

Policy Matrix

Screening of Digital, Data and Water Policies

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Abstract	<p>This deliverable introduces the policy matrix for the project <i>digital-water.city</i>. It serves as a framework of reference on the policies impacting smart water management in the five analysed cities (Berlin, Paris, Milan, Copenhagen and Sofia). Policies on water management, data and digitalisation are gathered and evaluated. The Matrix has been the object of a multi-stage peer review on the interplay of local, national and European policies. The final section assesses the status of the legal framework for digital water governance and recommendations for decision-makers on the way forward.</p>

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Dissemination level of the document

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List of abbreviations

ARERA.....	Italian Regulatory Authority for Electricity Gas and Water
CAP	Common Agricultural Policy
CoP.....	Communities of Practice
CSO	Combined sewer overflows
DESI.....	Digital Economy and Society Index
DWC.....	Digital Water City
EIP	European Innovation Partnerships
EIP-SCC.....	European innovation partnership on smart cities and communities
EU	European Union
G2C	Government-to-citizen
GDPR.....	General Data Protection Regulation
GIS.....	Geographic Information System
ICT.....	Information and communications technology
NOVANA	2017-2021 National Monitoring Program for the Aquatic Environment and Nature
SIAAP	Greater Paris Sanitation Authority
SISPEA.....	Water and Sanitation Public Utility Information System
WFD	Water Framework Directive
WHO	World Health Organization

Executive summary

This policy matrix analyses the policies affecting digital water management and governance in the five DWC cities (Berlin, Paris, Milan, Copenhagen and Sofia). This is defined as the regulation of water resources and related services through ICT solutions on multiple levels, actors and processes. The document targets a uniform assessment on the progress of digitalisation in the water sector across the five urban contexts. To that end, policies have been gathered, analysed and their impact peer-reviewed by local experts. Research particularly focused on thick vs thin institutionalism that is whether traditional top-down institutional mechanisms or participatory approaches to governance have weighed more in digital water governance. So as to improve the clarity of the analysis, a policy matrix has been drawn for each city, so that readers would have a visual representation of the level of smart water management. Finally, a set of lessons learned and recommendations has been drawn for a comprehensive picture of digital water governance in European cities, and the steps which should follow to enhance it.

One first finding is the preponderant role of the EU in enhancing smart water management. The quality and quantity of water provisions, from the Water Framework Directive, all the way through Drinking Water, Floods, Water Reuse, Urban Wastewater Treatment and Groundwater, have been decisive to start the ball rolling for integrated water management on the national and local level. Further provisions on Data Protection, Access to Environmental Information and Open Data have played the same role on the digital side. More importantly, initiatives such as the EIP Partnership on Smart Cities and the Digital Single Market for Water Services Action Plan have shown the increasing ambition and interest of the EU in digital water governance. While some pieces of EU legislation have been more influential than others in specific cities to boost digitalisation, such as the Bathing Water Directive in Paris, and its influence thereon varies by city, the EU has represented a primary driver of smart water management over the past two decades.

Berlin presents a mixed picture. Its policies on water management have transposed European regulation thoroughly. Digital wise, policies take the form of action plans and strategies rather than binding provisions. The intersection between digital and water policies is the most underdeveloped section. Other than cybersecurity requirements for critical water infrastructures, at present time there is no cross-sectoral focus on the application of digital solutions to water management.

Copenhagen features the highest level of smart water management in DWC. Programmes for enhanced monitoring, climate adaptation and online platform reporting have become commonplace in the light of European and national decisions. This also interplays with the Danish ambition of digitalisation as an end in itself, especially for smart cities. The need of improved water management prompts utilities and regulators to turn digital, and as improved management practices are found, there exists an increasing recourse to smart water systems.

The national framework encourages the growth of digital solutions in Milan's water management. National authorities let utilities and institutions opt up in smart solutions, alongside the more stringent standards imposed by EU legislation. However, in Milan specific provisions on data management in water services are still lacking and there is still no real integrated approach of the two policy areas.

Paris is turning to digital water solutions thanks to the bathing requirements in the Seine River, stemming from both European directives and the 2024 Olympic Games. The organisation of water services has led to the merger of small municipalities, thereby pooling resources and facilitating digitalisation. Some policies such as circular economy law may impact smart water management in the future, but for the moment this is limited to specific pilot projects and long-term strategies.

In Sofia, digital water is still far from reality. Newly approved strategies of digitalisation, particularly in the industry sector, could push smart solutions in water sector, as well. The latter, however, has transposed EU directives and related standards, but without a specific recourse to digital solutions.

All in all, digital water governance is still in the early stages across European cities. The proliferation of EU regulation and related standards doubtlessly imply that in the long run, smart solutions will be needed to face the increasingly high requirements of monitoring and reporting. While this top-down thick institutionalism perspective is true, the focus seems still to be on either water, or digitalisation, but not at the intersection between the two. In addition, processes of thin institutionalism have also shaped digital water in Europe. For instance, as utilities become an integrative part of decision-making processes, the digital solutions they adopted to make their business operations more efficient may influence the process of digital water itself.

A series of hurdles to digital water governance exist. First, actors on the local level usually need capacity-building programmes to fully grasp concepts and policy tools of digitalisation. Second, data protection from customised water services is still unaccounted for by law. Third, digital water governance may serve wider purposes of employment, emissions reduction, health and other policy domains, but it is not pushed as an end in itself. Decision-makers should therefore seek to address the relevant legal gaps to ensure cybersecurity and efficiency, but they should also think of policies encouraging digital water management as a whole, for instance through incentive schemes and awareness-raising programmes. While the digital transition is undeniably taking place, still a lot has to be done for smart water management to become the norm rather than the exception on the European level.

1. Introduction

1.1. Aim of the deliverable

The document delivers a cursory overview on [information and communications technology](#) (ICT) and water policies related to EU legislation as well as to those addressed in the five urban case studies Berlin, Copenhagen, Milan, Sofia and Paris. The starting point is digital water governance. It is defined here as the social function that regulates the management of water resources and provisions of water services by the means of ICT solutions at different levels of society. It comprises all actors, processes, regulations, structures and ICT solutions involved.

The identification of key issues on the uptake of digital solutions in water management from the different countries' perspectives enables the refinement of the methodological design. This task is closely linked to the work in the Communities of Practice (CoP) in WP5.

Results are compiled into a DWC policy matrix to allow for easy access, available in section 2 of this deliverable. The document presents the overarching EU legislation and mechanisms first (section 2.1). It then moves to the specific city dimension (section 2.2), exploring how local, national and supranational policies and actors interplay in digital water governance. Dynamics of interaction and influence have been taken into account both in terms of water management and digital policies. Finally, section 3 displays conclusions and recommendations from the research on policy matrices. Similarities and differences across cities are drawn to provide a comprehensive understanding of digital water governance in European cities. At the same time, best practices are extracted from context-specific scenarios. These will serve to frame a consistent narrative and to elaborate a set of recommendations for the enhancement of digital water solutions in the European urban context. The deliverable serves both the purpose of assessing the status of digital water governance in European cities and guiding decision-makers in urban water management towards its digital future in a sustainable and efficient way.

1.2. Approach & methodology

This deliverable has been the object of a multi-stage investigation method. **First, a literature review** from strands of literature in the Guiding Protocol (Deliverable 3.1) has been performed. This early stage research has focused on two main aspects.

First, it targeted the status of digital water governance in terms of policies and laws to improve understanding of the phenomenon and identify the main lines of action. Second, the literature review has explored techniques of research, data elaboration and visualization tools. The matrix has therefore been based on meta-research for policy evaluation, as well. A significant part of the review has been dedicated to strategies and instruments, which is one of the sections of the in-depth interviews to be performed in WP3. Findings on regulatory tools, economic mechanisms and forms of policy actions on the uptake of digital solutions in the urban water sector have been gathered and input into the policy analysis. In this context of policy evaluation, the governance dimension has been given particular weight.

Conceptually, the analysis builds on the distinction between thick and thin institutionalism (Trommer 2017; Paraskevopoulos 2002). Institutionalism is characterised by institutions shaping political actors' understandings of their policy goals and interests through formal and informal norms, standards of behaviour, and principles of interaction. The institutional design and the rules in use are part of thick institutionalism. By contrast, thin institutionalism occurs when institutions provide spaces in which actors exchange their pre-determined interests and enforce agreements. It is therefore related to

policy style and detail. Multistakeholder engagement, which the DWC project research on and aims to foster, is part of thin institutionalism. Intuitively, thick institutionalism is the primary driver of decision-making in digital water governance. Nonetheless, thin institutionalism is extending its influence thanks to the proliferation of participatory governance and innovative consultation and decision-making processes thereof. This research aims to capture both aspects of institutionalism as digital water governance, due to its cross-sectional nature, calls for innovative policy-making approaches.

Once identified the main policy areas, key concepts and strategic interactions, the research team conducted **desk-based policy research and analysis of current legislation and policies** in the 5 European cities. Research has been carried out in the original language to take into account as many relevant local sources as possible and also in order capture the nuances of meaning. As a result, only native speakers or people who were fluent in the language of the selected city were involved. Results of the research have been translated into English, the official language of the project, to allow for internal as well as partner-based feedback. Stage two has been based on the principle of coordination, in that the relevant European legislation on digital governance, water governance, or both, was shared across researchers. This allowed for the cities to have a common overarching framework to base their analysis on. After an initial phase of detecting the most impactful pieces of legislation, laws have been divided into different categories of policy instruments and their targeted stakeholders. Estimations were made to what extent these policies are up to date with current requirements of digital water governance. The analysis focused on policy gaps, to check whether policies and provisions were enforced on the ground, and had an effective impact thereon.

Finally, a **consultation with partners and local experts** was executed. Assessments given by researchers from the Ecologic Institute have been confronted against the expertise of local actors. This was based on the Delphi method. It consists of the consultation of a panel of local experts via electronic means, a model which has been progressively received and used in the academic field (Rowe and Wright 2011). It builds on the assumption that aggregated judgment on research helps more than hinders accuracy. In the Delphi method, the electronic format of responses facilitates communication and, most importantly, the equal consideration of opinions. Ecologic Institute has collected answers from experts separately, which means that no expert opinion has dominated over others as it may be the case in panel meetings (Ho et al. 2018). This expert judgment in such a new field is useful when scientific evidence on the topic is contradictory, speculative or not available, as it is the case for a new topic such as digital water governance.

Subsequently, the double assessment of (a) the impact of the DWC digital solutions on the respective city and (b) the digitalisation of the water sector as a whole has been adjusted, taking into account the opinion of local experts. Once the policy assessment has been finalised, the final stage of the study has **focused on visualisation**. Research and evaluation on the best graphical representation has been performed. The main point of debate has been finding a visualisation tool which would show at the same time the importance/relevance of the policy, its geographical scope and the intersection between the digital and the water sector.

The following section presents the policy matrices for the EU and [city-specific dimensions](#). Every city follows its own trajectory of analysis, as the relevance of local, national and EU policies varies with the specific urban context. For this reason, some cities focus more on a particular institutional level than others. A brief summary of the state of policies in terms of water management, digitalisation and the interplay between them is provided at the end of each section.

2. Policy matrices

2.1. EU

European Union legislation provides the regulatory backbone of both water management and digitalisation in the member states. First, while every member state and by extension every city autonomously decides on their digital water strategy, EU law provides thresholds of compliance in social and environmental aspects. Provisions include minimum water quality standards, biodiversity targets and respect of data protection among others. Second, EU institutions and initiatives (e.g. EIP Water, EIP partnership on smart cities) are often the forerunners in digital water management, promoting the application of ICT solutions on the urban level. Action plans as well as public-private partnerships are pushed forward by the EU for innovative projects, ranging from smart cities projects to the creation of a digital single market for water services.

The **Water Framework Directive (WFD)** constitutes the primary piece of legislation when it comes to water. It encompasses all aspects of the water cycle and throughout all its social implications, from ecosystems to drinking resources. Typically, the WFD envisages the preservation of good status or potential of water bodies. This implies maintaining the same replenishment capacity while ensuring adequate qualitative standards. To that end, it addresses the creation of river basin management plans and guidelines in water pricing for efficient resource use. It indirectly encourages digitalisation through its requirement of good ecological status. As member states are required to keep water bodies within acceptable standards, digital solutions can provide improved monitoring of environmental conditions and chemical status of water bodies, thereby enhancing resilience of water ecosystems. While there is no direct provision on digitalisation in the Directive, ICT solutions serve well the cause of cross-sectoral policy objectives, such as climate adaptation or drought management. Early warning systems, for instance, improve the resilience of water ecosystems while checking the compliance with water quality thresholds. Where good status has already been achieved, digitalisation can further drive down operational costs. This is the case in the Seine & Marne river basin, which encompasses Paris in the DWC framework. The **Quality of Water Directive (1998/83)**, lately amended in 2015 and complemented by the **Environmental Quality Standards Directive (2008/105)** in the field of water policy, and the **Floods Directive (2007/60)** follow the same logic. The former lays out drinking water standards in compliance with WHO guidelines. The latter requires member states to elaborate an assessment of flood risk and related management on the national territory. A similar process has occurred to the **Groundwater Directive (2006/118)**. Once again, enhanced management implies enhanced monitoring, which in turn can be guaranteed by digital tools. These directives pushed both utilities and local institutions to become familiar with innovative monitoring tools, from digital maps to smart sensors and geo-monitoring systems. Importantly, the European framework is not static, but rather it adapts to the evolving socio-economic and environmental context. In this sense, **Regulation 2020/741** has been recently approved to set minimum standards for water reuse. Starting 2023, this regulation will impose harmonised recycling and monitoring requirements, as well as risk management provisions for water utilities. The Regulation bears the potential to enhance treated wastewater for further uses, as it is for agriculture in the Milan case. The Pescheria Borromeo facility is precisely addressing risk management in wastewater reuse. Another possibly ground-breaking initiative is the **Digital Single Market for Water Services Action Plan**. The EU defined a series of milestones and interventions between 2018 and 2030 to evolve from uncoordinated initiatives in digital water management to a systemic adoption of digital solutions in the water sector. The Plan seeks to find interoperable, standardised technologies to promote a sustainable and smart model of water management among multiple stakeholders. While of no binding character, the action plan represents

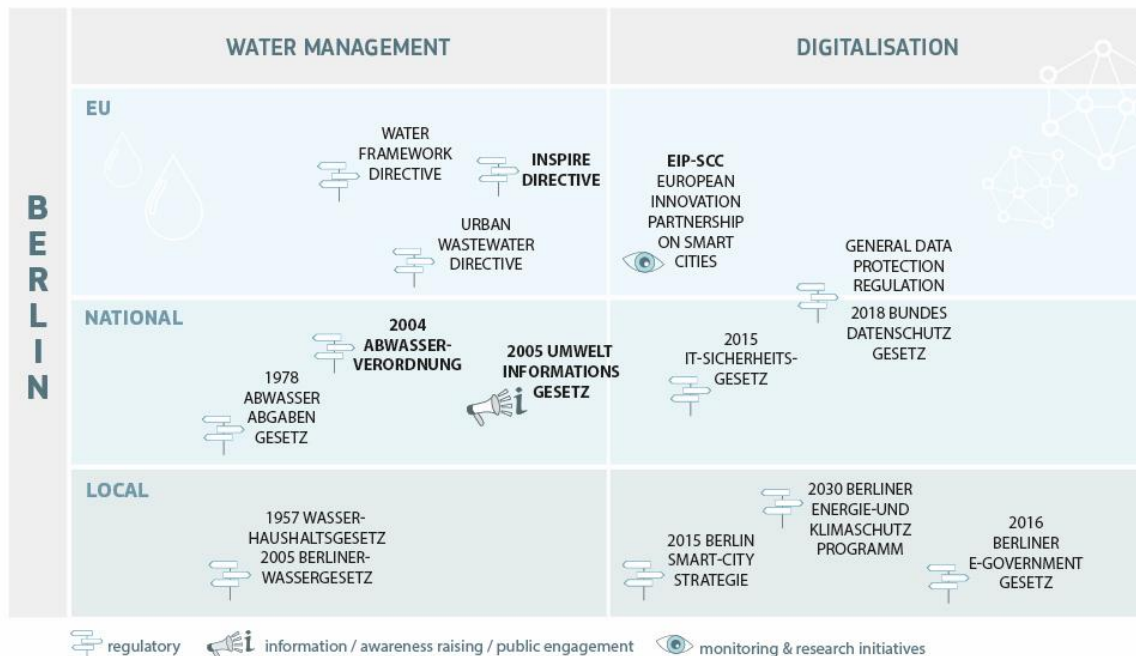
a first important step in the right direction in this new digital wave across European governance and legislation.

European policies impacting digitalisation in the water sector are also found in IT and information provisions. The reference framework is given by the latest **General Data Protection Regulation (GDPR)**, which imposes boundaries and restrictions to private data collection and management. Generally, water utilities and other relevant actors have to comply with the GDPR in the exercise of their tasks. However, the impact of the GDPR depends on the nature of the innovation. In case of government-to-citizen tools (G2C), smart solutions do not require the collection of private data, so this goes beyond the scope of the GDPR. On the other hand, the GDPR imposes a direct constraint to the digitalisation in the water sector insofar as bottom-up systems are involved, for instance in customised demand-side management from the optimised collection of users' water consumption levels. On the users' side, EU policies have encouraged enhanced access and transparency for a long time. The **Public Access to Environmental Information Directive (2003/4)** already enhanced the possibility of consultation on environment-related information for users. On the institutional side, the **INSPIRE Directive (2007/2)** and the **Open Data Directive (2019/1024)** regulated the use of personal data in the public sector. They improved transparency mechanisms and data use for the public sector, particularly for the creation of a shared platform on environmental spatial information across member states. As many water actors work with open source data, the directives are highly relevant to business practices, especially as digitalisation leads to the collection of a higher number of data at unprecedented pace. However, the GDPR has not yet been transposed in specific provisions for water utilities, so that data protection among water utilities still represent a grey area, pointing to an important policy gap in the sector.

The policies above constitute the main pieces of EU legislation in terms of digitalisation and water management. Other policies at the European level may contribute indirectly to the uptake of ICT solutions in the sector. While every policy on water contributes to adopt an integrated approach to water by including as many stakeholders and socio-economic dynamics as possible, some of them have a larger influence on specific DWC cities. The **Bathing Water Directive (2006/7)** provides for the management of bathing water quality also in relation to the urban context. It sets qualitative standards to be assessed on a specific amount of time to ensure that bathing water does not cause any health externalities. In addition, if bathing waters are subject to short-term pollution, the Directive explicitly demands the integration of early warning systems to prevent contamination. This is a direct driver of the early warning system in Paris, one of the digital solutions of the project. The **Urban Wastewater Treatment Directive (1991/271)** is applied in every DWC city, but it is of particular importance for the system of water reuse in agricultural sites in Milan. It is currently being reviewed to update the outdated requirements of monitoring, water quality, reporting and to harmonise the different assessment of "sensitive areas" by Member States. It also seeks to include other dynamics such as urban runoffs and combined sources of pollution in wastewater. The **Common Agricultural Policy (CAP)** could further push for digitalisation by some investment measures on improved irrigation systems, as well as in its indirect compliance of the WFD and other water-related directives. However, the focus of the CAP is not on digitalisation and there is no systemic approach to innovation uptake.

2.2. Berlin/Germany

Figure 1: Berlin Policy Matrix



Berlin Policy Matrix: in Berlin, there exists a considerable number of digitalisation and water management policies on the local level. EU directives have also been transposed consistently. At present time, few provisions and of limited binding character exist at the intersection between the two policy areas.

In Berlin, the water policy framework is largely coherent and comprehensive. The first law on water protection, the **German Water Management Act (*Wasserhaushaltsgesetz*)**, has been approved in 1957, introducing the principle of sustainable water management as a fundamental part of the natural balance among water ecosystems. The **2005 Berlin Law on Water (*Berliner Wassergesetz*)** implemented the 1957 law on the city level. Going in the same direction, the **1978 Wastewater Levy Act (*Abwasserabgabengesetz*)** draws on the polluter-pay principle to impose a tax on wastewater discharge into the water. The more harmful the substance, the higher the fee. The **2004 Wastewater Regulation (*Abwasserverordnung*)** regulates the minimum requirements to be set for permits to discharge wastewater into water bodies. The emission-related requirements are intended to define the state-of-the-art technology. Over the years, the German as well as Berlin's regulatory environment adjusted to European legislation, particularly the WFD, the Quality of Water Directive and the Urban Wastewater Directive. Transposition of European norms has not been limited to the water sector: The **2005 Environmental Information Law (*Umweltinformationsgesetz*)** set up the legal framework for free access to environmental information for reporting bodies, in compliance with the 2003/4 Directive.

This transposition process has been integrated in state and city legal practices for a variety of domains. The GDPR has been implemented in Germany through the **2018 National Data Protection Act (*Bundesdatenschutzgesetz*)**. The EU has been pushing forward privacy and IT pieces of legislation, in an effort to support the digital transition. Berlin is part of the online platform **European innovation**

partnership on smart cities and communities (EIP-SCC), with the target of a sustainable, smart city displaying smart tools for enhanced management. Clearly, the EU Commission is a driver of innovation. However, it does not seem to be so for digital water governance. This is due to a number of reasons. First, at present time innovative plans such as the Digital Single Market for Water Services Action Plan do not show any repercussions on the local level. Second, while the EU approves both water management and digitalisation provisions, the degree of intersectionality to which these are implemented is in the hands of national and local actors. For instance, the GDPR does not contain any specific provisions for water utilities, which leaves them in a grey area in case they want to use private data for improved management practices. Third, the water sector with its long investment cycles has a general tendency towards risk aversion which hinders innovative change (EIP Water 2014).

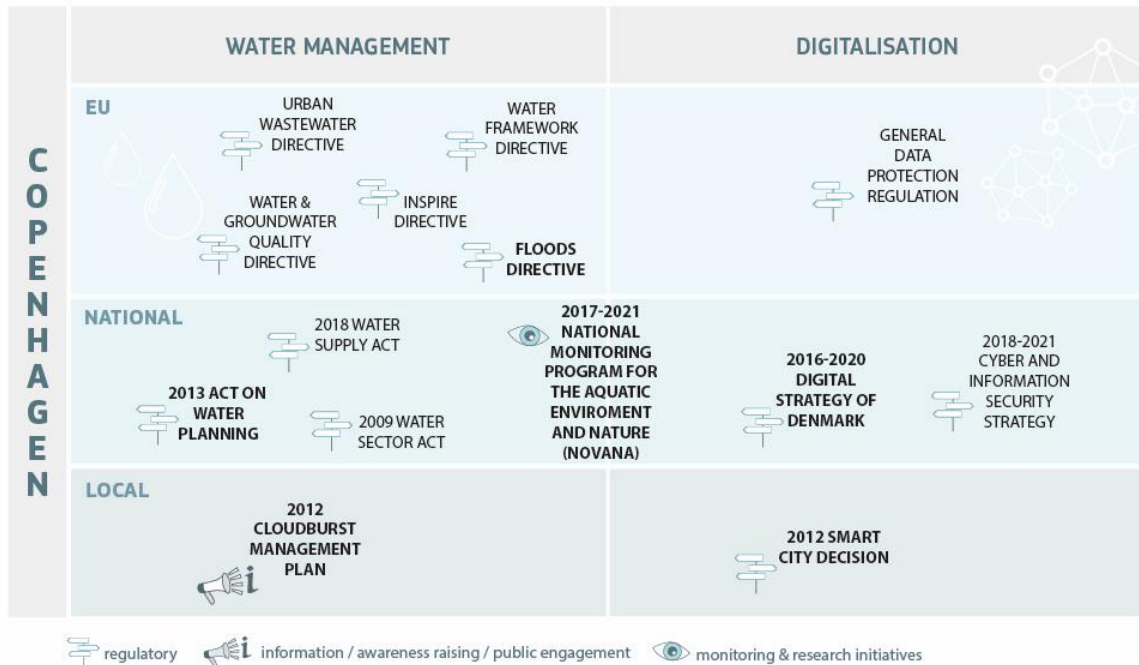
Apart from that, the city of Berlin has fuelled its digitalisation agenda through a series of initiatives. The **2015 Smart-City Strategy** aims to use intelligent technologies to address Berlin's social, economic and environmental issues. The **2016 Berlin Law on E-Government (Berliner E-Government Gesetz)** requires local administration to turn digital for transparency and efficiency. Finally, the **2030 Berlin Energy and Climate Plan (Berliner Energie- und Klimaschutzprogramm 2030)** constitutes the ultimate climate plan for the city of Berlin. Smart solutions are integrated in specific practices of optimised resilience and adaptation. However, none of the above contain any provisions on the digitalisation of the water sector, not even the 2030 climate plan.

As novel ICTs are increasingly applied in the Berlin water supply infrastructure sector, also new requirements regarding their cyber security arise. On the national level, the 2015 **IT Security Act (IT-Sicherheitsgesetz)** obliges the operators of critical infrastructure facilities or facilities themselves to establish IT security systems according to the state of the art. By definition, critical infrastructure also includes the sectors of sewage disposal and drinking water supply, which also encompasses other water management facilities, e.g. dams, if they are used for drinking water supply.

All in all, Berlin features a comprehensive water management framework, which is established in binding provisions and proven business practices. National and local actors are also used to transpose European directives on both institutional levels. In terms of digitalisation, many policies take the form of strategies and action plans rather than binding provisions. Germany itself scores higher than the EU average in the Digital Economy and Society Index (DESI), as digitalisation becomes an integrated part of business and institutional practices. However, the growing amount of digitalisation programmes and legislative schemes have not been quite impactful in the water sector yet. Cybersecurity risks to critical infrastructures provide a prominent exemption as water supply and wastewater facilities applying ICT technology are obliged by law to fulfil state-of-the art ICT security requirements. The increasingly digital agenda of Berlin leaves room for application of ICT technologies in water management, but there is no sectoral focus at present time, leaving the potential of digital solutions to water management largely untapped.

2.3. Copenhagen/Denmark

Figure 2: Copenhagen Policy Matrix



Copenhagen Policy Matrix: Copenhagen presents a series of policies in digital water management, although these stem from the national framework to a larger degree than city decisions. A significant number of European directives has played a large role. On the local level, particular effort has been put on climate adaptation policies, indirectly encouraging digital water management.

European legislation has acted as a driver for the development of digital solutions in Denmark. The EU Floods Directive contributed to the introduction of digital mapping for early warning systems. Directives on Urban Wastewater Treatment, Water & Groundwater Quality and INSPIRE further supported the integration of data-sharing platforms, modelling and enhanced monitoring through smart sensors. Importantly, EU law has been complemented and specified by national legislation and programmes. The **2009 Water Sector Act** introduced specific efficiency requirements for water and wastewater utilities. This lowered operational costs while stimulating utilities to adapt to a specific benchmarking mechanism. In turn, benchmarking encouraged the design of specific tools for asset management, integrating digitalisation among Danish water utilities. The **2013 Act on Water Planning** targeted the sustainable and long-term protection of aquatic ecosystems, which in turn led to the creation of the online Danish environmental portal. Concerning the field of digitalization, the **2016-2020 Digital Strategy of Denmark** pushed for a strong development. Digital data infrastructures have to be made available to improve public sector activities, including water and wastewater systems, both for utilities and the general public. Similarly, initiatives such as the **2017-2021 National Monitoring Program for the Aquatic Environment and Nature (NOVANA)** increasingly rely on digital methods, including a GIS supported monitoring system for river basins. The Danish policy framework also incorporates European requirements on data management and protection, the most important being the Directive of Public Sector Information and the GDPR. The former is of particular relevance in Denmark since a lot of companies work with open source data – something this directive seeks to

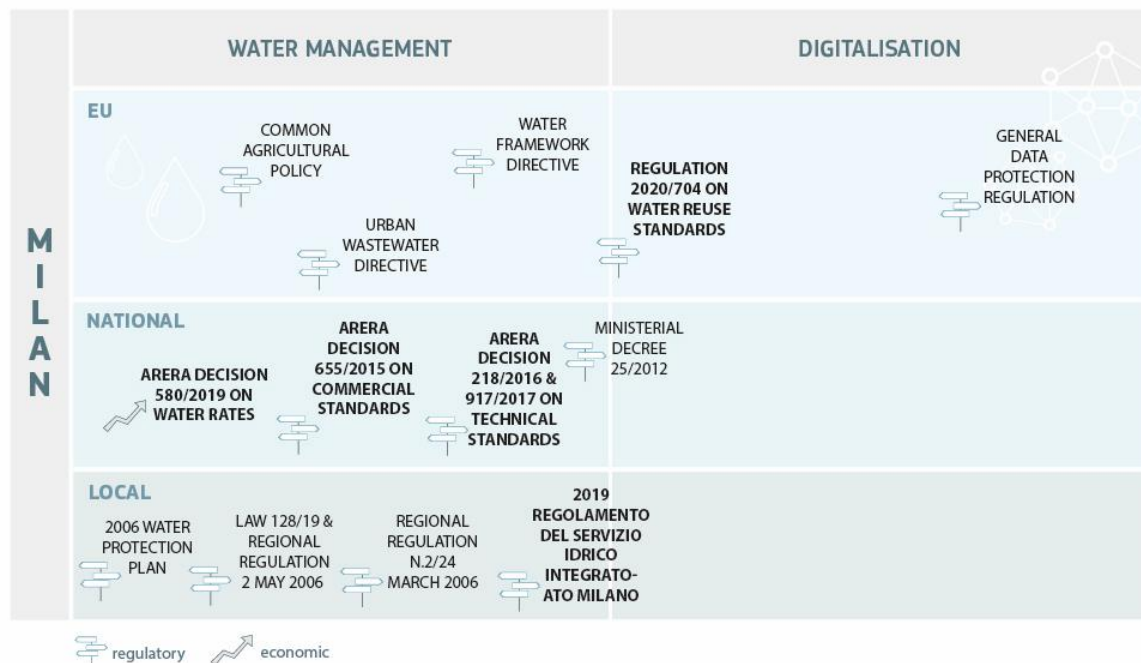
enhance. The Danish **2018-2021 Cyber and Information Security Strategy** is a main policy for IT and cyber security and is also applicable to drinking water supply. However, water supply does not depend on network and information systems as of yet, therefore this is still outside of the scope of water utilities. Generally, it seems that utilities can be supported with a stronger regulatory frame in order to manage data more efficiently. This could help enhance sustainability of water use as well as safety and resilience of the necessary information systems.

The topic of digitalisation can also be found in the City of Copenhagen's regulatory framework – although to a far lesser extent. Copenhagen's **2012 Climate Adaptation Plan** and **2018 SDG Action Plan** focus on climate change adaptation, calling for sustainable and resilient water management – while laying no particular focus on digital tools. Similarly, the **2019 Municipal Plan** for the City does not specifically focus on digitalisation. Sector-specific policies that include digitalisation can be found occasionally: The **2012 Cloudburst Management Plan** relies on data collection to monitor overflow deposits and prevent damage. Copenhagen also approved an open data policy in its **2012 Smart City decision**. It targets the creation of a public online platform from public and private sources including a water defence system for real-time decision making. Seeing that both policies date from years back, there seems to be room for policies to use the full potential of digital solutions for the municipal level.

Overall, the digitalisation of the water sector in Copenhagen is boosted by a strong regulatory frame and the effective interplay of local, national and European policies. Climate change adaptation and cross-sectoral digitalisation are two major drivers for enhanced water management. Denmark scores third in the Digital Economy and Society Index (DESI), the highest among the analysed cities. In Copenhagen, digital water applications mainly start from the need of improved water management through the application of digital tools. As water utilities turn smarter, further strategies to incorporate EU and national regulation become possible.

2.4. Milan/Italy

Figure 3: Milan Policy Matrix



Milan Policy Matrix: EU directives such as the CAP, the WFD and the Urban Wastewater Directive are the most influential in the Milan context. The national framework leaves freedom to water utilities to opt up and adopt digital solutions. Locally, policies are focused on water management rather than digitalisation and data management.

European directives push for enhanced monitoring of water management and thus for a use of latest technologies. In the DWC context, the urban wastewater treatment Directive, the WFD and the EU regulation 2020/741 boost the application of risk-based approaches and the geo-monitoring system for treated wastewater in agricultural sites. Nationally, the main provisions pushing for digitisation have been issued by the national agency ARERA, which regulates energy and water services. ARERA **Decision 580/2019** on national water rates is encouraging sustainability through provisions of efficient resource management and water reuse. Digital solutions can support this process by contributing to requirements of lower energy demand and recycling. The main regulatory tools by ARERA are found in **Decisions 655/2015, 218/2016 and 917/2017**. These provide for commercial and technical standards in water utilities' business practices. The decisions entailed obligations in terms of intervention, billing, customer service, dashboard and standard monitoring & collection standards as well as maintenance of measurement devices. They both provided technical and regulatory clarity on new devices and, in the case of utilities in the Milan area, led them to integrate digital solutions in their operations to an increasingly larger extent.

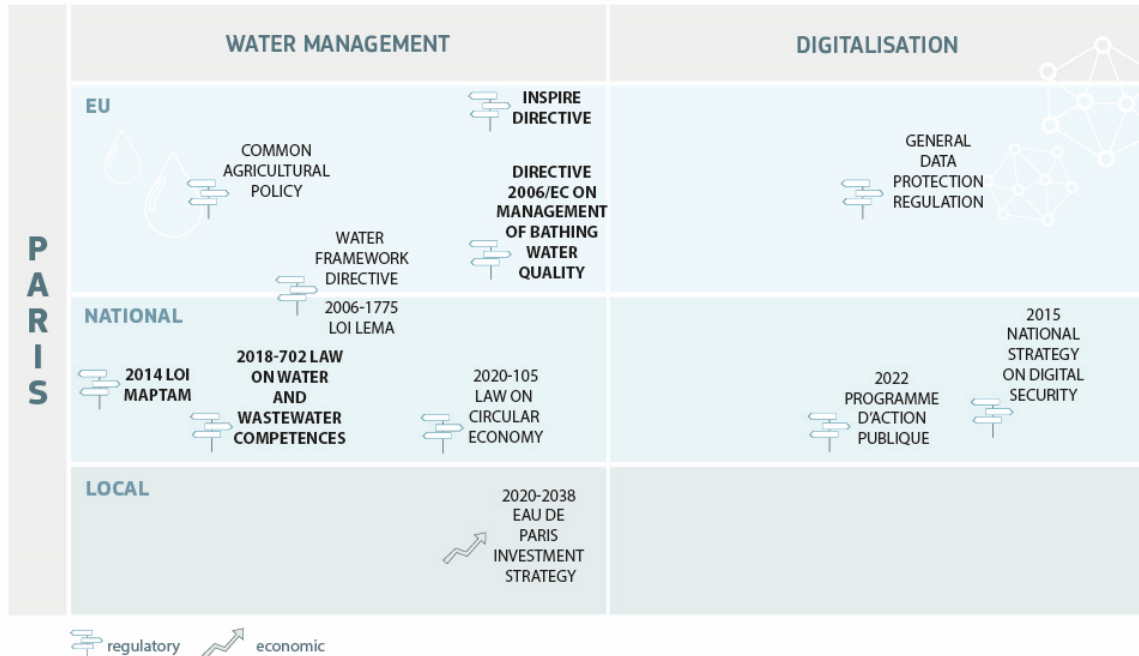
The national context provides the backbone of water management services. In addition, subnational actors in the form of regional governments, provinces and municipalities are in principle free to set more stringent standards. First, the Lombardy region approved the **2006 Water Protection Plan (Piano Regionale di Tutela delle Acque)**, regulating the use of water resources. It also issued **Regulation n. 2 / March 24, 2006** calling for the use of best available technology for water saving. A similar provision

can be found in the ATO's **2019 Integrated Water Service Regulation (*Regolamento del Servizio Idrico Integrato*)**, which pushes water utilities to have recourse to best available technology in compliance with national and EU legislation, as well as encouraging them to invest in R&D for such technologies. While this is not a binding provision *stricto sensu*, it is still an indirect driver for innovation uptake. **Law 128/19** further gives regional authorities the power to decide on what constitutes "end of waste", in compliance with EU Urban Wastewater Treatment Directive and **Regional Regulation of May 2, 2006** on water reuse qualitative standards. With the revision of the Urban Wastewater Treatment Directive, even local regulation will have to be updated. The new piece of legislation can boost digitalization for the monitoring of combined sewer overflows (CSO). This is particularly important for the Milan DWC pilot intervention, which relies on treated wastewater for agricultural purposes. In addition, the local water authority ATO plays a non-negligible role in public awareness on sustainable water consumption through specific programmes and rates, fostering effective demand-side management. In Milan, local actors enjoy a high degree of autonomy in water management, and this is turning more and more digital. Concerning data protection, the GDPR has not been transposed in particular obligations for water actors. However, **Ministerial Decree 25/2012** requires utilities to give consumers complete information on the water treatment process. This primarily pushes the digitalisation of customer care and communication, but it may also make utilities more acquainted with digital tools and, in the long run, more eager to integrate digital solutions in their on-the-ground management practices.

Italy is significantly below the EU average according to DESI, but Milan is a positive exception in terms of digitalisation. In Milan, the national framework leaves local actors relatively free to decide on their business practices, including digitalisation. Provisions on best available technologies, as well as higher monitoring and intervention standards, are pushing utilities in the Milan area to deploy digital tools. Some policy gaps exist, such as the lack of data management-specific provisions for customised water services. All in all, a systematic, integrated approach encompassing data management and protection, technologies, customer consideration as well as water reuse is lagging behind.

2.5. Paris/France

Figure 4: Paris Policy Matrix



Paris Policy Matrix: The bathing water quality Directive is of particular importance. National laws on the water management framework enhanced possibilities of digitalisation. Laws on circular economy and data management are yet to incorporate the water sector, and locally the Eau de Paris investment strategy in ICT solutions is the most relevant mechanism for digital water management.

In Paris, the digital solution piloted in the DWC project takes the form of an early warning system for bathing water quality in the Seine. The main drivers for this technology have been found to be the **2006/7 EU Directive of Bathing Water Quality**, which sets qualitative standards in terms of chemical status and temporal constraints, and the 2024 Olympic games in Paris. Taking a broader perspective, the main influence on the Parisian water sector appears to be European regulation. Other than the **2006/7 Directive**, the **WFD**, the **Water Quality Directive** and the **INSPIRE Directive** constitute the most relevant pieces of legislation. The latter is a particularly powerful tool, in that it facilitates the exchange of information between urban planning departments in the Paris area municipalities and the Greater Paris Sanitation Authority SIAAP for sewerage management. In this sense, a digital platform made communication quicker and more reliable, with a tangible impact on improved business practices and enhanced health supervision. Other EU initiatives, such as the Digital Single Market for Water Services Action Plan, could ensure interoperability of digital solutions in the future, fostering the exchange of digital best practices in the future of the water sector.

On the national level, the rearrangement of water competences appears to be the main driver of digitalisation in the water sector. First, the **2014 MPTAM Law** stated that municipalities held primary competence with respect to basin management, flood prevention, water body status and restoration of ecosystems. Integrated water management had been in place since the 1960s. What changed is that local municipalities would be the primary, on-the-ground actors in integrated water management. In

addition, the **2015-991 Notre Law** set in motion the **2018-702 Law** on Water and Wastewater competences. These have been assigned to organisations comprising multiple municipalities by 2020, with some exceptions up to 2026. In practice, smaller service providers have tended to merge into larger ones. Municipalities surrounding Paris had to merge into a specific administrative body called *établissement public territorial*, a peculiarity of the Grand Paris region. Although the transfer of competences takes time, the aggregation of institutional capacity, technical expertise and economic budget has favoured the introduction of digital tools. The reliance on local institutions has thereby favoured the development of context-specific technological solutions.

The **2006-1775 Lema Law** transposed the WFD requirements of good ecological status and set up the Water Agencies (*Agences de l'Eau*), responsible for river basin management plans. While no direct provision on digitalisation has been issued, the Law required *Agences de l'Eau* to report water-related data on the harmonised online platform *Eaufrance*. LEMA acted as a primary driver to integrate data in digital form on the national level. This has led to the approval of the **2018 Water Data Regulation (*Arrêté du 19 octobre 2018 approuvant le schéma national des données sur l'eau, les milieux aquatiques et les services publics d'eau et d'assainissement*)**, which provided for national platforms on publicly available water data. This encouraged local actors to report, although digital requirements are not explicit.

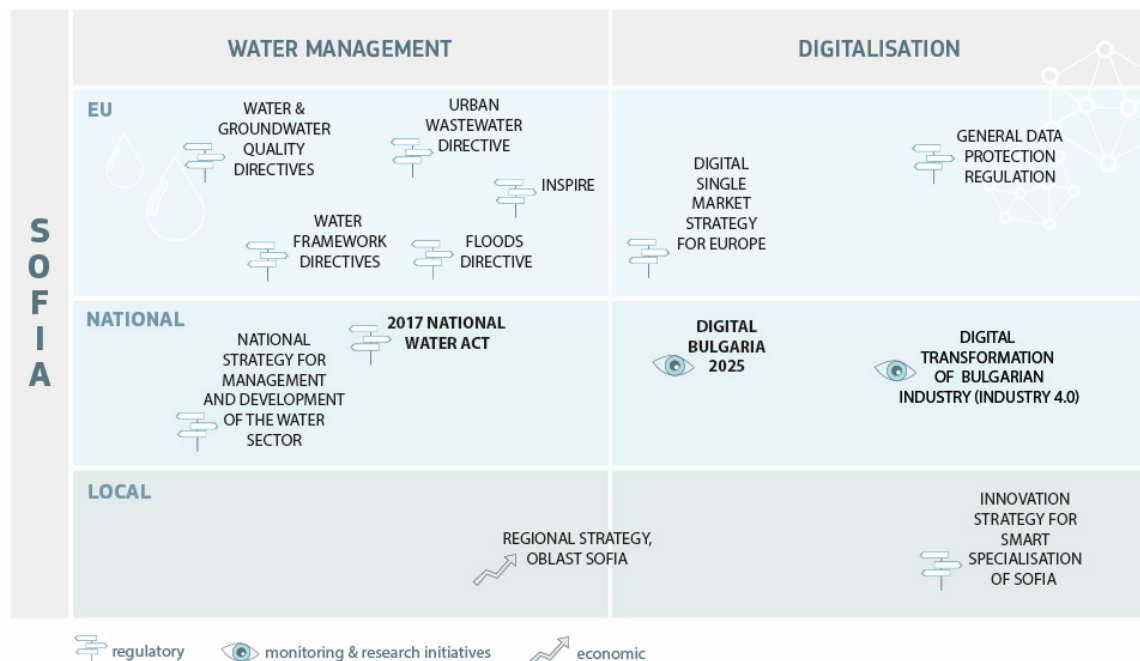
On the data side, the **2015 National Strategy on Digital Security** tries to enhance the digital security of firms and citizens through multistakeholder dialogue and capacity-building programmes. As it concerns open source data, the strategy helps in terms of interoperability and reciprocity with technology developers. This has potential for application in water utilities, but the level of data collection is still insufficient for the strategy to have an impact on the digitalisation of the sector. A stronger push stems from the French Biodiversity Agency (*Office Français de la Biodiversité*), which pushes water actors to turn digital in order to collect data for WFD reporting duties. Yet again, digital expertise in data collection and management remains the prerogative of larger organisations such as research centres and Water Agencies (*Agences de l'Eau*). Local water utilities are still lagging behind. Another relevant strategy on the national level is the **2022 Public Action Programme (*Programme d'Action Publique*)**. It targets the digitalisation of public administration services. It may indirectly involve water utilities in performing customer services online, as well as the informatisation of ecosystemic data in water bodies by *Agences de l'eau*. It might also facilitate sewer connection operations in terms of mapping and intervention. However, the strategy is oriented towards the digitalisation of data and customer services rather than promoting digital solutions themselves. This is also the case for the **2020-2038 Eau de Paris Investment Strategy** by the local utility. While some digital tools such as 3D modelling for underground water management is envisaged, once again digitalisation is associated with the administrative and customer service side. The national government has uniformised these digital aspects under the SISPEA platform. The introduction of SISPEA does not concern water directly, but national targets in water services are pressing local actors to expand online reporting from administration to asset management. However, some organisations do not have the right reporting standards, for instance indicators, and adherence to SISPEA remains voluntary. The recently approved **Law 2020-105** on circular economy may have some potential for application in the future for wastewater treatment and resource efficiency, but the link to digitalisation remains unexplored at present time.

In Paris, some ambitious pilot projects on digital water management are being encouraged, but legislation does not seem to be the primary driver. External factors such as the 2024 Olympic Games are playing an important role. Overall, sufficient ambition from water and digitalisation provisions

exists. This is mainly translated in open platform initiatives and the 2018 water data regulation. On the local level, things have been mostly lagging behind. In terms of digitisation, France scores slightly below the EU average on the Digital Economy and Society Index (DESI), although Paris is probably different from the rest of the national context and digitalisation is more deeply rooted. It remains to be seen whether innovative models promoted by legislation, such as the one on circular economy, will facilitate the uptake of digital solutions in water management. For the moment, this remains isolated in the form of pilot projects, private investment strategies or long-term strategies which are still to be implemented.

2.6. Sofia/Bulgaria

Figure 5: Sofia Policy Matrix



Sofia Policy Matrix: In Sofia, the Water Act transposed the EU directives on water management. On the digital side, some strategies are envisaged for industry and public administration. Locally, water management provisions – and subsequently digital solutions – are lacking.

Bulgaria has transposed a number of water-related European directives into national legislation. Particularly, the Flood and Water Directives are of some importance for the digitalisation of the water sector, as the first requires the use of digital models and maps for flood assessment and the later sets out objectives towards improved water infrastructure. With regard to the digitalisation, the National Programme “Digital Bulgaria 2025” has been developed in line with the EU Digital Single Market Strategy.

At national level, the **2012 National Strategy for management and development of the water sector** regulates water management, also in terms of future trends. It consists of short-term, medium-term and long-term plans. The strategy aims, among others, at the introduction of information technologies in the process of water supply and sewerage systems management without referring to specific digital solutions. Concerning water management, the construction, reconstruction and modernization of the

wastewater collection and treatment systems is one of the main actions outlined in the strategy.¹ This creates a favourable environment for digital solutions, but in practice there are no specific provisions boosting their deployment. The **2017 National Water Act**, whose final version has been approved in 2017, transposes a series of policy targets contained in EU Directives, mainly the WFD, the Floods Directive and the Directive of environmental quality standards into national water policy. Among other water management provisions, the Act encourages the application of water-saving technologies in agriculture, industry and household, particularly targeting regions affected by drought. It also envisages the practice of water reuse in the industrial sector, thereby pushing for enhanced monitoring. On the national level, digitalisation is encouraged as an end in itself rather than in being applied to enhanced water management. The **National Programme “Digital Bulgaria 2025”** targets smart, inclusive and sustainable growth through the deployment of specific technologies, ICT research and innovation and the digitalization of Bulgarian industrial sectors and related services, but it does not contain any sector-specific provisions and as such the water sector is not explicitly mentioned. As Bulgaria improves the know-how on digital business practices, regulation and processes, this may spill over to the water sector eventually, as ICT operations become integrated in management models. Since the implementation of the programme is in its early stages, its impact is still limited and its further implications for water management are yet to be observed. Currently, a Strategy on the **Digital Transformation of the Bulgarian Industry** (Industry 4.0) is under development. It was accompanied by a draft strategy paper, whereby specific standards, mechanisms and rules to guarantee the development of digital industry on the national level are foreseen. The ambition to launch this strategy is to develop Bulgaria as a regional centre of the digital economy by 2030. The adoption of the Industry 4.0 Strategy could provide room for the implementation of digital water solutions in Bulgaria. At national level, there are a number of initiatives, which aim to develop digital skills of the population. These include the Strategy for effective implementation of ICT in education and science (2014-2020), the National program "IT career training", and the Bulgarian Digital National Alliance. Once again, these may contribute to the uptake of digitalisation across sectors in the future, but no tangible impact can be detected at present time.

On the city level, two main pieces of regulation contribute to develop ICT tools for water. First, the **Regional Strategy, Oblast Sofia** envisages a series of measures for the development of the city between 2014 and 2020.² These include the development and improvement of water infrastructure for both supply and sanitation. In this sense, digital solutions can bring about the higher operational and quality standards set out by law. Second, the 2016 **Innovation Strategy for Smart Specialisation** seeks to stimulate private investment into applied technological innovation, supporting its implementation on the ground. It particularly helps entrepreneurs gain access to financial instruments to make investments in the ICT sector possible.³ However, no specific mechanisms for water are present. Technology wise, Sofia is in a favourable position compared to other cities in Bulgaria, as there are a few Innovation Hubs in place (e.g. Sofia Tech Park, DXC’s Sofia Digital Transformation Center) providing technical and financial support in the field of information and communication technologies, life science, green energy, education, entrepreneurship, innovation, technologies.

¹ https://www.moew.government.bg/wp-content/uploads/file/Water/IVodi/NSURVS/Strategiq/Vodna_Strategia.doc.

² <http://www.strategy.bg/FileHandler.ashx?fileId=6959>.

³ https://www.sofia-da.eu/images/iniciativi/ISIS_Sofia_ENG.pdf.

Overall, none of the policy strategies and programme include specific measures towards digitalisation in the water sector and mainly address either improved water infrastructure or digitalisation as a whole. Sofia has started to feature some ambitious policies in terms of digitisation of its public and private sector, but these remain in the early stages. Concerning water, provisions of best practices and quality standards do exist, but these do not seem to encourage the application of digital technologies at present time. In addition, the digital transition in Bulgaria is well below the European average. In **2019**, the country ranking last in the **Digital Economy and Society Index (DESI)**.⁴ This certainly affects the digitalisation of the water sector, which remains driven by pilot projects, mainly funded under the EU Framework Research and Innovation programme Horizon 2020. However, the potential impact of the recently adopted National Programme “Digital Bulgaria 2025” and the upcoming Industry 4.0 Strategy is yet to be seen.

⁴ https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=59979.

3. Conclusions & recommendations

The document sheds light on the untapped potential of ICT solutions in water management across the five DWC cities: Berlin, Milan, Copenhagen, Paris and Sofia. In the analysis, the cross-cutting nature of digital water governance, and thereby its multifunctionality in terms of policy goals became evident. Digitalisation in the water sector is still in its early stages and so is the corresponding regulatory, social and economic framework. What can be observed in every city is enhanced regulation and subsequent operations in the two macro policy domains of water management and digitalisation. With EU legislation bringing regulatory certainty and obligations of transposition into national laws, cities are now facing a more comprehensive set of provisions. Directives regulate the water cycle in an unprecedented level of comprehensiveness in the form of groundwater exploitation, quality standards, wastewater treatment, water reuse, bathing and further purposes. At the same time, digitalisation has constituted a disruptive force which has also been regulated and by extension boosted in an unprecedented manner. The GDPR provided clarity on data management, while requirements of public administration turning digital have become the norm rather than the exception. The proliferation of legal instruments in both water and data policies points to dynamics of thick institutionalism. EU legislation and policy initiatives represented a reliable and demanding backbone for water management and informatisation in the urban context. National governments, and cities, have incorporated European provisions in their own legal practices. To some extent, enhanced water governance and data governance have undergone a top-down learning approach. One of the most glaring examples are decisions of the national authority ARERA in Italy, which introduced specific technical and commercial standards for water utilities. The ones in Milan have had in turn an increasing recourse to digital solutions to meet more stringent monitoring and quality requirements. This shows that top-down learning has been recurrent for water policy on their own rather than in an integrated approach to digital strategies. The purpose of the analysed policies has often been enhancing water management, or digitalisation, but not necessarily their integration. The choice of using technologies in water management has been dictated by managerial decisions to cut on costs and time rather than by changing regulations. It follows that processes of thick institutionalism for digital water governance are hardly recognisable on the local level at this stage.

What is more, thin institutionalism mechanisms have also indirectly characterised digital water governance. In an increasingly informatised and regulated European context, local processes have sometimes constituted the main drivers for digitalising the water sector. In Paris, the planned 2024 Olympics have pushed local actors to find solutions for bathing in the Seine river through technological monitoring and early warning systems. In Copenhagen, concerns for climate change adaptation have pushed national and local institutions to set up online data platforms on the environmental status of water bodies to improve decision-making thereon. In addition, technological progress has, to different degrees characterised all the analysed cities, thus making more actors and more local solutions available for digital water management. Every analysed city entails a digital strategy for its public administration. While it has sometimes been limited to adapting to the national level, and marked by long time spans, enhanced ICT use has the potential to increase transparency and lower operational costs. Thus, digital water governance has benefitted from thin institutionalism rather than thick institutionalism mechanisms.

It is clear that both digital expertise and water management are being pushed and improved in the European urban context. However, a series of problems has arisen. First, while the EU may impose stringent obligations, cities may still lack the expertise to implement them on the local level. Considering our case studies, Copenhagen appears to have higher levels of expertise to deal with ICT

management solutions, whereas Sofia is still lagging behind. Capacity-building programmes are needed to ensure that the uptake of innovation is not prevented by the structural lack of experience. Second, as water utilities learn to use ICT solutions, they also have the opportunity to customise their services for demand-side management. This poses the question of personal data protection. Utilities are required to respect the GDPR, but not in all cities are they regulated by other specific laws. There is a grey area in digital water management when it comes to data protection, and decision-makers should look to fill the gap as soon as possible in compliance with national and European requirements. Cybersecurity risks to critical water infrastructures provide another important aspect that requires regulation. While Germany has passed an ICT security law to set respective minimum requirements to cyber security, other countries still need to fill cyber security gaps that emerge through the increased deployment of ICT solutions. Third, digital water governance can serve as a tool for horizontal coordination with further policy domains, but this remains largely unexplored at present time. The newly approved circular economy law in France, for instance, does not contain any provision for water management. Fourth, even when digital water governance is considered in external policy domains, it fails to have a tangible impact. The Berlin 2030 Climate plan acknowledges the importance of ICT solutions, but it does not contain any specific obligations or standards in digital capacity and related water management.

All in all, both digitalisation and integrated water management have risen in quantity and quality in the five DWC cities. As effective digital water governance draws on participatory approaches, the local context can provide a breeding ground for innovative partnerships and successful initiatives. The involvement of different stakeholders, as well as the careful assessment and implementation of on-the-ground solutions have a head start over larger national processes. This has also been encouraged by the EU itself through initiatives such as the European Innovation Partnership on Smart Cities and Communities (EIP-SCC). However, the novelty of the phenomenon demands a series of preliminary steps for digital water governance to thrive across European cities.

Decision-makers should facilitate multi-stakeholder dialogue and the subsequent development of local digital solutions. As they may lack the financial capacity and institutional expertise to do so, larger national and EU schemes should support the transition. Specific laws on data protection and technological requirements are also needed, ideally designed in an inclusive process. Local actors, specifically water utilities, should be put in the condition to operate through preliminary cost-benefit analyses and where needed capacity-building meetings. Particular effort should be put on strengthening the intersection between digitalisation and water management. While both processes are disruptive and being improved over time, there is still little regulatory, economic and social emphasis on digitalising water management as an end in itself. Digital solutions should be properly integrated in water management for the model to work both as a standalone and as a horizontal tool for external policy areas. The digital transition has been set in motion all over Europe, and water management is no exception. The question is not whether digital water governance will become a reality in European cities, rather at what pace this will take place, and whether this can support EU targets of sustainability, development, health and employment.

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Annex I: Type of policy instrument

Type of policy instrument			
Regulatory			
R1	National/regional planning law or regulations		
R2	National/regional strategies and action plans		
R3	Targets		
R4	Standards		
R5	Bans		
R6	Permits / quotas		
R7	Planning/zoning		
R8	Environmental impact assessments		
R9	Public procurement		
Economic			
E1	Pricing	E1-a	Taxes and charges/fees
		E1-b	Reduced taxes/charges
		E1-c	Trading of permits
		E1-d	Tariffs
E2	Payments/Subsidies	E2-a	Payments to landowners
		E2-b	Financing targeted research projects
		E2-c	Payments for insurances
E3	Voluntary agreements/ Cooperation	E3-a	Individual voluntary agreements
		E3-b	Public-Private Partnerships
R4	Private sector	R4-a	Loans+E23
		R4-b	Bonds
		R4-c	Crowdfunding
E5	Liability schemes (e.g. offsetting)		
Information, awareness-raising and public engagement			
IAP1	Trainings and qualifications		
IAP2	Public information programmes		
IAP3	Stakeholder and public participation		
Monitoring and research			
MR1	Monitoring systems	MR1-a	Manual or automatic system (technological or by hand) which collects data about activities, products used, timing, etc.
		MR1-b	Monitoring and reporting
		MR1-c	Monitoring and mapping of relevant activities
MR2	Research projects		
MR3	Assessments		

Note: These are the types of policy instruments that we were looking for when undertaking the analysis. It is obvious, however, that the policies identified do not cover all of the policy types identified beforehand. For the sake of transparency and comparability (e.g. to other analyses dealing with policy instruments), we keep the whole list in this Annex.

Annex II: Overview of smart water management policies

Berlin/Germany

Year	Policy Instrument	Scope		Sector	Description
		Issued by (level)	Directed at (level)		
Water Framework Directive					
2000	R1 + R2 – European Regulation but also Strategy	European	Member States	Water law	It seeks to maintain the good status of water bodies in replenishment capacity and qualitative standards. In a survey by the European Innovation Partnership (EIP) Directive was mentioned as the most relevant regulation driving innovation (Technopolis 2013: 207). However, this might differ if only city authorities are questioned
Quality of Water Directive 1998/83					
1998	R1 + R4	European	Member States	Water law	It sets out drinkable water minimum quality standards. Updated to integrate WHO guidelines and other health parameters for water quality
Urban Waste Water Directive 1991/271					
1991	R1 + R4	European	Member States	Water law	Its objective is to protect the environment from the adverse effects of urban wastewater discharges and discharges from certain industrial sectors (see Annex III of the Directive) and concerns the collection, treatment and discharge of domestic waste water, mixture of waste water and waste water from certain industrial sectors.
Directive 2008/105/EC on environmental quality standards in the field of water policy					
2008	R1 + R4	European	Member States	Water Policy, Environmental Protection, Health Policy	It sets out environmental quality standards (EQSs) concerning the presence in surface water of certain substances or groups of substances identified as priority pollutants because of the significant risk they pose to or via the aquatic environment. These standards are in line with the strategy and objectives of the EU's Water Framework Directive (Directive 2000/60/EC).
General Data Protection Regulation 2016/679					

2016	R1 – European Data Protection Regulation	European	Member States	Data protection law	Relevant as major actors water utilities and technology providers need to comply with data collection, open access and use boundaries.
Bundesdatenschutzgesetz (BDSG)					
2018	R1 – National Data Protection Regulation	National		Data protection law	The German Bundesdatenschutzgesetz (BDSG) is a federal data protection act that together with the data protection acts of the German federal states and other area-specific regulations, governs the exposure of personal data, which are manually processed or stored in IT systems
Gesetz zum Schutz personenbezogener Daten in der Berliner Verwaltung (Berliner Datenschutzgesetz - BlnDSG)					
2018	R1 Local	Local	Local	Data protection law	Berlin Act on the Implementation of the General Data Protection Regulation
UNECE Aarhus Convention					
1998		International (47 parties, mostly from Europe, some from Central Asia)	Member + Non-Member States	Environmental information and governance	Convention enhancing accessibility and transparency of environmental information for citizens. Encouraging multistakeholder environmental governance
Directive 2003/4/EC on public access to environmental information					
2003	R4	European	Member States		It fully adapts European Union (EU) countries' national laws to the 1998 Aarhus Convention on access to information, public participation and access to justice in environmental matters. It guarantees the public access to environmental information held by, or for, public authorities, both upon request and through active dissemination. It sets out the basic terms, conditions and practical arrangements that a member of the public must respect when granted access to the requested environmental information.
European innovation partnership on smart cities and communities (EIP-SCC) → Online Platform					
2012	R2	European	Member States (City level)		The European innovation partnership on smart cities and communities (EIP-SCC) is an initiative supported by the European Commission that brings together cities, industry, small business (SMEs), banks, research and others.

					<p>It aims to improve urban life through more sustainable integrated solutions and addresses city-specific challenges from different policy areas such as energy, mobility and transport, and ICT.</p> <p>It builds on the engagement of the public, industry and other interested groups to develop innovative solutions and participate in city governance.</p>
Umweltinformationsgesetz (UIG) (Act on public access to environmental information)					
2005	R4 – National	National	Public authorities at national and state level		The purpose of this Act is to create the legal framework for free access to environmental information for bodies obliged to provide information and for the dissemination of this environmental information.
ISO/IEC 38500:2015					
2015		International	Member + Non-Member States	IT policy	Provides guidelines on effective use of IT for members of governing bodies within their organizations. This might primarily of relevance for public authorities.
EU Inspire Directive (Directive 2007/2/EC)					
2007	R1 – European Regulation but also R2 – Regional Strategy	European	Member States	Spatial Policy, Environmental Policy	The INSPIRE Directive aims to create a European Union spatial data infrastructure for the purposes of EU environmental policies and policies or activities which may have an impact on the environment. This European Spatial Data Infrastructure will enable the sharing of environmental spatial information among public sector organisations, facilitate public access to spatial information across Europe and assist in policy-making across boundaries.
Digital Single Market for Water Services Action Plan					
2018	R2	European	Member States	IT policy, water policy	This Action Plan defines a group of Actions beyond uncoordinated and isolated initiatives, wide market uptake, aiming to end up with the creation of the Digital Water Services in the single market and contributes to the Connected Digital Single Market and the Resilient Energy Union objectives by promoting sustainable smart technologies in the water sector. Timeframe of 2018-2030, focuses on interoperability and standardization, data sharing, smart water, cyber-security, actors' awareness, policy and business models.
IT-Sicherheitsgesetz (IT-SiG/BSI-G) IT Security Act					
2015	R1 + R4 National Level	National	National	IT policy, data policy	The act names the critical infrastructures and obliges the operators of critical infrastructure facilities or facilities to establish IT security for these facilities according to the state of the art. By definition, critical infrastructure also includes the water sector with

					the sectors of sewage disposal and drinking water supply, which also includes other water management facilities, e.g. dams, if they are used for drinking water supply. The Ordinance on the Determination of Critical Infrastructures according to the BSI Act (BSI Critis Ordinance - BSI Critis Ordinance) specifies the threshold values for plants and facilities in the water/wastewater sector for which an IT security standard must be established and verified according to the state of the art.
Wasserhaushaltsgesetz					
2009	R1 National	National	National		The Water Resources Act (Wasserhaushaltsgesetz - WHG) is the core of water protection law and dates back to 1957. Its purpose is to protect water bodies as part of the natural balance, as the basis of human life, as habitats for animals and plants and as usable goods through sustainable water management (Section 1 WHG).
Abwasserabgabengesetz					
1978, 2005	R1 National	National	National	Water law, sewage regulation	The law regulates the obligation to pay taxes for the discharge of waste water (dirty water, precipitation water) into water bodies. The amount of the wastewater levy depends on the harmfulness of the wastewater in accordance with § 3 Para. 1 AbwAG. The Act contains authorisations for detailed provisions by the Länder in several places. For this reason, the Länder have enacted implementing legislation (→ Berliner Gesetz zur Ausführung des Abwasserabgabengesetzes).
Abwasserverordnung					
2004, 2010	R1 National	National	National	Water law, sewage regulation	Defines the emission-related requirements that should define the state of the technology.
Berliner Wassergesetz (BWG)					
2005	R1 Local	Local	Local	Water law	Berlin Act on the Implementation of the Water Resources Act
Berliner Gesetz zur Ausführung des Abwasserabgabengesetzes					
1989	R1 Local	Local	Local	Water law, Sewage Regulation	Berlin Act on the Implementation of the Waste Water Levy Act
Smart City-Strategie Berlin					
2015	R2 Local	Local (City Level)	Local (City Level)	IT policy, urban planning	The Smart City approach aims to use intelligent technology to find solutions to Berlin's ecological, social, economic and cultural challenges.

Berliner E-Government Gesetz					
2016	R1 Local	Local (City Level)	Local (City Level)	IT policy, public participation	The e-government law introduced in the same year concretizes the legal framework for modernizing the Berlin administration through digital and media-break-free processes. Internal processes, the services of the citizens' offices and central government tasks such as tax policy or legal compliance are to become more citizen-oriented, more transparent, more participatory, more efficient and more business-friendly. The central measures include electronic access via De-Mail, online forms and other secure procedures, the digitalisation of processes such as identification via eID, electronic file management, geodata referencing or the provision of Open Data.
Berliner Energie- und Klimaschutzprogramm 2030 (BEK)					
2018	R2 Local	Local (City Level)	Local (City Level)	Climate policy, adaptation, (water management)	Contains concrete strategies and measures in the fields of climate protection and adaptation to the consequences of climate change. In August 2018, the Senate adopted an implementation concept for BEK 2030, which specifies the individual steps for the implementation period until 2021. It refers to digitalisation in several instances, such as setting up digital information systems and creating incentives for the deployment of smart technologies. However, with regards to water, digitalisation is not specifically addressed.

Copenhagen/Denmark

Year	Policy instrument	Scope		Sector	Description
		Issued by	Directed at		
Water Framework Directive					
2000	R1 + R2 – European Regulation but also Strategy	European	Member States	Water Policy, Environmental Protection, Health Policy	It seeks to maintain the good status of water bodies in replenishment capacity and qualitative standards. At the moment Denmark is implementing the directive from the planning period 2015-2021 (second issued plans); A new assessment and plan is in work and covers the period 2021- 2027.
Quality of Water Directive 1998/83 (amended multiple times, latest modification: 2015/1787)					
1998 to 2015	R1 – European Regulation	European	Member States	Water Policy, Health Policy	It sets out drinkable water minimum quality standards. Updated to integrate WHO guidelines and other health parameters for water quality
Directive 2008/105/EC on environmental quality standards in the field of water policy					
2008	R1 – European Regulation	European	Member States	Water Policy, Environmental Protection, Health Policy	The directive sets out environmental quality standards (EQSs) concerning the presence of certain substances or groups of substances identified as priority pollutants in surface water. These pose a significant risk to or via the aquatic environment. These standards are in line with the strategy and objectives of the EU’s Water Framework Directive (Directive 2000/60/EC). Art. 4: Zones close to points of discharge may exceed the relevant EQS
Floods directive 2007/60/EC					
2007	R1 – European Regulation	European	Member States	Water Policy, Environmental Protection, Danger Prevention	The directive’s objective is to establish a framework for the assessment and management of flood risks in order to reduce the adverse effects of floods on human health, the environment, cultural heritage and economic activities in the Community. “Over the past 6 years the status of the EU Floods Directive in Denmark has, in the authors’ opinion, moved from being perceived as a minor addendum

					to the EU Water Frame Directive to become a driver for dealing with natural hazards and risks in Denmark.” ⁵
Directive 2006/118/EC on the protection of groundwater against pollution and deterioration of the quality of groundwater					
2006	R1 – European Regulation	European	Member States	Water Policy, Environmental Protection, Health Policy	It lays down specific measures to prevent and control groundwater pollution. Based on WFD; Art. 17: The European Parliament and the Council shall adopt specific measures to prevent and control groundwater pollution.
Directive 91/271/EEC concerning urban waste water treatment					
1991	R1 – European Regulation	European	Member States	Water Policy, Environmental Protection, Health Policy	The Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. The aim of this Directive is to protect the environment from the harmful effects of such waste water. In Denmark, all utilities have to report various data to the portal <u>PULS</u> created by ministry of environment and utilities. It collects among others data from direct industrial discharge to water bodies or data from WWTP discharge and it includes NOVANA data, see below.
EU Inspire Directive (Directive 2007/2/EC)					
2007	R1 – European Regulation	European	Member States	Spatial Policy, Environmental Policy	The INSPIRE Directive aims to create a European Union spatial data infrastructure for the purposes of EU environmental policies and policies/activities which may have an impact on the environment. A European Spatial Data Infrastructure will enable the sharing of environmental spatial information among public sector organisations, facilitate public access to spatial information across Europe and assist in policy-making across boundaries.
General Data Protection Regulation 2016/679					

⁵ https://backend.orbit.dtu.dk/ws/files/127609958/e3sconf_flood2016_23005.pdf: 7.

2016	R1 – European Regulation	European	Member States	Privacy Law, IT	Only relevant where data on water contains personal data. This can be the case e.g. if water meters are digital and send information via WIFI. In that case, it would be highly relevant.
Proposal 2018/0169 EU					
2019 -...	R1 – European Regulation	European	Member States	Agricultural Policy, Food Policy, Health Policy, Resource Policy	Water Reuse: Setting Minimum Requirements for agricultural use, health standards etc.
UNECE Aarhus Convention					
1998	R1 – European Regulation	International (47 parties, mostly from Europe, some from Central Asia)	Nation States	Environmental Law, Public Management	Convention enhancing accessibility and transparency of environmental information for citizens. It contributes to make digital data collections available.
Digital Single Market for Water Services Action Plan					
2018	R2 – European Action Plan	European	Member States	IT policy, water policy	This Action Plan defines a group of Actions beyond uncoordinated and isolated initiatives, wide market uptake, aiming to end up with the creation of the Digital Water Services in the single market and contributes to the Connected Digital Single Market and the Resilient Energy Union objectives by promoting sustainable smart technologies in the water sector. Timeframe of 2018-2030, focuses on interoperability and standardization, data sharing, smart water, cyber-security, actors' awareness, policy and business models.
A Blueprint to Safeguard Europe's Water Resources					
2012	R2	European	Member States	Water policy	This Blueprint for the Protection of European Water Resources is based on a comprehensive assessment of existing policies and aims to eliminate the problems that hamper action to protect European waters.
Proposal for a Regulation Privacy and Electronic Communications COM/2017/010 final - 2017/03 (COD) (E-Privacy-Regulation)					
2017	R1	European	Member States	IT Policy, Privacy Law	The proposal for this regulation lays down rules regarding the protection of fundamental rights and freedoms of natural and legal persons in the provision and use of electronic communications services, and in particular,

					the rights to respect for private life and communications and the protection of natural persons with regard to the processing of personal data. Water utilities might be concerned similarly as electric utilities.
Directive (EU) 2019/1024 on open data and the re-use of public sector information					
2019	R1	European	Member States	IT Policy, Privacy Law	<p>The open data Directive is intended to regulate the following topic areas:</p> <ul style="list-style-type: none"> • Stimulate the publishing of dynamic data and the uptake of Application Programme Interfaces (APIs). • Limit the exceptions which currently allow public bodies to charge more than the marginal costs of dissemination for the re-use of their data. • Enlarge the scope of the Directive to: <ul style="list-style-type: none"> ○ data held by public undertakings ○ Policies for open access • Strengthen transparency of public-private agreements
Network and information systems Directive, Directive (EU) 2016/1148					
2016	R1	European	Member States	IT Policy, Privacy Law	The Directive lays down measures with a view to achieving a high common level of security of network and information systems within the Union to improve the functioning of the internal market.
Danish Water Sector Act					
2009	R1	National	Municipal administration; Water and wastewater supply companies	Water Law	The act concerns the organization of water and waste water supply systems. It introduced efficiency requirements. This has resulted in greater stability and lower prices. In the water and wastewater sectors the total efficiency requirements were DKK 1.1 billion from 2011 to 2016 (fixed prices). Without the law on regulation of the water sector and the benchmark regulation, the requirements would not have been raised and the price of water and waste water would have been about DKK 1.1 billion higher. ⁶

⁶ <https://en.kefm.dk/water-and-waste/supply-of-water-and-wastewater/>

Water Supply Act					
2009	R1	National	Municipal administration; Water and wastewater supply companies	Water law	The purpose of the law is to secure 1) that the exploitation and the associated protection of water bodies occur after a comprehensive planning and after a comprehensive assessment of the considerations mentioned in section 2, 2) a coordination of the existing water supply with a view to the appropriate use of the water bodies; 3) a planned development and operation of a sufficient and quality satisfactory water supply; and 4) quality requirements for drinking water to protect human health.
Act on Water Planning					
2013	R1	National		Water policy, environmental policy, public management	The purpose of this Act is to establish a framework for the protection and management of surface and groundwater through the monitoring of protected areas. It seeks to prevent further deterioration and to protect aquatic ecosystems to promote sustainable water use based on long-term protection of available water resources; it aims to enhance the protection of aquatic environment through. It also serves the partial implementation of the Water Framework Directive. It pushed for solutions through open platforms, such as the Danish Environmental Portal.
Watercourse Act					
2013	R1	National		Water policy, environmental policy, public management	The Watercourse Act aims at ensuring that watercourses can be used to drain water with consideration for the natural and environmental quality of the watercourse according to other legislation. It also serves the partial implementation of the Water Framework Directive. ⁷
Environmental Protection Act (EPA)					
2010	R1	National		environmental policy, public management	The Environmental Protection Act (EPA) is the main environmental law. The EPA sets out the fundamental environmental protection objectives, the

⁷ <https://eng.mst.dk/nature-water/aquatic-environment/lakes-and-watercourses/>

					means by which to meet these objectives and the administrative principles by which the agency operates. The act is a framework act and is therefore supplemented with guidelines and statutory orders drafted by the agency and issued by the Minister of the Environment. ⁸ It indirectly encouraged the development of planning solutions, as it is the case for the Danish Environmental Portal.
NOVANA 2017-2021 National Monitoring Program for the aquatic environment and nature					
2017	R2	National		Water policy, environmental policy, public management	The programme monitors the state of the aquatic environment and nature within the areas prioritized in relation to the politically determined economic framework. In particular, NOVANA contributes to Denmark fulfilling the obligations we have in relation to national legislation, EU directives and international conventions on monitoring the aquatic environment, nature and air. Methods are supposed to become more digitalized over time ⁹ ; they are available in the PULS system (see above).
Cloudburst Management Plans Copenhagen					
2012	R2	Municipal	Citizens	danger prevention law, environmental policy	To combat the impacts of cloudbursts, the City of Copenhagen developed a Cloudburst Management Plan in 2012, which is an offshoot of the Copenhagen Climate Adaptation Plan. The Plan outlines the priorities and measures recommended for climate adaptation including extreme rainfall. It also includes alerting of cloud failures through data collection to better manage underground overflow depots and prevent damage.
Urban Water Agenda 2030¹⁰					

⁸ <https://uk.practicallaw.thomsonreuters.com/0-522-0619?transitionType=Default&contextData=%28sc.Default%29>

⁹, p. 124.

¹⁰ Primary source not found.

2017	R2	European	Local governments	Water policy, environmental policy, public management	<p>A joint initiative of the European Commission and local governments to safeguard Europe's water resources and strengthen the implementation of European Union water policies by fostering sustainable urban water management water in cities.</p> <p>Copenhagen's water management efforts revolve around two main objectives:¹¹</p> <ul style="list-style-type: none"> - Climate change adaptation in dense city areas - Bathing possibilities in the harbor
The City of Copenhagen's action plan for the UN SDGs					
2018	R2	Municipal	Citizens	danger prevention law, environmental policy	<p>The City of Copenhagen's action plan for the UN SDG's contains an overview of the city's current contribution to the realization of the goals as well as a plan for the municipality's strategic anchoring of the SDG's in its work going forward. Developing action plans as the civil level is voluntary, but essential if the UN's 2030 agenda is to be realized. It is the first time that non-state actors such as cities, regions, institutions and companies have been encouraged to take the lead in sustainable development. This is also why the 17 SDGs and the 169 targets can be adapted to local contexts.</p> <p>The plan also includes ensuring the availability of water and sustainable management of water and sanitation for all.</p>
Copenhagen Climate Adaption Plan					
2011	R2	Municipal	Citizens	environmental policy, public management	<p>With this climate adaptation plan Copenhagen outlines the challenges the city faces in the short and medium terms as a result of changes it expects in the future climate. The plan also identifies those solutions that, based on our present-day knowledge, appear to be most appropriate and reveal the opportunities climate change may also present to the city.</p> <p>Contains no specific mention of digitalizing the water sector.</p>
Municipal plan (Kommuneplanen)					

¹¹ Secondary source : https://www.almanac.in-jet.eu/downloads/M2M_Workshop_Presentations/Session%204/Mia_Copenhagen_smart_city_2015.pdf (e.g. slide 47)./

2019	R2	Municipal	Citizens, local authorities	public management strategy	The Copenhagen Municipal Plan 2019 sets the framework for Copenhagen's development over the next 12 years. The municipal plan 2019 consists of three main parts - a political main structure, guidelines and framework for local planning. The first draft does not contain any specific mention of digital technologies. The Municipal Plan 2019 is expected to be approved by the municipal council in December 2019 and translated into English in the beginning of 2020. ¹²
Executive Order on Security in Network and Information Systems for Operators of Essential Services (<u>Bekendtgørelse om sikkerhed i net- og informationssystemer for operatører af væsentlige internetudvekslingspunkter</u>)					
2018	R1	National	Citizens	IT Policy, Privacy Law	Implementation of the NIS Directive
Act on security in network and information Systems (<u>Lov om Sikkerhed i net- og Informationssystemer for Operatører af Væsentlige Internetudvekslingspunkter</u>)					
2018	R1	National	Citizens	IT Policy, Privacy Law	Implementation of the NIS Directive
Danish Cyber and Information Security Strategy 2018-2021					
2018	R2	National	Local governments, local authorities, citizens	IT Policy, Privacy Law	The strategy should help Denmark to ensure IT and cyber security. Also applicable to drinking water supply (p. 40). Supply of drinking water, however, does not (yet) depend on network and information systems. If this changes, a substrategy might be developed.
Digital Strategy of Denmark 2016-2020					
2016-2020	R2	National	Local governments, local authorities, citizens	IT Policy	The strategy should help Denmark to make progress in the field of digitalization <ul style="list-style-type: none"> Data must to a greater extent be improved and made available in a number of specific areas in which there is deemed to be a great potential for a more efficient and effective public sector and new business opportunities for Danish businesses. This includes data on waste, underground infrastructure, energy, topography, climate and water (p. 34)

¹² <https://kp19.kk.dk/artikel/municipal-plan-2019>.

					<ul style="list-style-type: none"> Focus area 6: an efficient utilities sector, amongst others water and wastewater, including easy access to good utility data (p. 41 f.)
IT Strategy 2010-14 of Copenhagen (IT-strategi 2010-14)					
2010-2014	R2	Municipal	citizens	IT Policy	Consolidation of network infrastructure, faster and cheaper data connections, as well as IP telephony to the municipality. It does not apply to BIOFOS, Denmark's largest wastewater treatment company
Smart city, 7 dir decision 2012, Open data strategy (Smart city, 7 dir beslutning 2012, Open data strategi)					
2012	R2	Municipal	local authorities, citizens	IT Policy	<p>Exhibiting public data, creating a platform for growth, involving citizens and businesses in the development of large-scale welfare and Cleantech solutions.</p> <p>Objective is, amongst others, to construct a digital platform which centralizes data from a range of public and private sources.</p> <p>Furthermore: Plan to install a water defence system incl a decision making platform for rapid response across city services.</p>

Milan/Italy

Year	Policy Instrument	Scope		Sector	Description
		Issued by	Directed at		
Testo Unico Ambientale					
2006	R1 – National Environmental Regulation R4 - Standard (also some provisions for R8 – Environmental Impact Assessment)	National	National institutions and local actors	Environmental Protection (including water policy)	It assigns competences of the State vs local actors on environmental topics. Environmental protection is an exclusive legislative competence of the state. Water management and urban water quality is addressed in Part III (Norme in materia di difesa del suolo e lotta alla desertificazione, di tutela delle acque dall'inquinamento e di gestione delle risorse idriche), where water quality standard are also reported (see Annex V to Part III). It is the main framework decree where the EU water-related directives (e.g. WFD; UWWTD) are applied at national level. In addition, the decree regulates the environmental impact assessment guidelines. Regions (e.g. Lombardia Region) can locally set standards that are different from the national ones
Law 229/2003 up to Legislative Decree n. 217, 13 December 2017					
2003 to 2017	R1 – National Law on Public Administration & Public Management	National	Public Administration local branches	Public Management	Digitalisation of Public Administration, creation of a Digital Administration Code (CAD). The process has not been transposed to water utilities (even though most of them are publicly owned) and the digitization wave is still slow paced. In compliance with European Regulation eIDAS 910/2014 (electronic Identification, Authentication and trust Services)
Ministerial Decree 185/ 2003 + Law 308/2004 + Decree May 2, 2006					
2006	R4 – Standards on water reuse	National	Water Utilities, Irrigators (Consorzi di Bonifica),	Agricultural Policy, Food Policy, Health Policy, Resource Policy	Water Reuse Qualitative and Quantitative Standards, sectors, mechanisms, legal responsibility, governance

			Agricultural businesses		
Legge Galli (Law 36/1994) up to Ministerial Decree 22 November 2011 + Law 205 / 2017					
1994 to 2011 to 2017	R1 – National Law on Water Governance	National	National water authority and local water utilities	Water Policy	<p>Water services governance framework – creation of ATOs, geographical scope, AEEGSI turned into ARERA</p> <p>Legge Galli 1994-2011:</p> <ul style="list-style-type: none"> - Horizontal and vertical integration (Optimal Regional Areas - ATO) - Regulation based on ATO - Introduction of the principle of Full Cost Recovery - Focus on investment planning <p>AEEGSI/ARERA (National Authority) from 2012 on:</p> <ul style="list-style-type: none"> - Multilevel governance - Tariffs regulated by an independent national authority - Application of Full Cost Recovery - Focus on financeability and planning of investment
Water Framework Directive					
2000	R1 + R2 – European Regulation but also Strategy	European	Member States	Water Policy, Environmental Protection, Health Policy	<p>It seeks to maintain the good status of water bodies in replenishment capacity and qualitative standards</p> <ul style="list-style-type: none"> - setup river basin management plans for efficient and sustainable use - water pricing policies shall provide adequate incentives for users to use water resources efficiently
Urban Wastewater Treatment Directive					

1991	R1 + R2 – European Regulation but also Strategy	European	Member States	Water Services Policies	The Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. The aim of this Directive is to protect the environment from the harmful effects of such wastewater.
Regulation 2020/741 on minimum requirements for water reuse					
2020	R4 – EU Minimum Quality Standard for Water Reuse	European	Member States	Water policies, agricultural policies	Includes new Minimum quality requirements for water reuse in irrigation and aquifer recharge; updated monitoring standards; and risk management provisions for wastewater treatment and reuse
Quality of Water Directive 1998/83 (amended multiple times, latest modification: 2015/1787)					
1998 to 2015	R4 – Standards for Water Quality	European	Member States	Water Policy, Health Policy	It sets out drinkable water minimum quality standards. Updated to integrate WHO guidelines and other health parameters for water quality (such as Legionella)
Common Agricultural Policy					
2014 to 2020	R1 – European Regulation	European	Member States	Agricultural Policy, touching upon Health Policy and	Protecting water quality, avoid pollution, ensure sustainable use of water resources: <ul style="list-style-type: none"> - some rural development measures support investment to improve irrigation infrastructures/techniques - cross-compliance framework has requirements on water protection and management, in compliance with the groundwater directive and nitrates directive - Art. 38 of Rural Development Regulation will contribute to the implementation of the WFD
Decree Law n. 105/2019 on Cybersecurity					
2019	R1 – National Law	National	National Government	Privacy Policy, IT Policy	Government powers on IT regulation are extended, including 5G, to ensure the safety of IT services / cybernetworks / informative systems necessary to run administrative tasks or service performances. Extension of national government’s “golden power”, which can veto or impose conditions/limits to external intervention/bond purchasing/partnerships in sectors characterized by high energy intensity and sensible security stance.

ARERA Delibera 580/2019/R/IDR METODO TARIFFARIO IDRICO 2020-2023					
2020	E1-d -Pricing: Rates	National	National with guidelines for local adaptation	Water governance / regulation	<p>Water tariff method 2020-2023</p> <p>A uniform but asymmetrical tariff method, in consideration of the local specificities and the planning decisions of the local governance bodies (EGA). Compared to the previous one, the four-year duration of the regulatory period is confirmed, with a biennial update, and the option of a possible intra-period review linked to the EGA request that certifies the extraordinary nature of events capable of affecting the economic-financial balance of management.</p> <p>More tools and control phases ensure that any tariff increases will only be possible following investments actually made or improvements in certificate management. In fact, the presence of a ceiling on the increases is confirmed, for the first time differentiated not only on the operating costs of the management, but also on the basis of the revenues per inhabitant served.</p> <p>Environmental sustainability is promoted through a series of incentives ranging from the containment of electricity consumption to supply water, to the reduction of the use of plastic in drinking water consumption, to the recovery of energy and matter. treatment of sewage sludge), to the reuse of purified water for agricultural and industrial purposes.</p>
ATO Citta' Metropolitana di Milano, Delibera n. 4 del 30/10/2018					
2018	E1- d – Pricing Rates/Subsidies IAP2 – Public information programmes	Local	Local water utilities (MM and CAP)	Water Policy	CAP water rate system. Providing incentives and exemptions for low-income households (<i>bonus acqua</i>) and enhancing public awareness on responsible water use
ARERA Delibera 655/2015					
2015	R4 – Mandatory commercial Standards	National	Local (sometimes interprovincial, sometimes	Water Policy	Commercial quality standards: contractual targets in service interruption, intervention timing, billing, customer service, communication; indirectly pushing for innovation by efficiency

			interregional) water utilities		
ARERA Delibera 917/2017					
2017	R4 – Mandatory technical Standards	National	Local (sometimes interprovincial, sometimes interregional) water utilities	Water Policy	Technical quality standards: targets for monitoring standards
ARERA Delibera 218/2016					
2016	R4 – Mandatory technical Standards	National	Local (sometimes interprovincial, sometimes interregional) water utilities	Water Policy	Definition of standard procedures for the maintenance of measurement devices, the collection and validation of measures (including self-reading), estimation and reconstruction of consumption data.
EU Inspire Directive (Directive 2007/2/EC)					
2007	R1 – European Regulation but also R2 – Regional Strategy	European	Member States	Spatial Policy, Environmental Policy	The INSPIRE Directive aims to create a European Union spatial data infrastructure for the purposes of EU environmental policies and policies/activities which may have an impact on the environment. A European Spatial Data Infrastructure will enable the sharing of environmental spatial information among public sector organisations, facilitate public access to spatial information across Europe and assist in policy-making across boundaries.
General Data Protection Regulation 2016/679					
2016	R1 – European Data Protection Regulation	European	Member States	Privacy Law, IT	ARERA and water utilities need to comply with data collection, open access and use boundaries. No other specific regulation on data protection set by ARERA

Proposal 2018/0169 EU					
2019 ...	R4 - Standards	European	Member States	Agricultural Policy, Food Policy, Health Policy, Resource Policy	Water Reuse: Setting Minimum Requirements for agricultural use, health standards etc.
Ministerial Decree 25/2012, 7 February 2012					
2012	R4 – National Mandatory Standards	National Ministry of Health & National Ministry of Environment	Water utilities, water treatment facilities	Health Policy, Water Policy	The decree requires every water utility, every business dealing with water treatment, and even every end user to comply with technical standards: water quality should not be affected by water treatment (hereby defined not as the process of making water drinkable, but simply changing its features for domestic or business use, such as reducing water hardness), technical appliances should achieve the declared effects in the time they predicted, and, more importantly, complete information on water treatment processes has to be given to consumers
Regolamento del Servizio Idrico Integrato – Città di Milano					
2019	R1 – Local regulation but also IAP2 – Public Information Programmes	Local ATO (<i>Ato Citta' Metropolitana di Milano</i>)	Water utilities in the Milan metropolitan area (= CAP)	Water Policy	Art. 5 utilities shall manage services applying the best technical expertise in full compliance with current legislation as well as favouring research and development of new technologies
Disciplina dell'uso delle acque superficiali e sotterranee, dell'utilizzo delle acque a uso domestico, del risparmio idrico e del riutilizzo dell'acqua, 24 Marzo 2006					
2006	MR3 – Status Assessment and R4- Regional Mandatory Standards	Regional council of Lombardy	Water utilities in Lombardy		Art 6.3.a: the best technologies available for water saving should be deployed. Moreover, a technical report on the plant and water reuse facilities, as well as an assessment on the reuse potential, should be issued by any utility intending to apply for a concession agreement
Piano Tutela Acque Regione Lombardia (d.g.r. n. 6990 del 31 luglio 2017)					

2006 – last updated 2016	R1 – Environmental Regulation and R4 – Regional Mandatory Standards	Regional council of Lombardy	Water cycle stakeholders	Water Policy, Environmental Policy	<p>The Water Protection Plan (PTA) is the tool for regulating water resources in Lombardy, by planning the qualitative and quantitative protection of water. The regional law n. 26 of 12 December 2003 identifies the methods of approval of the PTA envisaged by national legislation.</p> <p>The PTA is formed by:</p> <p>Guidance Act, approved by the Regional Council, which contains the regional strategic guidelines on the planning of water resources</p> <p>Water Protection and Use Program (PTUA), approved by the Regional Council, which constitutes, in fact, the planning and programming document of the measures necessary to achieve the environmental quality objectives</p>
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Paris/France

Year	Policy Instrument	Scope		Sector	Description
		Issued by	Directed at		
Water Framework Directive					
2000	R1 + R2 – European Regulation but also Strategy	European	Member States	Water Policy, Environmental Protection, Health Policy	<p>It seeks to maintain the good status of water bodies in replenishment capacity and qualitative standards</p> <ul style="list-style-type: none"> - setup river basin management plans for efficient and sustainable use - water pricing policies shall provide adequate incentives for users to use water resources efficiently <p>For digitization, the WFD requires that MS Achieve good ecological status 365 days per year. This obligation puts more emphasis on maintenance and zero failure is difficult to secure without digitalization. Hence WFD acts as an indirect driver for digitalization.</p> <p>In some instances, such as Seine and Marne, the good status target has already been achieved. Digitalisation may only help reducing costs of treatment by optimising equipment.</p>
Directive 2006/7/EC concerning the management of bathing water quality and repealing Directive 76/160/EEC					
2006	R1	European	Member States	Water Policy, Environmental Protection, Health Policy	<p>Defines bathing water quality in relation to fecal contamination. Requires that the bathing quality be achieved 90% of the time the 4 years before opening sites to bathing activities. Requires stewardship (guards) for security issues on any site of official bathing. Access should also be secured.</p> <p>This directive is the second main driver for designing the early warning systems on the Seine, based on fecal contamination sensors. The first one being the Olympic games in Paris, 2024.</p>
Common Agricultural Policy					

2014 to 2020	R1 – European Regulation	European	Member States	Agricultural Policy, touching upon Health Policy and	<p>Protecting water quality, avoid pollution, ensure sustainable use of water resources:</p> <ul style="list-style-type: none"> - some rural development measures support investment to improve irrigation infrastructures/techniques - cross-compliance framework has requirements on water protection and management, in compliance with the groundwater directive and nitrates directive - Art. 38 of Rural Development Regulation will contribute to the implementation of the WFD <p>Regarding Paris bathing quality, Nutrients and Pesticides pollution is an emerging questions. People bathing in river may become more sensitive to these issues. Yet, at the moment there is no sign of eutrophication on the sites nor demand for monitoring pesticides on bathing sites. It is a lever for improving quality of water, but not directly digitalisation.</p> <p>Today farmers do not have access to drinking water protection areas when they declare their surfaces to the CAP. They have no ideas on bathing site either. This could be a driver for changing their practice if data sharing was improved.</p>
Quality of Water Directive 1998/83 (amended multiple times, latest modification: 2015/1787)					
1998 to 2015	R4 – Standards for Water Quality	European	Member States	Water Policy, Health Policy	<p>It sets out drinkable water minimum quality standards. Updated to integrate WHO guidelines and other health parameters for water quality (such as Legionella).</p> <p>Specifically, data reporting for this directive provides a baseline information for calibrating DWC models on the Seine.</p>
EU Inspire Directive (Directive 2007/2/EC)					
2007	R1 – European Regulation but also R2 – Regional Strategy	European	Member States	Spatial Policy, Environmental Policy	<p>The INSPIRE Directive aims to create a European Union spatial data infrastructure for the purposes of EU environmental policies and policies/activities which may have an impact on the environment. A European Spatial Data Infrastructure will enable the sharing of environmental spatial information among public sector organisations, facilitate public access to spatial information across Europe and assist in policy-making across boundaries.</p>

					in Paris, this eases the circulation of information from municipalities urban planning services to the SIAAP in order to enforce/ control infiltration and compliant private connections to the sewerage system. All this information is now gathered to fill a website on both issues to inform resident and urbanists about their obligation (according to their location) and potential subsidies.
General Data Protection Regulation 2016/679					
2016	R1 – European Data Protection Regulation	European	Member States	Privacy Law, IT	Indirectly enhanced Eau De Paris recurrence to digital systems for accounting and customer care But G2C innovation do not deal with private information, so no application for digital solutions.
Proposal 2018/0169 EU					
2019 -...	R4 - Standards	European	Member States	Agricultural Policy, Food Policy, Health Policy, Resource Policy	Water Reuse: Setting Minimum Requirements for agricultural use, health standards etc. This proposal, if implemented, may impose minimum requirements for Fluidion to recycle the raw materials used in its sensors.
Arrêté du 19 octobre 2018 approuvant le schéma national des données sur l'eau, les milieux aquatiques et les services publics d'eau et d'assainissement					
2018	R1 – National water policy law	National	Governmental bodies, water service actors	Water Policy, Digital Policy	This law introduced regulation for setting up national online platforms on water data. This goes both to modernise public administration and enhance WFD compliance.
UNECE Aarhus Convention					
1998	XX Soft law	International (47 parties, mostly	Nation States	Environmental Law, Public Management	Convention enhancing accessibility and transparency of environmental information for citizens. It has been translated into EU directive on plans and programmes. This directive imposes

		from Europe, some from Central Asia)			minimum consultation and participation for all programmes. It has not been implemented for setting the bathing objectives on the Seine. So pragmatically, it had no impact. If participation was encouraged, it is not sure that it will support water quality improvement given the costs it implied. In the case of Paris, residents do not know the cost of achieving bathing water quality
Digital Single Market for Water Services Action Plan					
2018	R2 – European Action Plan	European	Member States	IT policy, water policy	<p>This Action Plan defines a group of Actions beyond uncoordinated and isolated initiatives, wide market uptake, aiming to end up with the creation of the Digital Water Services in the single market and contributes to the Connected Digital Single Market and the Resilient Energy Union objectives by promoting sustainable smart technologies in the water sector. Timeframe of 2018-2030, focuses on interoperability and standardization, data sharing, smart water, cyber-security, actors' awareness, policy and business models.</p> <p>Is the baseline for securing the interoperability between Paris and Berlin, in this sense it can ensure diffusion of digital solutions.</p>
Law n. 2006/1772 on water and water settings (Lema) of 30 December 2006 - Updating law 92.3 on sustainable and balanced water management					
2006	R1 – National water policy law but also R4 - Standards	National	National and local authorities	Water policy, environmental policy, public management	<ul style="list-style-type: none"> - transposing the WFD: good ecological status of water by 2015, improved access to water, transparency in water public service... - first recognition of the principle of climate change adaptation in water management - provisions against pollution and quality standards - municipalities and local communities are given more competences on control of wastewater systems and water networks, discharges, fiscal instruments on water services, guarantee fund for potential damages on agriculture by flooding, enhanced transparency and accessibility to water services - reorganization of water authorities (<i>“Agences de l’eau”</i>) with an all-round national plan (including the creation of river basin management plans SDAGE and SAGE) <p>Since this law has been approved, the competences departments (conseil départemental) have long exercised wastewater transport in large sewerage without a clear legal</p>

					<p>framework. In the Paris Region it is now acknowledged, a specificity of the Region. Nowhere else in France are departments in charge of sewerage.</p> <p>Another change of this law is to submit Agences de l'eau budget to the approval of the Parliament. This has partially diminished their autonomy as the state now use part of the water fee to fund biodiversity. Yet, no direct impact on digitalisation.</p> <p>The 2006 law does not really change the powers given to local authorities (for Parisian departments it only acknowledges what existed), elsewhere, the MAPTAM law is much more influential.</p>
Law n. 2018-702 on water and wastewater competences transfer to communities and local authorities of 3 August 2018 - Daughter law of a law on municipalities reorganization (loi Notr 2015-991).					
2018	R1 – National water policy law	National	Local communities (i.e. municipalitie s associations) and municipalitie s	Water Policy, Public management	<p>- confirmation of the full transfer of competences in water and wastewater to municipalities aggregations ("<i>communaute' de communes</i>") by January 1, 2020 with some exceptions up to 2026</p> <p>Locally, this law reorganises competences and tends to merge small services in bigger ones. This helps the choice for digitalisation. Yet the transfer of competence takes time. Recently the government opens derogation for postponed deadlines, after 2026.</p> <p>The municipalities directly surrounding Paris (petite couronne) had to merge their water services into <i>etablissements publics territoriaux</i> (EPT) gathering 40 000 residents. A critical size for implementing „modern management“. Yet today, not all municipalities have transferred their services to EPT yet.</p>
National Strategy on Digital Security (<i>Stratégie nationale pour la sécurité du numérique</i>)					
2015	R2 – National Strategy but also IAP2 – Public Information Programme	National	Government	Security Law, Privacy Law, IT Law	<p>Enhances powers of the ANSSI (National Agency for the Security of Information System) in terms of digital tools to : guarantee sovereignty, raise citizens' awareness and give a head start to French firms concerning digital security ; it includes multistakeholder dialogues, workshops and awareness-raising programmes.</p>

					<p>This law focuses on open data. The development of the app is the duty of actors who share the same ethos, professions, skills... It is easy to get information from each other. If data were more open, it would probably save some time in setting agreements of reciprocity, but those agreements are not obstacles, since the law applies at last resort. Therefore, no help or hindrance to digitisation in principle.</p>
Programme Action Publique 2022					
2017	R2 – National Strategy / Action Plan	National	Public Administration bodies	IT Policy, Public Management	<p>The strategy launched a series of interministerial committees and ad-hoc measures to digitalise public administration services. The strategy comes after a long series of strategies for digitalisation over the past decade, including ADELE (ELEctronic Administration), SGMAP and State as a platform (“Etat Plateforme”).</p> <p>It concerns mainly residents asking state and municipal services for id renewal, library cards, canteen affiliation, It may concern the agences de l’eau who offer the possibilities to pay the water fee online or to ask for subsidies online. Not in relation with the innovation uptake.</p> <p>Concerning the compliance of individual connection to the sewer, municipalities may offer to apply for subsidies online. This may help the acceptability of constraints due to bathing quality. In this sense, digitalisation may help achieving bathing quality.</p>
National law to tackle waste and circular economy (<i>Loi du 10 février 2020 relative à la lutte contre le gaspillage et à l'économie circulaire</i>)					
2020	R1 – National Law	National Government	Producers and consumers	Resource Management, Economic Policy	<p>4 main axes: raise consumer awareness, incentivise producers to change modes of production, improve collection of waste management and reduce waste of natural resources.</p> <p>This proposal, if implemented, may impose minimum requirements for Fluidion to recycle the raw materials used in its sensors.</p>

Index of expertise and asset management of drinking water networks (<i>Indice de connaissance et de gestion patrimoniale des réseaux d'eau potable</i>)					
2013	XX Soft law IAP 2 (based on Daniel Florentin & Jérôme Denis' report on HAL)	National Ministry of Environment	Water Utilities	IT Policy, Public Management, Water Policy	<p>The index is a performance indicator, assessing the level of</p> <ul style="list-style-type: none"> - expertise on the water network, and its connections - policies for pluri-annual renovation and update of the drinking water service <p>The system, called SISPEA, is an obligation for water services to report indicators of performance. It has been documented that municipalities without digitalisation have more pb to fill this PI. But it does not steer them to equip themselves, rather, they report fake information</p>
Eau De Paris Investment Strategy 2020-2038 (<i>2020-2038 Une stratégie d'investissement raisonnée</i>)					
2018	R1 Local regulation	Parisian water utility Eau de Paris	Parisian water utility Eau de Paris (investment strategy)	Water Policy, Economic Policy, Public Management	<p>Envisaging a transition to the firm 4.0 = digitalised. It is supposed to be horizontal, from customer care, to accounting, all the way through maintenance operations (focus seems on the former). Provisions include: integrating 3D modelling for the underground network/pipes/groundwater resources, uniformise digital models/forms, an integrated control centre to process all locally collected data and smoothen operations of installation and exploitation. Another important point is the introduction of Building Information Modelling BIM for the Orly water treatment facility to facilitate chain operations, pilot project of robot and drone-monitoring of the underground networks.</p> <p>Digitalisation has already been underway, which guaranteed the assessment of all available equipment (status, conditions, costs etc.)</p> <p>Paris partners do not consider that this applies for the innovation at stake. It rather focuses the general public and administrative services (transport card dematerialisation...)</p>
MAPTAM law on the modernisation of local public policies and metropolise(<i>Loi du 27 janvier 2014 de modernisation de l'action publique territoriale et d'affirmation des métropoles</i>)					
2014	R1- National Law	National Government	Municipalities, water utilities, local institutions	Water Policy, Public Policy	<p>Responsible for merging water services, in relation to the law of 2018.</p> <p>assigning competences to municipalities in the domain of basin management, flood</p>

					prevention, management of water bodies and protection / restoration of ecosystems, indirectly pushing for local solutions and therefore digitisation
Municipal by-law (<i>arrêté municipal</i>) of March 22, 2013					
2013	R1 – Local regulation but also IAP3 – Stakeholder participation	Paris Municipality Council	Paris Water Observatory (OPE)	Water Policy, Public Management	<p>It created the Paris Water Observatory (<i>Observatoire Parisien de l’Eau, OPE</i>), a consultative body composed of experts which is tasked to assist the municipality with water management decisions; it also provides technical expertise reports both for the municipality and end users.</p> <p>From 2019 onwards, the Observatory is guided by the Municipal Department for Sanitation and Water of Paris (<i>Direction de la Propreté’ et de l’Eau de la ville de Paris</i>), which more actively manages the programme of activities and the budget for water strategy by the municipality and appoints a representative of the Observatory to sit at the board of Paris water Utility <i>Eau de Paris</i>. The observatory further contributes to the creation of an annual report by the Paris municipality on water quality and related services / prices, enhancing transparency and accountability</p> <p>This is a platform for public participation. It exists in all large water services in France. Experts in this Observatoire were asked to validate orientation such as the abandonment of the non-drinking network for gardens. In other cities, it may be a driver for digitalisation, but more likely for equity and health issues.</p>

Sofia/Bulgaria

Year	Policy Instrument	Scope		Sector	Description
		Issued by	Directed at		
Water Framework Directive					
2000	R1 + R2 – European Regulation but also Strategy	European Commission	Member States	Water Policy, Environmental Protection, Health Policy	<p>It seeks to maintain the good status of water bodies in replenishment capacity and qualitative standards</p> <ul style="list-style-type: none"> - setup river basin management plans for efficient and sustainable use - water pricing policies shall provide adequate incentives for users to use water resources efficiently. <p>For digitization, the WFD requires that MS Achieve good ecological status 365 days per year. This obligation puts more emphasis on maintenance and zero failure is difficult to secure without digitalization. Hence WFD acts as an indirect driver for digitalization.</p> <p>In Bulgaria, the directive was transposed into the national Water Act.</p>
Floods directive 2007/60/EC					
2007	R1 – European Regulation	European Commission	Member States	Water Policy, Environmental Protection, Danger Prevention	<p>The directive’s objective is to establish a framework for the assessment and management of flood risks in order to reduce the adverse effects of floods on human health, the environment, cultural heritage and economic activities in the Community.</p> <p>In Bulgaria, the directive is transposed into the national Water Act. The directive requires the use of digital models and maps and as such plays a role for the digitalisation of the water sector.</p>
Directive 91/271/EEC concerning urban waste water treatment					
1991	R1 – European Regulation	European Commission	Member States	Water Policy, Environmental	The Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial

				Protection, Health Policy	sectors. The aim of this Directive is to protect the environment from the harmful effects of such waste water. The directive does not address the digitalization of the water sector. The digital solution, to be developed within the context of DWC, can, however, contribute to the objectives outlined in the directive.
EU Inspire Directive (Directive 2007/2/EC)					
2007	R1 – European Regulation but also R2 – Regional Strategy	European	Member States	Spatial Policy, Environmental Policy	The INSPIRE Directive aims to create a European Union spatial data infrastructure for the purposes of EU environmental policies and policies/activities which may have an impact on the environment. A European Spatial Data Infrastructure will enable the sharing of environmental spatial information among public sector organisations, facilitate public access to spatial information across Europe and assist in policy-making across boundaries.
The Digital Single Market Strategy					
2015	R1 European Strategy	European Commission	Member states	Digitalization	The DSM Strategy’s objective is to maximise the growth potential of the digital economy in Europe. It aims at the development, deployment and uptake of digital technologies. In Bulgaria, the strategy was transposed into the Programme “Digital Bulgaria 2025”.
Water Act					
Last amended February 2017	R2	Ministry of Environment and Water	National	Water Sector	The Water Law provides the ownership and management of waters on the territory of the Republic of Bulgaria. It includes measures for usage management. It particularly encourages the application of water-saving technologies in agriculture, industry and household in drought-affected regions, as well as measures for efficiency and reuse of waters in industry. The Water Act transfers the requirements of a number of EU directives, including the Water Framework Directive, the Floods Directive and the Directive on environmental quality standards in the field of water policy.
National Strategy for Management and Development of the Water Sector					

2012	R2	Ministry of Environment and Water	National	Water Sector	<p>The Strategy analyses resources and infrastructure in the water sector.</p> <p>It sets out an action plan for the National Strategy for Management and Development of the Water Sector in the Republic of Bulgaria, in the short-term (2013-2015), medium-term (2016-2021) and long-term.</p> <p>Among others, the strategy outlines goals to introduce information technologies in the process of water supply and sewerage systems management and to facilitate the construction, reconstruction and modernization of the wastewater collection and treatment systems.</p>
National Programme "Digital Bulgaria 2025"					
2019	R2	Ministry of Transport, Information Technology and Communications	National	IT Industry	<p>The preparation of the National Programme and a Roadmap for the period 2018-2025 started in 2018. It builds upon the European strategic and programming guidelines for achieving a smart, inclusive and sustainable digital growth for the period 2018-2025. The programme aims at ICT research and innovation and the digitalization of Bulgarian industrial sectors and related services. Because little time has passed since the introduction of the programme, its impact and on-the-ground relevance cannot be assessed at present time.</p>
Digital Transformation of Bulgarian Industry (Industry 4.0)					
In preparation	R2	Ministry of Economy	National	IT Industry	<p>The strategy is since 2017 in preparation and only available as a draft. The aim is to support the uptake of digitization by the industry. One out of three areas of intervention relevant for DWC is: "Technological innovation of the Bulgarian economy through: introduction of standards, construction of infrastructure, development of specific mechanisms for stimulating the development and</p>

					market introduction of technological innovations (new products, services and production processes) through the technologies of Industry 4.0.” The draft strategy does not include specific provisions for water management.
Sofia City District Development Strategy					
2013	R2	/	Sofia City	All sectors	<p>The strategy provides for an overall strategic framework for the development of the city in the period 2014-2020, aiming at smart and balanced growth. It includes measures for the improvement and development of water infrastructure, e.g. waste supply and treatment of water. Digitalization measures are mentioned, however, in the context of information technology, e.g. with regard to the supply of administrative services.</p> <p>One of the main priorities of the strategy is to provide basic infrastructure for development of innovation and a high-speed broadband Internet access throughout the territory of Sofia-city district.</p>
The Innovation Strategy for Smart Specialization of Sofia (Decision 138 / 28.01.2016)					
2016	R2	Sofia Municipal Council	Sofia City	overarching	The <u>strategy</u> supports technological, as well as practical and applied innovation, and aims to stimulate investments in the private sector. It sets out a number of tasks in the field of digital technologies. One of tasks outlined in the strategy relevant for DWC is the support of entrepreneurs in the ICT sector to gain access to financial instruments in order to commercialize the decisions at the European and global level.



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