment;
- Impact on civic and political participation;
- Impact on policies and institutions.

For each of these categories, a city can define a specific set of indicators to assess progress of the envisioned activities that address their specific challenge. As such, the activities need to be able to impact the indicators that are selected. A good starting point for this process is to select the most applicable KPIs provided in the extensive indicator catalogue by the IA4SI Methodological framework and to extend the resulting set with a number of self-defined indicators. In addition, nine common indicators related to for example the number of users, platform interaction or civic and political participation, form a common denominator for all the cities that apply the POWER approach (for a detailed list see Deliverable 4.2, table 2).

For some areas, it will be difficult to directly measure the impact of activities. However, appropriate indicators that are known to be closely connected to intended effects will allow cities to make tentative statements about the effectiveness of their activities – since it is often hard to ultimately prove causality.

2. Set target values

Next, target values for each KPI are identified. Adding a target to a KPI will provide a way of measuring success (i.e. whether a goal is achieved). Moreover, visualising a KPI against a target will allow to easily spot trends and take action based on performance. The level of ambition of these targets should be well-considered in that it should require superior effort to achieve but that is also realistically achievable. For example, the underlying assumptions on targeted visitor numbers, registered users, logins and interactions – as one type of indicators – have to take into account known dynamics of activity in similar online communities in which

most users (typically 80-90 %) participate only as "passive" readers accessing information and only a very small fraction of the users (between 1-10 %) actually become contributors of content, of which again only a very small share (often as little as 1 % of users or less) become regular collaborators or "lead users", forming groups with lively discussions. Section 4.1.3 in Deliverable 4.2 provides a detailed explanation of the considerations which must be reflected in the choice of different types of indicators, their target values and their relative proportions with respect to each other.

3. Define a subset of the most important indicators & establish continuous monitoring

Once a city has defined their KPIs and their respective target values, it is important to establish a process of regularly monitoring progress. Depending on the number of indicators that a city has defined, it might not be feasible to assess all of them with a high frequency. To keep efforts within reasonable and feasible limits without giving up the benefits of frequent monitoring, a two-fold monitoring approach is advised. A subset of the most important KPIs that cover the main areas of impact and are easy to monitor, can be assessed frequently (e.g. on a monthly base). A more comprehensive assessment can be performed less often (e.g. once per year). For example, cities can easily monitor the category of "Impact on community building and empowerment" by assessing the number of users (e.g. platform visitors, registered users) and platform interaction (e.g. logins, touchpoint interactions) through the statistics module provided by the POWER DSP.

4. Identify areas of low performance and define preventive and corrective actions

By establishing this two-fold impact monitoring approach, a city is able to quickly identify any potential insufficiencies in progress and timely implement corrective actions. Corrective action becomes the vehicle that identifies the root cause of negative KPI trends. For example, when cities monitor the number of users of your platform on a monthly base and encounter a growth that is below a pre-set threshold for more than two months in a row, then the underlying causes of such unexpected low performance have to be scrutinised. In most cases, additional assessments are required, such as detailed platform usage statistics or target group surveys in order to identify starting points for corrective measures. Learning from the experiences of similar initiatives cities should also try to pre-empt well-known challenges (e.g. a frequently observed low public engagement or slow uptake of online platforms) and promptly create preventive actions to address them. For both preventive and corrective actions, it is advised to define and monitor success criteria, which will help to refine and further improve these actions.

2.3.2 Using the POWER gamification engine to assess public awareness

The POWER DSPs include gamification design elements that provided tailored incentives to the platform users to further interact and learn. The objective for the users is to become prepared for the given water issue themselves and help their community in reaching the community objective. The gamifications elements enable comparison of one's own performance to that of the community's average. This can be useful for individual users, but also is of high interest for the cities themselves to evaluate how well prepared the whole community is, and in which areas it can improve. Accordingly, such insights on community awareness can provide valuable input for policy-makers and for operational decisions. For example, the community perspective allows the city to decide on what aspect to focus specific measures for improving the community preparedness (e.g. whether it is the awareness of the problem, or the know-how or the readiness to act). Both, the community preparedness section visible for administrators in the backend of the POWER DSP (Figure 6), and the gamified visualization dashboard visible to all registered users of the platform (Figure 7) show how the local community is prepared in nine categories (consisting of three dimensions: Problem Awareness, Know-How, and Readiness to Act). These nine categories are in turn assessed with respect to three aspects: the individual, social, and political aspect. The table with the average score of the community and spider chart diagram enable the monitoring of how the knowledge of the entire community develops in the nine categories simultaneously. The chart can easily reveal in which dimension the community has "gaps" and in which ones the community is close to the goal of being well-prepared for water issues. Hence, the

gamification model supports the measures that cities undertake to engage with their citizens and motivate them to gain knowledge and raise their awareness of water-related issues. Even more so, it also provides a tool for cities to measure and monitor progress in the awareness and preparedness of its citizens. For example, in order to measure progress in user knowledge and awareness during the POWER idea contest campaign, the platform gamification engine is a powerful assessment tool (for a detailed description of the gamification elements see Deliverable 3.3, section 3).

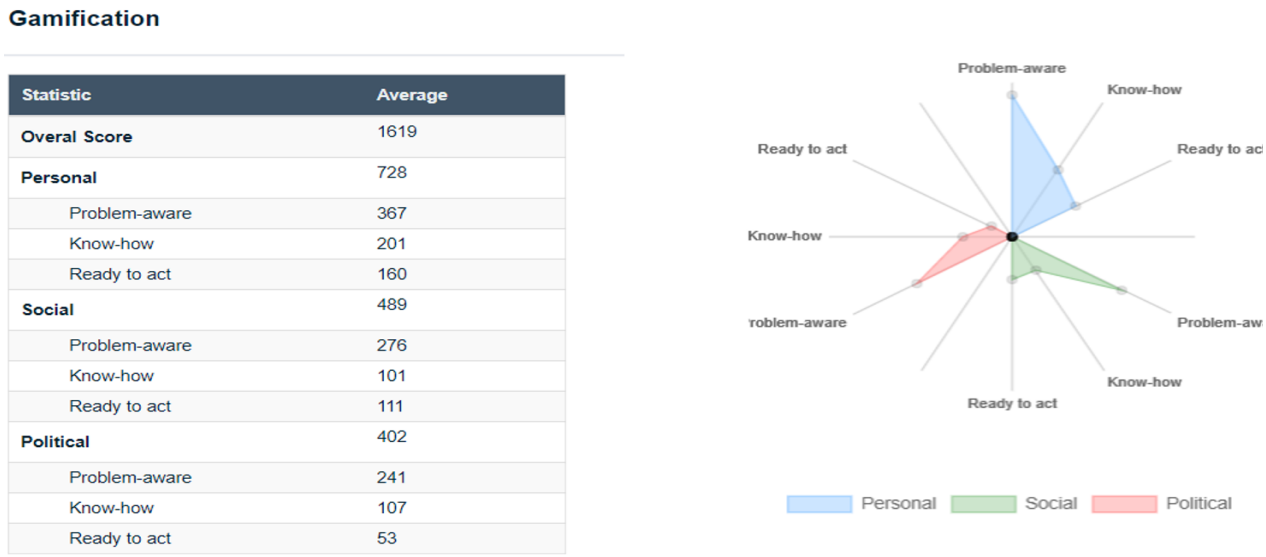

Figure 6 Administrator view of community scores regarding problem-awareness, know-how and readiness to act on three different levels

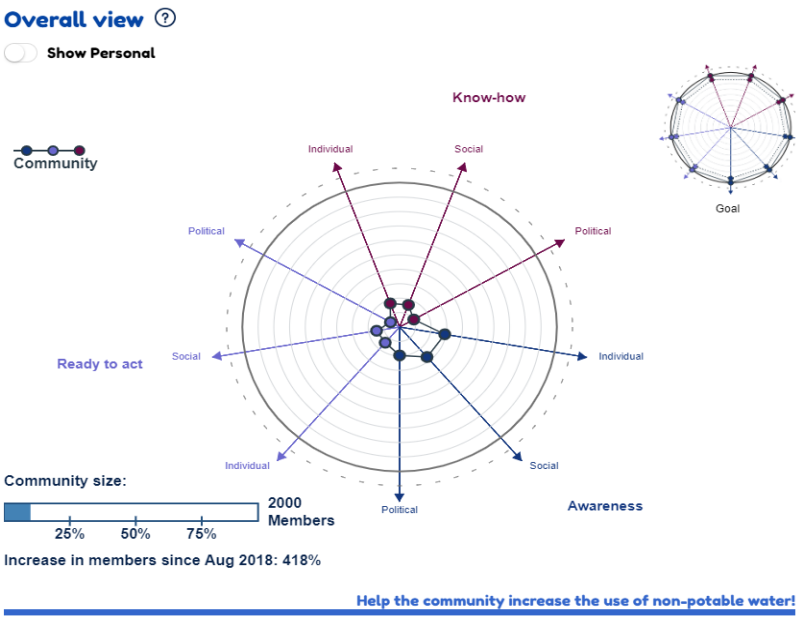

Figure 7 Overall community scores on problem-awareness, know-how and readiness to act. This figure is visible to the DSP-users (at the gamified visualization dashboard)

3 Key actions for achieving sustainable transitions towards water-wise cities

Assessments alone will not make cities water wise. This section therefore provides three additional steps that cities need to take for a transition towards water-wisdom:

4. Stimulate public engagement
5. Secure long-term political and social continuity
6. Mainstreaming city-to-city learning

3.1 Step 4: Stimulate public engagement

The fourth step of the POWER approach is to stimulate public engagement, as it is essential to initiate and promote collaborative processes for change and innovation in the water sector across the public and private sector, non-governmental organisations and the general public. In this section, the lessons learnt based on the in-depth analysis on public engagement in Deliverables 3.4 and 4.8 will be elaborated.

Public participation and engagement are central topics in urban water governance. In addition to advancing democracy, public participation may contribute to effective, efficient and legitimate decision-making (Fung et al. 2013; Glucker et al. 2013). Public engagement in governance concerns the direct involvement of key stakeholders in decision-making about policies, plans or programmes in which they have an interest. Core attributes for public engagement involve:

1. Considering the needs, desires and abilities of the stakeholders;
2. Bi-directional dialogue between public and private actors and the general public;
3. Both sides feeling empowered by mutual learning experience (Storksdieck et al. 2016).

With the rapid spread of ICTs, the intensity and nature of public participation in water governance may have shifted. The studies of Deliverable 4.1 and Mukhtarov et al. (2018) found that ICT tools allow citizens to be better informed and co-produce water services with a government. Furthermore, ICT tools have the potential to help in efficiency and effectiveness of urban water service provision. These tools can enable data collection and processing by involving the wider community. Influential organisations (e.g. European Union's research agenda) increasingly advocate the idea of public participation in research as a way of engaging and empowering citizens in order to improve the science-society-policy interaction (EC 2016; Lamy Committee 2017). This Citizen Science (CS) is scientific research that is at least in part conducted by nonprofessional scientists with outcomes that contribute to scientific knowledge (on for instance urban water challenges) as well as an increase in the public's understanding of science. CS may pose an interesting opportunity to engage citizens in the research and management of municipal water challenges. Through CS projects, individuals may get more engaged and they may be messengers to others through, amongst others, a DSP, public meetings, voluntary organisations and social events. However, getting and keeping a diverse group of citizens engaged is an often highly underestimated difficult challenge and many authors argue that most CS projects do not fulfil these conditions (e.g. Strasser and Hakley 2018; Raddick et al. 2013; West and Pateman 2016). Another challenge for CS is have a representative, sample of citizens participating in the research (Brouwer and Hessels 2019).

The use of digital tools such as the DSP should be accompanied by a solid understanding of the needs of the different stakeholder groups. In fact, technology is not always easily adopted by users, particularly when communities are very heterogenous. Another factor that should be considered with public engagement is the fact that engagement processes are often isolated initiatives, such as single events, and they rarely trigger a long-term participatory process. Therefore, additional steps towards structuring the participatory approach

should be considered so that this process becomes a natural part of the daily life of institutions, their actors and counterparts.

In order to engage a large number of people from different social and demographic tiers and create a collective intelligence that is able to influence the decisions about water concerns, the POWER project developed a framework for enhancing public participation in the digital context. This framework or engagement model (fully described in Deliverable 3.4) uses a combination of online (digital) and offline (physical) channels to engage and motivate users to take action. Digital (online) tools, such as the DSPs or Water Communities, the Best Practice Repository and dedicated social media (Twitter, Facebook and LinkedIn) are useful tools for collaborative knowledge formation, dialogue, information exchange and as a political instrument for collaboration. Physical (offline) engagement channels are essential participation tools that allow bi-directional and interactive communication with the different target groups and provide opportunities for dialogue and mutual learning. These offline activities include: workshops, industry panels and conferences, Science Cafés and participation in cultural festivals/community events, and innovation bootcamps and design jams. The activities have been sucessfully tested in the POWER project and other offline activities may be explored as well. These tools and activities have been used for specific purposes according to the three different engagement approaches developed in POWER that targeted different audiences (with different motivations, needs, expertise, levels of knowledge, attitudes, digital skills, and time to dedicate to the process):

1. The citizen engagement approach which targets citizens, politicians, activists, and SMEs at the local level with the objective of raising awareness for an effective change in attitudes and behaviour, nurturing volunteering and crowdsourcing time or skills.
2. The Collaborative idea generation approach which aims to nurture engagement of individual citizens and from public and private organisations with the objective of facilitating grassroots and bottom-up initiatives in cities and local communities and of co-creating innovative solutions.
3. The ConCensus approach (further described in step 5) aimed at linking citizens and local politicians with the objective of enhancing representative democracy and of overseeing the implementation of strategies at the local level.

In the citizen approach, various participation methods and behavioural interventions are used to accommodate different types of users by addressing or supporting the individual (needs-based, social-based or rewards-based) motivations by taking into account different target groups, culture and local context in each city. Behavioural interventions are conducted not only through digital activities (such as motivational videos, crowdsourcing, pledges, social media pictures), but also through physical engagement activities (such as workshops, awareness raising events, ambassadorships) to address different needs-based and social-based intrinsic motivations of users. These interventions trigger participants of some target groups to become regular users of the DSP for searching specific information or events (but they do not necessarily become registered users). Individuals with high-intrinsic or rewards-based motivations are the ones who usually become registered users and whose motivations can be further supported and amplified by the gamified features of the DSP.

Categorising users in groups also helps to devise strategies to overcome barriers to engagement. Disadvantaged groups can be brought on board by captivating them with specifically designed messages and actions, for example, by understanding and discussing local concerns using their local language (e.g. in Jerusalem the DSP was translated into Hebrew and Arabic). Participation can be also activated by giving users the most suited tools and methods by addressing a variety of different motivational drivers in order to overcome common preconceptions or design biases (e.g. gender bias) that may occur if the design elements chosen focus on just one or few motivational types (e.g. competition vs. collaboration) (see Deliverable 3.3).

The POWER Idea Contest for Sustainable Communities, described in detail in Deliverable 3.4, was developed as an engagement mechanism that applies and evaluates a novel setting of a contest that stimulates

collaborative and open innovation on water and sustainability issues, while combining both digital and physical participation elements. During the contest citizens were invited to submit ideas that offer innovative solutions to local water and sustainability issues. Other members of the POWER community were called to give feedback to and vote for the submitted ideas and thus help the idea submitters refine and develop further their proposals. Ten winning ideas were then selected after community voting and jury selection. To measure the outreach of the campaign, additional KPIs were developed that related to both direct levels of engagement (number of submitted ideas, comments, votes) and indirect levels of engagement (views, contest page shares).

Through the POWER Idea contest for Sustainable Communities and various "Ideathons" (innovation bootcamps or design jams), the exchange and development of ideas and engagement in local water management was enhanced. Ideathons are brainstorming events that lasted for 3-8 hours and have taken place in Leicester, Berlin Sofia, Milton Keynes and Sabadell between October 2018 and January 2019. Through these series of Ideathons, offline and online engagement was enhanced and this co-creation process delivered new ideas that were submitted to the POWER Idea contest. In the course of this intense co-creation format specifically developed by and for the POWER project, further attention for sustainability and water-related challenges of local communities was created and the exchange of bottom-up knowledge was fostered among citizens within KDCs and across Europe. Such incentives for mutually reinforcing online and offline engagement activities are promising to engage citizens, develop better policies and increase awareness about local water challenges.

Once citizens are engaged, it is particularly helpful for local water authorities and municipalities to keep people engaged by fulfilling citizens' expectations in the long run. This aspect has been addressed in the next step (step 5) where the importance of establishing secure long-term political and social continuity is considered.

3.2 Step 5: Secure long-term political and social continuity

None of the previous steps described in this paper would be of use if the resulting *coherent long-term social, economic and ecological agenda* (Van Leeuwen and Elelman 2019) is not provided with a realistic period of time and sufficient funding so that it is able to be effectively implemented and concluded. In order to guarantee the presence of these elements, the creation of public awareness and the subsequent engagement of representatives of the different components of the *Quadruple Helix* (i.e. public administration, the private sector, the academic and research sector and the general public) is not sufficient. It has been observed all too often, that once a research project has completed the agreed period of execution, many of the initiatives that have been executed are simply abandoned.

Successful measures are continuous exercises that employ the knowledge, the interest and the desire of stakeholders to accomplish clearly established objectives. In order to achieve this, the role of the citizen is a vital one. A citizen is not only a resident of a municipality. A citizen is also a voter and, as has been noted in Step 4, the hitherto uniformed, non-professional stakeholder can, through Citizen Science techniques and regular interaction via the DSP, become an important source of information and timely data. However, supranational organisations such as the World Economic Forum (2016) have emphasised that '*Empowering citizens to make their voices heard is not enough. We have to go beyond just listening to citizens; rather, we need to support governments to build institutional systems that incorporate citizen voices in decision-making processes, and thereby increase the responsiveness of government programs to people's real needs*'.

In response to the demands of citizens, engaged in the previous steps described, for further involvement in actions which have been envisioned thanks to the contributions of the general public, POWER has developed an approach named ConCensus (The Council of Citizen Engagement in Sustainable Urban Strategies). This methodology, which is described in detail in D4.4, is a form of rewarding citizen participation at the policy creation stage by engaging members of the general public in the implementation and post-implementation analysis of an action. Working in liaison and with the active support of the elected City Council of the municipality in question, POWER gives the non-qualified stakeholder the role of official overseer of the chosen policy's progress. Both the elected politicians and professional agents who have to fulfil the technical requirements of the developed initiative must report periodically to the ConCensus whose membership has been decided according to their participation employing the POWER DSP and their attendance at POWER workshops. The members of the ConCensus must, in turn, using the DSP as their principal means of both internal and external communication and dissemination maintain the general public informed whilst further establishing an important relationship with the local members of the press, both written and audio-visual. By ensuring that recruitment for ConCensus is the result of earlier participation in the previous steps, one avoids local political party interests being represented covertly. The ConCensus approach produces a number of direct and collateral results:

a) It represents a form of direct local democracy and enhanced transparency in the process of decision-making and the subsequent actions taken. This dissuades the temptation of newly-elected politicians to arbitrarily dismiss initiatives that their predecessors commenced for purely party-political reasons and thus avoids the potential waste of both funds and manpower which may have been invested to date by the local taxpayer. Under the observation of a non-political group of representatives publicly advocating the completion of a policy, trans-mandate continuity is all but guaranteed.
b) ConCensus allows an administration to plan beyond the limits of their mandate or funded action. Long-term actions are often necessary in order to provide tangible environmental results.
c) ConCensus provides evidence to funding organisations that the money will be invested correctly and that the action will not cease until fully completed.
d) The approach provides the politician with a guarantee that their policy will be completed beyond their own mandate. Therefore, not only can the elected representative claim to be more democratic and inclusive, but they are also creating more favourable conditions for achieving of their objectives.

ConCensus, which has, to date, been put to the test in a number of municipalities including the Key Demonstration Cities of the POWER project succeeds when all the steps described in this document are completed satisfactorily. ConCensus is only effective for one action; that which has been co-created between its members and the other elements of the local *Quadruple Helix.*

3.3 Step 6: Mainstreaming city-to-city learning

The sixth step of the POWER approach is to mainstream city-to-city learning. The role of city-to-city learning will be discussed as it comprises the last step of this step-wise approach to enable cities to engage in a sustainability transition to become water-wise. It may help cities to better address water challenges. In this section, the lessons learnt regarding city-to-city learning will be discussed, bringing together insights from deliverables such as Deliverable 4.4, 4.5, 4.8 and 4.9.

Initiatives such as the POWER DSP and in particular the POWER best practices repository together with the creation of the ConCensus mechanism described in Step 5 provide a promising basis for cities to exchange knowledge, experiences and best practices. However, in order to prolong this initiative, it is important to understand the motivations of cities to join such activities. Mutual learning between cities happens almost exclusively through an operable Transnational Municipal Network (TMN). In principle, three key motivations for cities to join TMNs have been identified in the international literature (Kern and Bulkeley 2009). The first motivator is the exchange of experiences and best practices. The second motivation to participate is that TMNs provide a political platform and access to financial resources (Betsill and Bulkeley 2004). TMNs form a collective capacity to influence policy at the central level and member cities get access to first-hand information, such as information on new legislative requirements or funding opportunities, from central authorities (Fünfgeld 2015). The third motivator to join a TMN is that it provides benchmarking or some form of certification that improves the city's reputation, visibility and recognition for innovations on the topic. Consequently, a membership can be politically exploited to attract additional funding (Heinrichs et al. 2013; Betsill and Bulkeley 2004) and put the projects or ambitions higher on the local, national or international political agenda.

City-to-city learning requires some preconditions in order to be effective (Koop 2019 p. 252). First, it is widely acknowledged that successful implementation of innovative policies and projects generally requires larger administrative staffs with sufficient expertise and experiences (Collier 1997; Mathy 2007). Larger and wealthier cities tend to have the financial resources to meet these conditions (Rashidi and Patt 2018; Den Exter et al. 2014; Dannevig et al. 2012), and these cities are the ones that are actively engaged in TMNs (Hawkins et al. 2016; Krause 2012). Accordingly, TMNs are often primarily 'networks of pioneers for pioneers' (Kern and Bulkeley 2009; Aall 2012), attracting early adopters and organisations leading the sector. On the contrary, many predominantly smaller cities with less financial resources are passive (Kern and Bulkeley 2009). A key question for mainstreaming urban climate adaptation, seems to be: how can we actively engage the smaller municipalities that have limited financial resources to employ sufficient specialised staff?

A second important precondition for effective city-to-city learning is that TMNs provide more tangible results if they can help cities comply to national or transnational goals, policies, guidelines and help seize financial resources (e.g. Gierst and Howlett 2013; Den Exter et al. 2014; De Villiers 2009). The support of a (trans)national enforcing body such as the European Commission is pivotal.

A third precondition appears to be regional collaboration. Global networks tend to have limited accountability due to a lack of a national or transnational enforcing body to ensure the compliance of member cities to goals and guidelines. In addition, the network's ambitions are often relatively detached from large plurality in national goals and policies. Moreover, language barriers also pose serious challenges (Kern and Bulkeley 2009). For example, Hakelberg (2011) observed that regional networks such as Cities for Climate Protection, Climate Alliance and Energie-Cités provide more incentives for cities to develop a climate action plan than the international high-profile C40 network. Cities entering C40, either adopted a local climate strategy in the first year of their membership or became less and less active (Hakelberg 2011). The latter suggests prolonged membership of a high-profile TMN does not lead to significant climate adaptation efforts, but the implementation of a local action plan does. Moreover, many studies find that most cities that applied sustainability initiatives did that through many horizontal cooperation's with private, public and non-

profit regional actors (e.g. Dannevig et al. 2012; Zeemering 2012; Hanssen et al. 2013). Accordingly, cities active in regional networks tend to adopt more climate policies. Many authors argue that cooperation in functional regional areas, improves coordinated policy responses, reduces knowledge gaps, and builds enforcement structures and sustained trust-relations that reduce transaction costs (Hawkins et al. 2016).

Hence three factors are important conditions for city-to-city learning: 1) larger cities, 2) the support and alignment with national and international policy, goals and regulation, and 3) regional collaborative networks (Koop 2019 p. 253). Regional networks appear to be most promising, in particular when frontrunners can share knowledge, experiences and financial means with neighbouring cities (Den Exter et al. 2014). Since these cities operate in the same region, they face similar regulations and contextual factors, often speak the same language and can work towards a more cohesive strategy in the region. This may be the only option for smaller municipalities to get access to international funding schemes and address environmental challenges with their limited staff and financial resources. Another complementary factor is city twinning. Twinning is commonly referred to as a form of collaboration between similar institutions that have comparable responsibilities and tasks to execute and typically involves a peer-to-peer exchange of staff (Bontenbal 2013). The direct interaction between like-minded people with similar professional backgrounds working together to address municipal challenges is considered key in city-to-city learning (Johnson and Wilson 2006; Bontenbal 2009; Baud et al. 2010). The level of similarity of these professionals is considered as a unique twinning feature that provides opportunities to create a shared understanding of policy and practices that is necessary for constructive dialogue and trust between participants (Johnson and Wilson 2006). The POWER DSP and the best practice repository provide a good basis to foster city-to-city learning. However, cities also require supranational policy and financial incentive that reinforce the primary purpose of TMN, which is sharing knowledge, experiences and best practices.

4 Suggestions for applying Digital Social Platforms

In the current application within the POWER project, the DSPs have been developed for the KDCs, which form an example of how the DSP can be applied in other cities. In this section, the lessons learnt from these applications will be elaborated as well as knowledge on critical conditions for high-impact applications of the DSPs.

The user-centred design process of the POWER approach is a key element of the engagement model through ongoing consultation of different stakeholders during the development process, starting with the user requirements elicitation activities (deliverable 3.2), continuing with the evaluation of consecutive prototype releases and the implementation of engagement approaches (deliverable 3.4), and finally culminating with the assessment of the system's impact. Feedback is a key part of this process in order to enhance the effectiveness of the sharing of knowledge and experience. Lessons learned at each stage of the user-centred design process should be input into the DSP development process (functionalities and content) enabling improvements and further implementation of the engagement approaches. Feedback from target audiences have shaped and will continue shaping the requirements and future releases of the DSP. The goal is to maximise the adoption among stakeholders and be capable of motivating the users so that they return to and contribute to the platform for the co-creation and maintenance of the collaborative innovation process.

In each of the cities, the DSP has similar objectives such as to raise awareness and increase knowledge of stakeholders on the specific water challenge. To raise awareness and increase knowledge on the water challenge at hand, users can browse through information on the DSP. After browsing the information that is provided on the DSP, users can leave comments and discuss with each other about the water challenge. Furthermore, users can like other comments or share the comments on their social media pages. Users first need to register to the platform before they can actively engage on the platform.

DSPs have a high potential to enable more inclusive and effective citizen engagement in water issues in cities throughout Europe and beyond as the examples in the KDCs have demonstrated. However, much also depend on how the DSP is being applied and how it is embedded in existing platforms of public engagement and decision-making. For example, Wesselink et al. (2015) argue that ICT tools do not deterministically empower public participation. This conclusion is in line with the arguments of Fung et al. (2013) that argues that democratization and public participation are political issues that cannot be triggered only by means of implementing ICT tools. DSPs have high potential to enable more inclusive and effective citizen engagement in water issues if certain critical conditions are met. We propose six suggestions to better realise the full potential and optimal use of the DSP (also see Deliverable 4.8):

1. **Make use of a perceived sense of urgency for addressing a specific water challenge**: There should be a specific actual or future water challenge. Without a local sense of urgency it is pretty hard to progress.

2. **Ensure information reliability and transparency**: The DSP communicates information to relevant stakeholders to raise awareness and increase the knowledge of the water challenge. It is therefore of significant importance that the information provided on the platform is reliable and transparent. It might be useful to assign a moderator who is responsible for the implementation and maintenance of the platform, and who ensures that the content remains productive and apolitical.

3. **Apply different tailored approaches to reach out to different users**: Different stakeholders have different expertise, knowledge, needs, motivations, attitudes, digital skills and time to dedicate to the process. It is therefore essential to understand the characteristics of different stakeholders, and how to effectively address their needs. Furthermore, to create a dialogue it is important to encourage

a conversation and create engaging content that aligns with the needs of the stakeholders. In the current application in the KDCs, gamification techniques are incorporated into the DSP to provide motivational drivers and incentives. The gamified incentives (e.g. a point mechanism) motivate stakeholders and support a variety of perspectives. In addition to this, users can join the idea contest on the DSP in KDCs. The contest is an innovative participatory method that helps cities engage their citizens with sustainability topics and develop innovative ideas. Besides online participation, there are also design workshops organized which enable any citizen to effectively create ideas in a short session.

4. **Align with existing initiatives and social events**: The alignment with existing citizen engagement initiatives could lead to an increase in outreach, search for mutual strengthening with other initiatives (and avoid competition), and ensure that the opinions and feedback that have been given through the DSP are capable of influencing the decision-making process on water governance.

5. **Embed the public participation model in the local institutional context**: To ensure that the content that is provided by users on the platform is capable of influencing the decision-making process, the city should be open to citizen engagement initiatives. Dawes (2008:91) claimed that "IT (Information Technology) considerations must be appreciated as being nested within a variety of organisations, sociological, ideological, and political contexts that all need considerable attention". This aspect is addressed directly by POWER by means of the implementation of an approach that the consortium has developed named the Council of Citizen Engagement in Sustainable Urban Strategies (ConCensus) and which is described in more detail in Step 5.

6. **Ensure that citizens have sufficient connection and equipment to participate**: With more emphasis on digitalisation in urban water governance, a potential "digital divide" between the rich and poor requires more attention from scholars and policymakers alike. In addition, open-access can be considered as a pre-condition to ensure that citizens are sufficiently connected to the participation process. At present, users of the POWER DSP can only share knowledge and experiences if they are registered to the platform. Although most platforms do not allow open access, it could be beneficial to make information open access in order to make optimal use of the potential of the DSP it could be beneficial to make information open access. This could also be in various hybrid forms that would be key to explore in the context of citizen engagement in local water and climate challenges.

In conclusion, this report has presented a six guidance steps that cities can apply to enable a sustainable transition towards water-wise management. First of all, if you cannot measure it, you cannot manage it. Therefore, we have proposed three assessment steps that enable a prioritization water challenges, assess capacity-development requirements and assess public awareness and engagement through smart functionalities within Digital Social Platforms. Beyond assessment methods we have also proposed three actions for sustainable transitions that cities should take into account: stimulating public engagement, political continuity and city-to-city learning. These actions are considered essentials for enabling long-term and thorough environmental, political and social change. These actions also form key elements for a methodology for the methodology for the implementation of the long-term visions in deliverable 4.4.

References

Aall C (2012) The early experiences of local climate change adaptation in Norwegian compared with that of local environmental policy, Local Agenda 21 and local climate change mitigation. *Local Environment* 17:579-595

Arnstein S (1969) A ladder of citizen participation. *Journal of the American Institute of Planners,* 35:4 216-224

Akhmouch A and Roman O (2016) Water Governance in Cities. https://sustainabledevelopment.un.org [11-05-2019]

Baud I, Hordijk M, Van Lindert P, Nijenhuis G, Van Western G, Van Ewijk E, Bontenbal M (2010) *Towards improved local governance through strengthened local government – Evaluation of the LOGO South Programme*. Den Haag: VNG International

Betsill MM, Bulkeley H (2004) Transnational networks and global environmental governance: the cities for climate protection program. *International Studies Quarterly,* 48:471-493

Biesbroek GR, Klostermann JEM, Termeer CJAM, Kabat P (2013) On the nature of barriers to climate change adaptation. *Regional Environmental Change 13*:1119-1129

Bonney R, Ballard H, Jordan R, McCallie E, Phillips T, Shirk J, Wilderman CC (2009) *Public participation in scientific research: defining the field and assessing its potential for informal science education. A CAISE inquiry group report.* Washington, DC: Center for Advancement of Informal Science Education (CAISE)

Bontenbal M (2009) Strengthening urban governance in the South through city-to-city cooperation: Towards an analytical framework. *Habitat International* 33:181-189

Bontenbal M. (2013) Differences in learning practices and values in North-south city partnerships: towards a broader understanding of mutuality. *Public Administration and Development* 33:85-100

Brouwer S, Hessels LK (2019) Increasing research impact with citizen science: The influence of recruitment strategies on sample diversity. *Public Understanding of Science* 1-16

Buytaert W, Zulkafli Z, Grainger S, Acosta L, Alemie TC, Bastiaensen J, De Bièvre B, Zhumanova M (2014) Citizen science in hydrology and water resources: opportunities for knowledge generation, ecosystem service management, and sustainable development. *Frontiers in Earth Science* 2:1-21

Chandler M, Bebber DP, Castro S, Lowman MD, Muoria P, Oguge N, Rubenstein DI (2012) International citizen science: Making the local global. *Frontiers in ecology and the environment* 58:192-197

Collier U (1997) Local authorities and climate protection in the European union: putting subsidiarity into practice? *Local Environment* 2:39-57

Cordell D, White S (2011) Peak phosphorus: Clarifying the key issues of a vigorous debate about long-term phosphorus security. *Sustainability* 3:2027-2049

Dannevig H, Rauken T, Hovelsrud G (2012) Implementing adaptation to climate change at the local level. Local Environ 17:597-611EC (2014) European Commission: The European critical raw materials review. MEMO/14/377 26/05/2014. Brussels. http://europa.eu/rapid/press-release_MEMO-14-377_en.htm [11-05-2019]

Dawes S (2008) The evolution of continuing challenges of E-governance. *Publ Adm Rev* 68:S86-S102

De Villiers JC (2009) Success factors and the city-to-city partnership management process – from strategy to alliance capability. *Habitat International* 33:149–156

Den Exter R, Lenhart J, Kern K (2014) Governing climate change in Dutch cities: anchoring local climate strategies in organization, policy and practical implementation. *Local Environ* 9:1062-1080

EC (2016) European Commission: Public engagement in responsible research and innovation. https://a.eu/programmes/horizon2020/node/766 [16-06-2019]

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

EEA (2016) European Environmental Agency: Urban adaptation to climate change in Europe 2016. Transforming cities in a changing climate. Publication office of the European Union, Luxembourg. ISBN 978-92-9213-742-7

Eisenack K, Moser SC, Hoffmann E, Klein RJT, Oberlack C, Pechan A, Rotter M and Termeer CJAM (2014) Explaining and overcoming barriers to climate change adaptation. Nature Climate Change 4:867-872

Elelman R, Feldman DL (2018) The future of citizen engagement in cities – The council of citizen engagement in sutainable urban strategies (ConCensus). *Futures* 101:80-91

Fünfgeld H (2015) Facilitating local climate change adaptation through transnational municipal networks. Environ Susain 12:67-73

Fung A, Gilman HR, Shkabatur J (2013) Six Models for the Internet + Politics. *International Studies Review* 15:30–47

Gawlik B, Easton P, Koop S, Van Leeuwen K and Elelman R (2017) The European Urban Water Atlas, European Commission, Publication Office of the European Union, Luxembourg, 160 pp.: https://publications.europa.eu/en/publication-detail/-/publication/c296a413-24cc-11e7-b611-01aa75ed71a1/language-en/format-PDF/source-31420221 [20-09-2019]

Gierst S, Howlett M (2013) Comparative climate change governance: lessons from European transnational municipal network management efforts. *Environ Policy Gov* 23:341-353

Glucker A, Driessen P, Kolhoff A, Runhaar H (2013) Public participation in environmental impact assessment: why, who and how? *Environmental Impact Assessment Review* 43:104-111

Hakelberg L (2011) Governing Climate Change by Diffusion, Transnational Municipal Networks as Catalysts of Policy Spread. Forschungszentrum Für Umweltpolitik, Freie Universitaet Berlin, FFU-Report 08-2011

Hanssen GS, Mydske PK, Dahle E (2013) Multi-level coordination of climate change adaptation: by national hierarchical steering or by regional network governance? *Local Environ* 18:869-887

Hawkins CV, Krause RM, Feiock RC and Curley C (2016) Making meaningful commitments: Accounting for variation in cities' investments of staff and fiscal resources to sustainability. *Urban stud* 53:1902-1924

Heinrichs D, Krellenberg K, Fragkias M (2013) Urban responses to climate change: theories and governance practice in cities of the global south. *Int J Urban Reg Res* 37:1865-1878

Huitema D, Mostert E, Egas W, Moellenkamp S, Pahl-Wostl C,Yalcin S (2009) Adaptive water governance: assessing the institutional prescriptions of adaptive (co-) management from a governance perspective and defining a research agenda. *Ecology and Society* 14:26

IBNET (2019) The International Benchmarking Network for Water and Sanitation Utilities: Search by country http://www.ib-net.org/en/production/?action=country [Accessed 10-09-2019]

International Water Association (IWA). N.d. The IWA Principles for Water Wise Cities. Retrieved November 20, from http://www.iwa-network.org/wp-content/uploads/2016/08/IWA_Principles_Water_Wise_Cities.pdf [1-07-2019]

Johnson H, and Wilson G (2006) North-south/South –north partnerships: closing the 'mutuality gap. *Public Admin Dev* 26:71-80

Kern K, Bulkeley H (2009) Cities, Europeanization and Multi-level Governance; Governing Climate Change through Transnational Municipal Networks. *JCMS* 47:309-332

Koop SHA and Leeuwen CJ (2017) The challenges of water, waste and climate change in cities. *Environment, Development and Sustainability* 19:385-418

Koop SHA, Koetsier L, Van Doornhof A, Van Leeuwen CJ, Brouwer S, Dieperink C and Driessen PJ (2017) Assessing the governance capacity of cities to address challenges of water, waste, and climate change. *Water resources management* 31:3427-3443

Koop S, Brouwer S and Van Leeuwen K (2018) Assessing governance capacity in cities to address water challenges. *Global Water Forum*

Koop SHA (2019) Towards water-wise cities: Global assessments of water management and governance capacities. Dissertation https://dspace.library.uu.nl/handle/1874/378386 [11-05-2019]

Krause RM (2012) Political decision-making and the local provision of public goods: The case of municipal climate protection in the US. *Urban Stud* 49:2399-2417

Lamy Committee (2017) LAB – FAB – APP – Investing in the European Future we want. Brussels: European

Commission

Ligtvoet W, Hilderink H, Bouwman A, Puijenbroek P, Lucas P, Witmer M (2014) Towards a world of cities in 2050. An outlook on water-related challenges. Background report to the UN-Habitat Global Report. PBL Netherlands Environmental Assessment Agency

Mathy S (2007) Urban and rural policies and the climate change issue: the French experience of governance. *Environ Sci* 4:159-169

Moller MS. Olafsson AS (2018) The use of e-tools to engage citizens in urban green infrastructure governance: where do we stand and where are we going? *Sustainability* 10:3513

Mollinga PP, Bhat A, Cleaver F, Meinzen-Dick R, Molle F, Neef A, Subramanian S, Wester P (2008) Water, politics and development: Framing a political sociology of water resources management. *Water alternatives* 1:7-23

Mukhtarov F (2008) Intellectual history and current status of integrated water resources management: a global perspective. In Claudia Pahl-Wostl , Pavel Kabat, Joerg Möltgen (Eds), *Adaptive and Integrated Water Management: Coping with Complexity and Uncertainty*. Berlin: Springer Berlin Heidelberg 167-185

Mukhtarov F, Dieperink C, Driessen PPJ (2018) The influence of communication technologies on public participation in urban water governance: A review of place-based research. *Environmental Science & Policy* 89

OECD (2003) Organization for Economic Co-operation and Development: OECD environmental indicators: development, measurement and use http://www.oecd.org/dataoecd/7/47/24993546.pdf [Accessed 18-09-2019]

OECD (2015) Organization for Economic Cooperation and Development: OECD Principles on Water Governance. OECD, Paris http://www.oecd.org/governance/oecd-principles-on-water-governance.htm [11-05-2019]

Pahl-Wostl C (2009) A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change* 19:354-365

Plummer R, Crona B, Armitage DR, Olsson P, Tengo M, Yudina O (2012) Adaptive comanagement: a systematic review and analysis. *Ecology and society* 17

Raddick MJ, Bracey G, Gay PL, Lintott CJ, Cardamone CN, Murry P, Schawinski K, Szalay AS, Vandenberg J (2013) Galaxy zoo: Motivations of citizen scientists. *Astronomy Education Review* 12:1-27

Rashidi K, Patt A (2018) Subsistence over symbolism: the role of transnational municipal networks on cities' climate policy innovation and adoption. *Mitig Adapt Strag Glob Change* 23:507-523

Reed MS (2008) Stakeholder participation for environmental management: a literature review. *Biological Conservation* 141:2417-2431

Steflova M, Koop S, Elelman R, Vinyoles J, Van Leeuwen K (2018) Governing non-potable water-reuse to alleviate water stress: The case of Sabadell, Spain. Water 10:739

Storksdieck M, Stylinski C, Bailey D (2016) Typology for public engagement with science: a conceptual framework. Oregon: Center for Research on Lifelong STEM Learning

Strasser BJ, Haklay M (2018) Citizen science: expertise, democracy, and public participation. Bern: Report to the Swiss Science Council

Strzelecka A, Ulanicki B, Koop S, Koetsier L, Van Leeuwen K, Elelman R (2017) Integrating water, waste, energy, transport and ICT aspects into the smart city concept. Procedia Engineering 186:609-616

Turnhout E, Van Bommel S, Aarts N (2010) How participation creates citizens: participatory governance as performative practice. *Ecology and Society 15*:26

UN (2015) World urbanization prospects: The 2015 revision. New York: United Nations United Nations Department of Economic and Social Affairs. N.d. International Decade for Action 'Water for Life' 2005-2015. http://www.un.org/waterforlifedecade/water_and_sustainable_development.shtml [1-07-2019]

UNESCO (2017) United Nations Educational, Scientific and Cultural Organization: The United Nations World Water Development Report. Wastewater the Untapped Resource; UNESCO: Paris, France http://unesdoc.unesco.org/images/0024/002471/247153e.pdf [7-06-2019]

UN SDGs (2019) United Nations Sustainable Development Goals: Sustainable Development Goals. 17 goals to transform our world. http://www.un.org/sustainabledevelopment/sustainable-development-goals/ [11-05-2019]

UN-Water (2019) United Nations Water. Coordinating the UN's work on water and sanitation United Nations. http://www.unwater.org/about-unwater/ [11-05-2019]

Van Leeuwen CJ, ElelmanR, (2019) Indicators City Blueprint framework.
https://www.eip-water.eu/sites/default/files/Indicators%20of%20the%20City%20Blueprint%20Framework_0.pdf [7-06-2019]

Van Rijswick M, Edelenbos J, Hellegers P, Kok M, Kuks S (2014) Ten building blocks for sustainable water governance: an integrated method to assess the governance of water. Water Int doi:10.1080/02508060.2014.951828

Wesselink A, Hoppe R, Lemmens R (2015) Not just a tool. Taking context into account in the development of a mobile app for rural water supply in Tanzania. *Water Alternatives* 8:2 57-76

West SE, Pateman RM (2016) Recruiting and retaining participants in citizen science: What can be learned from the volunteering literature? Citizen Science: *Theory and Practice* 1:1-10

World Economic Forum (2016) 10 Lessons on Citizen Engagement.
https://www.weforum.org/agenda/2016/01/10-lessons-on-citizen-engagement/ [7-06-2019]

Zeemering E (2012) Recognising interdependence and defining multi-level governance in city sustainability plans. *Local Environ* 17:409-424