DESSIN

DEMONSTRATE ECOSYSTEM SERVICES ENABLING INNOVATION IN THE WATER SECTOR

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D12.1: Governance regime factors conducive to innovation uptake in urban water management

Lead Author: Ecologic Institute, March 2015

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D12.1: REPORT ON GOVERNANCE REGIME FACTORS CONDUCIVE TO INNOVATION UPTAKE

SUMMARY

This Deliverable reports the results of the assessment of governance factors conducive to innovation uptake carried within the context of the FP7 DESSIN project. The research is based on the analysis of innovation uptake in the three DESSIN mature case-study sites (i.e. Aarhus, Emscher, Ebro) which had welcomed some successful transformation in urban water management. A number of recommendations are presented in the conclusion to inspire future "entrepreneurs" in promoting innovation uptake in urban water management.

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List of Acronyms and Abbreviations

EG	Water management association Emscher (“Emschergenossenschaft”)
EIP	European Innovation Partnership
LP	Lake Phoenix, Dortmund, Germany
MP	Master Plan Emscher Future (“Masterplan Emscher-Zukunft”)
RVR	Emscher landscape park 2010 (“Emscher Landschaftspark, **R**egional**v**erband **R**uhr”)
WFD	Water Framework Directive
WSCP	Water Saving City Programme (Zaragoza)
WWTP	Wastewater treatment plant
ZE	Mine colliery Ewald (“Zeche Ewald”)
ZVR	Future Convention for Stormwater (“**Z**ukunfts**v**ereinbarung **R**egenwasser”)

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Executive summary

The DESSIN project aims to demonstrate and promote innovative solutions to water-related challenges with a focus on (i) water quality issues related to the implementation of the Water Framework Directive (WFD), and (ii) water scarcity. WP12 of DESSIN specifically aims at identifying innovative and innovation-friendly modes of governance, financing and payment. The objective of the research presented in this deliverable is to identify key governance factors that have contributed to innovation uptake in urban water management, and factors that hindered it, in historical cases of innovation uptake. The research is based on the analysis of innovation uptake in the three DESSIN mature case-study sites (i.e. Aarhus, Emscher, Zaragoza) which in the recent past have witnessed successful transformation processes in their urban water management. The three case-studies present different scales and types of innovations. This is complemented with a broader review of innovation uptake in urban water management in other contexts.

The research was organised in three steps. The first step consisted in developing a DESSIN governance regime assessment tool to analyse innovation uptake in urban water management (presented in detail in DESSIN's Milestone 3). The second step consisted in applying this governance assessment tool to each mature site. The methodology adopted is qualitative, combining desk-based analysis of 50 research papers, policy documents and other publications, and in-depth interviews with 24 actors, for example actors who played an active role in one of the innovation uptake processes. Filled-in assessment tool matrices and storylines of innovation uptake for each site highlighting key processes and factors were produced. The third step consisted in comparing results between the sites and generalizing the results. The filled-in assessment tool matrices allowed for a systematic comparison between the three sites on key factors, while storylines helped to consider the context, processes and dynamics of innovation uptake.

The results of this study show that the process of innovation uptake is a complex process where multiple levels and actors influence dynamics. Firstly, innovations in the urban water sector often have the potential to affect a huge amount of actors not related to urban water management. This can generate strong arguments and open up opportunities for developing the innovation, as it often means that additional drivers can be harnessed, such as neighbourhood valuation processes, inhabitants' quality of life, city branding, etc. Second, it is clear that the local level is the critical level for innovation uptake in urban water management, although higher levels do appear influential, sometimes by justifying and reinforcing the case for innovation uptake, or by providing opportunities for funding. Thirdly, "entrepreneurs" usually drove the innovation uptake, often providing a clear "vision" of the improvement and capable of "selling" their idea to other actors. Broad coalitions may be built, by finding synergies with other beneficiaries of the innovation; such coalition-building may be further broadened through participative and engagement processes. Fourth, political support was in all cases key to innovation uptake, as it set the ambition and target of the transformative process. Discursive strategies that can be used by "entrepreneurs" to achieve such political support are varied: they may present ("frame) the benefits of an innovation in such a

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way that those benefits adhere to central societal values or political priorities, or they may highlight the multiple benefits of an innovation in order to convince additional actors to support innovation uptake. Fifth, awareness-raising programmes and creating dialogues were important means to support the above discursive strategies. Sixth, regulative and economic instruments were found to frame the innovation uptake, potentially creating barriers, but also providing opportunities to initiate and secure change. In that sense, they open specific "pathways" which the innovation's particular design and implementation. Seventh, the structuring of the partnerships and the design of the roles of actors were crucial in the successful implementation of the innovation, and were given considerable evaluation before implementation.

A number of recommendations are presented in the conclusion to inspire actors with the potential to be "policy entrepreneurs" in promoting innovation uptake in urban water management. These recommendations are targeted at innovators themselves, regional water managers, and national and European policy-makers.

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1. Introduction

1.1 What are DESSIN and WP12 objectives?

The DESSIN project aims to demonstrate and promote innovative solutions to water-related challenges with a focus on (i) water quality issues related to the implementation of the Water Framework Directive (WFD), and (ii) water scarcity. It also aims to demonstrate a methodology for the valuation of ecosystem services as catalyser for innovation in water management. DESSIN takes into account the need to meet the requirements of "daughter directives" (e.g. drinking water, groundwater, urban wastewater, bathing water) as well as other European policy initiatives (e.g. EU Commission's Communication on Water Scarcity and Droughts; Blueprint for Safeguarding European Waters). DESSIN aims to promote more sustainable, adaptive, and cost-effective urban water management.

WP12 of DESSIN aims specifically to identify innovative and innovation-friendly modes of governance, financing and payment. It does so in four inter-related tasks:

- Development of an analytical framework for the assessment of governance regimes, with particular focus on conditions favourable to innovation.
- Identification of good practice aspects/hindering factors for uptake of innovative measures/technologies.
- Analysis of financial models/funding mechanisms encouraging uptake of innovative and sustainable measures, with consideration of ecosystem services valuation uptake.
- Provide concrete guidance for practitioners linking good practice and lessons-learned in governance regimes and financing options, with the ecosystem services framework.

This Deliverable deals with the second bullet point, and presents an assessment of good practice and hindering factors for the uptake of innovative measures and technologies.

1.2 Innovations and governance in the context of DESSIN WP12

DESSIN starts from the basis that the water sector is a crucial part of modern economies, meeting basic human needs and adding value to society. At the same time it recognizes that the water sector faces many challenges, such as an ageing infrastructure, inefficient forms of organization, and the need to increase environmental performance and respond to climate change. Innovations can help tackle these challenges, but they often face considerable barriers for their testing and uptake.

In DESSIN WP12, the main hypothesis is that governance variables can have a critical impact on the acceptability, affordability, and feasibility of innovations. The objective of WP12 is therefore to

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develop and apply a governance assessment framework to understand what can favour the uptake of innovations in the water sector.

DESSIN includes technological and process innovations in a number of areas: treatment of sewer overflow and restoration of hydro-morphology of river (Emscher), combined sewer overflows (Hoffselva), aquifer recharge recovery and desalinisation (Westland), sewer mining with ICT solutions (Athens), deep injection system in drinking water treatment plant (Llobregat), and improved storm and wastewater treatment through investment in capacity and real-time monitoring (Aarhus). Besides these technological and process innovations also other dimensions of DESSIN could be considered as innovations, including concepts such as the use of the ecosystem services approach in urban water management, or governance mechanisms such as increased collaboration between innovators, the water sector, etc.

Given that the focus of DESSIN is on fostering technological uptake, innovation uptake in WP12 will primarily be associated with the uptake of technologies that lead to what can be considered a significant change in urban water management (at a local scale). In other words, the analytical focus is on the uptake of specific technologies. Other elements (concepts, administrative procedures, etc.) will only be considered as contextual factors influencing technological uptake, even though they may be innovative themselves (Figure 1).

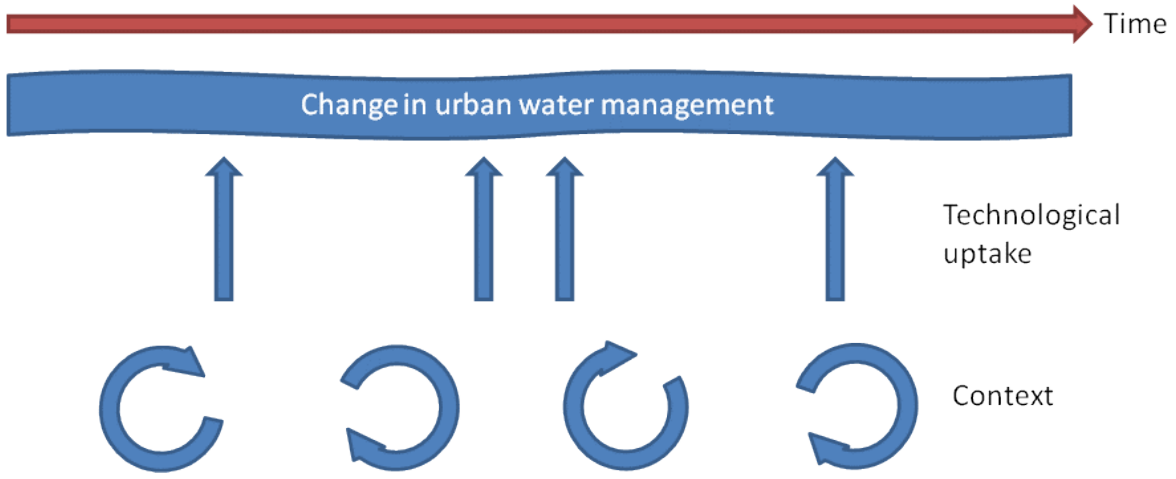

Figure 1. Schematic representation of innovation uptake in DESSIN. Cicurlating arrows represent the multiple contextual elements that influence technological uptake. Technical uptake influence changes in urban water management practice.

To define governance and to develop the assessment framework, DESSIN WP12 draws on the governance assessment tool developed within the INTERREG DROP project. Given that the DROP governance assessment tool was developed in the context of drought governance, for DESSIN WP12 purposes the tool had to be adapted to the context of urban water management and innovation uptake. Drawing on the DROP definition, governance in the context of DESSIN can be said to be the organisational, financial, political and legal aspects that guide and organise the

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interactions among, and collective actions taken by, public and private actors involved in the uptake of innovations in the water sector, or:

"Governance is the combination of the multiple scales, actor-networks, goals, strategies, responsibilities and resources that forms a context that, to some degree, restricts and, to some degree, enables actions and interactions in the uptake of innovations in urban water management."

1.3 Assessing governance factors influencing innovation uptake in urban water management

The objective of the research presented in this deliverable is to identify, in historical cases of innovation uptake, key governance factors that have contributed to innovation uptake in urban water management, and factors that hindered it. By identifying such factors, some guidance as regards the facilitation of innovations may be provided (fourth objective of WP12 and objective of D12.3). The research is based on the analysis of innovation uptake in the three DESSIN mature case-study sites (i.e. Aarhus, Emscher, Zaragoza) which have witnessed successful transformation processes in their urban water management. This is complemented with a broader review of innovation uptake in urban water management in other contexts. The research was organised in the following three steps (more detail on the methodology is provided in Chapter 3).

The first step consisted in developing a governance regime assessment tool to analyse innovation uptake in urban water management, presented in detail in DESSIN's Milestone 3 and which is synthesised below in Chapter 2. For this, two successive reviews were carried out. The first review identified governance regime assessment tools which could be used to analyse the study sites and select the most suitable one for the analysis of innovation uptake in urban water management. The DROP governance assessment tool (Bressers et al., 2013) was selected. The second review adapted the DROP assessment tool using existing knowledge on innovation uptake in urban water management.

The second step consisted in applying the DESSIN governance assessment tool to each mature site. The methodology adopted is qualitative, combining desk-based analysis of existing research, policy documents and other publications, and in-depth interviews with key informants, for example actors who played an active role in the innovation uptake. Filled-in assessment tool matrices and storylines of innovation uptake for each site highlighting key processes and factors were produced. The storylines are provided in Chapter 4.

The third step consisted in comparing results between the sites and generalizing the results. The filled-in assessment tool matrices allowed for a systematic comparison between the three sites on key factors, while storylines helped to consider the context, processes and dynamics of innovation uptake. The lessons learned of this analysis are presented in Chapter 5. Chapter 6 presents conclusions and recommendations for innovations seeking to improve their chances of uptake.

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2. A governance assessment tool for innovation uptake in urban water management

Rather than developing a new theoretical approach, the governance assessment framework in DESSIN builds on the framework developed during the Interreg DROP project (and previously the EU FP5 EUWARENESS project). The main advantage of building on this framework is that it provides a coherent theoretical basis to the analysis of governance in European environmental policy regimes. Another advantage is its high policy and practice relevance: the data generated should be easily applied and translated into best practices and recommendations to innovators, water managers and policy-makers.

The methodological approach to move from the DROP governance assessment tool to the DESSIN governance assessment framework was realised by 1) drawing on the DROP framework to cover relevant dimensions and criteria, and 2) using existing knowledge to make questions more specific to the context of innovation uptake in urban water management. A short review of the literature on innovation uptake and transformation in urban water management was therefore carried out. Two methods were used to collect existing knowledge on innovation uptake in urban water management. First, websites of past and on-going EU projects on urban water management were examined to collect project reports and deliverables examining governance and innovation uptake. Such projects included: FP6 SWIFT-WFD; FP7 PREPARED; FP7 SWITCH; FP7 TRUST. Second, two commonly used databases were searched (Google Scholar and Web of Science) using combinations of key words (e.g., urban, water sector, innovation, uptake, transition, transformation, barrier, change). Three main streams of research on change and transformation in urban water management were found: (1) policy and practitioner oriented papers, (2) more theoretical-oriented papers drawing on e.g. the Multi-Level Perspective (arising from science & technology studies) and (3) papers grounded in the complex system theory (arising from Social-Ecological Systems).

The DROP governance assessment tool is grounded in Contextual Interaction Theory which starts with the assertion that multi-actor processes can be understood from the motivations, cognitions and resources of the stakeholders involved in the process (Bressers et al., 2013). In turn these stakeholder characteristics are influenced by the specific circumstances, in particular those originating from previous decisions. The structural and general context can also exert direct influence on motivations, cognitions and resources of stakeholders, and thus on the process and its likelihood of success. Bressers et al. (2013) present the DROP dimensions in the following way: At different levels and scales (dimension 1), public and private policies are implemented by responsible social actors and their networks (dimension 2), and *goals* and *means* can be considered as structuring such policies. *Goals* arise from the perceptions of the problems and the ambition (dimension 3) in addressing them; particularly in a public sphere, different goals are brought to the table by different people; these goals represent the different dimensions of the problem at hand. *Means* are about the resources and the responsibilities (dimension 5) in the organisation of implementation activities, and the associated strategies and instruments (dimension 4).

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Governance in addition is not only multi-actor but also multi-scale. In the water sector, international, national and local factors are at play.

The five dimensions listed above are the DROP framework's five descriptive dimensions. They are described below in more detail, and in the context of urban water management, so as to derive the key research questions of the DESSIN framework.

2.1 A review of the literature related to innovation uptake in urban water management

Overall, the literature on urban water management observes that radical change in urban water management does not occur suddenly, but rather through some form of "system-hybridisation", where old and new technologies exist concurrently. Different phases have been identified, moving from unstructured and poorly organised systems to a gradual expansion of the use of water pipes, sewers, wastewater treatment, and stormwater infrastructure – usually as a response to public health issues and environmental concerns. Recently, much debate has focused on how to improve the performance of the existing, mostly centralised approach, as well as complement or replace it with alternative or decentralised approaches (Hering et al., 2013; Marlow et al., 2013). Such approaches include a diverse range of technologies and practices, such as the "naturalisation" of waterways, disconnecting waterways from impervious surfaces (e.g. constructed wetlands), stormwater harvesting, water recycling, managed aquifer recharge, sewer mining, wastewater use (e.g. nutrient recovery), on-site wastewater treatment, and desalination. In addition, many "new" approaches are considered, which may not replace or complement old technologies but which improve their performance (e.g. leak detection, real time monitoring).

One barrier to system transformation commonly mentioned in the literature relates to the innovations themselves. First, major inertia in water infrastructure exists due to the durability of existing assets. Second, existing infrastructure is designed to be centralised and large-scale, and does not necessarily accommodate technologies that are decentralised and/or small-scale. Investment cycles and institutional as well as technological "lock-in" effects (Foxon et al., 2002) work against radical change and in favour of smaller innovations that support traditional systems and solutions. Third, the degree to which the technology has matured is a major factor influencing its uptake (Taverne, 2006). Technologies evolve through distinct phases, from being ideas into prototypes to marketable products, each step increasing its utility and usability for end-users.

While the above technology-related factors are important, the literature also points out to governance factors, and emphasises that change in urban water management occurs through a co-evolutionary process between technological, social and ecological systems. The following five sub-sections map these factors against the dimensions of the DROP framework in order to help identify key research questions to be investigated in the mature site.

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2.1.1 Levels and scales

The urban water cycle is constituted by water bodies (e.g. rivers, lakes, surface run-off and sub-surface flows), artificial structures (e.g. reservoirs, pipes, drains, tanks, gutters) and urban land (e.g. houses, pavements, gardens, parks). In addition, whole catchments and river basins, including upstream rural land, are increasingly taken into account for urban water planning (e.g. flood risk management, water quality improvements). Given the multiplicity of elements in the urban water cycle, multiple "social" levels are in play. The lowest level is mostly characterised by policies and activities of water companies and local authorities, acting on household and business level. National agencies, or those devolved at regional level, may be in charge of managing at river basin level. State/federal levels are structured around the activities of national governments, while the international level, in Europe, mostly relate to the activities of the European institutions and the influence of international markets.

The reviewed literature sees these multiple levels as a complex, nested system of rules which often works for the status-quo (Marlow et al., 2013; Markard, 2011; Taverne, 2006). In Australia for example, a major barrier to the establishment of Water Sensitive Cities is the lack of understanding of the urban water cycle and the potentially far-reaching impacts associated with the introduction of new technologies (Ryke et al., 2013). Managers of urban water systems must meet strict user demand and needs, and comply with regulatory standards. They may be unwilling to take risks by introducing an innovation in a system where it is difficult to predict impacts and understand trade-offs. Two strategies are highlighted in the literature that may help deal with this complexity and encourage innovation uptake: (1) decentralisation (e.g. devolution of power) – because smaller systems can be more readily understood – (Smits et al., 2008), and (2) the use of experimentation and pilot studies (Marlow et al., 2013).

2.1.2 Actors and networks

A large range of actors potentially influence innovation uptake. Butterworth & Morris (2007) identified: those taking and effecting decisions (policy-makers, service providers, national regulatory agencies, local government planners), those closely influencing decision-making (e.g. civil society, individuals, water users, professional associations, unions), those supporting research and advisory activities (e.g. academia, consulting, training), local champions working to address cross-cutting issues, the media and financial institutions (e.g. banks, investment agencies). Other actors may include technology-related actors such as laboratories, manufacturers, and distributors (Rouillard et al., 2006). Recent studies (Huitema and Meijerink 2009; Brouwer, 2013) suggest that by effectively placing emphasis on particular strategies, individual change agents or so-called policy entrepreneurs are particularly capable of effecting policy change and may therefore play an important role in innovation uptake.

Literature commonly identifies fragmentation as a major barrier to innovation diffusion. Fragmentation is not only expressed in the number of actors, but also in the range of relevant sectors (e.g. water supply, wastewater and stormwater, waste, agriculture, and energy), associated networks, policies, regulations, etc. The EIP (2014) states that a lack of strategic and planning

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capabilities within and across organisations hinders innovation uptake in the water sector, in particular due to actors being small and largely independent of each other while having very different interests. Limited exchange between innovators, manufacturers and distributors, and end-users has been found to reduce the usability of innovations and act as a major impediment to their uptake (Rouillard et al., 2006).

As highlighted in the Innovation System Frame (OECD, 2005), a proportion of scientific and technological knowledge is unwritten, and alongside framework conditions, human, social and cultural transfer factors, including mobility and international links, must be given due consideration. Much of the reviewed literature highlights that innovation uptake could benefit from better communication and exchange between relevant actors, as well as more collaboration and inclusive decision-making. Projects in Europe and Australia have explored the role of participatory mechanisms as an avenue for innovation uptake. “Learning Alliances” or “shadow networks” for example are platforms that aim to foster informal debates of problems and potential solutions, so that strategies will be generated for addressing institutional constraints and enhancing institutional learning (Verhagen et al., 2008). However, while some studies suggest that increased participation and the set up of consultative networks has led to system transformation and innovation uptake (e.g. Makropoulos et al., 2012; Smits et al., 2008), other studies remain more critical (e.g. Hering et al., 2013).

2.1.3 Problem perceptions and goals ambitions

The reviewed literature strongly supports the view that problem perception and personal interests (or goals) of involved actors are major factors influencing innovation uptake. Potential users of innovations do not necessarily use the best solution, but the satisfactory one, influenced by such variables as loyalty, habits and cost of change (Marlow et al., 2013; Taverne, 2006). The water sector is generally considered risk-adverse because of the financial risks involved in changing a sector characterised by large capital investments. Innovative approaches that fail to deliver results can result in large losses. Some researchers argue therefore that change usually occurs through crisis, e.g. perception of high environmental impacts of certain practices or the impossibility to ignore shortcomings of the existing system through an exceptional weather event or financial strain (Kingdon, 2003).

Innovations may require different expertise and capabilities within an organisation, and may thus be actively opposed by those negatively impacted by the associated changes in competencies (Taverne, 2006). More broadly, innovations related to water production and distribution (e.g. water re-use and recycling) often face low acceptance by policy makers and the general public (EIP, 2014; Marlow et al., 2013). In these circumstances, innovation uptake often occurs through a wait-and-see where diffusion is fostered mostly through imitation from first “uptake champions” (Ryke et al., 2013; Butterworth and Morris, 2007; Taverne, 2006). The uptake of innovation can be encouraged by continuously improving the understanding of the system being managed on the basis that knowledge gathering is a major step in influencing perceptions and attitudes to uncertainties and risks (Makropoulos et al., 2012). In parallel, cultural change in practitioners' behaviour is necessary,

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towards more openness for emerging and multi-disciplinary approaches (Hering et al., 2013; Marlow et al., 2013). This may occur through education and training, and may therefore take several years to be effective.

2.1.4 Strategies and instruments

It is commonly accepted that policy instruments on urban water management can create barriers to innovation uptake (e.g. when they forbid specific activities or by-products) (Ryke et al., 2013), but can also drive innovation adoption (e.g. by requiring new standards or practices) (Rouillard et al., 2006). For example, the current standard of public procurements is believed to constrain innovation uptake by giving preference to low(est) cost offers and proven technologies (EIP, 2014).

For the EIP (2014), the water sector appears embedded in an intricate regulatory environment with requirements at EU and national levels, resulting in an increase in the overall cost of certifying innovations (across the EU). This favours sub-optimal innovations for which the cost of getting approval across national contexts can be justified. Homogenising requirements across the EU has the potential to stimulate innovations and their diffusion at lower costs (EIP, 2014).

The reviewed literature puts great emphasis on the role of policy for increasing innovation uptake in practice (Butterworth and Morris, 2007). Innovations are supported by strategies that are long-term and provide investment security to innovators (Makropoulos et al., 2012; Rouillard et al., 2006). Strategies to develop human and social capital for innovation uptake are also important. Ryke et al. (2013) argue for a mix of informal communicative networks to exploit tacit knowledge and decentralised implementation to build local capacities. In addition they argue for a regulative/legislative approach to catalyse innovation uptake and build economies of scale once networks for experimenting and learning have enabled the exploration of the potential for innovations, and market-based (see next sub-section) approaches to further mainstream and sustain innovation uptake.

Innovation uptake may be limited by the type of financial model used. For example pricing policies based on high standing charges (as mostly done currently) do not give incentives to reduce consumption (and adopt water efficient technologies) by end-users (Marlow et al., 2013). Innovation uptake can also be limited because innovations may challenge established financial models. For example, strategies based on decentralisation and/or diversification could impair economies of scale achieved through large scale centralised infrastructure. Reducing water consumption may also jeopardise cost recovery strategies of water utilities as they see their revenue streams reduced (Marlow et al., 2013).

Many researchers acknowledge the existence of market failure in the water sector, including a lack of incentives for investing due to the high capital cost of infrastructures and the lack of incentives to account for externalities (such as resource depletion or pollution from wastewater). While government funds are typically used to support investment in the water sector, little exists to integrate multiple benefits and non-monetary values (Marlow et al., 2013; Hering, 2013). Innovation uptake can benefit from appropriate tariffs and investment cycles and alternative public

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and private financial models. It is in that context that the ecosystem service approach potentially provides an innovative framework to foster innovation uptake.

2.1.5 Responsibilities and resources

As discussed above, fragmentation of tasks and powers across multiple organisations is commonly seen as potentially creating barriers to innovation uptake, as well as the way that tasks are crafted (e.g. regulatory requirements applied onto specific authorities). For example, water quality monitoring agencies may focus on measuring chemicals that are part of their statutory duties, rather than attempt to measure emerging pollutants (and adopt relevant innovations for measuring them) (Rouillard et al., 2006).

The reviewed literature discusses at length the role of resources, in particular financial ones, in modulating innovation uptake. Many studies highlight that uptake is highly dependent on investment cycles which, in the water sector, is skewed by typical large-scale, long-term investments: transformation therefore usually occurs in times of massive needs of re-investment (Markard, 2011). The EIP (2014) observes that water companies can face, in some circumstances, a low pay-back on investments and weak profitability compared to other industries, because of limited capacity to recover costs through appropriate pricing (due to the perception that water is a public good and should therefore be free or at least affordable). This can limit interest in risky initiatives such as innovation uptake. In parallel, SMEs innovating in the water sectors still face a lack of financial resources (both in total funding and continuity) for further development, customization, demonstration and commercialization (EIP, 2014; Rouillard et al., 2006).

2.2 The DESSIN governance assessment tool

In the context of DESSIN, and drawing on the DROP framework, the DESSIN framework defines the following:

- Levels and scales are associated to hydrological scales (e.g. catchments, water bodies, rivers, lakes, surface run-off, sub-surface flows, reservoirs, pipes, drains, tanks, gutters, houses, pavements, gardens, parks) and administrative levels (i.e. public authorities at municipal, regional, national, European) relevant to the uptake of innovations in urban water management.

- Actors and networks are the range of public authorities, private companies and other stakeholders, and the inter-organisational structures (e.g. fora), involved in, benefiting from or impacted by innovation uptake in urban water management.

- Problem perceptions and goal ambitions are associated with the various angles that debate took towards the innovation and its uptake in urban water management as observed through the arguments held by different actors and stipulated in relevant policies.

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- Strategies and instruments are the particular approaches and the regulatory, economic and voluntary forms of policy action influencing innovation uptake in the water sector.

- Responsibilities and resources are the allocation of tasks, powers and capacities influencing innovation uptake in urban water management.

A series of questions are then derived using the reference questions from the DROP framework (Table 1).

Table 1. Research questions of the DESSIN governance assessment tool

Dimensions	Research questions
Levels and scales	• What administrative levels (i.e. public authorities at municipal, regional, national, European) were relevant for innovation uptake? How (e.g. general responsibility in innovation uptake and implementation)? Which hydrological scales did they relate to? • Were important administrative levels missing? To what effect? • Were there conflicts or synergies between administrative levels? • Was it possible for one administrative level to take leadership for innovation uptake? • Was there a strong impact from a certain administrative level?
Actors and networks	• Which actors were involved in the uptake of the innovation? Why? Which actors were only involved as affected by, or beneficiaries of, the innovation? • What forms of dialogue (e.g. public participation, expert fora, etc.) existed between actors? Were they informal or institutionalised? • Were all relevant actors involved in the relevant fora for innovation uptake? Were any actors excluded? • Was it possible for new actors to be included in the relevant fora? • How would you describe the strength of interactions (e.g. history of working together) or opposition between actors? • Were there actors with a mediating role? • Was there a strong influence or pressure from one or more specific individual actors (“policy entrepreneurs”) and/or coalition of actors towards supporting/preventing innovation uptake?
Goals and ambitions	• Which various angles did the debate on the uptake of the innovation take? How similar/different was the goal associated with the uptake of innovation from the status quo? • To what extent did views/arguments/positions support each other, and to what extent were they in competition? • How, if at all, were actors encouraged to re-assess their own perspectives? Were compromises made in the process of innovation uptake? To what extent did one/several perspective(s) dominate the process of innovation

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Dimensions	Research questions
	uptake? • Did new knowledge of the system (e.g. ecological, social, economic) play a role in making the case for innovation uptake? • What types of evaluations were done (e.g. stakeholder analysis, cost-benefit, non-monetary evaluations)? Were pilot studies conducted at a smaller scale before full-blown implementation? How did the evaluations and/or pilot studies influence uptake?
Strategies and instruments	• Which strategies and policy instruments were relevant for the innovation uptake? Did they reflect a regulative, incentive, communicative, or technical approach? • In particular, what pricing policy and financial cycle arrangements existed? What costs did they include (e.g. capital, maintenance, resource, environmental)? • How (specific rules, mechanisms) did the different strategies and policy instruments (intentionally or unintentionally) facilitate innovation uptake or work against it? How effective were they in encouraging innovation uptake? • How did pricing policies and financial cycles facilitate innovation uptake? To what extent were they effective in supporting and/or raising resources for innovation uptake? • To what extent did strategies and instruments support each other, or were in competition? Were there any (intended or unintended) synergies and/or conflicts between strategies and instruments? • Could policies and instruments be adjusted to support innovation uptake? In particular, could pricing policies and/or timing of expenditure be adjusted as a way of facilitating innovation uptake?
Responsibilities and resources	• What were the mandates (i.e. responsibilities as set by statutes and regulations) of the different actors that are of relevance for the innovation uptake? • What technical, financial, knowledge, social, cultural (e.g. norms, values, symbols, artifacts) resources were available/used to encourage innovation uptake? • Were there any “missing” types of mandates or types of resources for enabling innovation uptake? • Did the allocation of roles and resources create cooperation or struggles on innovation uptake? • Could roles, responsibilities and resources be adjusted to support innovation uptake? In particular, did capacity-building play role in innovation uptake? • Were mandates and statutory powers (e.g. specific legal authority granted to enforce/enable mandates) strong enough to enable innovation uptake? Were enough resources allocated to enable innovation uptake?

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3. Data collection and analysis

The DESSIN governance assessment framework, as applied to the mature case studies, consisted of four main methodological steps. The first step involved broadly characterising case-studies in order to identify the innovation(s) uptake(s) of interest. The second step involved answering a series of research questions (i.e. the DESSIN governance assessment tool) regarding governance factors on innovation uptake. The third step consisted of preparing a historical storyline of innovation uptake which highlights the influence of the governance regime, amongst other important factors. The final step is the comparative analysis to reach some conclusions about governance factors facilitating or hindering innovation uptake.

Three sub-research teams amongst WP12 participants were set up, each responsible for one case-study, and consisting of one "local" partner and one "methodological" partner. The WP leader, together with the methodological partners, ensured consistency of data collection and analysis by preparing the research questions (governance assessment framework), interview templates, and assisting in document and interview data collection and analysis. Each team prepared therefore a filled-in assessment tool and a storyline for their site. The cross-comparative evaluation and conclusion was led by the methodological partners. All WP partners were then invited to revise the research report.

3.1 Selecting the focus of analysis

As defined in Chapter 1, innovations in DESSIN WP12 are associated with technologies, understood as concrete measures, products or tools, that have led or are leading to what can be considered a significant change in urban water management (at the local level). The analytical focus in assessing the mature case studies was on the uptake of specific technologies. Other elements (concepts, administrative procedures, etc.) were primarily considered as contextual factors influencing technological uptake, even though such contextual factors may be significant and innovative themselves. Nevertheless, in order to learn from new experiences in fostering technological uptake, it was recommended to select cases where not only the technology was innovative but also the governance factors were (e.g. use of new form of partnership or administrative procedure).

The determination of the focus of analysis involved a description of the mature site, including:

- Key environmental, social and economic characteristics;
- Challenges regarding (urban) water management;
- Any uptake of a technology that can be considered as new to the particular context of the mature site, and that has helped in improving urban water management.

The brief description of the case-studies is presented below (see Appendix 3 for more extensive description of each case).

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3.1.1 The Aarhus case-study

Aarhus is a coastal city of about 311,000 people, located in the eastern part of mainland Denmark (Figure 1). Historically a centre for the food-processing industry, the town is transitioning to become a centre for research, development, and manufacturing of clean energy technologies. The river, culverted around 1930 due to hygienic and urban planning purposes, started to be reopened from 1989. The city has since made considerable investments in environmental planning with the goal of becoming a so-called "green city". As part of this, water-related recreational elements are being developed to enhance the quality of life in the city centre, the old harbour area and the upstream Lake Brabrand. The city engaged in an integrated approach to urban water management involving in particular two different but related objectives: to restore a segment of the Aarhus River flowing through the city centre, and to improve the hygienic quality of harbour water so that the harbour will be suitable for bathing. These two objectives have been pursued through an integrated solution that is consistent with the city's overarching goal of managing water from a holistic water-cycle perspective that accounts for climate change impacts. This solution is the subject of this case study: "Improved water quality in receiving waters in urban areas through investment in capacity and real-time monitoring and control". Of particular interest is the process that led to the development and implementation of an innovative real-time monitoring system and a warning system for bathing water quality.

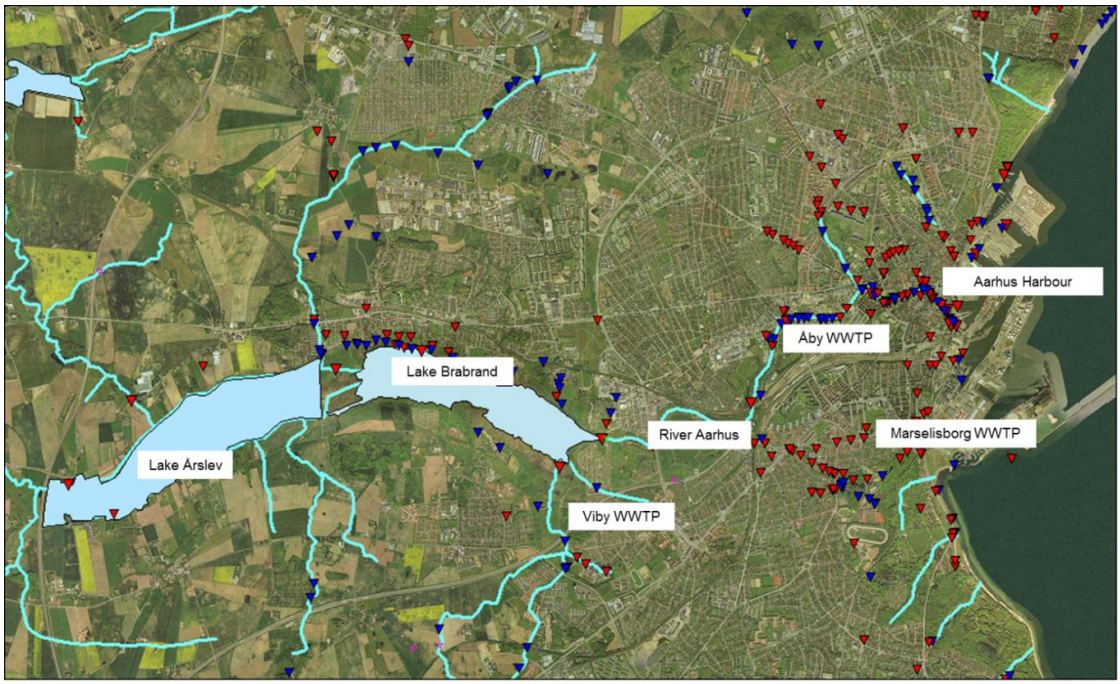

Figure 1. Map of Aarhus River and harbour area

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3.1.2 The Emscher case-study

The Emscher catchment is located on the eastern side of the river Rhine in the west of Germany (Figure 2). With the start of industrialization in the 19th century, flooding of newly-built urban and industrial areas became a problem, together with growing wastewater discharge. As a result, the Emscher was straightened and channelized (the so-called 1st Emscher conversion). Its original length was reduced from 109 km to 85 km and a concrete bed and dykes were built. Underground coal mining led to heavy subsidence (up to 30m), leading to higher groundwater levels and disturbing the natural drainage capacity of the Emscher. To address this, pumping stations were built and the discharge point of the river moved northwards, which meant that the catchment grew from 784 km^2 to 865 km^2. Wastewater was discharged along with the natural river flow in open water channels. An underground discharge of the wastewater - separated from the natural river bed - was not considered an option until 1990 (when subsidence rates due to historical mining decreased). It was in this context of heavy urbanization, industrialization, pollution and modification of the natural river bed that the 2nd Emscher conversion was initiated, the aim being to disconnect wastewater and river water by conducting the wastewater in underground wastewater sewers to wastewater treatment plants, and to subsequently revitalize the original Emscher stream and its tributaries. The focus here is on two regional commitments: the "Master Plan Emscher Future" (MP), an informal commitment signed in 2005 between regional actors promoting the overall objectives of the 2nd Emscher conversion; and the "Future Convention for Stormwater" (ZVR) also signed in 2005 by key regional actors. Two specific projects, initiated under the umbrella of these regional policies and promoting new technologies and approaches, were examined: the Zeche Ewald (ZE) in Herten, where a gutter system was installed to separate rainwater from the combined sewer system; and Lake Phoenix (LP), created on the site of an old steel production factory to serve as a stormwater retention basin, a biodiversity hotspot, and a place for local recreation.

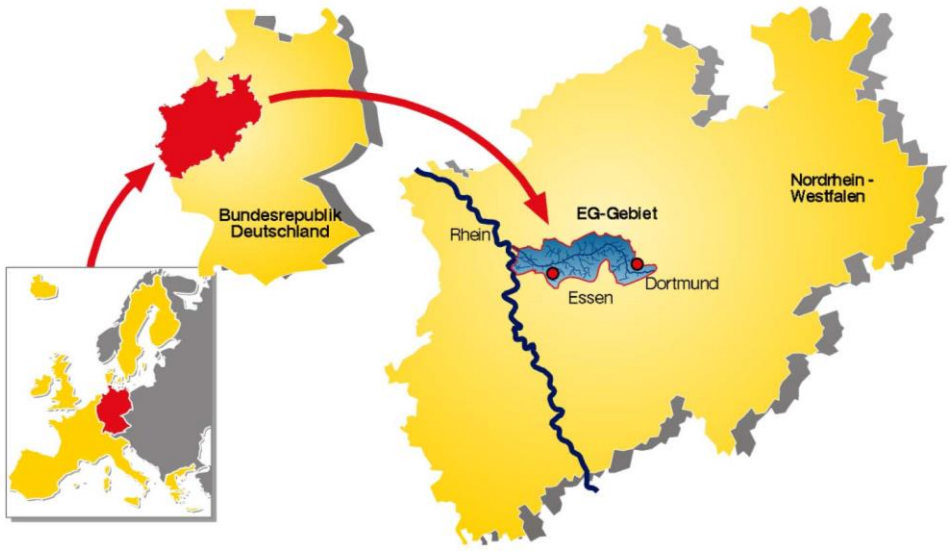

Figure 2. The Emscher catchment

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3.1.3 The Zaragoza case-study

Zaragoza is situated in the centre of the Ebro basin in north of Spain along the Pyrenees mountains (Figure 3). One of the major water challenges that Zaragoza, and other cities of Spain, faced was water shortages due to a combination of water scarcity, high water consumption rates and inadequate management structures. Historically, seasonal water scarcity was dealt with the building of reservoirs and water transfers: 138 dams have been constructed in the Ebro basin since the 1930s. However, this approach was also accompanied with high costs, environmental impacts, and social tensions among regions. In the late nineties, cities in Spain underwent daily water restrictions in a context of droughts and water scarcity, which reinforced conflicts between farmers, energy producers, and domestic and industrial consumers. A series of projects in Zaragoza were initiated, which mainly focused on changing behavior and upgrading existing water infrastructure in order to reduce water consumption and increase water use efficiency. As a result, Zaragoza freshwater withdrawal was reduced significantly, and per capita domestic water consumed was reduced from about 136 liters per day in 2000 to below 100 in 2012. The focus of this case-study is on the flagship Zaragoza Water-Saving City Programme (WSCP) (1997-2008), that aimed to reduce water demand and establishing what it was so called a "*water saving culture*" through education programmes, the change in water tariffs to recover infrastructure costs and incentivise water savings, and the recent ZINNAE (2009-on-going), an open European platform for EU excellence in water efficiency for urban water management.

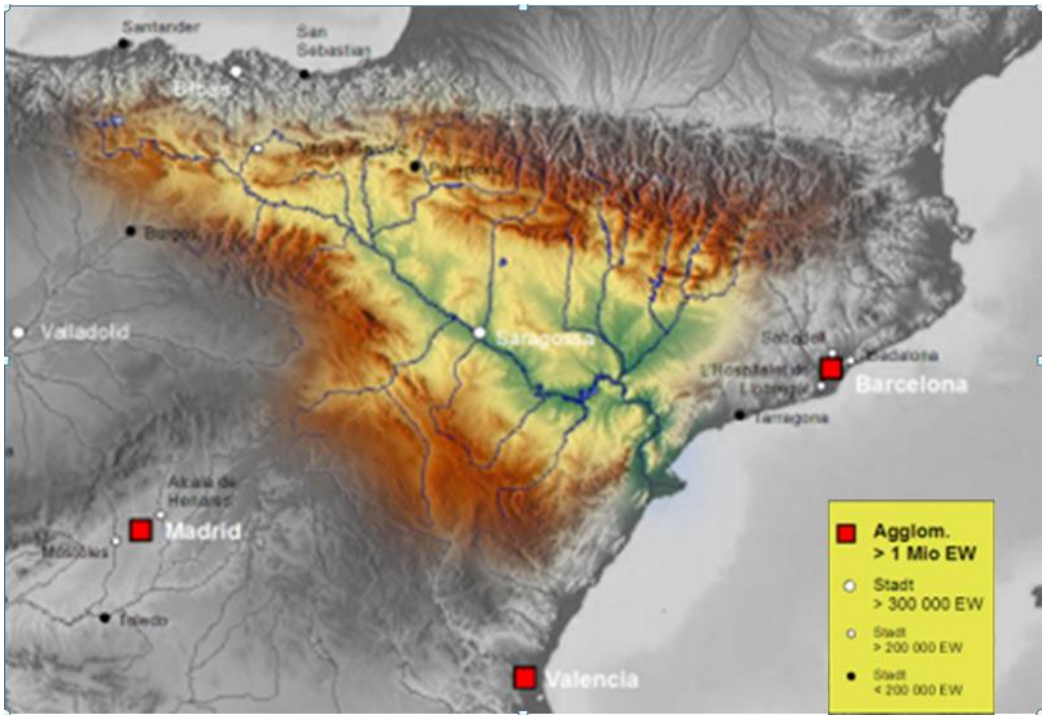

Figure 3. Zaragoza in the Ebro basin

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3.1.4 Comparing between sites

The three sites are complementary and provide useful contrast for analyzing innovation uptake in urban water management (Table 2). In the three sites, a range of challenges for urban water management existed, covering amenity, water quality and wastewater management, stormwater management and run-off, and water scarcity. The Aarhus case-study is focused on improving the aesthetics of the river and water quality issues, in particular for allowing bathing in the harbour and using the Bathing Water Directive as a design target. The Emscher catchment is focused on reaching multiple objectives between river restoration, flood management, upgrading wastewater management infrastructure for water quality and meeting Water Framework Directive standards, and upgrading the region. The Zaragoza case-study is focused on water scarcity, managing water demand, and reducing water leakage. All three cases include a strong urban regeneration dimension.

The case-studies include contrasting technological innovations, such as advanced information systems (e.g. monitoring and warning, district metered areas), household level devices, and infrastructure level solutions (e.g. active leakage control, separate wastewater/stormwater networks, storm retention basins) with different degrees of maturation. Importantly, the implementation of these innovations required different levels of cooperation: some required relatively little collaboration between relevant stakeholders (e.g. monitoring and warning system, district metered areas, active leakage control) whereas others required close collaboration between a larger number of actors (e.g. water efficient devices, stormwater retention basin, separate stormwater and wastewater network).

Table 2. Key challenges and drivers: case-studies and innovations examined

	Challenge	Drivers	Innovation
Aarhus city	Water quality, heavily modified water body, wastewater and stormwater management	Bathing Water Directive, WFD, urban regeneration	Improved water quality through increased capacity (retention basins) and real-time monitoring and control
Zaragoza municipality	Water scarcity, drinking water, water user consumption, water network leakage	Water crisis, urban regeneration	Water efficient technologies, district metered areas and active leakage control
Emscher catchment	Heavily modified water body, wastewater and stormwater management, water quality	WFD, urban regeneration	Separate stormwater and wastewater network, storm retention basin

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3.2 Data collection: documentary and interview data

The assessment tool research questions were examined in two steps. Each case study team was first asked to answer to as many questions as possible through documentary evidence. A total of 50 documents were considered, including laws and policies, administrative and research reports, stakeholder publications, and other relevant documents. Documents were found within the repository of the WP partners (some of which have been involved in the innovation uptake), through government and administrative repositories, via academic publication portals (scopus, sciencedirect, webofknowledge, researchgate), and on the internet (websites of relevant actors).

The second step was to identify gaps in understanding regarding the innovation uptake process and influencing factors (via the answers to the assessment tool), and thereafter to perform an interview campaign with key actors to validate some first findings and fill in knowledge gaps. A total of 24 interviews were carried out across the three sites (Table 3, see Apendix 4 for more detail), including:

- Public authorities, in particular municipalities (e.g. Aarhus municipality, City of Dortmund, Zaragoza municipality);
- Semi-public organizations with a private status but largely owned by the public sector, in particular drinking water and wastewater companies (e.g. Aarhus Water, EG);
- Private organizations, such as development and construction sector (e.g. RAG Montan Immobilien GmbH, Krüger);
- Civil society organizations, such as environmental and civil rights NGOs (e.g. NABU, ECODES);
- The academic sector (e.g. Zaragoza University).

The type of social actor interviewed depended on the case-study investigated and the information needed. However, in each case-study, an effort was made to select a range of interviewees both within and outsite the core groups of actors driving the innovation uptake, in order to ensure the inclusion of different perspectives in the analysis.

Table 3. Overview of interviews performed in the case-studies

Case-study	Public	Semi public	Private	Civil society	Academic	Total
Aarhus	3	2	2			7
Emscher	3	3	3	1		10
Zaragoza	3	1		1	2	7
Total	9	5	3	2	2	24

As the questions of the DESSIN (and DROP) framework necessarily call for subjective judgements, it was deemed necessary to have more than one researcher to ensure all important aspects or issues

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were considered, and make the observations more objective. This was achieved via the teams created for each mature site and via targeted questions during the cross-comparative analysis. It was also recommended to include counter-examples when answering questions (and hence ask for them in the interviews), in particular where it was useful to contrast why a particular factor was critical or not in the case examined as opposed to other similar cases. If during the interview no contrasting examples were brought up spontaneously by interviewees, the interviewer could specifically ask for such contrasting examples.

The questions in the governance assessment framework were not designed to be interview questions. They mainly served to diagnose the innovation uptake, guide the analysis in a comprehensive manner, ensure consistency and comparable results, and support the development of storylines. Specific interview questions, common to the three case-studies, were therefore developed (Appendix 1). The methodological partners then supported local partners in carrying out the interviews via comprehensive interview guides (see Appendix 2 for an example on the Zaragoza case-study) and/or attending the interview(s). The interviews were audiotaped and transcribed or extensive fieldnotes were taken.

3.3 Data analysis: answering the guide, developing narratives, comparing across sites

Each case-study team reported interview results against the interview reporting template (Appendix 1 and 2), resulting in a thematic classification of interviewee responses. Each team then analysed interview data using the governance assessment framework. The thematic classification of the interview reporting template was closely related with the questions of the governance assessment framework, allowing for a structured analysis of interview answers. In addition, the consideration of interview data with documentary data (applied against the governance assessment framework before the interviews) allowed for a validation, enrichment, and/or adjustment of documentary evidence. Patterns of agreements and disagreements were analysed between interviewees, and between interview data and documentary data. Filled-in governance assessment frameworks are provided in Appendix 5.

Storylines highlighting the key processes and factors influencing innovation uptake were developed, based on the answers to the governance assessment framework. They were first structured around a chronological timeline of the innovation uptake. Key factors identified through the governance assessment framework were then matched against key events and processes on this timeline. The objective of developing these storylines was to maximize neutrality and objectivity and to place emphasis on facts and general principles.

Using a common template for the reporting of data and its analysis facilitated the comparative assessment between case-studies. Answers for each question were compared between case-studies. Main commonalities and differences were noted and contrasted in order to identify relationships between governance factors and innovation uptake. Thematic groups and issues were examined through the five dimensions of the governance assessment framework in order to link

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findings with the theoretical basis of the research. The list of thematic groups and issues is presented in Table 4. They form the discussion presented in Chapter 5.

A first list of "recommendations" for innovation developers and policy-makers aiming to support innovation uptake was prepared on the basis of these thematic groups and issues, and are presented in Chapter 6. All results were presented in an internal DESSIN workshop where methodological and case-study partners discussed individual cases, lessons learned, and recommendations. Building on this input, a first draft of the report was produced and reviewed by the group before submission.

Table 4. List of thematic groups and issues arising from the comparative analysis

Dimensions	Lessons learned
Levels and scales	*Local as the main level for innovation uptake in urban water management* • Most responsibilities/mandates held at municipal level (with some involvement by river basin/catchment levels…?) • Degree of local autonomy important: local solutions for local problems *But higher levels influential* • No particular "leadership" or "opposition" at national level • Opportunities/drivers by broader regulatory/policy frameworks, policy discourses and funding streams • Processes of adjustment to fit with these higher levels
Actors and networks	*A small group of "entrepreneurs"* • Providing a "vision", behind which other actors aligned over time • Close, established personal relations –but a risk in the long-term? *Building coalitions* • Finding synergies with other beneficiaries of innovation *Mixed use of public participation* • All cases have involved many actors –but role of public participation remains unclear • May help create common agenda/alignment of perspective, especially when innovations involve a large number of actors • May help raise profile of initiative and communicate results, especially when innovation relevant for small number of people or not controversial
Goals and ambitions	*Political support* • Political drivers key to processes. Political actors capable of generating "vision". Political competition productive • Positive feedback loop between increasing public interest in topic and political interest for "invisible" topic *Issue linking* • Linkage with other (political) issues can provide very powerful drivers: e.g. urban regeneration, recreational value, quality-of-life improvements, economic development. • Unrelated ambitions can provide strong impulse: relationship of national vs. local levels in Zaragoza and Aarhus

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Dimensions	Lessons learned
Strategies and instruments	• Active search for multiple benefits, to leverage/save money and build broad supportive coalitions *Working on perspective alignment/seeking compromise* • Flexible attitude with regards to goals and ambitions important in all CS: alignment of perspectives and search for win-win situations • Ditto for development/implementation phase: incorporation of new co-benefits, additional support *Communication* • Communication/dialogue key to build social capital and legitimacy in face of opposition. • (Zaragoza and Aarhus: no resistance to water price hikes; Emscher: continuous dialogue incorporated additional co-benefits.) • Benefits of "common-good perspective" *Plans and regulations* • Regulation as significant influence for innovation uptake (but usually not main driver) • Plans/memorandum of understanding to build overarching supporting policy framework and political awareness • Over time: change towards more innovation- and risk-seeking attitudes *Economic instruments* • Economic incentives proved to have mixed effects in case studies • Ambition of actors main point – then actors "find" funding: issue-linking *Dynamic over time* • Combinations /sequencing of instruments

Responsibilities and resources	*Form of collaboration/role allocation*
	• Structuring of partnerships/roles of actors unleashes very significant potential for success. Different models:
	  ○ flexible partnering;
	  ○ independence of project management;
	  ○ distribution of roles acc. to strengths of actors
	• Further possibility: flexible roles over time
	Building knowledge base
	• Use of feasibility studies, pilots, showcases in different CS. However: not necessarily use of CBA and stakeholder analysis
	• Use of knowledge networks/EU projects

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4. Storylines of innovation uptake

Storylines of innovation uptake highlighting enabling governance factors were written for each case-study. The production of these storylines serves as detailed reporting of the processes and mechanisms that led to the innovation uptake, allowing an in-depth understanding of enabling factors or posing barriers. Presenting innovation uptake chronologically allows for a “rich” understanding, avoiding the simplification and over-reductionist approach of much research in environmental management (Adger et al., 2003). In order to generalise from these detailed narratives, Chapter 5 presents lessons learned from the cross-comparative assessment of the three case-studies, together with the broader literature on the governance of urban water management reviewed in Chapter 2.

4.1 The Aarhus case-study

The innovation uptake in the Aarhus case is seen as a multiplex, largely locally driven process, with several layers of discourse and action. Key actors trace its development back to 2003/2004, but it may also be related to an enabling environment, stemming from a national priority following the oil crises in the 1970s: Denmark decided to take a new path to meet growing energy needs, and since the early 1980s there has been an ambition to lead the transition towards a green economy. Under the public-private partnership "State of Green" Denmark has become a leader in sustainable new technologies, and it is claimed, green issues have become deeply embedded in the mindsets of the Danes.

The 1990s in Aarhus was a period with increasing focus on urban planning and development. The city adopted the ambition to become a "Green City" and aimed towards considerable investments in environmental planning. Efforts included initiatives to develop green spaces in the city and surrounding areas, watershed protection, including afforestation measures in drinking water catchments, reduction of fossil fuel use and CO_2 emissions, and river restoration, with two parts of the Aarhus River being re-opened in 1996 and 1998, respectively.

Most of the local actors attribute the start of the project to improve water quality in receiving waters by an integrated solution with increased capacity and real-time monitoring and control to a vision forwarded by a local politician. The politician was looking for a popular cause that might strengthen his position for an upcoming election, and around 2003/2004 he promised his voters that he would bring back the once bustling life or "Leben" in the city centre, by restoring and cleaning up another section of the river. The political vision was applauded by the national minister for the environment and well received in the local news channels.

Around the same time, the municipality had to turn down an application to establish a kayak-rental on the river, due to poor water quality. The entrepreneur was agitating actively, and others pointed to the recently completed harbor restoration in Copenhagen, arguing that Aarhus also should develop its old harbor area, including residential as well as recreational and bathing areas. The

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concept of improving life in the city by improving the water quality in the river received a lot of media attention, which resulted in broad popular support for the intervention. Thus, local opinion leaders played an important role in the initial stages, and there was also an element of "immitating" a successful innovation uptake in the capital, playing on local patriotic sentiments.

The opinion leaders did not, however, operate in isolation. Behind them, water experts in the municipality and technology-providing companies were pushing for an innovative water management solution. The networks and degree of trust at this level were strong and quite decisive for the success of the process, and seem to have developed due to a number of factors. Firstly, Aarhus *"is not a very big city"*: People in the same sector easily get to know each other and are often connected through multiple ties. Secondly, all the main actors had local offices in Aarhus, making it easy to meet face-to-face. Thirdly, there was a high level of personnel mobility: Lead persons in the municipality had careers spanning across several of the involved organizations, with close insights into what the various actors could and could not deliver. Individuals on the side of the companies, likewise, had been working for the municipality before and had detailed knowledge of their culture, challenges and systems. Last, but not least, there was a tradition for informal, direct person-to-person communication; it was very *"easy to just pick up the phone and call"*.

A core group of 4-6 experts with a strong enthusiasm for technology development did a lot of work, both at a formal and an informal level, to prepare the grounds for the innovation project. These local experts were entrepreneurs, in the sense that they had networks spanning across organizational and sector boundaries and were good at manouvring in the interface. They had developed a high level of trust in each other, accumulated as social capital over time, and a related willingness to risk, based on their shared experiences and objectives.

As water supply and sanitation in Denmark for a large part is considered a local responsibility, the technological entrepreneurs also enjoyed a broad room for action. Up to 2007 a county administrative level called the "amt" had more of a say regarding water cycle services, but the "amts" have since been replaced by five regional councils. These are still responsible for the use and protection of water resources, but do not interfere much when it comes to planning and development of infrastructure. According to some of the stakeholders interviewed the "amt" and municipality used to be *"at war",* so the new, further decentralised structure is more conducive to development and innovation.

While the national Environmental Protection Agency is responsible for environmental policy and there was an interface with the Marine Authorities regarding some issues, the national level was not actively involved in the innovation uptake. The European level was influential indirecly through the Bathing Water Directive, but the city of Aarhus was the principal driver. Most critical discussions and decisions in the process were made by the city council. This meant there was only limited spatial and social distance to bridge, and it was relatively easy to achieve a high level of involvement and ownership among local stakeholders. The broader public was involved through public hearings, a few well-staged promotion events, and continued media attention, but according

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to the actors interviewed there were no cpecial communication or awareness campaigns, as there was no real resistance to the innovation.

By 2005, the city council of Aarhus decided formally to improve the hygienic water quality in Lake Brabrand, Aarhus River and the harbour.A proposal for a new trunk sewer solution at the cost of around 50 million EUR had already been made. The original political vision was extended to include a larger geography, and climate change adaptation had come in as an important aspect. The linking of these arguments to the already broad array of issues involved – environment conservation, recreation, "green" business, urban development, increasing the city's attractiveness to tax payers as well as tourists, harbor restoration, etc. – was another enabling factor. As it relates to fortunate timing and broader historical influences, as well as to active framing on the side of the involved actors, it seems fair to describe this issue-linking as a feature of the process.

Considering climate change adaptation in particular, the municipality wanted to explore the possibilities for developing a more adaptive solution with a series of retention basins, and asked its own experts to liaise with DHI for this. By 2006, an initial proposal including 7-8 combined sewer overflow retention basins, enhanced wastewater treatment, and a real-time control system to coordinate releases from the retention basins was presented to the city council. The solution also included a bathing water quality warning system, which was motivated by the EU Bathing Water Directive (BWD). The BWD permits more frequent events exceeding bathing water standards if a warning system is in place; the warning system was estimated to save 25 million EUR in infrastructure costs that would otherwise be required to reduce the frequency of non-compliant events. In other words, economic arguments were brought in strongly, as far as this specific innovation was concerned.

Around 300 000 EUR were spent on a six-month feasibility study, focused mainly on technical aspects and carried out by DHI, Krüger and Aarhus Water. Following this study a model concept was developed, which one to a large extent kept to since then. The budgeted costs of the designed solution were almost 50 million EUR. However, financing was not considered as a barrier. On the contrary, some saw the financing as a driver, as it was readily available locally, unlike in most research and development projects in Denmark, where one has to rely on national funding. The cost of the initially proposed trunk sewer solution was used as a reference. Since the greater part of the budget for the integrated solution went into construction of physical infrastructure, local user-financing in line with common Danish practice was considered as appropriate, and the whole project was financed through a small, gradual increase in tariff – 2 DKK, or around 0.27 EUR, per cubic water - which was not controversial, since it was for a good (blue/green) cause.

In 2007, the City of Aarhus allocated the funds for Aarhus Water, which was singled out as a separate business entity the year before, to execute the project. For the real-time monitoring and control and the warning system for bathing water quality, Aarhus Water organized an open bidding competition. DHI as well as Krüger are competitors as well as long-term development partners for Aarhus Water, but they were specifically encouraged to submit a joint bid to tender. Aarhus Water wanted to combine DHI's expertise in how to make a platform, with Krüger's expertise in how to

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implement the control system. After DHI and Krüger won the competition, the project was organized as a partnering contract. According to Aarhus municipality and Aarhus Water, use of partnering contracts is a conscious strategy, to build capacity in "total projects", rather than through pilot studies or dedicated capacity-building activities. In their view, as well as that of several other stakeholders, this was an important enabling factor. Another enabler was a "*willingness to risk*", apparent in the readiness to implement a new solution, limited concern with economic assessments, and will to enter partnering contracts. This was presented by local stakeholders as a feature of the management culture and general *"mindset"* in Aarhus municipality at the time.

Like the dialogue in the initial phases of the innovation uptake, the project was characterized by informal communication and close personal relations among individual experts. The partnering contract was seen to bring about *"a common project culture",* where teamwork and capacity-building were inherent. According to the lead person from DHI; "*we knew what the objective was, where we wanted to go, but not exactly how to get there. All the three partners got wiser on the way."* Another important feature of the partnering form of contract was that it is flexible, allowing for the adjustment of roles and responsibilites to meet technological and process challenges. While the financial management of the project was on the hands of Krüger throughout, the technical management was handed from Aarhus Water to DHI and back again. Despite such changes, individual tasks were considered clear and there was a stable team. As one participant saw it; *"It was only 'the drawers' that changed"*.

Other important resources lie in the capacities and ambitions of the partners. For DHI, the project was an opportunity to strengthen their position and further develop work they amongst other had developed in relation to the solution in Copenhagen. Krüger's motivation was to do further development of a control algorithm developed in the EU project SWI, both for Aarhus and to sell abroad. Aarhus Water, on their side, was considered as a customer of very high capacity. The partners all drew on their international networks where possible – amongst other using the EU Water supply and sanitation Technology Platfom strategically and pulling in additional resources from EU project PREPARED - and they had a common goal of making Aarhus a showcase for innovative, future-oriented water management. On the other hand, some of the interviewed stakeholders indicated that partnering with competitors also involved certain challenges, especially when unforeseen technical challenges brought different agendas and priorities to the fore.

During the wider process of innovation uptake, the water utilities were separated from the municipalities in Denmark, and given different roles. In the Aarhus case, the fact that the lead person in the municipality was the responsible authority as well in charge of operations in the early stages was considered an advantage. Later, the municipality remained responsible for the water supply, while the supplier became the operating actor. According to some, Aarhus Water in later stages got more focused on the delivery of a solution they had "bought" and less focused on their role as partner in technological development. On the other hand, some suggested the establishment of Aarhus Water made the utility "think more like a business corporation", without

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the bureaucracy that goes with public management, and that this may have strengthened their focus on learning and innovation and thus benefitted the innovation uptake.

The construction of the physical infrastructure for the new integrated wastewater management solution in Aarhus was completed in 2012. The project to develop the real-time control was officially closed in the summer of 2014. The real-time control system consists of one model system, which is operated by Aarhus Water. The bathing water quality warning system consists of four models, operated by three agencies: the catchment rainfall-runoff model is operated by the Environmental Section of the city of Aarhus; the sewer system model and the river/lake hydraulic model are operated by the water utility, Aarhus Water; and the harbour model is operated by DHI. Although the innovation uptake in both cases is regarded as successful, the optimization aspect can still be improved. How to get the good linkages between the control algorithm and the hydraulic model remains a challenge. Aarhus Water is currently funding a smaller test project, which also involves the three original partners.

The overall solution is also functioning well, and has saved money for the municipality. Water quality has improved dramatically, and bringing the river back to surface has had a significant impact on the quality of life in the city centre. A core area with derelict houses, dense traffic and limited business activity has been turned into a busy and aesthetically pleasing district with many shops, cafes, restaurants, and bars. While one of the water quality experts thought it still may take some years before bathing water quality is achieved, representatives of the municipality expected that in 1-1,5 years from now there will be swimming and leisure fishing in the old harbour. The municipality is currently participating in an EU project to determine the impact on real estate values more exactly, but the impression so far is that the innovative solution has led to a *"fantastic value creation".*

Summing up, the approach by the core actors in the Aarhus case was technological rather than regulative, communicative or incentive, and part of a long-term strategy to improve the water quality and strengthen the water sector in Aarhus. No major barriers were identified. At the European level, the EU Bathing Water Framework Directive helped facilitate the innovation uptake, and some of the most influential strategies and instruments at the national level, beside the overarching "State of Green", seem to have been the emphasis on decentralization and increasing local autonomy, combined with the principle of user-financing and recent privatization of water utilities.

At the local level, we find important enabling conditions in the goals and ambitions of the actors, their local and international networks and their institutional capacities, as well as in social and cultural capital developed over time, most notably in the form of trust, informal modes of communication and a mindset characterized by *"willingness to risk"*. These "transfer factors" (OECD 2005) were quite critical enablers for the actors to utilize the opportunities in the broader and governance context. Some interesting strategies at this level were use of long-term development partnerships and capacity-building in total projects, matching general water sector competence with specialised knowledge, issue linking, combining formal and and informal communication, and

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strategic use of available resources in the EU research and development system. Innovation as such was not a stated focus in the studied case, but has since become a conscious aim. By 2015, Aarhus municipality and Aarhus Water are working actively with processes and structures to encourage innovation, and several interviewees said they doubted that a successful innovation uptake could have played out the same way today.

4.2 The Emscher case-study

The Emscher is an originally 109 km long river flowing through the "Ruhrgebiet", the most densely populated area in Europe. With the start of industrialization, coal mining, and a rapid urban growth by 1860, the natural regular inundation of the broad Emscher floodplains turned into a problem. The only solution seen by experts was to straighten and channelize the Emscher River. This task, later known as the so-called 1st Emscher conversion, resulting in open wastewater conducts, was conducted by the newly established Emschergenossenschaft (EG).[1] The continuing soil depressions, which occurred in the region during the entire industrial period as a result of underground mining, did not allow building subsurface sewers for the discharge the wastewater. When the industrial period came to an end, the occurrences of subsidences slowly lessened, and the planning of the so-called 2nd Emscher conversion commenced in 1990.

During this time of structural change, the nternationale Bauausstellung/International Architecture Exhibition, which took place in the Ruhrgebiet from 1989-99, gave enormous impulse, motivation, and "new values" to the entire region and initiated a several-decade lasting structural transformation process. Part of this process is a commitment of the Ruhrgebiet cities for a landscape park (Emscher Landschaftspark), with the conversion and restoration of the Emscher as its central element. The aim of the Emscher re-conversion is to disconnect the wastewater from the river water by conducting the wastewater in underground sewers to the next wastewater treatment plant (WWTP). This is the first step of the conversion, followed by the subsequent revitalization of the original Emscher stream and its tributaries. This large-scale project affecting the entire Emscher catchment is to be realized within 3 decades. The technical Emscher conversion is scheduled until 2017 and the finalization of the ecological restoration is planned for 2020. Its costs sum up to 4.5 billion Euros.

The "Master Plan Emscher Future"

The "Master Plan Emscher Future" (MP) is an informal, flexible and award-winning plan for the development of the new Emscher valley, harmonizing water management, urban management, and open spaces management.[2] The Emscher conversion is the core task in the MP, containing all measures planned within the Emscher valley as part of the Emscher conversion, which can be

[1] The Emschergenossenschaft (EG) was founded by law in 1899 with members of the cities of the Ruhrgebiet as well as the mining and industrial companies. The main task of this water association was to assure water and wastewater discharge and to avoid further floodings.

[2] The MP won several prices such as the German Landscape Archtecture price for infrastructure and landscape ("Deutscher Landschaftsarchitektur-Preis 2013").

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represented by 22 ecological hot-spot areas and 11 focus areas. Also the construction of the Emscher canal and the canal along the tributaries (400 km, 4 WWTP with 5 Mio. population equivalents, 290 combined sewer overflow structures, 350 km of restored waterways) as well as the ecologic restoration of all these streams is part of the MP. But the MP goes beyond the Emscher valley itself and comprises also projects in its surrounding area, such as more than 20 Emscher landscape parks and more than 50 rainwater management projects, ideas, or areas with potential. Apart from being a supra-regional plan, the MP gives impulses, orientation and visions, links measures, creates a sense of community via a commitment to common Leitmotives and a common goal, and provides a communication platform.

The MP was developed by EG in cooperation with the Regionalverband Ruhr (cooperation "New Emscher Valley") and together with the cities, districts, and industries in the Ruhrgebiet. In 2003, an interdisciplinary contest for a planning concept was initialized by EG. During the following 1.5 years, the concrete development of the MP based on the winning concept took place, organizing several dialog events between all actors involved to put together and link single project plans and ideas. In 2005, a first MP draft was published and signed by representatives of the Emscher cities as a consensus & commitment document. In 2006, the revised and elaborated MP was published. At that time, also the link between EG and Regionalverband Ruhr/association of the region Ruhr (RVR) was established by linking the "Masterplan Emscher Future" (EG) with the Masterplan "Emscher landscape park 2010" (RVR). Parts of the projects in the MP are still realized after finalization of the Emscher conversion, i.e. after 2020, especially those in the complementary area.

One of the measures or projects being part of MP is Lake Phoenix (LP). This measure, one of the two sub-projects highlighted in this study's Emscher case-study, represents a typical project that involves the Emscher itself and its surrounding, the first part under the responsibility of EG and the second in joint responsibility with the respective municipality (Dortmund), involving also urban development interests. LP is also one example of an ecological hot spot within the MP, where wetlands and biotopes can develop without narrow spatial restrictions. Via the link between the various hot spots a colonization of flora and fauna along the entire waterways is expected, the so-called "ripple effect".

Until 2001, an enormous steel production company used to be located where LP is situated now, while the Emscher was flowing in an underground channel underneath the industrial area. Signs of the coming end of steel works emerged the 1990s. Therefore, already at that time first brainstorming on how the area could be developed was conducted. In 2001, the steel production factory was shut down, demounted, and transported to China. The city of Dortmund bought the area which until then was owned by the mining company. Following discussions about the future use of the area also the idea to transform the area into a lake was proposed, an idea initially only laughed-at. However, a few committed individual actors/policy entrepreneurs who believed in the project, were willing to take risks, and able to bring the project forward, among others by making the important first steps towards a feasibility study and a public discussion. In fact, and as the result of the successful linking of issues, the option of a multiple purpose lake surrounded by new properties turned out to be feasible: It could serve as a biodiversity hotspot, as a flood retention

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basin, as a place for local recreation, water sports, and sports along the lake shore, plus, it had the potential to make the city more attractive for both people and businesses by upgrading a problematic district.

The PHOENIX-See Entwicklungsgesellschaft was founded as a subsidiary of the municipal utility company to manage this large-scale project, an external project leader was employed and expert engineering offices were contracted. EG was involved concerning all topics related to water management of the Emscher and the lake. In this coalition, various parties (many with positive histories of collaboration and relationships of trust) with different problem perceptions, solutions and resources (knowledge, financial capacity, etc.) worked together, however – and this is considered an additional important factor of its success - with a clear division of tasks, responsibilities and expertise. From the governmental side, a large number of agencies was involved in the process. Public participation was realized with formal and informal meetings and discussions, and was also topic in the Emscher Dialog, a public forum held by EG every 1-2 years since 2001.

Further feasibility and assessment studies were conducted to improve the solution and to convince decision makers that the risks involved were acceptable. After a long planning phase, digging operations started in 2006. In 2009 the new stream bed of the upper waters of the Emscher was completed. Also the selling of land properties surrounding the future lake began in 2009. In 2010 the lake was flooded and officially opened in 2011. Also house building along the lake started in this period. In 2013, the Entwicklungsgesellschaft “delivered” the lake back to the city of Dortmund.

Given that the project served various goals funding could be organised from various parties and domains (water management – EG; ecology - Ökologisches Progamm Emscher Lippe Raum by the federal state of NRW; urban development). EG, for instance, provided the amount of money that was already budgeted for the construction of a flood retention basin. The consortium took great care of timing, for instance regarding the deadlines of the various funding programs. Some funding sources were not even used in the end, because it would have slowed down the marketing of the real estates and hampered a wide variety of possibilities. The marketing of the real estates was a financial aspect considered from the beginning in order to make the project partly self-supporting.

The combination of various problems (flood risks; abandoned brownfield site) and goals (flood retention; Emscher conversion; attractiveness of the city, etc.) was a crucial factor for the successful realization of LP. Also the fact that LP was a solution that served multiple actors’ interests and aims facilitated the realization of LP. For instance, although the environmental NGO NABU acknowledges that LP is not a nature conservation project, they are very positive about various elements of the plan. One of the reasons for their enthusiasm was expectation management, i.e. they were aware from the beginning that a pure natural area was not realizable. There were only few conflicting goals. One of them was a conflict for space – a compromise had to be found between ecologically (size of the lake) and economically (size of the real estate area) required areas. The actors’ good relations, enthusiasm, and believe in the project helped in finding solutions for this conflict of interests, just as it helped to settle discussions concerning upcoming

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additional costs and risks.[3] The realization of LP was furthermore facilitated by a favourable timing, being that the Emscher conversion coincided with the abandonment of the brownfield site. Since the Emscher was still flowing underneath the abandoned area, it was clear to all actors that a restored Emscher needed to be part of the development plan. Also the European WFD can also be seen as an important driver; since EG needs to comply with the WFD, it has an interest in a good water quality of LP and a balanced water quantity in the Emscher and its tributaries.

LP became a big success and its quality exceeded the expectations: It acted like a motor for a fast economic development, it created jobs as well as attractiveness for the city and a new ecological hotspot, and it improved urban climate. It serves as a huge showcase for urban development even far beyond the region. This success and potential was already felt during the process, which helped to overcome hurdles.

The "Future Convention for Stormwater "

Along with the enormous Emscher conversion project, and owing to several problems associated with conventional rainwater management, the need for several complementary developments in water management was perceived, for instance, in relation to stream water quantity and flood prevention. After a first pilot measure and several relatively small EG decoupling projects in order to gain know-how and experience in the 1990, the "Future Convention for stormwater" (ZVR) program was launched in 2005. This program is a regional commitment for a sustainable urban drainage approach/rainwater management signed by EG, the ministry of the environment and all municipalities of the Emscher region. It aims at a 15% reduction of sewer runoff by 2020 by disconnecting stormwater from the combined sewer system[4]. More in detail: starting from 2005, the yearly sewer runoff in the combined sewer systems in the Emscher region is supposed to be reduced by 15% until 2020, which is a time period of 15 years. This decoupling is expected to result in a number of advantages that can be categorized into ecological, economical, and socio-cultural "profits", such as a balanced runoff regime, groundwater recharge, adaptation to future climate, urban design and attractiveness, and less wastewater discharge in channels and WWTPs resulting in lower costs. This saved money resulting from lower costs could instead be invested in facilitating the 15% decoupling in the first place; this is an important funding aspect of the ZVR. An additional (and successful) funding instrument and financial motivation for decoupling is the wastewater discharge fee calculation in place. The height of this fee relates to the sealed and built-up area, and can be decreased as a result of decoupling.

[3] The (historical) role and position of EG is key in this respect. Given that both municipalities and mining companies are associates of EG, and consequently traditionally always in dialog concerning water aspects, water management interests represented by EG are deeply rooted in activities in the region.

[4] Apart from providing funding for ZVR measures, EG is the consulting and supporting partner in those projects, involved in feasibility studies and planning.

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Zeche Ewald (ZE) in Herten, an active coal mine from 1872 until 2001, is one of the examples in the Emscher region where decoupling measures have been completed as part of the ZVR program, and the second sub-project part of this study's Emscher case-study. It is a large-scale project with the aim of transforming a brown-field into a multi-use area, while at the same time decoupling rainwater of this area. In fact, and similar to LP, it is a project in which single interests were overlapping synergistically, and the result of a balancing act between, and successful linkage of, water management, green landscape, recreation and economic welfare for the region. With the decommissioning of the mine in 2000/2001, a loss of jobs and economic power was to be compensated as soon as possible. As the end of mining activities could be foreseen from the structural change in the region, thehe "project association Ewald", composed of the city of Herten and the RAG Montan Immobilien GmbH (the company developing former mining areas in the Ruhrgebiet), was already founded in 1999 while the mine was still in operation. After the closure of ZE, two international competitions were initiated in 2001 and 2002 by the project association to identify promising concepts for the future development of the area. The development was closely linked to the development of Halde Hoheward (former mine dump) into the "landscape park Hoheward", opening up funding opportunities.

The defining elements of ZE are its historic colliery buildings and since 2006 the central and connecting element in the area is the newly designed Ewald promenade, the so-called "Blue Ribbon", which is presented as an important solution to upgrade the area by creating attractiveness. This gutter system has been created as part of the development of the area. It is connected to the Resser Bach in the North and to the Schellbruchgraben in the South, both tributaries of the Emscher River. The "Blue Ribbon" as a design element needed to be supplied with water. The "solution" was to utilize rainwater from the area. The rainwater that, inter alia, comes from the roofs of the old colliery buildings, is directed to the "Blue Ribbon" and from there to the two streams. Interesting detail from a time perspective is that the "Blue Ribbon" was already designed before it was realized that the issues (I) water need for the "Blue Ribbon", and (II) the rainwater decoupling opportunity as part of the ZVR could be linked and serve as a win-win. This link was identified and pushed forward by individual policy entrepreneurs. Another important stimulus for the uptake of the decoupling measure was, just as we have seen for LP the WFD, and at least as important, the fact that the newly developed areas on the Eastern side of the "Blue Ribbon" were built with a separate sewage system, which is required by law since a regulation was passed in 1995/6. The decoupling of the long-standing buildings on the Western side was a voluntary extra, but it was decided in favour of it, also in view of the will to develop ZE into a sustainable, future-oriented, high quality, multifunctional area. Furthermore, the decoupling in the existing area was presented as a solution for possible (future) hydraulic problems.

Given the fact that there was sufficient funding available (not least thanks to the linking of various goals and programs) and no apparent disadvantages, relatively few barriers had to be taken for

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realising this specific measure.[5] Further important factors of success were a good project structure and communication, targeted heading towards the main goal, having individual drivers who believed in the project and were able to bring it forward, trust between the actors due to positive working relations in the past, and enthusiasm and pleasure in working together. For instance, it was already in an early stage realized that the development of ZE had to be a collaborative task; therefore, the choice to form a project association (instead of a regular public-private-partnership) was promising. Although public involvement, including formal and non-formal forms of dialogue, was from its very start part of the ZE development, no public participation did take place for the decoupling element, as it was regarded as only an operational detail of the overall ZE development.

Lasting impacts of the ZE development in general are the creation of new economic power and jobs, a place for recreation, and a more sustainable water system for the city of Herten, plus a positive radiance and economic impulses even far beyond Herten.

4.3 The Zaragoza case-study

The Zaragoza Case Study is best described as a *transformation process* in which different social actors joined forces with the aim of reducing water demand and thus the environmental impact of drinking water provision. It has expanded over time, to cover additional topics and approaches as opportunities were identified. It contrasts to the other DESSIN Case Studies in the prominent role of the broader public in it, both as target of very extensive communication activities, and as actors in the uptake of innovation. A series of different innovations were implemented over 20+ years, including a series of technical ones, such as 1) user level uptake of water saving technologies, including flow regulators and water saving appliances; 2) leakage control technologies including rehabilitating pipeline networks, pressure management controls, and 3) District Metered Areas. As the implementation of these innovations is intricately linked with the transformation process – in effect only possible as a result of it – the analysis will include aspects of the overall process which facilitated the innovations.

The backdrop to the start of the initiative was water shortages in the 1990s in Zaragoza (and other Spanish cities) due to a combination of seasonal water scarcity, high water consumption rates and inadequate management. Traditionally, water supply options had been preferred (dam and reservoir building), but, in addition to the costs and environmental impacts, the approach had lead in the 1990s to social tensions between regions and actor groups. At that moment in time, planned infrastructure developments to secure water supply included a new reservoir for Zaragoza, to be used for drinking water and irrigation, and plans for water transfers from the Ebro basin to southern Spain. An early justification for additional water storage was given in the late 1980s with high prognoses for the city's future water consumption (from 90 Hm^3 in the 1970s, it was forecasted to grow to 212 Hm^3 by year 2000 – in reality, the consumption in 2012 was about 60Hm^3). This was seen by some as an attempt to support the development of irrigation while asking

[5] Funding was provided by the federal state of NRW (Ökologisches Progamm Emscher-Lippe Raum), the federal state together with the country (Gemeinschaftsaufgabe Bund-Land), RAG MI, EG (ZVR), and via the marketing of the real estates.

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drinking water users to pay disproportionately for the storage infrastructure. However, a significant change in municipal policy towards a demand management approach (e.g. reducing water use) occurred in opposition to the national plans to transfer water from the Ebro river basin (supplying Zaragoza) to the south of Spain, seen by many as an attempt to provide unsustainable irrigation to farmers, and develop tourism facilities like golf courses. An alliance in opposition to the national government was thus forged at the municipal level between municipal actors and local NGOs who saw the potential to reduce environmental impacts of drinking water infrastructures and reduce social conflicts.

Two features stand out for the process' initiation: the adequate timing, and the special nature of the alliance between the two key actors. Regarding timing, around 1994 the municipality was in the process of developing its Agenda 21 together with its long-term Municipal Strategic Plan (1996 – 2010), which ended up featuring water as one of the key areas. Regarding the two key actors' relationship, there is a strong alliance between an NGO (ECODES) and the municipality – owner of the local water utilities. Indeed, the initiative's start was the product of the personal relationship between the general manager of the NGO and an influential civil servant (with roles in the regional water authority and the environmental council of the municipality), this civil servant also being part of the NGO's council since the early 1990s, which would show a similar outlook on certain issues. This alignment in Problem Perceptions and Goal Ambitions between the local government and the NGO, and the trust between both actors, are seen by interviewees as key to the consequent success. The healthy relationship and the alignment behind a common agenda allowed for constructive interactions – interviewees highlighted that this would not have worked with other, more oppositional environmental NGOs. In their partnership, both actors benefited from each other as they could resort to their different strengths. In Zaragoza, the involved NGOs hold more credibility with citizens and are better at involving and engaging the broad public, whereas the municipality can provide resources for such projects and owns the water infrastructure. Relationships between both organizations were continuously enhanced, e.g. by participation of the municipality as partner developer in the NGO's campaigns to raise water saving awareness.

Somewhat schematically, the transformation process can be summarized in the following actions: 1) the 4 phases of the Zaragoza Water-Saving City Programme (1996-2008), 2) different municipal management plans and regulations (e.g. Municipal Strategic Plan (1996-2010), Agenda 21 (2000), "Plan for improving the water supply quality and management" (2002-2009)), 3) active work to increase the city's international profile in the field of urban water management (e.g. hosting the UN Water for Life Decade 2005 to 2015 and the International Exhibition Water and Sustainable Development in 2008), and 4) European-funded research, demonstration and networking projects, aiming inter alia at establishing a market for Zaragoza's experience and for its technology companies.

The actions, building on each other and broadening the scope of the process, also show how the overall process benefited from making the most of chances to raise the topic's visibility. Interviewees highlight the amount of efforts invested in this topic, and the strategy used in the 4 phases of Zaragoza - Water Saving City Programme, which started with households and then

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expanded to other sectors. The outset was already favourable, with the conflictive nature of the issue (social conflicts surrounding new water infrastructure) meaning that the topic had prominence for actors and the broader public in the early 1990s. Interviewees highlighted how substantial efforts were made to keep actors informed, not only of the different technologies and options, but also showing them the outcomes of individual water saving actions (a "touch-to-believe approach"). Showing actors concrete results, e.g. by concentrating efforts on hospitals and schools for close collaboration ("pampering") and then showcasing the results to other actors, was seen as key for uptake of water saving appliances by other actors and the broad public. The simplified water tariffs that established incentives for reducing water use were communicated in municipal services bills, which now distinguished between different items (water and waste), explained savings and provided examples of how to achieve usage reduction.

The focus on having a high visibility and awareness, which is to be expected for actions aiming for technology uptake by end users, was also of benefit for implementing leakage control and reduction, performed mainly by the municipality and mostly not related to end users. A municipal authority interviewed mentioned how municipal authorities from other countries could hardly believe their investing in leakage reduction, as from their perspective this is an improvement that isn't "seen" by citizens and thus provides no political advantages. In Zaragoza, success in investing in leakage control was also a product of involving the broad public first, and thus generating awareness and political support.

The implementation of both innovations would seem to have been favoured by main actors being restricted to the same, local (municipal) level. Other levels (mostly regional and national) provided key support (e.g. funding) at different points in time, but leadership in the process was clearly at the local level. The group of actors involved is comparatively small, and there is not much fragmentation in the system (and thus no fragmentation of responsibilities), with the municipality and its utility playing a major role in water resources management. Only in the later phases of the process the emphasis has shifted to go beyond Zaragoza and the region of Aragón, to building international networks and showcasing of Zaragoza and its water sector to the world.

What the history of the case study shows is how good the main actors were at linking the issue with other, related topics. The main driver for the change of water tariffs was in reality legal action by the association of large families, as the old tariffs would not fulfill equity criteria by unduly punishing large families. Previous tariffs were complicated (thus hard to communicate to users), did not include incentives for use reduction, and did not recover costs. The design of the new water tariffs also made reference to the recently passed Water Framework Directive as justification for the tariff change, in particular to its principles of cost-recovery, transparency, and equity. In this way, a water tariff system that is in many ways positive for water reduction was achieved. A similar linkage of issues was made when a new drinking water reservoir was built (necessary due to water quality issues), with the argument that "if we are going to spend money in an infrastructure to bring water, let's use it properly and not waste it". Other "spin-off" actions were also carried out, such as the restoration of Ebro banks and rivers for the Expo Zaragoza 2008, which are not related to water saving but link with the topic of environmental quality.

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Another point strongly conveyed by the process' history is the continuous identification of opportunities to push the agenda/broaden the process, for instance by expanding actions into new fields as chances arise. Examples include the good use of municipal strategy processes to push the issue of water saving and leakage reduction, the identification of the whole initiative as a flagship initiative for the city (1999), the generation of international attention culminating in Expo Zaragoza and UN Water conferences (in the 2000s), and capitalizing on established networks to promote Zaragoza's water sector and experience internationally (from 2008, ongoing). Additional, synergistic agendas (e.g. exporting experience and know-how) have "grown" on the back of the initiative. The example of the water tariffs is also pertinent to this point: legal revision processes were capitalized for the aims of the process.

A further element worthy of highlighting is the approach used to create support from different actors. The initiative counted with a broad support base, including additional environmental NGOs (apart from the founding NGO), different knowledge institutes, different levels of government, the river basin organization, etc. Actors who were not part of the process were at least not opposed to it – according to interviewees they did not "annoy" during implementation. The approach to anchoring the process in the municipality was clever, as it was carried out both with politicians and at the technical level. This created ownership on both levels, technical ownership helped ensure the process was not interrupted by political changes, and political ownership helped gave impetus to the process in certain phases. The process would seem to show a capable analysis of actors' motivations and efforts to align agendas and create synergies for all involved.

Not all agendas were aligned, however. It was not possible to motivate plumbers to support the process of water saving appliances; there was a failure to identify a win-win situation for this particular actor group. A second failure was that the municipality itself, being the owner of the water utility, had no incentives to reduce its own water consumption, and could not be brought to lead with its good example. As a result, a Bylaw was passed in 2010 to overcome the limitations of awareness-raising programmes and new water tariffs in incentivising households, the construction sector and municipalities to save water. The Bylaw requires the installation of individual water meters and water appliances (in new and upgraded buildings), and promotes more trees and less grass in gardens, water reuse from swimming pools, reduced water use for street cleaning, and alternative water resources for less quality needs (irrigation, cleaning, etc.).

The broad support for the overall initiative and for different parts of the process (e.g. water tariffs change) could also be a product of the new stakeholder fora on environmental topics, mostly created during the 1990s (e.g. Zaragoza Water Commission, Consejo Sectorial de la Agenda 21 Local). Interviewees highlighted that there was practically no resistance to the new water tariffs, although they brought with them price increases. Some interviewees emphasized the need for local actors to decide implementation decisions, rather than implementing results of an external study, as key to have support. Other institutional actors such as the Aragón Institute for Water also supported participatory processes in the design of water policy.

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Research and pilot initiatives were key for both technological innovations. Technologies addressing active leakage management were first tested in a European research project, for a 40,000 inhabitants neighbourhood, before it being successfully upscaled to around half the city. Ex-ante and ex-post research studies to set water tariffs were developed by the University of Zaragoza to figure out, among other aspects, water price elasticity and average basic minimum household demand. In 2009, Zaragoza's local actors took advantage of European and national funding for formalizing the long-term collaboration (but project based) between public bodies, the private sector, research institutions and civil society through an institutionalised fora labelled "ZINNAE". Its purpose is to further consolidate the city of Zaragoza as a setting for knowledge and demonstration for the efficient use of water, enabling local companies to be more innovative and ground proofed (using the city as a space for testing innovations) and, therefore, more competitive. ZINNAE pretends to attract innovative activity from Spain and worldwide; a new variable to be introduced with this initiative is energy efficiency linked to the urban water cycle. It is currently aiming to further the upgrading water appliances at homes and buildings and test ways to reduce Municipality water use (e.g. the "Zero park" project for designing and managing park). However current limitations viewed by interviewees remain the lack of proactive engagement by the private sector, possibly due to the fear held by private actors that participation in an industrial cluster such as ZINNAE can lead to a reduction of individual actors' power and leverage.

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5. Lessons learned from cross-comparative analysis

The three storylines provide a comprehensive overview of the complex dynamics involved in innovation uptake in urban water management. When examining the sequence of events in the uptake of innovation and the multitude of factors contributing to it, such dynamics may at first appear as unpredictable and critical factors difficult to identify. Two observations, common to the three case-studies, can nevertheless be made: First, all three cases are embedded in a broader transformation of societal demands and values regarding the urban landscape (i.e. towards urban regeneration and the improvement of quality of life) and environmental management (i.e. towards protection and restoration of ecological assets). Second, these long-term changes are punctuated by events that appear like "catalysers" of change. For example in Aarhus, the Green City initiative, plans to develop an old port area, the implementation of the EU Bathing Water Directive, as well as the electoral campaign all appear to represent key periods of change in the innovation uptake. Similarly, in Zaragoza, the water crisis of the early-mid 1990s, together with the implementation of Agenda 21 in the late 1990s, have played a role in accelerating innovation uptake. In the Emscher, defining elements are the end of the mining industry in the region and the implementation of the EU Water Framework Diective. Indeed, it appears that all three case-studies present periods of stagnation and rapid changes (or "windows of opportunities"). The analysis presented in this section focuses on governance factors influencing decisively on innovation uptake during these periods of rapid change. A comparison is made between (I) the case-studies and (II) with the broader literature on urban water management transformations. The central themes of the governance assessment framework are used for conceptual clarity and linked with the theoretical basis of this study. Where relevant, linkages between themes are also highlighted.

5.1 Levels and scales

Lowest possible level as the main level for innovation uptake in urban water management

The first observation is that the cases of innovation uptake occurred mainly at the lowest possible level regarding the nature of the problem faced. In the case of Aarhus and Zaragoza, the focus was on the municipal level as the issues were mainly of an urban nature. For example, Aarhus city was the focus of the project (although considered in its broader river basin). Also in Zaragoza most activities were managed at the municipal level, and the role of the river basin agency (the "Comisión Hidrográfica del Ebro") does not appear significant. In the case of the Lake Phoenix and ZE project, local councils were involved in the innovation uptake, but the involvement of the water management association "Emschergenossenschaft" working at the level of the Emscher basin was highly significant as the problem of flooding and urban pollution is basin-wide in this highly urbanised basin. The importance of the local level as focus of innovation uptake in urban water management is not surprising as most responsibilities and mandates are held at that level. An interesting finding in the case-studies presented here is the relative importance of some local autonomy in urban water management for promoting the innovation uptake in the reviewed case-

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studies. The general idea that local solutions are needed for local problems was a strong theme in all case-studies. As they were not dependent on regional or national funding or policy, and because the capacity to increase local water tariffs was an interal part of the mechanisms for innovation uptake, the Aarhus case-study was in that regard particularly significant (see illustration 1).

Illustration 1: Local autonomy in Aarhus

In Denmark, water supply and sanitation is mainly a local responsibility, decentralized to more than 2000 water utilities. Since 2007, five regional councils are responsible for the use and protection of water resources, including monitoring the water quality of recipient water bodies and authorizations to discharge wastewater, but according to those interviewed, neither the national authorities nor the regional council were much involved in the Aarhus innovation uptake.

Before 2007, a county administrative level ("Amt") played an important role in water management. That this level was abolished and replaced by the regional councils was considered as an enabling factor. According to some, the water and sanitation experts at the county and municipal level used to be *"at war"*, and development in the water sector got a lot easier with the new structure. In the early stages of the innovation uptake in Aarhus, one and the same person in the municipality was the responsible authority as well as in charge of operations, and this *"made everything easier"*.

A key aspect of the local autonomy was that the municipality also had the capacity to increase local water tariffs, under an overarching principle of user financing and cost-recovery in Denmark. Since it was part of a larger infrastructural development it was possible to finance the project this way, and according to some interviewees, the availability of local financing was actually a driver and never a barrier in the Aarhus case.

During the process, all major decisions were made by the city council, and there was a high level of interaction between decision-makers and technology developers at the local level, that many deemed critical to the success of the innovation uptake.

Higher levels have an important role in providing opportunities

The second observation on the dimension “levels and scales” is that higher levels influenced the dynamics of innovation uptake not so much by determing the agenda, as this was based on the initiative of the local actors, but rather by providing opportunities and/or legitimation. In fact, no national level “leadership” or “opposition” to individual local projects was observed. However, linkages were made and synergies sought with overarching policies. Local actors exploited opportunities offered by broader policy frameworks. For example, the uptake of the monitoring technologies in Aarhus was clearly embedded in the implementation of the EU Bathing Water Directive, while both the Lake Phoenix, the ZE project in the Emscher as well as the water tariff reforms in Zaragoza (regarding the application of cost-recovery) were embedded in the implementation of the WFD. In the Emscher, the ZE project and Lake Phoenix benefited from

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regional priorities for regenerating the Emscher valley (see illustration 2). Innovation uptake was also influenced by the existence of broader policy discourses. For example, the urban regeneration project, with the opening of Aarhus River and the monitoring technologies, was embedded in the national "State of Green" initiative. In Zaragoza, the implementation of a water demand approach was in direct opposition to the national water plan, aiming to transfer water from the north, in particular the Ebro basin in which Zaragoza lies, to the south of the country. Local actors not only exploited supra-local windows of opportunities with respect to the content, but also took advantage of funding streams set up at higher levels to support activities relevant for the innovation uptake at local level, including research projects funded by the EU Research Framework Programmes in Aarhus and Zaragoza, or the North-Rhine Westphalian programme "Ökologieprogramm Emscher-Lippe-Raum" funding the "New Horizons" concept in the ZE project.

Illustration 2: The role of the Master Plan and Future Convention in Emscher

Lake Phoenix and ZE are two local projects where EU framework and regional umbrella programs had a strong influence on both their design and implementation (including their financial viability). Looking at the influence of the EU frameworks we find that especially the WFD stimulated and (at times) legitimised the vast investments in the Emscher Conversion and rainwater decoupling projects. Even more important, however, are the regional umbrella projects "Masterplan Emscher Future" and the "Future Convention for Stormwater". In fact, certainly when focussing on the realisation of Lake Phoenix, it can be concluded that this project wouldn't have been possible without the regional Master Plan. Indeed, this plan, an informal map and vision for the development of the new Emscher valley with the objective to separate surface and wastewater and to renaturalise the river, did not only provide the legitimation of the creation of the lake (the lake is serving both as a flood retention basin and as one of the so-called ecological hotspots in the conversion project where wetlands and biotopes can develop without narrow spatial restrictions), but also provided support (the overall plan was developed by EG together with the cities, districts, and industries in the Ruhrgebiet) and of course funding. At least as important, however, is the fact that this umbrella programme (which also applies for ZE), and the prior successes within those programs, resulted in an atmosphere of trust, enthusiasm, and optimism that change and ambitious projects could succeed. It was especially this mood and atmosphere that proved essential for the successful implementation of both projects.

5.2 Actors and networks

A small group of entrepreneurs drive innovation uptake processes

The first observation is that innovation uptakes were often advanced by a small group of actors which took "entrepreneurial" forms of leadership. The role of key individuals in promoting innovation uptake is coherent with the literature on policy change and societal transformation (Huitema and Meijerink, 2009). These actors provided a "vision" behind which other actors aligned

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over time; they are more willing to take risks and are skilled in connecting policy proposals (solutions) to problems and participants, and thereby build political momentum (Brouwer, 2013). In Aarhus, the momentum was initiated by a mayor candidate in his bid to get re-elected. It was then taken forward by a small group of experts in the municipality, water utility and consulting firms (see illustration 3). In Zaragoza, key individuals in the municipality and an environmental/civil rights NGO built and maintained the momentum over a decade. They actively tested the implementability of innovation, and looked for opportunities to diffuse them. Also in the Emscher, interviewees often refered to key individuals, either mayors or experts in the Emschergenossenschaft.

Another observation on these “entrepreneurs” is that some were technical experts and bureaucrats (“policy entrepreneurs”) while others acted more as political figures, or as mediators (“political entrepreneurs”). It is important to note the complex role of politics, as a powerful source of change or inaction. In Zaragoza, the project was purposefully anchored in the municipality as an institution (aiming for the ownership of its civil servants), as well as particular political actors. This allowed for insuring against priority changes in elected individuals and political groups, while making use of the impetus that political actors could provide. Besides the crucial roles of individual policy or political entrepreneurs in highlighting and selling their ideas, this study also identified the vast importance of intermediary or brokering roles of actors. For example, various interviewees highlighted that the NGO ECODES could play a role as a trusted intermediary between the municipality and the public, and, as such, had a more effective awareness-raising role. In the Emscher Case Study, the Emschergenossenschaft was seen by other organisations as having a more neutral role.

Illustration 3: Policy entrepreneurs in Aarhus

In the Aarhus case, all stakeholders interviewed emphasized the importance of close personal relations and trust. *"Aarhus is not a very big city",* it was pointed out. Most of the individuals in the water sector know each other, through professional contacts and/other other social ties. There is also a certain level of mobility across organizations. Many of the persons central to the innovation uptake had actually been employed both by the municipality and one or more of the technology providers in previous stages of their career, so they had personal experience and detailed knowledge of the capacity and "inner life" of the partner organizations.

While the political vision to bring back life to the city centre by improving the water quality and restoring sections of Aarhus River was presented as the most important trigger, it seems clear that the innovation uptake as a process was driven for a large part by a core group of 4-6 technical experts in the municipality, Aarhus Water, DHI and Krüger. These people had been working with each other from various positions in the respective organizations before. They shared an enthusiasm for technology that could make Aarhus a show-case for future-oriented water management, and seized on the political vision as an opportunity, further linking it to other issues that could strengthen their cause.

The core group also knew each other well enough to throw around ideas and discuss them informally, alongside the formal processes required. This seems to have anchored the proposed

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innovation very well in the involved organizations, and to have created a sense of shared ownership from the very beginning. According to one of the key actors, this was actually "*decisive*" for the success of the innovation uptake. It is most often the people you know well you consult with, he said, and the way he saw it, smooth, informal communication was a characteristic of the process in the Aarhus case.

Finding synergies with other actors and building coalitions to create momentum

The second observation relating to the actors and network dimension is on the role of coalitions in influencing innovation uptake. Academic literature highlights the importance of not only individual entrepreneurs but also of building coalitions for promoting change. Such coalitions may be built on the multiple beneficiaries of an innovation. For example, a clear process of building a coalition for implementing Lake Phoenix took place in the Emscher, where as a result of the linking of multiple objectives (e.g. flood risk management, urban development, nature protection) multiple actors could expect benefits by joining the coalition. As the project developed, linking these different objectives and issues was key (see next section on goals and ambitions). An alternative strategy to coalition-building is to ensure that actors do not oppose the innovation and obstruct the process (as one interviewee put it: that they "don't annoy"). Attention must be given not only on the impact of the innovation itself, but also on the consequences of the innovation (design of its implementation). Whereas in Aarhus there was no real opposition to the plan of uncovering the river, opposition was related to the details of the impacts on traffic, businesses and real estate values.

In line with the views of various scholars (e.g. De Bruijn and Ten Heuvelhof, 2008; Brouwer, 2013) who suggest that the relational aspect greatly matters in policy change trajectories, interviewees in all three case-studies stressed the importance of close, long-established personal relations, and trust – even if the level of initial trust (that is, trust at the launch of the projects) varied substantially between the different actors and cases. For example, the collaboration between the experts in Aarhus appears to be particularly close, and innovation uptake depended on this trust. Despite being less strong, in Zaragoza, the collaboration between the municipality and the civil rights NGO was key to promote water saving technologies in the population (see illustration 4). It could be argued nevertheless that particularly strong collaboration could be, in the long term, a source of inaction as the involved actors are not open to newcomers and new ideas (Huitema and Meijerink 2009). In other cases, coalitions may be more loose, and depend more on the existence of informal communication channels or a structured collaborative process to enable speedy knowledge exchange and exchange of good will and 'favours'.

Illustration 4: Coalition-building between environmental NGOs and municipality in Zaragoza

Two individuals, one of ECODES and one of the Municipality, had a significant role in promoting water savings in Zaragoza. The two actors first aimed to raise citizen awareness on household water use and water saving options (via the WSCP). With this, they also aimed to build citizen support for

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a water demand approach, which would put pressure on politicians and strengthen political willingness to invest in water saving technologies and practices. Interviews with these actors suggest that strategies used were very varied. This included for example prioritising issues over time to focus first on key and high impact (e.g. domestic sector for water saving), and then on broader issues (e.g. municipality water use, etc.). Moving from facts to action through pilots was a key strategy to build some evidence, raise awareness, and sell the ideas in a concrete manner. It was important in that regard to have achievable and measurable targets with high symbolic value. For example the "100,000 commitments" or the "saving 1.000 million liters" were used. As one interviewee stated, they developed a "kind of epic, an initial challenge, a collective dream were citizens understand that every individual action has a meaning, a course and a direction". Targeting children and women as change agents, promoting change in social facilities (e.g. schools, hospitals), using multiple forms of language (based on logic, emotions, fears), were all instrumental in selling the benefits of water savings, and gaining additional supporters. Communication with actors less related with the topic was also pursued, not with the aim of gaining support, but with the aim of ensuring their acceptance and thus avoiding their opposition to the initiatives.

A differentiated use of public participation

The third observation is on the mixed use of broader engagement processes with society in the three case-studies. Although the academic literature often advocates for strong public participation, and all case-studies invested in the involvement of actors as well as the diffusion of information, the role of engagement processes in the case-studies presented here is not very clear. Whereas engagement helped create and sustain a common agenda between different actors in Zaragoza (illustration 5), in Aarhus and the Emscher the projects were more technocratically led and – without noticeable negative consequences – were characterised by making limited use of public engagement at project level, at least during the design phase. Public participation was rather used in an ex-post manner to overcome potential opposition to implementation, such as in the Emscher in order to increase acceptance of disruptions (e.g. traffic, dust). This could represent a failure to include potential dissenting voices. Interestingly, findings from Aarhus indicate that the success of the project is linked with the flexibility and space for testing ideas and innovations by technocrats, and thus possibly with the lack of interference that participative processes may create.

Illustration 5: Public participation in Zaragoza

In the 1980s and 1990s there was growing social dissent in Zaragoza and more widely in Spain with the way water was used and managed. The first platform for dialogues however does not seem to be associated with public institutions. In Zaragoza, two NGOs were particularly active: ECODES and *Fundación Nueva Cultura del Agua*. ECODES fostered dialogue fora such as the "*Iniciativa Social de Mediación para los conflictos del agua en Aragón – Social Iniative for water conflicts arbitration in Aragon*". Pedro Arojo from *Fundación Nueva Cultura del Agua* organised the "*Congreso Ibérico sobre Planificación y Gestión del Agua*" (academic congresses held in Zaragoza in 1998 and

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subsequently held every two years across Spain).

Zaragoza municipality started to foster dialogues via the *Consejo Sectorial de Medio Ambiente*, created on 1998 as part of the development of the local Agenda 21 and renamed on 2004 as *Consejo Sectorial de la Agenda 21 Local*. This promoted citizen participation in municipal management planning in the 1990s. It is a large body constituted of about one hundred representatives of different municipal departments, from citizen groups, business, non-profit organizations, farmers, neighbourhood associations, etc. It is a deliberative body providing advice on all municipal policies and by-laws around water supply and sanitation services. Several commissions are set up within the *Consejo* and one is devoted particularly to water, the *Comisión 21 del Ciclo Integral del Agua*. It appears from interviews that the Agenda 21 related public discussions helped to build broad public support for increasing levels of water savings, as well as for the water tariff reforms which were implemented with minimal discontent. In addition, several events accompanied the tariff review (e.g. lectures, dissemination of academic reports, presentations to citizens and councillors). Since the reform, the municipality has developed an "self-explaining water bill" which differentiates the different cost categories, in order to make the invoicing more transparent. Since it appears from interviews that household water bills in Zaragoza have increased since the reform, the Municipality sees this tool as very important to raise awareness and reduce opposition.

In parallel, Zaragoza has hosted the UN Water for Life Decade 2005 to 2015 and the International Exhibition *Water and Sustainable Development* in 2008, together with associated events (e.g. 200 lectures between June and September 2008, educational events). These initiatives helped to engage with the local population, raising awareness and support uptake of the municipality water reduction consumption programs. Other fora, but less prevalent in interviews and documents, are the Water Institute of Aragón set up in 2004, working on the design and implementation of water policy and investments in infrastructures. The Institute is guided by a Board, a Council and an assembly of water users (including the Municipality of Zaragoza).

Overall, citizen and academic movements and the creation of several venues of public participation across the 1990s and 2000s suggest that past fora were inadequate and may not have included all relevant actors in the decision-making process. Since then, there is no evidence that actors were excluded. However evidence from interviews do suggest that the WSCP and now ZINNAE lack adequate levels of engagement from private actors, and that the impact of these initiatives on household and business uptake of water efficient technologies would have been greater if private actors had been more pro-active.

5.3 Goals and ambition

Political support was key to success in all case studies

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In the three case studies analysed, political support provided key momentum for the projects. The clearest example of how political support can enable projects is in Aarhus, where a political candidate strongly promoted the idea to regenerate the harbour area. Although the innovation had already been discussed at the technical level beforehand, it was this capacity to gain broad attention for the topic, coupled with a window of opportunity (press coverage of water quality issues in harbour), which got the initiative started. The case of Zaragoza is interesting in that political support was only achieved during the course of the project, as a result of targeted communication both to the political level and to the broad public. This support was key for the later stages of the process, in which water saving initiatives were expanded in scope, as well as for initiatives such as the Zaragoza Expo, which showcased the city's initiatives. The original, local environmental and civil right agenda met a regional political agenda, as the topic of water saving gained prominence in debates of regional autonomy against the national level (water transfers to south Spain), which created regional support for the local initiative. In the case of Lake Phoenix, political support was a necessary condition, as the city of Dortmund was one of the key actors in the development of LP, while the city of Herten was key actor for ZE.

In line with the work of Mintrom (2000) who suggests that it is beneficial to adapt your language and highlight issues differently depending on the unique positions and preoccupations of the recipient, our study shows that creating support depended on "framing" the benefits of the innovation in a politically appealing way. In the case-studies presented here, political support was usually based on the idea of regenerating urban areas, and not so much on environmental considerations. Lake Phoenix in the Emscher valley and the Samstyringsprojekt in Aarhus both increase the attractiveness of neighbourhoods and their quality of life, causing huge "value creation" in adjacent real estate. The value of these initiatives for a city, in terms of city marketing or city branding, was important to create this political support – the Aarhus municipality was interested in showcasing the city as green and regenerated as part of the "Green City" initiative. In both Aarhus and Zaragoza there was an element of political competition between cities and regions that increased the political support. This does not imply that political support from higher administrative levels is a necessary condition for innovation uptake, but the case-studies clearly suggest that it is a very strong enabling factor. This is also backed by scientific literature, which stresses the importance of political drivers in enabling change in societal systems (Rouillard et al., 2012).

Issue linking as means to gain broad support and unlock resources

Issue linking is a strategy often observed amongst entrepreneurs in the literature (Brouwer, 2013), and was also observed in all analysed case studies. In Aarhus it was the link between water quality and quality of life improvements associated with using the river and harbour for nautical sports/swimming which was behind the project idea from the very start. In the case of Lake Phoenix, the possibility of linking the renaturation of the Emscher River with flood protection requirements and urban regeneration around a new lake was a strong rationale during scoping studies for the future of a brownfield area, and was key for its economic viability. Zeche Ewald also made use of existing planning instruments with reduction of costs for wastewater release and

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valorisation of cultural heritage (old buildings) – and again, the multiple purposes served by the approach were key to its being economically viable (see illustration 6). In Zaragoza, a case study in which the initiative 'snowballed' to grow and incorporate additional elements over time, the issue linking was permanent: actors continually made use of opportunities as they arised to incorporate new aspects to the initiative and to link them with other topics, such as city branding as a centre for water innovation.

Illustration 6: Issue linking in the Emscher

Zeche Ewald can be considered a multi purpose project per excellence. When looking at the general developent we find that the project's prime goal was economic development and the re-creation of jobs. Linked to this goal was the objective to transform the former mono-structural industrial site into a diversified business location by cultivating its cultural heritage (fully in line with 1989 International Architecture Exhibition that identified the cities and buildings of the Ruhrgebiet as "treasures and cathedrals of the area", i.e. as chances instead of burdens) and boosting green development, i.e. by investing in qualitative urban design and sustainable development. One of the elements of this attractive design and ecological intergration was the idea to structure and link the area by an attractive water course, realised under the name "Blue Ribbon".

In a later stage, this water course idea was linked to yet another multi-purpose program: "Future Convention for stormwater" (ZVR). The ZVR program aims at a 15% reduction of the amount of stormwater and clean water discharged in the sewer system by 2020 by disconnecting stormwater from the combined sewer system and relates, among others, to objectives of flood control, rainwater management, climate change adaptation, compliance with the WFD, urban development, improvements in biodiversity, and environmental education. To realise the coupling between this Blue Ribbon and ZVR, the latter project was succesfully framed as a "solution" to, among other things, the "problem" that the Blue Ribbon needed to be provided with freshwater. In practice, the linking of issues turned out succesful as the two projects were muturally reinforcing.

Searching for multiple benefits helped leverage and save money, and build supportive coalitions. However, agendas can meet, but specific objectives can diverge. In Lake Phoenix the City of Dortmund and the Emschergenossenschaft had a common interest in building the lake, but whereas the City was interested in maximising waterfront area and real-estate possibilities, the waterboard had somewhat opposing requirements related to lake size for flood protection; negotiations resolved the opposing interests (see illustration 7). An aspect specific to Zaragoza is that the objective of the initiative was not related to individual actors, but identified with the "common good". Actors worked hard on creating a "vision" for the population, in which the different actions made sense. It was decided that the communication campaign be delivered by the NGO and not by the municipality, as this helped to convey the message of an initiative beyond private and local government interests.

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Illustration 7: Seeking compromise in the Emscher

One of the key success factors for the realisation of Lake Phoenix was the successful linking of different actors, goals and ambitions. Nevertheless, and regardless of the positive connotation of collaboration in terms of cooperation and resolving problems collectively, it should be noted that even this process of building coalitions and linking of issues was (at times) accompanied by struggle, negotiation and finding compromises. Most eminent example in this respect is the compromise that had to be made regarding the actual size of the lake. Whereas the Entwicklungsgesellschaft wanted to downsize the size of the lake as to maximally exploit real estate opportunities (and financial gains), several other actors, including EG, pledged for a bigger size of the lake to ensure its ecological viability and to maximise its attractiveness and flood protection potential. Relational management, and especially the shared belief and wish to make a success out of this project made that eventually all actors involved were willing to find mutually acceptable compromises.

5.4 Strategies and instruments

Plans and regulations as beneficial framework conditions

Plans and memorandums of understanding were instrumental in the case studies to build an overarching supporting policy framework and political awareness. This was particularly the case in the Emscher region, with its larger scale planning initiatives (Emscher Master Plan, Future Convention for Stormwater), but also locally (municipal plans to gain collaboration from different departments). While in the case-studies examined regulations did not provide the key motivation for innovation uptake, they were usually brought in by actors following particular interests as additional supporting rationales for the innovation uptake. In Aarhus, the influencing regulation was the EU Bathing Water Directive (see illustration 8), whereas in the Emscher the WFD was an influential factor for innovation uptake. In Zaragoza, where there was no clear regulatory driver for the implementation of the innovation, the cost-recovery principle of the WFD was used as an additional argument for redesigning the city's water tariffs. More recently, the municipality set in place local regulations to further promote water savings, as a response to the failure to ensure such savings using solely financial and communicative instruments (see below).

Illustration 8: The influence of the Bathing Water Directive in Aarhus

In Aarhus, the warning system for bathing water quality was established because the standards of the EU Bathing Water Directive would permit one non-compliant event per year with a warning system in place; otherwise, a non-compliant event could be permitted only once every four years. The installation of the warning system was estimated to save 25 million EUR that would have been required for additional infrastructure to reduce the frequency of non-compliant events.

The warning system is a quite complex solution, integrating four different models:

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- A catchment rainfall-runoff model that estimates runoff to Lake Brabrand and the Aarhus River
- A sewer system model to estimate discharges to the river system and harbour, also simulates the transport of E. coli and Enterococci
- A hydraulic model estimating outflows from Lake Brabant and the Aarhus River, also simulating the fate and transport of E. coli and Enterococci
- A hydrodynamic model of the harbour, also simulating the fate and transport of *E. coli* and *Enterococci*

Viewed on its own, in terms of the bathing season and number of swimmers in Aarhus, some would question this investment. Relating it to plans for developing the old harbour area and achievements linked with the use of similar technology in Copenhagen was a favouring argument, but what seems to have made the difference was the adoption of the standards of the Bathing Water Directive and the estimated cost savings.

Economic instruments as important enablers, but not as necessary condition

The role of economic incentives presents a mixed track record in the analysed case studies. In Emscher (ZE) for example, various economic considerations were clearly at play in adopting decoupling, including the discharge fee on wastewater/ tax incentives (see illustration 9). In Zaragoza, municipality-organised market discounts for water-saving appliances seem to have contributed to their uptake by the broad public, as well as the reforms of the water tariff structure. However, the recent set up of municipal regulation to promote additional water savings amongst households and the municipality itself would suggest that tariffs have had a limited impact.

Rather than incentivising change, economic instruments were most often used to increase financing. In Aarhus, the municipality increased water rates to help fund the new projects, and research grants from the EU were sought to develop the innovation. Zaragoza made use of regional and European funds, but also increased local tariffs; and in Emscher regional and local funds were combined, and private financing was tapped. As mentioned above, issue-linking was relevant as a strategy for accessing funds for other issues, as well as accessing funds of existing programmes. However, issue-linking for funding purposes has its complications, if only because various sources of funds mean various different deadlines, which can complicate project delivery, to the point that a source of funding becomes a drawback. In Lake Phoenix, the consortium took great care of the deadlines and consequences on time of the various (potential) funding programs. One particular fund was not used in the end, because complying with its conditions of use would have slowed down the marketing of the real estates and hampered a wide variety of other possibilities.

Illustration 9: Combination of public and private financing in Emscher

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Both Lake Phoenix and the on–the-ground implementation of a subproject of the "Future Convention for sSormwater" programme at ZE are examples of projects with an interesting mix of public and private financing, both, among others, as a result of the linking of various goals. When looking at Lake Phoenix, we find that the public funding was realised through various actors and different domains (including EG for the water management goals, and the Ökologisches Progamm Emscher Lippe Raum by the federal state of NRW for the ecological objectives). Given that the project also involved the marketing of newly built real estate on the shore of the lake, extensive funding was also generated from the private market. Also looking at ZE we find an interesting mix between public and private financing. Apart from the establishing of the "project association Ewald", composed of the city of Herten and the RAG Montan Immobilien GmbH (the company developing former mining areas in the Ruhrgebiet), which successfully linked resources and expertise in the area, we find that the ZVR program could be realised by a combination of funding and a tax stimulus programme boosting private rainwater decoupling investments. In fact, although within the "Future Convention for Stormwater" house owners and industries are not legally forced to reduce the amount of rainwater discharge into the sewage system, they do, however, pay a wastewater discharge fee (based on the size of sealed and built-up area on their real estate/leased land). If they reduce this sealed area, the discharge fee decreases due to separated costs for sewage- and rainwater. Besides the public funding mechanisms, also this tax system proved an important financial motivation and success factor for the decoupling of rainwater.

Communication

Communication and dialogue processes were seen as key success factors by interviewees. They help build cultural and social capital and legitimacy, particularly in those cases where public or stakeholder opposition could have created significant resistance to innovation. They allow for actors knowing each other and for relationship building, which are key for aligning perspectives and identifying options for win-win solutions. In Zaragoza, the initial phases of the citiy's transformation were based on an extensive communication strategy (see illustration 10) which contributed to justifying increases in water tariffs and further investments over the years. Zaragoza actors used every chance to communicate the issue of water scarcity and the importance of water savings, even with topics which were not directly related, such as the restoration of Zaragoza River. In Aarhus, communication played less of a crucial role after the initial electoral process, possibly because the innovation is less controversial and built into a broader project for regenerating the river. However, the water utility used ex-post chances to communicate the innovations, for instance by organising guided tours and concerts in the newly built, not yet functional wastewater retention tanks.

Illustration 10: The Water Saving City Programme in Zaragoza

The first major initiative for encouraging water savings and the uptake of water saving technologies was the Water Saving City Programme. Phase I (1997-2000) of the project mainly consisted in an awareness-raising campaign targeted to households. Phase II (2000-2003) targeted other sectors,

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such as public buildings, parks and gardens, industries and the service sector. The initiative "*Zaragoza water saving city: 50 Good Practices*" was launched with the aim to create 50 management and use models which could be reference for every sector. Phase III (2004-2006) further broadened and disseminated the material developed in phase II (e.g. more than 10.000 pocket guides were distributed among the city's major water consuming sectors). Phase IV (2006-2008) promoted "*Zaragoza water saving city: 100,000 commitments*" which intended to sign more than 25.000 entities, institutions or citizens in adopting at least 4 certified actions on water use. It is reported that 26.000 citizens and 250 entities had been engaged with the commitments in 2006.

Key communicative instruments in the WSCP (taken from Kayaga et al., 2011)

Key partners	Main actions
Professionals involved in domestic water use	• Project objectives and strategies mailed to builders, property agencies, promoters, architects, etc. • Information sessions arranged for plumbers, distributors and manufacturers • Publicity materials distributed in retail outlets • Competitions organised to reward sales staff promoting water-saving devices • Development & distribution of a catalogue providing water-saving technology • Development & distribution of a catalogue of techniques for planning, design and maintenance of parks/gardens, and planning of water management
Large scale consumers	• Information sent on environmental & economic advantages of saving water • Information sessions arranged on efficient water management • Stickers provided for public washrooms, which identified water-saving equipment; showed users how to use them properly; and remind users on importance of water saving
School children and teachers	• Teaching materials were produced for teachers to work through with pupils: o Big Book of Water - with blank pages for pupils to fill in their ideas o Water Card – each pupil designed an image & slogan to persuade others of the need to preserve precious water o Water Savings Book – to keep a record of monthly progressive savings achieved o - Experiences Directory - a collection of classroom activities related to water
General Public	• Publicity campaign using TV stations, radios, newspapers, leaflets, posters, billboards, buses, urban installations. • Water help-line – a telephone service to inform the public about water-saving technology and where they could find the devices. • A web-page - to publicise the project on the internet • Water –saving products toolkit – a package including a flow regulator for taps, water-saving shower, water-saving cistern, plus information on their use, distributed free of charge to public personalities

5.5 Responsibilities and resources

Allocation of roles important for articulating actors' interests and relationship to project

It appears from all the case-studies that success was not only related to the innovation "fitting" several agendas, but also to the feeling of some form of ownership on the innovation uptake, where partners are able to influence its design and implementation. Lake Phoenix interviewees for example highlighted how all partners identified strongly with the project (to the fact that a number of different actors claimed the original idea had been theirs), which helped further implementation.

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All case studies analysed gave significant thought on how to structure partnerships and allocate roles, and interviewees often highlighted the importance of this point for success. In Emscher (LP), the implementation of the project was managed by an independent project manager, and within the entire project structure there was a clear division of tasks, responsibilities and expertise. This helped avoid conflict between stakeholders suspicious of more influential actors imposing their interests to the project. In Aarhus, roles were also established clearly, but using a 'partnering' form of contract which meant that subsequent role allocation was flexible. It allowed for technical project leadership to be transfered from Aarhus Water to DHI and back in the course of the project period in response to arising needs (see illustration 11). This was seen as very positive because it enabled common ownership of the project, and not simply a contractor/supplier kind of relationship. However, it also meant that tensions arose towards the end of the project in partnership, as attitudes of actors towards the project were in flux.

Illustration 11: Flexible task sharing between Aarhus municipality, Aarhus water, and consultants

In the Aarhus case, the municipality had a conscious strategy to nurture relations to DHI and Krüger as long-term development partners. The two companies are in many ways competitors, and although they collaborate in other ways, they did not have a tradition for this in projects with Aarhus municipality.

For the project to develop the real-time monitoring and warning system for bathing water quality, however, the municipality specifically requested that the two should make a joint proposal. Once the bid to tender was accepted, the collaboration was organized as a partnering contract between Krüger, DHI and Aarhus Water, where all shared responsibility for the process and the final results. This was a way to ensure participation and joint ownership, and in line with the concept of Total Water Management, aiming to combine capacity building in planning and preparing projects with the implementation of the most urgent needed investments in the water company**.**

The form of contract allowed a level of flexibility that most interviewees deemed important, since, as one put it: *"We knew where we wanted to go, but not exactly how to get there."* Individual roles were clear, but the overall work description and process between the partners were quite open for adjustments and changes. While the financial responsibility rested with Krüger, the technical management of the project was transferred from Aarhus Water to DHI and back to Aarhus Water, due to capacity changes. It was also possible to bring in resources from other projects, i.e. PREPARED. This was mostly seen as a strength, making it easier to adapt to changing circumstances and meet technological challenges. On the other hand, there were challenges related to different priorities. Some also felt the role of Aarhus Water changed slightly during the process, from being more of a partner to being more of a *"customer".*

Building the knowledge base

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Building knowledge on the development of the innovation and its implementation is recommended in the literature on socio-technological systems transformation (Marlow et al., 2013). All case-studies saw significant investment in innovation development, usually carrying out feasibility studies. In Aarhus and Zaragoza, many EU-funded research projects (e.g. PREPARED, SWI, SWITCH) and networks (e.g. platform on technology WssTP, ZINNAE) contributed to the innovation uptake. Zaragoza welcomed a systematic use of knowledge production activities and use of pilot sites to test and showcase the technologies (see illustration 12). However, in-depth and extensive assessments, especially on the socio-economic impacts of the innovation, were not carried out so systematically in other case-studies. For example, in Aarhus, no stakeholder analysis and no cost-benefit analysis were carried out, perhaps because innovation did not involve a radical change and the initial feasibility study showed its cost reduction potential compared to alternatives.

Illustration 12: From bottom-up pilots to a business platform in Zaragoza

The Water Saving City Programme (WSCP) was strongly based on the view that water savings had to be promoted with evidence, and by providing concrete examples. The WSCP included many pilots on sites with a high symbolic value and whose related actors showed enthusiasm and commitment (e.g. large water users with social objective such as schools or hospitals).

A number of technical assessments were commissioned by the Municipality to help with the review of water tariffs. This was externalised to the University of Zaragoza, who had been previously engaged in promoting the water saving agenda, and was locally seen as a trusted intermediary between the muncipality and local citizens. Ex-ante and ex-post research studies to set water tariffs were developed by the University of Zaragoza to figure out e.g. water price elasticity and average basic minimum household demand (i.e. common good). These studies influenced the design of new water tariffs.

Technologies associated with Active Leakage Management through District Metered Areas were first tested through the SWITCH project (2006-2011). In a first step, a test area was set up in the north of the city on the so called *Actur* neighborhood (40,000 inhabitants). Pressure management actions with a cost-benefit analysis were used to set optimal leakage. The experience was a success and was scaled up in 2010 to around half of the city. However, for some interviewees, the SWITCH project also shows the limitations of research projects for supporting the municipality, as they did not take into account all the decision-making criteria considered by decision-makers (e.g. water re-use, public participation) or all the existing regulatory constraints (e.g. for water re-use).

The long-term collaboration between local stakeholders led to the creation, in 2010, of ZINNAE, an institutionalised fora of firms, research institutions and local and regional administrations. Its purpose is to consolidate the city of Zaragoza as a setting for knowledge, demonstration and experimentation for the efficient use of water, enabling local companies to be more innovative and, therefore, more competitive. ZINNAE was created to facilitate the testing of innovations, and is currently aiming to further the upgrading of water appliances in homes and buildings and test ways to reduce Municipality water use (e.g. the “Zero park” project for designing and managing park).

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ZINNAE is based on the Triple Helix innovation model: *the potential for innovation and economic development in a Knowledge Society lies in a more prominent role for the university and in the hybridisation of elements from university, industry and government to generate new institutional and social formats for the production, transfer and application of knowledge.* ZINNAE pretends to attract innovative activity from Spain and worldwide; a new variable to be introduced with this initiative is energy efficiency linked to the urban cycle of water.

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6. Conclusion and recommendations

The research presented in this report is part of on-going academic work aiming to understand transformations in urban water management towards more sustainable systems, and policy efforts aiming to increase these systems' sustainability as well as the competitiveness of sustainable technology providers. The research developed an assessment framework to systematically analyse governance factors influencing innovation uptake in urban water management. It applies the framework in three case-studies of successful uptake, examining different scales and types of innovations used to tackle challenges in European urban water management. Different processes of innovation uptake were examined, involving either few actors but technologically complex projects (e.g. real-time monitoring control; district metered areas; active leakage management); or requiring close collaboration between multiple actors for ambitious large-scale projects (e.g. lake creation; disconnection of stormwater and wastewater networks); or (relatively) simple technologies requiring large societal uptake (e.g. water saving devices).

The results of this study show that the process of innovation uptake is a complex process where multiple levels and actors influence dynamics. Hence, observed behaviours may at first look unpredictable and critical factors difficult to identify. To overcome this difficulty this research mapped the observed phenomena and processes against a governance assessment framework, which helped to examine in detail historical dynamics. This study has produced a number of key observations about innovation uptake. Firstly, innovations in the urban water sector often have the potential to affect a huge amount of actors not related to urban water management. This can generate strong arguments and open up opportunities for developing the innovation, as it often means that additional drivers can be harnessed. Fundamental drivers in the analysed innovations were related to neighbourhood valuation processes, inhabitants' quality of life, city branding, etc. On the other hand, this constellation of actors can imply significant challenges, related to the recognition that innovation uptake is not only a technical process but also a political one, requiring negotiation and alliance building, thorough communication processes, and a commitment to flexibility in both design and implementation phases.

Second, it is clear that the local level is the critical level for innovation uptake in urban water management, although higher levels do appear influential, sometimes by justifying and reinforcing the case for innovation uptake, or by providing opportunities for funding. All innovations analysed were initiated at the lowest possible level (local and regional). Local autonomy appears thus critical, as it allows local actors to respond more pertinently to local problems, and drive implementation more effectively.

Thirdly, findings suggest that (small groups of) entrepreneurs usually drive the innovation uptake, often providing a clear "vision" of the improvement and capable of "selling" their idea to other actors. These entrepreneurs rely on close collaboration to take risks and promote change locally. Broader coalitions may be built, by finding synergies with other beneficiaries of the innovation; such coalition-building may be further broadened through participative and engagement processes,

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especially when the innovation is deemed controversial or may result in controversial impacts, in order to create societal support and legitimise the innovation uptake politically.

Fourth, political support was in all cases key to innovation uptake, as it set the ambition and target of the transformative process. Discursive strategies used by "entrepreneurs" are multiple: they may present ("frame) the benefits of an innovation in such a way that those benefits adhere to central societal values or political priorities; or they may highlight the multiple benefits of an innovation in order to attract additional supports into supporting innovation uptake. Entrepreneurial strategies may also involve some degree of adjustment in the design or implementation of the innovation, for instance when problems and/or solutions are linked ("issue linking"), and it was found that such compromise-seeking attitude was also important to gain additional support over time.

Fifth, we have seen that communicative instruments such as awareness-raising programmes and creating dialogues were important to support the discursive strategies mentioned above. Regulative and economic instruments were found to frame the innovation uptake, potentially creating barriers, but also providing opportunities to initiate and secure change. In that sense, they open specific "pathways" which influence the innovation's particular design and implementation. As mentioned above, the initiative remains largely local, and it is local actors that will drive innovation uptake, while taking into account the broader policy framework or crafting new regulations and/or funding streams trying to meet local priorities.

Sixth, and finally, interviewees highlighted that the structuring of the partnerships and the design of the roles of actors were crucial in the successful implementation of the innovation, and were given considerable evaluation before implementation. The allocation of roles between partners varied between case-studies, between flexible partnering to clear allocation of tasks. These arrangements were often key to generating common ownership between the different partners involved. Clearly, the approach may differ with the type of innovation uptake and the local governance context, considering such varied factors as the involved risks, the number of (potential) partners, or the existing level of trust.

While the research has provided a number of insights in the governance factors affecting innovation uptake, it has faced a number of methodological challenges. First, despite the specification of the assessment framework, different interpretations of the five dimensions remained possible, and had to be managed throughout the analytical process. It resulted in some difficulties in creating clear and non-overlapping themes during the inductive analysis and matching them with the initial framework. The second challenge is the static nature of the framework. On the one hand, this is a strength as the framework is focused on "diagnosing" in detail the range of factors that may affect innovation uptake and allows the generated to present objectively causal links. On the other hand, however, it requires an additional level of attention to systematically consider the influence of a dynamic context, certainly when used in historical perspective as is done in this research. Third, at times it was difficult to reach out to stakeholders, therefore limiting the number of interviews and perspectives included for each case-study. Nevertheless, all cases managed to cover a diverse range of different actor perspectives on each individual innovation

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uptake process. Fourth, the study focused exclusively on successful examples of innovation uptake and on enabling factors. It is to be hoped that this work will stimulate further work in this field where the DROP framework is used to compare success stories with cases of non-successful innovation uptake, in order to provide additional insights into the barriers to innovation uptake.

To conclude, a number of recommendations were developed to inspire actors with the potential to be "policy entrepreneurs" in promoting innovation uptake in urban water management. These recommendations are aimed at three key target audiences: innovators themselves, regional water managers, and national and European policy-makers. They are outlined below.

To innovators

- **Study the local actor agendas**: identify those who would really want the implementation to occur, as well as those that could derive indirect benefits from the innovation, and use their impetus/lobbying capacity. To this end (informal) networking efforts may be beneficial. **Engaging with the political level** can be a powerful support for innovation uptake.

- Explore the potential of the innovation to serve other, non-related interests, and **how it can create co-benefits**. Linking with other societal challenges, dominating values, incentives, policy discourses is useful to broaden access to funding, to increase the number of actors supporting the innovation (for instance beyond municipalities, e.g. different NGOs, civil society organisations, etc.), or to reduce the number of actors actively or passively opposed to the uptake.

- Explore in particular the links of the innovation with the **city or regional branding and marketing**, and with other aspects beyond the water/environmental domain such as increasing quality of life (clean water bodies, new green areas), recreational value (promenades, water sports in lakes) or local real estate value. Incorporating these improvements can be key for improving affordability and thus feasibility of options.

- **Exploit "windows of opportunities".** This may relate to the introduction of new regulations, sudden social or political game-changers, extreme physical e.g. droughtevents (droughts, floods), etc. Keep eyes open for new opportunities to link the innovation with "trendy" (new and upcoming) topics.

- **Innovation developers should emphasise relational management** from the early phases of project design. Relational managment should be seen as an investment that enables *inter alia* alignment of perspectives and priorities, and thus the finding of common agendas. Benefits of intensive dialogue/communication processes include knowledge of partners and their traits and interests, and possibly creation of personal relationships and trust.

- **Communication is essential**: look out for ways to highlight the benefits of the innovation in ways that speak to potential buyers. Cost reduction, and a clear **business and economic case**, are unsurprisingly powerful arguments for innovation uptake. However other matters

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can be play an important, in particular **"common-good" dimensions** and highlighting broader societal, environmental and moral justifications – in particular for innovations in which the broad public plays a key role in uptake.

- Consider the challenges faced by the potential buyers, and **present the innovation as tackling that particular problem**. This may be an answer to a particular regulatory requirement, societal demand, organisational targets, etc. It is important to be flexible over time, and to look for opportunities to link with other issues and new objectives, and broaden the scope of the innovation.

- **Give intense scrutiny to management and partnership structures to be put in place**, in view of how they balance the representation of different actors' interests, and if they create common ownership of the project. Give thought to the roles of different actors involved in implementation, and assess if different role distribution (including changes over time) may further the success of innovation.

- **Do not wait to reach out to potentially interested buyers:** success is for those who think of design the innovation for the needs of potential buyers, find early adopters, and sell their products through concrete experience and pilots. Explore interests and constraints of local actors by examining municipal policies, business strategies, and organisational objectives. Actively exploit different arenas and modes of communication, from open marketing and campaigns to informal exchanges.

- **Maintain a collaborative spirit** by fully considering options of other organisations, maintaining flexibility in design and implementation over time, and searching for compromises.

To water managers

Many recommendations relevant to innovators are also relevant to water managers. In addition:

- **Build a core group of persons dedicated to implement the technology**. They should be able to act as promoters and "entrepreneurs" and operate across sectoral and organisational boundaries over several years.

- **Focus on the long-term development of partnerships between local actors**, and on building social capital and trust**.** Social and geographical proximity, actor knowledge and strong local collaboration (through e.g. employee mobility) are factors that strongly support implementation processes and help discover new possibilities, such as win-win options.

- **Establish a willingness to take risks** by building long-term partnerships and promoting an open mindset amongst collaborators. This may require "phasing in" the innovation uptake,

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for example through a period of testing and experimenting with new ideas – and with potentially limited interference from external actors – followed by increased competition and participation of other actors.

- **Build political support**, either individually, or through raising public awareness and broader support for the type of transformations related to the innovation uptake.
- **Help ensure stable framework conditions over the long-term.** Continuity of policy frameworks/initiatives is important for the planning security of actors.
- For innovations in which the broad public plays a key role in their uptake, the communication of the initiative should take into consideration **how to increase the credibility of the initiative**. Common good arguments should not be compromised by the perception (justified or not) of them being a fig leaf for private interests.
- **A clear allocation of roles is an advantage, but a collaborative spirit and flexibility in role allocation over time is even more important** in order to adapt to changing needs. Mobility across sectors and organisations can be of great benefit to build collective ownership, trust, and capacity for successful implementation.
- **Building knowledge and capacity is – not surprisingly – important**. For more controversial technologies/issues, building the scientific evidence and testing in "pilots" to reach out to sceptical/wider audience is crucial, whereas for less controversial ones, demonstration sites and building strong partnerships should be the focus.

To national and European policy-makers

- **Maintain a local focus in urban water management,** and reinforce local autonomy, in terms of capacities to raise financial resources or establish local regulations.
- **Ensure careful attention to the design of regulations and economic instruments**, and how they may impact the development and uptake of innovations locally. National and European rules and financing streams have a clear influence on the choice and design of innovations locally, and they can direct priorities for investments and frame opportunities for cost savings.
- **Promote international exchange of experience and knowledge**. International opportunities can be a source of motivation for local actors, and promote change locally.
- **Maintain funding opportunities from higher levels for testing innovations and new collaborative approaches**. They can help local "entrepreneurs" to overcome local risk aversion by political actors, and other local barriers and constraints.

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7. References

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