DESSIN

DEMONSTRATE ECOSYSTEM SERVICES ENABLING INNOVATION IN THE WATER SECTOR

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D12.1: Governance regime factors conducive to innovation uptake APPENDICES

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

SUMMARY

This document reports the appendices to D12.1 on "governance factors conducive to innovation uptake" carried within the context of the FP7 DESSIN project.

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12.1	WP12
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Table of contents

Appendix 1 Interview questions

0 – Introduction (including introduction to the project, 5 minutes)
For my understanding, can you briefly elaborate on your position and your work?
1 – History (20 minutes)
1.1 Looking at the start-up phase of the project:
a) What problem did the project aim to address?
b) Did the innovation uptake result from a conscious, long-term strategy, or did it come as a more immediate response to a problem?
c) Who presented the first ideas? Why at that time?
d) What were the main arguments for setting up the project? Who voiced the respective arguments?
e) In my understanding, this project aimed to promote this innovation. Were alternative technological innovations considered? Why was this one selected?
1.2 Looking at the evolution of the project:
a) Was the initial launch of ideas successful? Why (not)?
b) Did the project goals undergo significant modifications over time? Why (not)?
c) How would you describe the current/final project goals: as the best possible solution or merely as a satisfactory one? Why?
d) What is the current status of the project?
e) What are the lasting/on-going impacts of the project?
f) In your view, how successful has the innovation uptake in connection with the project been?
2 – Actors (i.e. individuals, organizations) involved (10 minutes)
2.1 What were your personal/organization's role in the coming about of this project?
a) What was your personal/organization's key motivation to participate?
b) How did your personal/organization role develop over time? Why?
2.2 Based on prior study and interviews I understand that the following actors [list the identified actors] were all involved.
a) Do you concur with this list, or do I miss one or more actors?
2.3 To what extent, if at all, did the composition of involved actors change over time?
a) Why, and to what effect?
b) Are/were all relevant actors involved in the coming about of this project?
c) If not, why weren't they involved (unwilling; excluded?)
2.4 How would you describe the working relationship between actors involved (e.g. a long history of working together; clear long-term opposition)?
a) From a process point of view, to what extent did they work well together? Why (e.g. similar/opposing views on appropriate approach, coherent/incoherent mandates, availability/lack of resources, informal interaction (based on previous contact)?
b) Have there been any significant changes in the form/level of cooperation over time? If so, why?
c) Was there a strong influence from one or more specific individual actor(s) for the innovation uptake? If yes, in what role and to what effect?
d) Were there individuals/organizations with a mediating role?
2.5 Specifically, regarding public organisations, did the distribution of their official mandates (i.e. responsibilities as set by statutes and regulations) affect the innovation uptake in any particular way?
2.6 In your view, what were for the innovation uptake the most important arenas and forms of dialogue between the core group and, for instance, experts, the general public, and fellow stakeholders (e.g. specific consultation events, committees, conferences)?

a) Why?
b) Which ones were the least successful? Why?
3 – Strategy and knowledge base (10 minutes)
3.1 How, if at all, did new concepts, values or trends (e.g. in urban planning, natural resource management, local, national or regional development) play a role?
a) If so, please elaborate on which and how they came to influence the innovation uptake?
3.2 Was there sufficient expertise in the group of involved actors?
a) If not, how was this overcome (capacity-building, etc.)?
b) Were specific types of evaluations done (e.g. stakeholder analysis, cost-benefit, non-monetary evaluations, environmental assessments)? To what extent did they have an impact?
c) Were pilot studies conducted at a smaller scale before full-blown implementation? To what extent did they have an impact?
4 – Responsibilities and instruments (10 minutes)
4.1 What financial mechanisms [e.g. grant/subsidy for funding the project, a water pricing policy for incentivising innovation uptake] were made available to facilitate the project?
a) Who participated financially/who were important investors?
b) In what ways were these mechanisms successful in supporting innovation uptake?
c) Were they deliberately adjusted during the project as a way of facilitating the innovation uptake? If yes, could you elaborate how this was made possible?
4.2 Were there any [local, national, EU] regulations with a significant impact [negative or positive] on the development and/or successful completion of the project?
a) Were one or more regulations deliberately adjusted as a way of facilitating the project? If yes, how and to what effect?
4.3 Were there any specific awareness-raising programmes with a significant impact on the successful completion of the project?
4.4 Were there conflicts between discussed regulations, financial mechanisms and/or awareness-raising programmes? [e.g. an awareness-raising programme may encourage the uptake of a technology, but this technology is heavily taxed]
a) What about synergies? Were they sought/intentional?
5 – Finishing the interview (5 minutes)
5.1 To conclude, what is the most important lesson you've learned on the success and fail factors that relate to the realisation of this project?
Thank you very much for your answers, they are very valuable. Unless you feel that we missed something out, or that you want to add any additional thoughts, we have come to the end of this interview. Thank you.

Appendix 2 Interview guide (Ebro example)

1. Overview

The guide for the analysis of governance factors influencing innovation uptake has shown that several initiatives over the last 15-20 years have contributed to the uptake of water saving technologies by water users, including flow regulators and water saving appliances. The foreseen interviews are intended to complement the information collected through the analysis of existing documentary evidence, focusing in particular on the Water Saving City Programme and the new cluster ZINNAE:

- **Zaragoza Water-Saving City Programme (1997-2008),** that aimed to reduce water demand and establishing what it was so called a "*water saving culture*" through education programs which stressed the need to change consumers habits and replacing water devices for more efficient and water saving ones.
- **ZINNAE** (2009-on-going), an open European platform for EU excellence in water efficiency for urban water management. ZINNAE is an Innovative Business Group driven by the Saragossa Municipality and ECODES and including companies of different nature (water saving technology, water measuring and meter reading technology, companies, the main research and training centres in the city, as well as all the local public administrations.

Of general interest is also the various management plans and regulations of the Municipal Council**,** including the Municipal Strategic Plan (1996-2010), Agenda 21 (2000), the "Plan for improving the water supply quality and management" (2002-2009), the "Infrastructure Improvement Plan" (2004-2009), and the "Plan to Improve the Water Cycle Management" (2012-2019). They aim to reduce water demand through consumer awareness campaigns, applying economic policy instruments, and reducing leakage on the distribution network. The latest developments include a Water Bylaw (2011) which aims to achieve efficient water use in all city activities. The Municipal Activities were also supported by a range of stakeholder engagement initiatives of which the Water Saving City Programme was part of, but other fora existed including the Zaragoza Water Commission.

The interviews primarily aim to gain an in-depth understanding on the drivers behind the Water Saving City Programme and the ZINNAE cluster: who was involved and why, what were the challenges, how/if they were overcome, and what lessons could be drawn in terms of best practice and hindering factors on governance mechanisms and financing options for promoting the uptake of water saving technologies. Some key knowledge gaps, collected via Step 2 of the Analytical Framework, are highlighted in Annex 1.

The outcomes of the interviews should be provided no later than **October 31, 2014**.

2. Selection of interviewees

The selection and number of interviewees should depend on the project/initiative explored and the current gaps in understanding as highlighted by the first completion of the governance analytical framework (step 2).

The total of interviews should depend on the level of data needed to reach a good understanding of the initiatives, with a minimum target of 10-15 (telephone or face-to-face) interviews in total.

Regarding the Water Saving City Programme

The Water Saving City Programme has been the most analysed initiative, and several sources of (documentary) information/evidence are available. The interviews should try to fill in the gaps identified so far in the step 2 of the analytical framework. The interview template draws on those to ask specific questions to help fill those gaps.

Specific challenges and opportunities with running interviews are:

- Its long history (10 years running) will mean than many people will have been involved, and many factors may have influenced its development. On the other hand, the programme will have received intense scrutiny and improvement over its lifetime, providing an abundant source of lessons learned.
- Its not-so-recent past (completed 6 years ago) means many may have moved on, may not be available or may not remember the details. On the other hand, some may have a more distant view and may be able to reflect more accurately on its successes and limitations.

In terms of who to interview, the campaign should at least interview one member of civil society, one from the Zaragoza council and one from the academic sector University of Zaragoza). Preliminary suggestions on where to look for relevant people would be:

- Start with a contact point at ECODES, and perhaps also the Fundación Ecología y Desarrollo (e.g. Pedro Arrojo Agudo or Martínez Gil).
- The Water Institute of Aragón of the Government of Aragón may also be a good source of information (Raphael Izquierdo from this Institute has written an article about water governance in Aragón).
- The FP6 SWITCH project has produced a case-study factsheet on Zaragoza. The author could be contacted to check where he got his information: Ralph Philip, ICLEI European Secretariat, Leopoldring 3, 79098 Freiburg, Germany, www.iclei-europe.org, Phone: +49-761/368 92-0, Email: water@iclei.org.
- The SWITCH project provides the following interviewees for an assessment of their pilot project in Zaragoza:

Regarding ZINNAE

ZINNAE is a relatively recent initiative and has not been examined in previous research. The interviews should be more systematic and comprehensive than for the Water Saving City Programme.

Specific challenges and opportunities with running interviews are:

- Its medium-length history (5 years running) will mean than many people will probably have been involved (many projects visible on the web-site), and many factors may have influenced its development.
- Its recent past means many may people may still be available for interview and may have fresh memories, although they may not benefit from a more critical reflection.

In terms of who to interview, preliminary suggestions would be:

- To contact the Executive secretary to ask who best to interview: Cámara de Comercio e Industria de Zaragoza, Paseo Isabel la Católica, 2, 50.009 Zaragoza. Tfn: +34 976 306 161 ext. 237. info@zinnae.org
- The Cluster includes the Municipality, ECODES (non-for-profit), private companies, academics => interview campaign could focus on the different partners to evaluate their perception and experience of the cluster.

3. CONTACT DETAILS OF INTERVIEWEES

NOTE: Include as many contacts as necessary

#	Name	Institution/ department	Reasons for interviewing	Email and/or phone number	Date of interview	Willing to be listed by name as an interviewee? (Y/N)
1						
2						
...						

4. INTERVIEW GUIDE

NOTE: The questions below should serve as a general guideline for conducting the interviews, with all three main topic areas being addressed. However, the exact questions and shape of the interview should be flexible to account for:

1. Interviewees not wishing to restate/re-answer topics they've already addressed in the workshop
2. Additional related topics being raised by the interviewees which are seen as being particularly relevant

Introduction to interview

A brief introduction (maximum 2 minutes) should be provided about the DESSIN project, its aims, and how these interviews will help develop recommendations on ways for promoting innovative solutions for scarcity.

Thank you for your time today and agreeing to participate in this interview; it should not take longer than an hour. I'm going to start by providing a brief introduction to the project within which the interview is taking place, and then move onto questions about the Water Saving City Programme and/or ZINNAE. If you have any questions throughout the interview, please don't hesitate to ask.

Before we get started, *I would like to mention that your comments will remain anonymous within our reporting. However, would it be alright to list your name in a list which provides an overview of all interviewees*?

This interview takes place within the context of an EU-funded research project called 'DESSIN'. The project has started at the beginning of the year. It aims to demonstrate and promote innovative solutions on water quality issues and water scarcity. Part of this project is interested to identify modes of governance, financing and payment for promoting the uptake of innovative solutions for water saving. Zaragoza, with its long experience in promoting water saving, is one of three case-studies (the others are the Emscher in Western Germany and Aarhus in Denmark).

In this context, we are particularly interested to learn about the history (and current undertakings) of the Water Saving City Programme and/or ZINNAE. We hope your responses will help to give us a better idea of the drivers behind this initiative/these activities, who was involved and why, what were the challenges, how/if they were overcome, and what lessons could be drawn from the experience in Zaragoza.

Interview schedule

The guide tries to follow an intuitive approach to exploring an historical process. That means the first questions focus on early phases of the project and the general process up to today. Then, more specific questions are asked about different dimensions of the project. This should preferably be followed to allow the interview a soft start on the interview, examining particular issues in more depth later on. But each interview is different, and it is up to the interviewer to decide if it is preferable to move away from this approach. Also, interviews run at different pace depending on the interviewee: please keep in mind the time, and make sure you finish within the agreed timeline.

Some generic terms are used because we are using the same interview schedule for all three mature case-studies and all interviewees. Thus, for the Ebro:

- "Project" is used to refer generically to the Water Saving City Programme and/or ZINNAE.
- "Innovation" is used, depending on the question, to refer to water saving in general and water saving technologies by water users.

Most verbs are currently in the past tense. This may be adapted depending on the project studied (e.g. whether the project is already completed or is on-going).

Additional questions specific to the project/innovation may be added where needed.

See interview questions in Appendix 1.

TEMPLATE FOR REPORTING ON INTERVIEW OUTCOMES

NOTE: Main findings, noteworthy quotations and relevant points addressing each of the three main topic areas (as well as additional comments) should be summarized in English, according to the structure provided below. The results of interviews for each initiative should be summarized in *separate* documents.

NOTE: Depending on the comments of the interviewee, you can either provide direct quotations or summarize the main points made regarding each topic. For each item listed, please refer to the interviewee who made the statement/point (use the interviewee number from the "Contact details of interviewees" table). The sub-questions in the Interview Guide should be used to orient the presentation of results under each of the following headings.

1 – Introduction	
1.1 Position and your work of interviewee	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
1.2 The start-up phase of the project: problems, first ideas, people involved, main arguments, alternative technologies considered	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
1.3 Evolution of the project: barriers, modifications, final/current status, lasting impacts, success for innovation uptake	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
2 – Actors (i.e. individuals, organizations) involved	
2.1 Personal and your organization's role: motivations and over time	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
2.2 List of relevant actors:	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
2.3 Evolution of composition: why, to what effect, missing actors (unwilling; excluded)	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
2.4 Working relationship: history, quality of cooperation and why, evolution over time, influence of specific actors, mediation	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
2.5 Impact of mandates of public organisations	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
2.6 Forms of dialogue: list, most/least important and why	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
3 – Strategy and the knowledge base	
3.1 Long-term strategy or immediate response to a problem, drivers, barriers encountered, solutions found	
e.g.	"…." (Interviewee 1)

	…… (Interviewee 2)
	"….." (Interviewee 3)
3.2 New concepts, values or trends: role, origin, impact on innovation uptake	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
3.3 Technical know-how: initial capacities, capacity-building, types of evaluations/pilot studies done and their impact	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
4 – Responsibilities and instruments	
4.1 Financial mechanisms: which, who (investors), success in supporting innovation uptake, barriers/constraints and how to overcome them	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
4.2 Regulations: impact, adjustments	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
4.3 Awareness-raising programmes and their impact	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
4.4 Conflicts and synergies between regulations, economic and/or awareness-raising programmes	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
5 – Finishing the interview	
5.1 Most important lesson on success and fail factors	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
5.2 Additional thoughts	
e.g.	"…." (Interviewee 1)
	…… (Interviewee 2)
	"….." (Interviewee 3)
6 – Supplementary information: Key knowledge gaps from the documentary analysis	
The interviews build on the knowledge already collected through documentary analysis. Key current knowledge gaps include:	
*6.1 Questions related to the **History** section of the interview schedule*	
a)	Who promoted the supply side approach **locally**? Who promoted the demand-side approach **locally**?
*6.2 Questions related to the **Actor** section of the interview schedule*	
a)	What was the main space for dialogue on urban water management before 1990s? Was this a problem?
b)	Why was the Zaragoza Water Commission set up? What has been and is its current role regarding promoting water savings in Zaragoza? Is it successful and why?
c)	Why was the Aragón Water Institute set up? Did the Water Institute of Aragón have an influence on the Water Saving City Programme or on the actions promoted by the Water Saving City Programme (e.g. through rules on

	subsidies for investment in infrastructure)?
d)	Did the Spanish Government Office for Infrastructures have an influence on the Water Saving City Programme or on the actions promoted by the Water Saving City Programme (e.g. through rules on subsidies for investment in infrastructure)?
e)	Which organisation was responsible for making decisions on the Water Saving City Programme? What was the relative role of the Municipality and ECODES in managing and influencing the project? Why and how was the responsible organisation successful in mediating the Water Saving City Programme for four consecutive phases? Is ZINNAE a follow up to the Zaragoza Water Saving City Programme?
f)	What were the main points of agreement and disagreement between involved actors (e.g. between the Municipality, ECODES, citizen groups, the Ebro River Basin Commission, etc)? What is the level of disagreement today? Does the level of trust and willingness to work together remain high?
g)	How could other actors (than the Municipality and ECODES) influence the Water Saving City Programme, especially when preparing the next phase?
*6.3 Questions related to the **Responsibilities and resources** section of the interview schedule*	
a)	Were there difficulties, especially in the early days of the Water Saving City Programme arising from a conflict of official responsibility or legal powers between e.g. municipal departments, regional government, river basin confederation, national government?
b)	Were responsibilities or resource allocation to the relevant administration modified to facilitate collaborative working?
*6.4 Questions related to the **Strategies and instruments** section of the interview schedule*	
a)	How did the Municipal plan encourage the uptake of water saving technologies?
b)	What regulatory, economic or communicative instruments have been most effective at encouraging uptake of water saving technologies by water users? Why?
c)	What barriers and challenges did the Municipality face when implementing its water efficiency programme? How were they overcome?
d)	Why was the Agenda 21 so important in the Municipality attempts at achieving water savings?
e)	Was there opposition to the changes in water tariffs? Why, and if yes by whom?
f)	Why was the Bylaw passed? Was there consensual support or some opposition to it?
g)	Were there research projects carried out in Zaragoza to support the uptake of water efficient technologies? Did the Water Saving Programme and now ZINNAE use research projects? If yes, which ones? Did the results have subsequently an influence on the Programme or its next phases?
h)	Have training activities been organised for relevant public officials?
i)	Were there any conflicts between existing regulatory, economic or communicative instruments with regards to their influence on water user uptake of water saving technologies?

Appendix 3 Detailed description of case-studies

1. THE AARHUS CASE-STUDY

The Aarhus River is 40 km long and drains a basin of 324 km² on the eastern coast of Jutland, or mainland Denmark. The river originates 54 m above sea level in the swampy bogland of Astrup Mose close to Stilling-Solbjerg Lake, passes through the city of Aarhus and exits into Aarhus Harbour. Aarhus is the second-largest city in Denmark. The population is approximately 300,000, with about 1.2 million inhabitants residing in the greater Aarhus region. It is the largest port in the country, handling 50% of Denmark's container traffic.

The economy of Aarhus has historically been based on food-processing industries serving Denmark's agriculture sector. However, the city is transitioning to become a centre for research, development, and manufacturing of clean energy technologies. The University of Aarhus is Denmark's largest by student enrolment and a major centre for research. Over the past 30 years, the city has developed a large research park for the incubation of start-up companies in applied science and technology sectors.

Following Denmark's "State of Green" initiative, Aarhus has made considerable investments in environmental planning with the goal of becoming a so-called "green city".[1] These efforts include: initiatives to develop green spaces in the city and surrounding area; watershed protection, including afforestation measures in drinking water catchments; reduction of fossil fuel use and CO2 emissions; river restoration; water quality and recreational improvements in the city's harbour; and green building initiatives. There is the perception that these investments will increase quality of life, ensure sustainability, and save money. In particular, the city seeks to attract a dynamic and well-educated population and it is thought that many of the recreational elements and sustainability objectives will be attractive to potential residents. In addition, the city seeks to market itself as an example of progressive environmental planning, with the intention that other cities tap local expertise to implement similar initiatives.

A centrepiece of the city's environmental planning is a comprehensive effort to manage water from a holistic, water-cycle perspective that accounts for climate change impacts. From 2006 to 2014, Aarhus municipality and Aarhus Water implemented a grand project that included two different but related objectives: to restore a segment of the Aarhus River flowing through the city centre that had been diverted underground; and to improve the hygienic quality of water in the harbour so that the harbour is suitable for bathing.

Prior to the project, Aarhus River received effluent from 75 combined sewer overflow discharge locations (CSOs), 58 storm water drains, and 2 wastewater treatment plants (WWTPs) in the reach between Lake Brabrand and the harbour. WWTP and CSO discharges to the Aarhus River are the main causes of water quality impacts to the harbour. In addition, a third WWTP discharges directly

[1] State of Green website: https://stateofgreen.com/en/profiles/city-of-aarhus.

into the harbour. A map showing the locations of Lake Brabrand, the river, the harbour, and the three WWTPs is given in Figure 1.

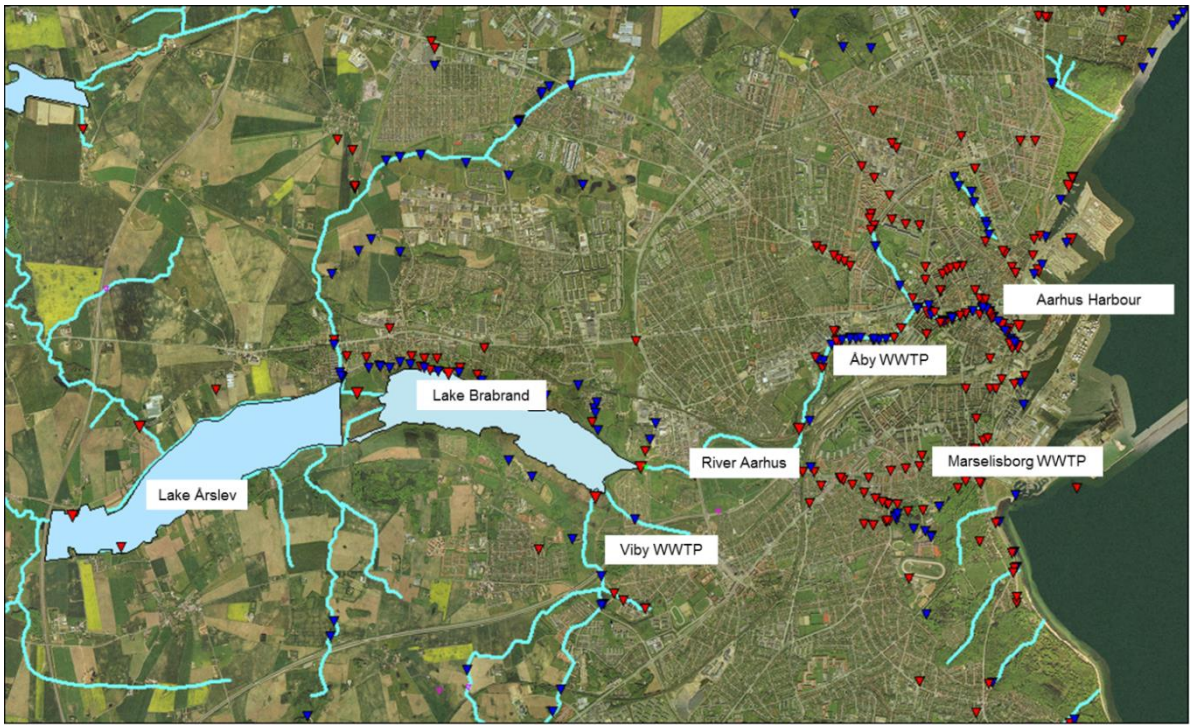

Figure 1: Map of Aarhus River and harbour area.

The two objectives have been achieved through a 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".

Technological uptake

To support the opportunities for recreational use of the lake, river and harbor, Aarhus municipality decided to improve the hygienic water quality in all three locations. To define water quality targets for the project, the municipality adopted standards from the European Union Water Framework Directive (WFD) and the Bathing Water Directive (BWD). The municipality also adopted a climate change objective, requiring that the project be designed to function given the following climate change scenario:

- an increase in rainfall intensities of 20%, but no increase in the yearly rainfall
- a sea level rise of 50 cm

An integrated modeling approach was used to investigate the impact of wastewater treatment plant discharges and CSOs on the water quality of the lake, river, and harbor. Modeling results

suggested that the existing system could be adapted to reduce the intensity of wastewater discharge to receiving waters, improving hygienic and aesthetic qualities (Möller et al 2014).

The following adaptation measures were undertaken:

- Construction of 7 new storage tanks (incl. new trunk sewers where necessary) with a total volume of app. 67.000 m3
- Installation of extra hydraulic capacity at 3 wastewater treatment plants (secondary clarifiers and optimization/control of the treatment plants during rain)
- Disinfection of treated wastewater at 2 wastewater treatment plants discharging to the river
- Implementation of integrated real-time control (RTC) of sewer systems and wastewater treatment plants and a warning system for the bathing water quality in the harbor.

The budgeted costs of the designed solution were almost 50 million EUR, and in 2007 Aarhus municipality allocated the necessary funds for the water utility, Aarhus Water, to undertake the project. The construction works were concluded in 2012 (ibid.).

The two central innovations in the solution, which are our focus here, are the system of real-time monitoring and control and a warning system for bathing water quality. The two systems were developed in one and the same project where Krüger and DHI, as technology providers, partnered with Aarhus Water. This project was officially closed in the summer of 2014.

The real-time control system coordinates storage of CSO discharges in storage tanks to optimize system-wide capacity and minimize spills. The system of real-time monitoring and control includes the following elements:

- Physical infrastructure including sewers, CSO storage tanks, and WWTPs.
- A radar system that is used to make short-term forecasts of rainfall intensities.
- A sewer system model to simulate movement of wastewater and storm water flows through the combined sewer system.
- A risk assessment and optimization system that manages water levels in the CSO storage tanks to minimize total overflow risk. The risk assessment and optimization system runs and re-sets storage tank outflow set points every five minutes.
- A network of software sensors that provides measurements of system parameters (flows, storage tank volumes, etc.) in real time to the risk assessment and optimization system.
- A SCADA/PLC system to implement solutions identified by the risk assessment and optimization system.

The warning system for bathing water quality was established because the BFD permits one non-compliant event per year if a warning system is in place; otherwise, a non-compliant event is 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 includes the following elements:

- A catchment rainfall-runoff model that estimates runoff to Lake Brabrand and the Aarhus River (excluding urban runoff).
- A sewer system model to estimate WWTP discharges to the river system, CSO discharges, and storm drain discharges to the river system and harbour. The sewer system model also simulates the transport of E.Coli and Enterococci.
- A hydraulic model of Lake Brabant and the Aarhus River. The hydraulic model estimates outflows from Lake Brabant and the Aarhus River. The hydraulic model also simulates the fate and transport of E.Coli and Enterococci. Upstream boundary conditions are provided by the catchment rainfall-runoff model and the sewer system model.
- A hydrodynamic model of the harbour. The hydrodynamic model also simulates the fate and transport of E.Coli and Enterococci. The downstream boundary condition of the hydrodynamic model is Denmark's national marine model. The hydrodynamic model provides the downstream boundary condition for hydraulic model of Lake Brabant and the Aarhus River.

The complexity of the solution and the scale over which the solution is implemented resulted in a number of technical challenges that led to specific innovative developments during the implementation of the project.

- The project has contributed to several enhancements of existing software and systems as well as major contributions to the platform on which they are running (called DIMS.CORE). The Dynamic Overflow Risk Assessment methodology for optimizing combined sewer overflow to the receiving waters has been developed as part of the Aarhus project.
- The bathing water quality warning system integrates four models operated by three different 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. This requires sharing data between agencies using the Internet, as well as procedures for sharing responsibility between agencies for maintaining real-time operations.
- The real-time control system requires a network of software sensors that are used to measure system parameters within the sewer and CSO overflow tank network, as well as SCADA/PLC components for real-time control of the system. This required the implementation of procedures for validation/filtration of sensor measurements,

communication infrastructure for system control, and backup plans and procedures to maintain operations if some components of the control system are not functioning.

This study examines governance factors conducive to innovation uptake of the monitoring and warning systems described above. The analysis, addressing (i) levels and scales, (2) actors and networks, (iii) goals and ambitions, (iv) strategies and instruments, and (v) resources and responsibilities, is carried out to investigate impacts on the uptake of these two technologies. It should be kept in mind, however, that the two systems form part of the integrated water management solution and therefore many governance factors need to be discussed in relation to the overarching solution as much as in relation to the specific technologies.

The analysis is based on seven interviews with representatives of the project partners and various departments in the Aarhus Municipality, complemented with a review of secondary evidence for more insight into historical dimensions and wider contextual influences.

References

Aarhus Municipality (2001): Municipal Plan 2001. Available for downloading at http://kort.plansystem.dk/searchlist.html?key=%22KomNr.-1%22

Aarhus Municipality (2009): Municipal Plan 2009. Available for downloading at http://kort.plansystem.dk/searchlist.html?key=%22KomNr.-1%22

Aarhus Municipality (2013): Municipal Plan 2013. Available for downloading at http://kort.plansystem.dk/searchlist.html?key=%22KomNr.-1%22

Aarhus Municipality (2006): Bedre vandkvalitet in Braband Sø, Århus Å og Århus Havn. Report from Afdelingen for Teknik og Miljø, Aarhus Municipality.

Aarhus Municipality (2007): Rekreativ Vision for Århus Å – Fra Brabrand Sø til Århus Havn. Available at http://www.urbanmediaspace.dk/sites/default/files/pdf/vision-for-aarhus-aa.pdf, retrieved 20.03.2015.

Aarhus Municipality (2010): Water Vision 2100. Report from Afdelingen for Teknik og Miljø, Aarhus Municipality.

Aarhus Municipality (2014): Klimatilpasningsplan 2014 – tilpasning til mere vand. Aavailable at http://reader.livedition.dk/aarhuskommune/394, retrieved 15.10.2014.

DANVA (2012): Water in figures. DANVA's Benchmarking and Water Statistics 2010, retrieved 16.04.2012.

Möller, A., Hansen, H.P., Pedersen, L., Kaltoft, J., Nygaard, M., Bassø, L., Frier, H. and N. Mølbye (2014)2: Real Time Monitoring, Modeling and Control of Sewer Systems. PREPARED report no. 2013.012 & 2014.014.

2. THE EMSCHER CASE-STUDY

The Emscher catchment is located on the eastern side of the river Rhine, in the West of Germany, more precisely, in the federal state of North-Rhine Westfalia (NRW), the most populated state in Germany. About 2.4 Mio people live and work in the Emscher catchment, the so called "Ruhrgebiet", which is the most densely populated area in Europe (Figure 1, Table 1).

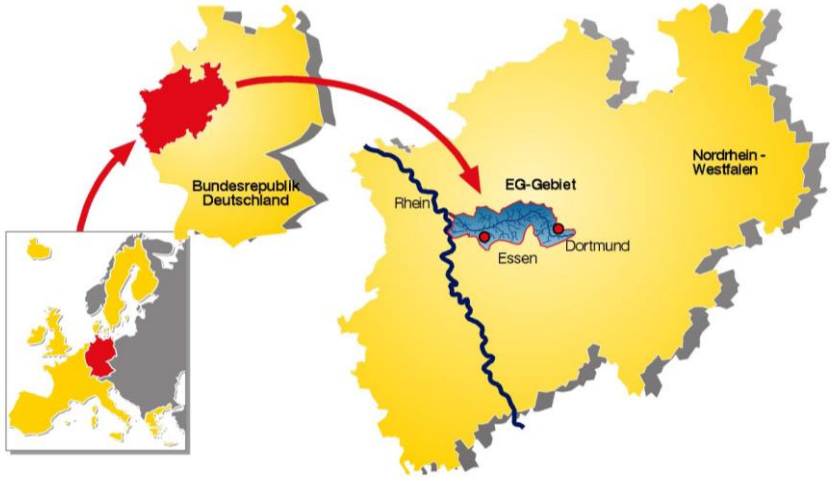

Figure 1. Emscher catchment.

Table 1. Emscher socio-economic data.

Area	Data
catchment area	784 km^2 (= 2.5% of state NRW)
population	2.4 Mio inhabitants
population per km^2	2775 inhabitants /km^2
Gross value added (2002)	44,7 Mrd. EUR/a (= 10,5 % of state NRW)
built-up area	~ 50%
agricultural area	~ 18%
natural area (incl. forested area)	~ 22%
other	~ 10%

Sources: EG, 2009 "Flussgebietsplan 2009"

The Emscher river used be a slow flowing, meandering river with a length of 109 km from its source in Holzwickede (150 m above sea level) near Dortmund until its discharge into the river Rhine close to Duisburg (25-50 m above sea level), draining a catchment of approximately 784 km^2 (figure 2). With the start of industrialization and a rapid urban growth by 1860, the natural regular inundation of the broad Emscher floodplains suddenly turned into a problem. Because urban and industrial

areas were built close to the river shore, frequent floodings occurred. An additional problem was that the Emscher River received more and more waste water originating from industry and settlements. Flooding with such water qualities caused the spread of water-borne diseases and epidemics.

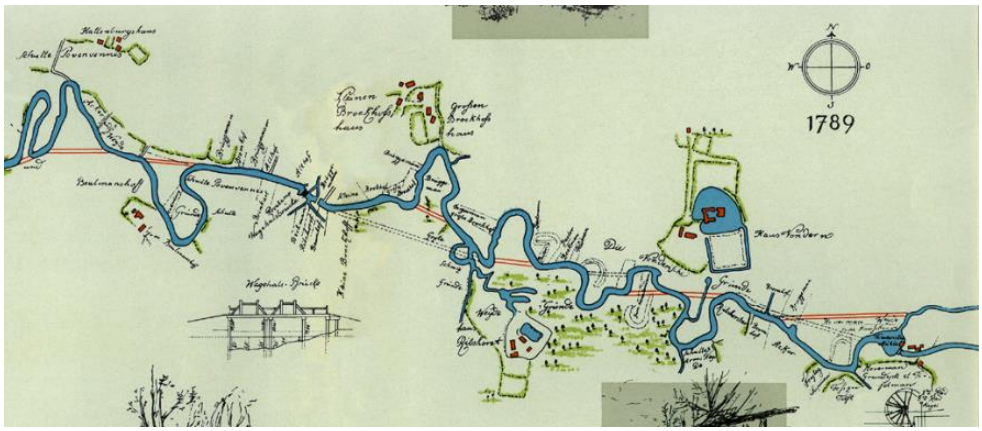

Figure 2. Emscher catchment in 1789.

In order to overcome the problems associated with the frequent floodings, the single cities within the Ruhrgebiet had to find a joint solution. For this reason, 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 waste water discharge and to avoid further floodings. The only possible solution was to straighten and channelize the Emscher River. As a result of this so-called 1st Emscher conversion, its original length has been reduced to 85 km, it received a concrete bed and dikes were built.

The ongoing subsidences in the Ruhrgebiet, caused by underground coal mining, resulted in depressions of up to 30m depth. Consequently, the natural drainage capability of the Emscher was disturbed and the ground water level rose. To re-allow water flow, pumping stations had to be built in the whole area and the discharge point of the Emscher had to be moved northwards to Dinslaken. This made the Emscher catchment grow up to 865 km^2. 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 concrete channels for the discharge the wastewater. They would have broken frequently. The only possibility was to discharge wastewater 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 the industrial period came to an end in 1960s, the occurrences of subsidences slowly lessened. By 1990, underground wastewater channels were possible and the planning of the so-called 2nd Emscher conversion commenced. The aim was to disconnect/decouple wastewater and river water by conducting the wastewater in underground wastewater pipes/channels to the next wastewater treatment plant (WWTP) and to subsequently revitalize the original Emscher stream and its tributaries. A scheme of the Emscher conversion process is depicted in Figure 3.

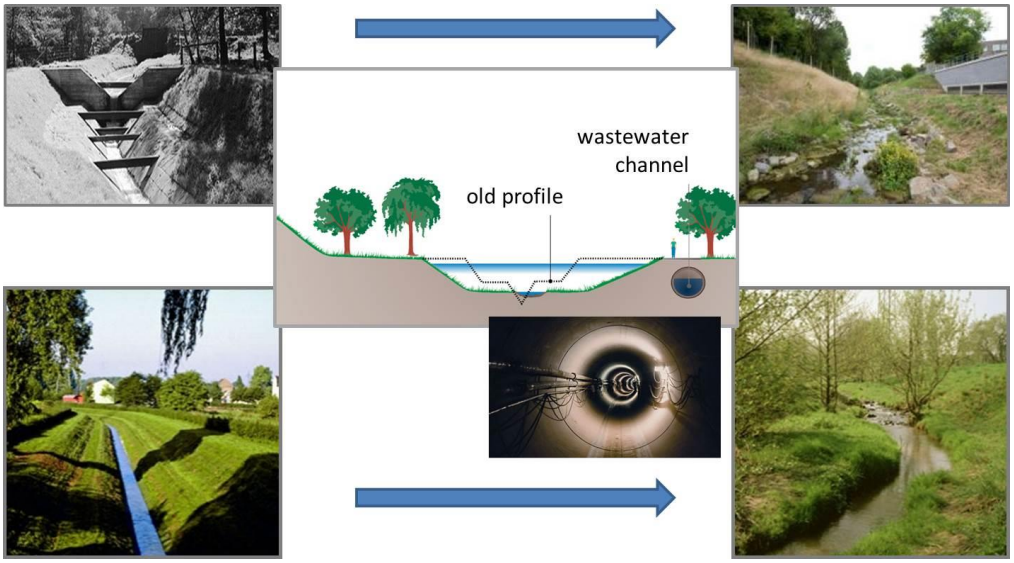

Figure 2: Emscher conversion. Left side = open wastewater channels in the former river beds before restoration, center = conversion process by building underground wastewater channels and widening the river profile, right side = near natural river bed after restoration.

As 40% of the Emscher area are depressed due to subsidences, pumping stations to control water discharge and groundwater level will be required for eternity (see figure 4). The challenges in the region are diverse, however, all of them are related to the former mining activities (coal mining, steel production), industrialization, and urbanization. During more than a century, wastewater was transported together with the Emscher surface water in open waste water channels. Both the Emscher and its tributaries were channelized and surrounded by dikes, which turned them into heavily modified water bodies. This is also recognized in the WFD's requirements concerning the Emscher catchment. The new challenges include also the ongoing construction of a subsurface network of wastewater channels along the Emscher and its tributaries, which separates surface and wastewater flow. Subsequently, the re-naturalization of the former open wastewater channels/conduits can take place. Only after completion of these actions, the goals of the water framework directive can be met.

Figure 4. Emscher with subsidence areas, pumping stations, and wastewater treatment plants.

The conversion of the Emscher is a joint effort of many different actors. The key player is the Emschergenossenschaft (EG), Germany's first water management association. The EG is cooperatively organized and, from a legal point of view, a corporation under public law. It is an organization subject to special-legal-status, and therefore, has its own internal regulations and association legislation.

The main task of the EG are wastewater treatment, care and maintenance of bodies of water, flood protection, regulation of water flows, groundwater and rainwater management, and two major and outstanding keynote tasks that were agreed upon by the associates. These keynote tasks are the construction of underground wastewater channels and the re-naturalization of the open wastewater conduits. For the financing of these tasks, in addition to the annual contribution of the associates, there was a one-time payment for revitalization of wastewater systems; there is a contribution of the federal state NRW; and there is a fixed annual increase in the sewage fee/tax in the whole Emscher region.

Since almost 90 years, EGLV is a joint company between EG and Lippeverband (LV), the water association of the Lippe catchment, which was founded in 1926. EGLV is a non-profit public body, which is financed by the compulsory members. The members of the EG are the associates, i.e. the cities and municipalities within the Emscher catchment as well as the major industrial and mining companies. The associates meet once per year in the associates meeting. The association board instead meets three times per year. The 15 members of the association board are elected by the associates. The management competence of the EGLV tasks is with the executive. The association board controls the management of the EGLV executive, and thus, has the function of a supervisory board. Fundamental decisions are made together with all associates in the associates meeting (comparable to a main or shareholder meeting). An additional supervisory authority is the investment committee, controlling all investment plans, as well as the appeals committee, entrusted for objections towards decisions/demands for payments/etc.

The tasks of EG are financed by the associate's member fees. These are rated according to the advantages/benefits experienced by a member has from the work done by EG. Also other sources of financing are in place, mainly funding by the state NRW and sewage fees. EG's work serves for improving common welfare, therefore, it is a non-profit organization. Currently, EGLV has 1590 employees.

On the governmental side, the ministry of the environment of the state NRW is in charge of water management (Ministerium für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz, MKULNV) and acts as the supervisory authority of EG's decisions. Further governmental bodies involved are the district government Münster and the national environmental ministry.

The whole process of re-structuring the Emscher catchment on such large-scale (consisting of the separation of surface water and wastewater, and subsequently, the re-naturalization of the Emscher) is a *new measure/process* - not only for the region, but for water management in general. These re-structuring measures are not only conducted in the Emscher river itself, but also in its

tributaries. The Emscher and all direct tributaries belong to EG. Several secondary tributaries, however, belong to single cities/municipalities. They are conducting similar measures at their waterways as part of the Emscher conversion in parallel and in close collaboration with EG.

Also an integrated rainwater management approach in the Emscher catchment resembles a *new approach* for the region. In a densely populated region with a high proportion of sealed surfaces (streets, built-up areas, etc.) large volumes of rainwater are discharged into the sewers during rain events. In a combined sewer system existing in the Emscher area, this has several negative implications: sewer channels need to be able to take up large amounts of water, waste water treatment plants (WWTPs) need to be able to deal with large amounts of water, combined sewer overflow events into reclaimed streams, and missing recharge of groundwater conducts. To counteract these disadvantages, EG aims at decoupling more and more rainwater from the sewers. Achieving this goal is only possible if all municipalities in the region act in concert. As a common motivation and goal, a joint convention named "Future Convention for stormwater – ways to a balanced runoff-regime" has been brought forward by EG. It is a regional committment signed by EG, the environmental government and all municipalities in 2005. Section 2.3 of this document will elaborate on the "Future Convention for stormwater".

Another regional convention was developed in the Emscher area, serving both as a common goal and management plan for the Emscher conversion. This *collaborative approach* is the so called "Masterplan Emscher Future", a commitment developed by EG in cooperation with the Ruhrverband (the water association of the river Ruhr which flows at the southern border of the Ruhrgebiet) together with the cities, districts, and industries in the Ruhrgebiet. The "Masterplan" will be elaborated more in detail in section 2.1.

Also *new technologies* have been taken up as part of the Emscher conversion:

- Large-scale energy efficient WWTPs,
- Combined sewer storage channels (SKUs) storing large volumes of water during rain events,
- Large-scale pumping plants necessary to allow waste water in the future Emscher waste water channel to reach the river Rhine,
- Innovative ideas for flood water retention areas, such as a public lake (Lake Phoenix), a zoo, vegetative basins, secondary floodplains.

New financing modes are also necessary to allow innovative processes. In the Emscher case, this can be seen within the "Future Convention for stormwater": House owners and industries are not forced by law to reduce the amout of rainwater discharge into the sewage system. They do, however, pay a wastewater discharge fee which is calculated from the sealed and built-up area on their real estate/leased land. If they reduce this sealed area, the dicharge fee decreases due to separated costs for sewage- and rainwater. This is an important financial motivation for the decoupling of rainwater.

The Masterplan Emscher Future and Lake Phoenix

The "Masterplan Emscher Future" is an informal map/plan for the development of the new Emscher valley (Figure 5). This means it is not a binding contract, by which its signers are legally obligated to realize the agreed development, but rather an informal commitment and declaration of intent. It was developed by EG in cooperation with the Ruhrverband (cooperation "New Emscher Valley") and together with the cities, districts, and industries in the Ruhrgebiet. The content of the Masterplan includes all measures planned within the Emscher valley as part of the Emscher conversion but also beyond. All cities and municipalities in the Emscher catchment were involved, all signed the Masterplan, all were affected and all benefitted. Depending on the individual sub-projects within the Masterplan, various actors are involved: owning, operating, living nearby or using the areas that are to be developed according to the Masterplan.

The Emscher conversion, consisting of the separation of surface water and wastewater by building subsurface wastewater channels and the subsequent re-naturalization of the Emscher River is the core task and basis of the Masterplan. But it goes further. The Masterplan links all single measures within the Emscher conversion into one management plan. It combines and harmonises water management, urban management, and open spaces management. The New Emscher Valley comprises all these aspects.

The Masterplan resembles a common consensus and commitment, as it was signed by all cities within the Emscher valley in 2005. The fact that all cities had

- the same problems (an open waste water channel, ground water problems, no natural recovery areas for the citizens, streets and houses inundated during rain events, increasing number of inhabitants moving away from the city, end of mining and steal production period, decreasing number of jobs available, etc.) and
- the same goals (reclaiming the Emscher river to allow leisure time activities, attractiveness for inhabitants and industries, getting more sustainable in terms of water managment and energy management, etc.) convinced them to signing and sticking to the informal commitment as an integral solution to their common problems.

Overall, the purpose of the Masterplan is to serve:

- as an integrated planning tool
- for keeping track of milestones throughout the long-term process
- for allowing integration and synergy of single measures
- for illustrating the complex and differentiated tasks within the Emscher conversion
- for creating a sense of community among the actors involved

During the Emscher conversion the whole system is changing continuously, and these changes alter the basis for following up measures. This requires the plan to be continuously updated and adapted. The Masterplan does not give a strict time schedule for when the project should be completed. The technical Emscher-conversion is scheduled until 2017 and the finalization of the

ecological restoration is planned for 2020. However, part of the projects in the Masterplan will still be realized after 2020, especially those in the complementary area. In 2013/14 the idea developed to update and advance the Masterplan by focusing on the 3 topics "Integrated water management as an engine of urban and open space development", "Flood management as a cooperation task", and "Integral design approach for the Emscher and its banks".

As a graphic scheme, the Masterplan can be visualised with the 4 viewpoints that feed into it (Figure 5):

- BLUE: Basic planning of water resources management (flood protection, subsurface waste water discharge via the Emscher channel, re-vitalizing the Emscher river and its tributaries)
- GREEN: Ecological concept (ecological goals of freshwater development)
- RED: Concept for open spaces and urban development
- YELLOW: Corporate Architecture (a common design of the single elements will show that these elements actually belong together)

The individual wires of the cable in the right picture of Figure 5 represent the interconnection of water, landscape and city and signal the wide bifurcations already present here and extending deep into the region.

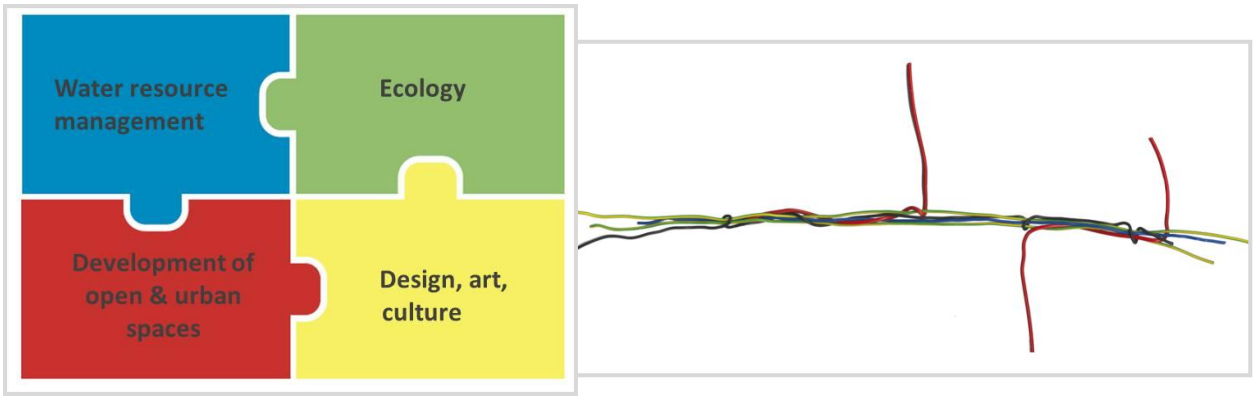

Figure 5. 4 viewpoints feeding into the Masterplan.

The responsibilities for the single measures included in the Masterplan are assigned into 3 areas (Figure 6):

- The core area New Emscher: the area where future development (water resource management), flood protection and ecological functionality must be ensured (EG manages these tasks alone in accordance with its legal mandate)
- The integration area: the Master Plan contributes with ideas for developing open and urban spaces, in developing design typologies, but also for linking the New Emscher with its environment (done in collaboration with regional planning partners)

- The complementary area: will be defined by topics in a broader environment (here the impetus of the Emscher conversion can and must be continued without active involvement of EG)

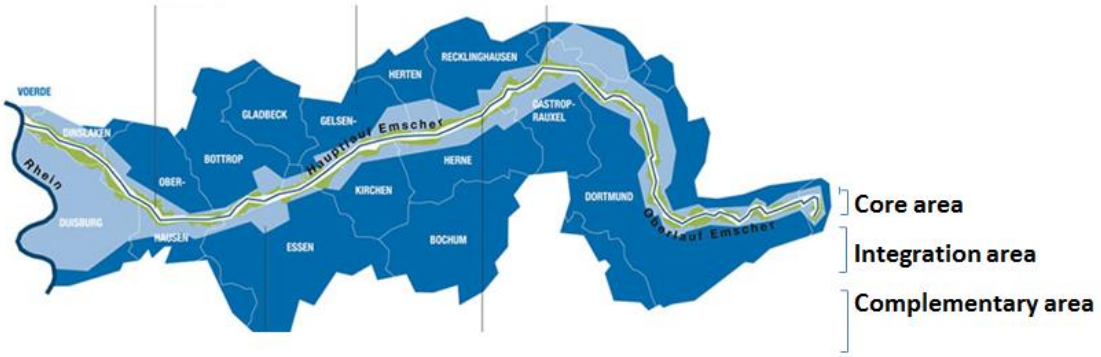

Figure 6. Responsibilities within the Masterplan.

Furthermore, an overarching concept for the Masterplan was developed, which is based on 8 general principles. These are: standards for flood prevention; ecological development of the aquatic system; connection with the environment; clear and corporate design of constructions; the development of open spaces; quality of life enhancement; profit from economic potential; and incorporating history of the region. Overall, the Masterplan appears to be an innovative collaborative approach and has won 3 awards for urban development & landscape architecture.

The Emscher conversion is the overall process in which the single measures within the Masterplan are realized. In more detail, this means, that in a first step the waste water channels need to be built (which is to be realized until 2017) and in the second step, the waterways – including the Emscher river as well as its tributaries – need to be reclaimed and ecologically improved (to be realized until 2020). This concentrates on the core area of the Masterplan. Only then, measures along the waterways, i.e. in the integration and complementary area, become meaningful, because the waterways will have turned from “no-go-areas” to appreciable areas.

The extent of the reclamations/ecological improvements of the waterways is largely depending on availability of space. Space restrictions left and right of the waterways prohibit the generation of near natural banks, secondary floodplains, etc. These restrictions are caused by conflicts for existing or planned land uses – e.g. for housing areas, industrial areas, parks, sports and leisure areas, flood retention areas, and others. The solution aimed at to deal with these restrictions makes use of the concept of the “ripple effect”. It focusses on centers/hot spots of ecological development, where wetlands and biotopes can develop without spatial restrictions. Via the link between the various hot spots a colonization of flora and fauna along the entire waterways is expected.

At these hot spots the hydro-morphology of the stream, i.e. is physical structure of the stream bed, as well as the structure of the banks and surrounding area is being improved in order to allow

subsequent ecological improvement. Such hydro-morphological improvements at hot spots consist of a number of measures:

- Elongation of the stream length by excavating a new stream bed with meanders
- Increasing stream bed coarseness by replacing the open waste water channels stream bed with gravel, sand, stones, etc.
- Connecting (secondary) floodplains to the streams
- Improving the hydro-morphology, necessary to meet the aim of a good ecological quality for the WFD
- Principle of the “ripple effect”/”stepping stones concept” (ecological hotspots where space is available, with a restricted distance between them, still allowing ecological links between the hotspots)

As mentioned, future land uses can be housing areas, industrial areas, parks, sports and leisure areas, flood retention areas, etc. Flood management, however, has to be ensured by EGLV by law, and therefore, has the highest priority. Flood control used to be provided by the fast flowing channelized streams and the dikes surrounding them. After the reclamation, dikes will still be necessary to handle extreme flooding, but will be widened up where possible. Flood control for less extreme flooding will mainly be assured through the ecological improvement by:

- Decreasing flow velocity in general via the elongation of the stream length in order to reduce flow during rain events
- Regulating water flow
- Allowing a higher retention of discharge
- Inside the stream bed which receives a larger potential storage volume via the elongation and
- Outside the stream bed by using secondary floodplains to retain discharge during heavy rain events

Lake Phoenix is one example of such an ecological hot spot (Figure 7). Until 2001, an enormous steel production company used to be located here, and the Emscher was flowing in an underground channel underneath the industrial area. In 2001 this industrial area was abandoned and the steel production factory was demounted and transported to China. The city of Dortmund bought the area which until then was owned by the company Thyssen Krupp. After a long period of discussions about the future use of the area, it was decided to develop a lake with several purposes: It was supposed to serve as a biodiversity hotspot, as a flood retential basin, as a place for local recreation, water sports, and sports along the lake shore. Furthermore, it should make the area, and thus, the city more attractive for both people and businesses. Alternative possible solutions would have been industrial parks, as is commonly done in other brownfield restorations. However, it was desired to use the area in a different way for various reasons: There was a vast number of brownfields in the area, so there was no real demand for another industrial park. The area was in the middle of a problematic part of the city that was inteded to be upgraded. 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. House building along the lake also started in this period. In 2013, the PHOENIX-See Entwicklungsgesellschaft “delivered” the lake to the city of Dortmund.

The total costs for developing Lake Phoenix were 230 Mio EUR. The project was supposed to mainly finance itself. Less than 10% were funded. Funding was realized by several parties. The largest part was from the ÖPL program (Ökologisches Programm Emscher-Landschaftspark), providing also the basis for the development of the ecologic potential. Other funding came from urban development budget. The 90% which were not funded were provided by the city, Stadtwerke, and the economically profitable concept – the marketing of the real estates. EG contributed 10 Mio EUR which was the amount that would have also been due to build a conventional flood water basin. The contribution of EG was provided by their associates (i.e. all the cities of the Emscher catchment), however, with the municipality of Dortmund as the main payer. Plus, funding of the federal state NRW was provided.

Figure 7. Phoenix in 2000 (left) and in 2010 (right).

The Future Convention for stormwater and Zeche Ewald

Along with the Emscher conversion project, the need for several complementary developments in water management was perceived. In particular, in the densely populated and developed Emscher catchment area, stormwater can often not find its natural way into the ground. A high proportion of the surface area is paved or build-up. During rain events, the rain water cannot penetrate into the soil and from there into the groundwater, but it is discharged into the combined sewer system where it is mixed with wastewater and conducted to the next WWTP. This process has a whole range of expensive disadvantages. Wastewater sewers have to be quite large to be able to take up incoming wastewater plus the (comparatively) clean stormwater. The clean stormwater would not need a purification treatment in the next WWTP. But since it gets mixed with wastewater, the whole mixture will need to be purified, which is a process involving considerable costs and efforts at the WWTP. Furthermore, the discharged stormwater which did not penetrate into the soil cannot provide groundwater recharge. This again has implications on the water flow of the bodies of water: If the groundwater level is low, streams cannot be supplied with water from the groundwater aquifers. They might even lose river water which will penetrate into the low groundwater aquifers. Some small streams can even fall dry during certain periods. Thus, the basis flow of streams can be disturbed.

The Future Convention for stormwater aims at 15% reduction of the amount of stormwater and clean water discharged in the sewer system by 2020. This aim is supposed to be accomplished by a disconnection of stormwater/clear rainwater from the combined sewer system. The Future Convention is a regional consensus for a sustainable urban drainage approach/rainwater management. This regional committment was signed by EG, the environmental government and all municipalities of the Emscher region in 2005.

The common goals of the actors involved were: 1) an integral and sustainable rainwater management; 2) a risk reduction of heavy rain runoffs in the cities to avoid basement flooding; 3) reducing flood peak flow in small tributaries (for flood events of up to yearly return periods); 4) a risk reduction of flooding, and therefore, improved flood control/management; 5) strengthening the low flow in dry periods, i.e. an improvement of the basis flow in the streams necessary for good ecological water quality, the aim of the WFD; 6) reducing the volume of and the financial effort for end-of-pipe-measures of combined flow treatment in WWTPs; and, 7) financial advantages by reduced wastewater fees/taxes. The advantages can be categorized into ecological, economical, and socio-cultural benefits (Table 2).

Table 2. Benefits of the Future Convention.

Benefits	Description
Ecological	Balanced runoff regime Groundwater recharge Adaptation to future climate (more extreme weather events like heavy rain or droughts)
Economic	Less wastewater discharge in channels + WWTPs Reduced costs for maintaining/renewing wastewater channels, because they can be dimensioned smaller Reduced costs for separated system Funding for infiltration measure (by NRW)
Socio-cultural	Urban design and attractiveness Cooling factor during urban heat waves

The Future Convention comprises a large variety of activities as an integral approach to reach the aim, including:

- Conceptual studies, feasibility studies, and design solutions to achieve a higher acceptance with the property owners;
- Financial support for the decoupling measures: Funding by EGLV accounted for 80% of the costs (average 8-9 EUR per m^2, maximum 20 EUR per m^2) in the beginning phase of the Future convention in order to incentivize; later on the funding rate was decreased to 60%;
- Raising public awareness through pilots on public sites: sports stadiums, schools, churches and administration buildings;
- Support of municipalities: finding the right tax model, maintaining instructions, software, communication strategies, etc;
- Technical measures implemented (examples in Figure 8 and Figure 9)

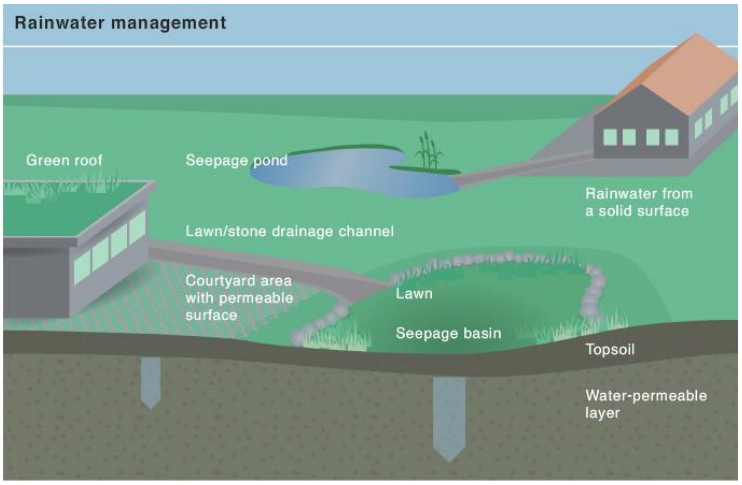

Figure 8. Options for sustainable rainwater management.

Figure 9. Examples of measures in the Emscher region as part of the Future Convention for stormwater.

Zeche Ewald in Herten, an active coal mine from 1872 until 2001, is one of the examples in the Emscher region where as part of the Future Convention of Stormwater program decoupling measures have been completed. As a large-scale project for developing a brown-field into a multi-use area, while at the same time decoupling rainwater on this area, it can be seen as a showcase.

With the decommissioning of the mine a loss of jobs and economic power was to be compensated as soon as possible. For this reason, the “project association Ewald” was founded in 1999, while the mine was still in operation. This project association is composed of the city of Herten and RAG Montan Immobilien GmbH. RAG Montan Immobilien is part of the RAG Aktiengesellschaft (formerly Ruhrkohle AG), a German company located in Herne which originally focused on coal mining but lately expanded into the areas of chemistry, power plants, and real estate. RAG Montan Immobilien is an enterprise located in Essen that administrates, renovates, develops, and markets the real estate of the RAG company.

The goal of the “project association Ewald” was the economic revitalization of the approximately 52-acre area and the creation of at least 1,000 new jobs. The concept of "service as impetus" was supposed to provide service, education, small-scale and large-scale industry including a market place as a meeting place for the newly established business owners and their customers. In the end, the former mine was developed into a business and logistics park. Comprising technology, business, service, culture, and leisure time, Zeche Ewald can now be called a multi-usage-area. The concept for the development of the area, called "Landschichten"/”land layers”, stemmed from the italian star architect Cino Zucchi.

The area was released from contaminated soil and was subjected to extensive renovations. In 2007, 18 acres of logistics area were sold to international companies. Also the old colliery buildings could be marketed easily. Settled businesses include a hydrogen competence center (h2Herten), a fuel cells company, a demonstration plant for gas production from biomass, a center researching the

fuel cell technology as well as hydrogen as an energy carrier and hydrogen generated by wind energy. Zeche Ewald also serves as event location and it hosts a tourism office. All in all, more than 20 new establishments were founded and 1,000 new jobs have been created.

The defining elements of the transformation are the historic colliery buildings. Connecting element is the newly designed Ewald promenade in parallel to the drainage canal, the so-called "Blue Ribbon", which extends across the whole site (Figure 10). This gutter system for rain water 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, tributaries of the Emscher River. The rainwater that, inter alia, comes from the roofs of the old colliery buildings, is directed to these streams via the canal.

Overall, the area where the rainwater is decoupled from the sewage system currently comprises 5.5 hectares of impervious surface, mainly located at the former coal production area – on one side of the “Blue Ribbon”. Of these, 3.4 acres are traffic areas and 2.1 acres are roof areas. Through the decoupling, 36,000 m^3 of clean rain water feed into the water bodies every year. The project of the rainwater decoupling at the newly developed Zeche Ewald is one measure realized as part of the Future Convention on storm water. The measure results in a relief of the canalization, an improvement during low flows, and additionally as contribution to flood control during heavy rain. The total costs for the rainwater decoupling at Zeche Ewald amounted to 280.000 EUR, 80% of which was funded by EG via the Future convention on stormwater. Currently, the city of Herten is also developing the other side of the “Blue Ribbon”, where formerly railways, a coke oven, and a mining pit used to be located. This newly developed area is also supposed to be marketed to business enterprises.

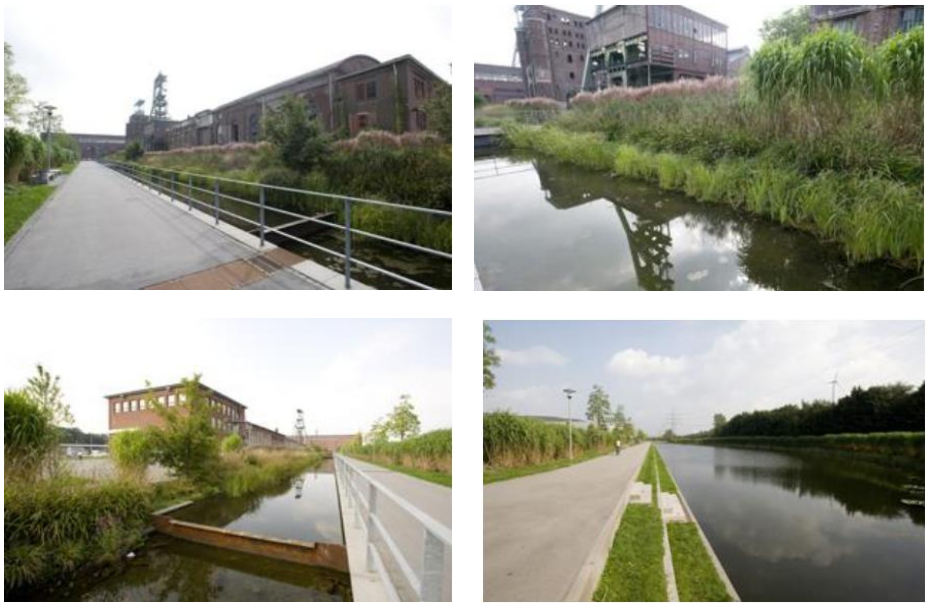

Figure 10: The drainage canal ”Blue Ribbon“ running through Zeche Ewald.
(Sources: www.emscher-regen.de)

3. THE ZARAGOZA CASE-STUDY

The city of Zaragoza is the capital of "*Aragón*" region in North-eastern Spain, and located in the central area of the River Ebro basin (Figure 1 and 2). While Zaragoza has a population of about 700.000, its basin has one of the lowest population densities in Europe (34,8 inhabitants per km^2) (Table 1 for some key socio-economic data). The Ebro basin is a semiarid region with an average annual precipitation of 367 mm concentrated in 67 days, ranking as the driest inland region in Europe and having an evapotranspiration rate about 795 mm per year (Arbués and Villanúa, 2006; Arbués, et al, 2004). Zaragoza is reached by three rivers, the Ebro, Gállego and Huerva. The Ebro, with a total length of 930 km and an average flow of 600 m^3/s at its mouth, is the largest river in Spain and the second in the Iberian Peninsula after the *Tajo*). Ebro river discharge strongly fluctuates on a seasonal basis, being as high as 500 m^3/s in March and as low as 30 m^3/s in August.

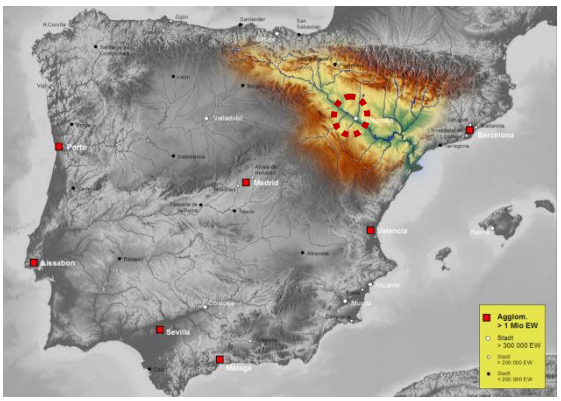

Figure 1. Ebro river basin.

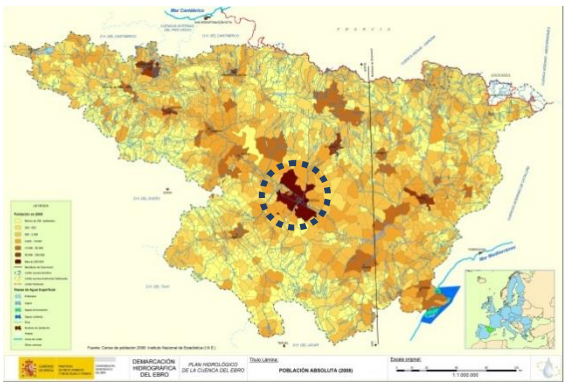

Figure 2. Population on the Ebro river basin.

Table 1. Zaragoza socioeconomic data.

Area	Data
Zaragoza city population	682.004 (INE 2013)
Zaragoza metropolitan area	Estimated around 800.000 inhabitants (INE 2012)
Zaragoza province population	978.130 (INE 2012)
Aragon region GDP (estimated 2013 and on market prices)	32.257.502.000 EUR
Gross Disposable income per capita (2011 INE)	16.651 EUR

One of the major water challenges in Zaragoza, and other cities of Spain, is water shortages due to a combination of water scarcity, high water consumption rates and inadequate management

structures. In 2012, total water withdrawal from surface waters for Zaragoza city and neighbouring municipalities (i.e. Utebo, Villamayor de Gállego, La Puebla de Alfindén, Pastriz, El Burgo de Ebro and Fuentes de Ebro) was 60.6 million m^3. Main water uses in the Ebro river basin are agricultural irrigation, hydropower generation, urban supply and industrial activities (Penagos, 2007). Urban water for Zaragoza is abstracted from the Ebro River (through the Aragón Imperial Canal) and the Yesa reservoir on the Aragon River (Figure 3). Despite plentiful groundwater resources, high concentrations of minerals have prevented their use for urban water supply (Arbués and Villanúa, 2004).

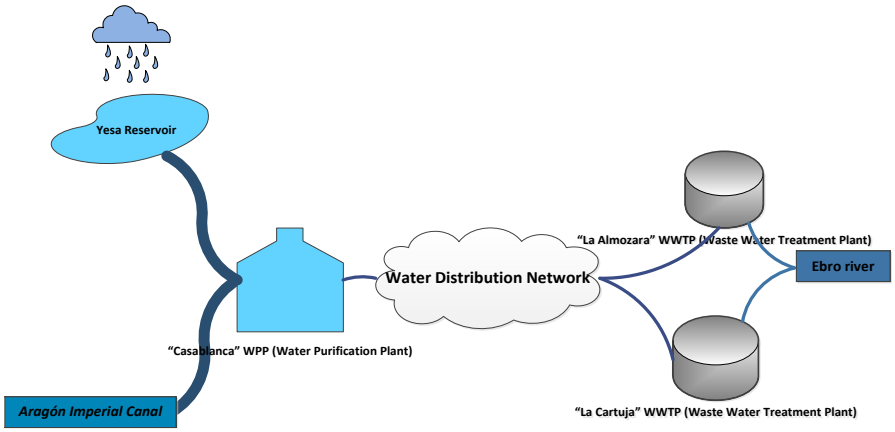

Figure 3. Zaragoza water cycle.

Historically, seasonal water scarcity was dealt with the building of reservoirs and water transfers. Following this approach, 138 dams have been constructed in the Ebro basin since the 1930s, with a total storage capacity of 6,837 Hm^3 (Penagos, 2007). 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 Spain, and especially 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, per capita domestic water consumed was reduced from about 136 liters per day in 2000 to below 100 in 2012.

It is important to note also that investments on changing water use in Zaragoza are also linked to the need to improve water quality. Historically, raw water for the city supply was mainly abstracted from the River Ebro 110 km upstream from Zaragoza, and diverted through the "*Aragón Imperial Canal*", built in the 18th century for watering and sailing purposes. Water quality was however a recurring problem, with several parameters of tap water quality often exceeded standard regulations. In summer, strong reduction in water discharge increased conductivity and hardness, making it eventually unsuitable for drinking purposes. During spring and fall, high discharges increased suspended solids and organic matter, eventually leading to hyper-chlorination and high concentrations of oxidation and disinfection by-products. To improve water quality and reduce

treatment costs, the city has diversified its water source with the Yesa reservoir in the Pyrenees Mountains on the Aragon River since 2008, as well as the construction of a new chlorination station, with some preliminary positive results[2].

The Ebro case represents a successful case where a range of technologies were adopted to meet the challenge of water scarcity, converting Zaragoza into a reference city for water efficiency policies. In that regard, a number of projects and initiatives were developed in Zaragoza over the last 25 years fostered by public authorities and by non-for-profit organizations. Key projects may be summarized as:

- Zaragoza Water-Saving City Programme (1997-2008), that aimed to reduce water demand and establishing what it was so called a "*water saving culture*" through education programs which stressed the need to change consumers habits and replacing water devices for more efficient and water saving ones.
- Zaragoza municipality management plans, including the Municipal Strategic Plan (1996-2010), Agenda 21 (2000), the "Plan for improving the water supply quality and management" (2002-2009), the "Infrastructure Improvement Plan" (2004-2009), and the "Plan to Improve the Water Cycle Management" (2012-2019). They have been aiming to reduce water demand through consumer awareness campaigns, applying economic policy instruments, in particular a considerable change in the structure and levels of water tariffs, and reducing leakage on the distribution network. The latest developments include a Water Bylaw (2011) which aims to reach an efficient water use in all city activities.
- ZINNAE (2009-ongoing), an open European platform for EU excellence in water efficiency for urban water management. ZINNAE is an Innovative Business Group driven by the Saragossa Municipality and ECODES and including companies of different nature (water saving technology, water measuring and meter reading technology), the main research and training centres in the city, as well as all the local public administrations.

In addition, several parallel initiatives have occurred. For the UN water for Life decade (2005-2015), Zaragoza organised a series of events, including the International Exhibition (2008), conferences "Sustainable Water Management in Cities: Engaging stakeholders for effective change and action" (2010), and the Water Annual International Zaragoza Conference (2015). A key outcome was "*The Zaragoza Charter*", delivered to the United Nations General Assembly and accepted through Resolution 64/292. A series of European funded projects aimed to (i) test and demonstrate the potential of specific water saving technologies (OPTIMIZAGUA, 2003-2006), (ii) support a more systemic transition towards sustainable urban water management (SWITCH, 2006-2011), and (iii) disseminate knowledge gained in Zaragoza internationally (LIFE programme AQUANET, 2007). Finally, several European Innovation Partnership groups are associated with organisations from Zaragoza. The CITY BLUEPRINTS (2013-ongoing) organizes interventions to overcome barriers that hinder the development and uptake of innovations in municipal water management, while FINNOWATER (2013-ongoing) aims to innovate on financial instruments and mechanisms to support public and private sector in water innovation.

[2] https://www.zaragoza.es/contenidos/medioambiente/memoria/sexto.pdf.

This study examines factors conducive to innovation uptake of specific technologies in the Zaragoza, contributing to the DESSIN goal of identifying enabling factors, good practices and constraints to innovation uptake in urban water management. Two relevant technological uptakes are identified as key in securing Zaragoza's success and will be the focus of the analysis in this report:

- Water user-level uptake of water saving technologies, including flow regulators and water saving appliances.
- Leakage control technologies including rehabilitating the pipeline network, pressure management controls, and District Metered Areas (Figure 4), allowing for the reduction, measurement and detection of leakages in the drinking water network.

The analysis of governance factors, including (i) levels and scales, (ii) actors and networks, (iii) goals and ambitions, (iv) strategies and instruments, and (v) resources and responsibilities, will be carried out specifically on the uptake of the two technologies. The analysis is based on a review of secondary evidence, in particular for earlier historical dimensions, complemented with targeted interviews. The interviews primarily aim to gain an in-depth understanding on the drivers behind the Water Saving City Programme (WSCP) and the ZINNAE cluster: who was involved and why, what were the challenges, how/if they were overcome, and what lessons could be drawn in terms of best practice and hindering factors on governance mechanisms and financing options for promoting the uptake of water saving technologies.

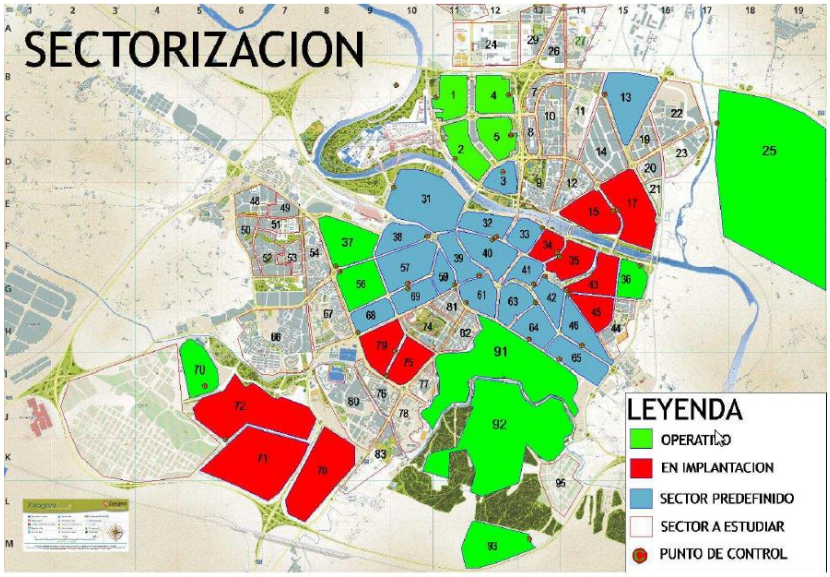

Figure 4. Sectors or DMAs created on under study in Zaragoza on 2010 (Source: Ayuntamiento de Zaragoza, 2010).

More detail on District Metered Areas (DMAs) and Active Leakage management (ALM)

With an age ranging from 30 to nearly one hundred years, Zaragoza distribution network had significant leakages, so as well as actions fostered to change consumers behavior, reducing leakages through the creation of DMA's (District Metered Areas) was considered paramount. Water Losses due to leakages on transmission or distribution mains is an important topic on Non-Revenue water (NRW) (a preferred term than "unaccounted water") (WA Water Task Loss Force). The International Water Association (IWA) in its Water Loss Task Force, created on 2002, set the "*IWA best practice standard water balance*" as a necessary and essential first step in practical management of water losses and is currently one of the research priorities for the IWA. Since then, it has been adopted increasingly by several water utilities all over the world including Zaragoza.

In general, water savings potentials from leak detection and overhauling were estimated between 20% and 30% on average, being able to reach till 50 % for some systems (Cheong, 1991). Reducing leakages on distributing pipelines provides several benefits (Muñoz and Smout, 2010) such as:

- Savings in money on treatment and distribution process
- Savings in energy used during the pumping
- Optimizing system pressures: Higher pressures will improve network operation on eliminating negative pressures or air-blocks formation in the pipelines as well as pollution risks. On the other side, lower pressures will reduce energy consumption and water leakage/consumption and of course, water.

On dealing with WLM, it is important to differentiate between active and passive leakage control. Passive control stands for detecting and repairing water drains when water from pipelines reaches the ground surface. Nevertheless, many leakages remain undetected cause when a drain appears on a pipeline, water uses the less resistance path (impedance), appearing only on surface and allowing its detection when a threshold on flow rate and pressure is overpassed. As a consequence it is important to implement active measures (*Active Leakage Management* - ALM) to detect leakages before water reaches the surface (Muñoz and Smout, 2010). The creation of District Metered Areas (DMAs) is the first necessary step to achieve this goal, so for this reason, the city created DMAs in order to decrease leakage levels.

District Metered Areas (DMAs)

District Meter Areas (DMAs) stands for the creation of water distribution sectors (Figure 5). A district is a defined area of the distribution system which can be isolated by valves and for which the quantities of water entering and leaving can be gauged through flow and pressure meters placed at zone boundaries (Figure 6).

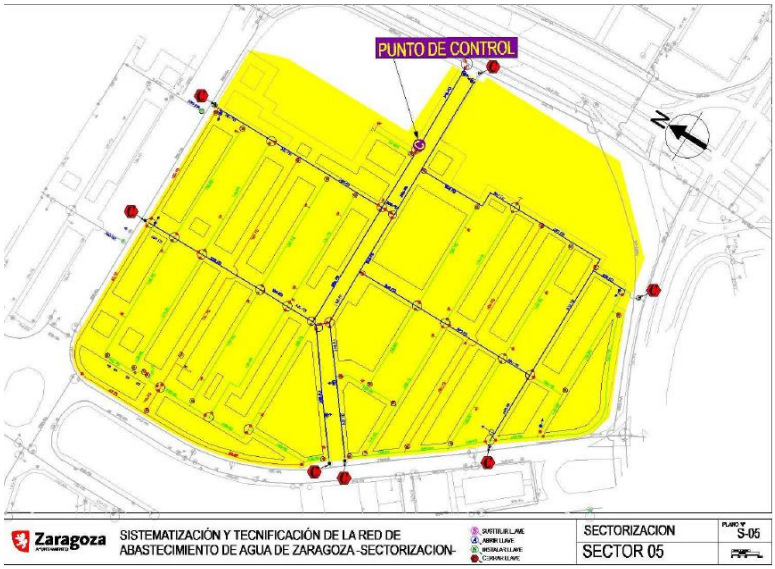

Figure 5. DMA metering points (Ayuntamiento de Zaragoza, 2010).

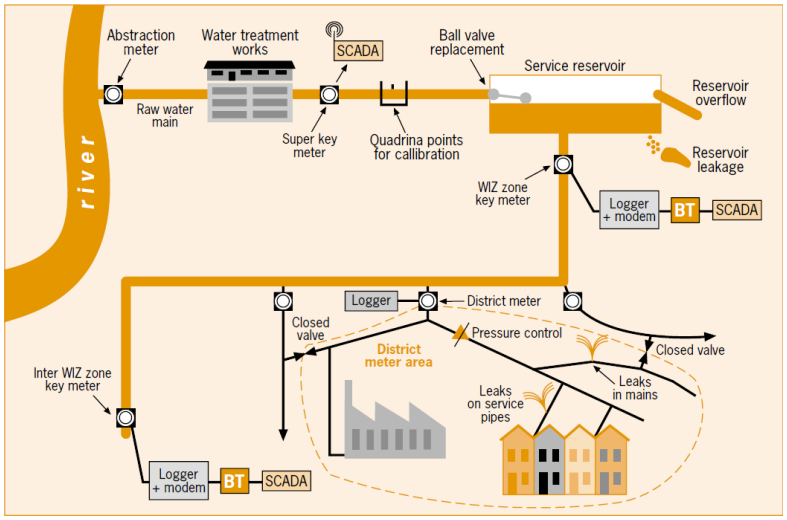

Figure 6. Key points for leakage monitoring and detection (Farley, 2001).

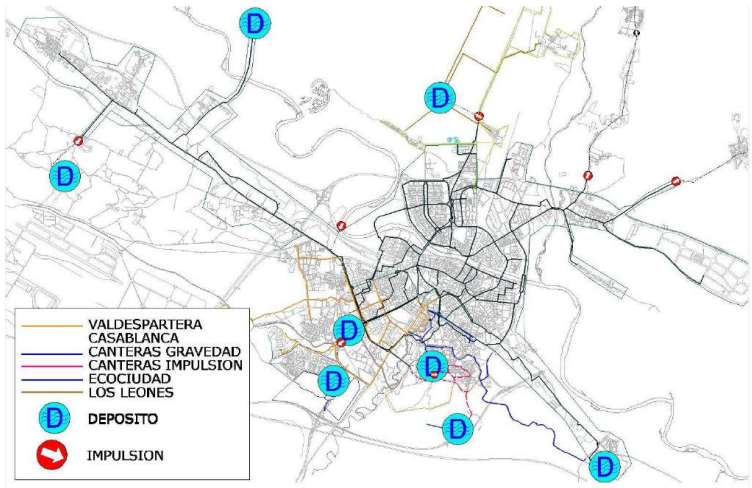

Figure 7. Transport and Distribution networks (Ayuntamiento de Zaragoza, 2010).

Data gauged is especially relevant at night, when a high proportion of users are inactive, and it is possible to study incoming and outcoming flows, inferring potential losses or detecting bursts or any anomalous data. Data monitored are gauged and collected using a SCADA (Supervisory Control And Data Acquisition) system and delivered continuously or just periodically to a Control Centre where all the information is gathered and processed. A Data link may be implemented using the telephone network (3G, 4G) or just sending data by SMS.

District creation requires grouping the network in two distinct categories: transport and distribution (Figure 7). Transport or primary network, is composed of large diameter pipes (over Ø 300 mm) delivering water from scattered deposits to the distribution or secondary network. This last network holds for pipe diameters usually smaller (less than or equal to Ø 300 mm.). Usually, every district will be fed from one source of the primary network ensuring a reasonable supply in case of loss of load on the supply.

In 2002 most water distribution network and facilities in Zaragoza were old, ranging between 30 and 90 years old. That year, the water supply improvement plan began, being non-revenue water over 32 million m^3 a year (nearly 43 % of total withdrawal). Rough leakage estimation in the distribution system was about 17 million m^3 (23% of total withdrawal). The original Zaragoza water supply network was not segmented and it was a kind of maze with a number of interconnections among parts of the network which allowed redundancy, but made it difficult to detect bursts and leakages as well as to regulate pressure. So, the first necessary step to circumvent this problem and implementing ALM was to split distribution network into manageable DMAs.

Active Leakage Management (ALM)

ALM implemented through previously created DMAs, allows when detecting abrupt consumption, early detection of leaks and breaks and taking the necessary actions before it results in major damage (Farley, 2001). It is important to stress that if a leak is not detected and as a consequence no corrective work is performed, as long as time goes by, the system will keep deteriorating and flow leakages will increase. So, when a problem is detected it is possible to:

- manage pressure on the pipelines in order to reduce water losses on potential detected leakages,
- set priorities for infrastructure replacement,
- obtaining data for statistical treatment which allows an adequate interpretation of the network performance and planning better upgrading actions.

On dealing with ALM, it is important to figure out the *Economic Level of Leakage* (ELL), because if we stand just in pure financial terms, an economic balance needs to be reached as leakage detection and repairing costs increase when the leakage level decreases (Muñoz and Smout, 2010). When replacement infrastructure is to be taken, it is necessary to infer which zones are accounting for the more important losses in order to set priorities. ALM will allow detecting those priority zones and acting depending on the *Economic Level of Leakage* as well as developing other actions such as reducing water pressures on pipes. If replacement is considered to be an option, a cost benefit analysis on additional repairing costs, reduction of leakage level and its return frequency,

needs to be developed (in addition to considering other variables.So if costs exceed benefits, a certain amount of leakage is to be allowed (Muñoz and Smout, 2010; Morrison et al., 2007).

In 2006, and after several works to improve and upgrade the distribution network (pipelines were being replaced at about 33 km a year), non-revenue water figures were reduced to17 million m^3 a year (over 32 % of total withdrawal). Today, this figure accounts for 9 hm^3, 15 % of total withdrawal. On achieving this last figure, it was not possible to differentiate leakages at the distribution network from other reasons contributing to non-revenue water such as those on public gardens, so once these consumptions are properly valued, leakage estimations are considered to be reduced.

Regarding the existing network in 2001, 212 km from a total of 1,024 km have been renovated. Materials deemed to be adequate have gone from a 37 % to a 66.2 %, and the most difficult materials from 48.3 % to 24.5 %. As a consequence the number of bursts has been reduced from 750 to 350, and bursts per km and year have gone from 0.70 to 0.19 on 2012.

References

Arbués, F. and Villanúa, I. (2006). Potential for pricing policies in water resource management: estimation of urban residential water demand in Zaragoza, Spain. Urban Studies, 43(13), 2421-2442.

Ayuntamiento de Zaragoza (2010). Sistematización de la red de abastecimiento de agua de Zaragoza – Sectorización – Aplicación de experiencias en sectores piloto. http://www.zaragoza.es/contenidos/medioambiente/switch/Sectorizacion.pdf

Farley, M. (2001). Leakage management and control. A Best practice training manual. WHO – World Health Organization. http://whqlibdoc.who.int/hq/2001/WHO_SDE_WSH_01.1_eng.pdf

Morrison, J., Tooms, S., and Rogers, D. (2007). DMA Management Guidance Notes. International Water Association-Water Loss Task Force.

Muñoz-Trochez, C., Smout, I., Kayaga, S. (2010). Incorporating energy use into the economic level of Leakage Model. Daniel Thevenot. World Wide Workshop for Young Environmental Scientists: 2010, May 2010, Arcueil, France.

Penagos, P. (2007). Systems Analysis of Zaragoza Urban Water System (Spain): A Preliminary Assessment of Environmental Sustainability. MSc Thesis, UNESCO-IHE Institute for Water Education, Delft, the Netherlands. http://www.zaragoza.es/contenidos/medioambiente/switch/Thesis_Guillermo_Penagos.pdf

Additional sources used

Arbués, F., and Villanúa, I. (2002). Potential for Pricing Policies in Water Resource Management: Estimation of Urban Residential Water Demand in Zaragoza. Water Intelligence Online, 1 (5)

Arbués, F., Garcia-Vilinas, M. A. and Martinez-Espineira, R. (2003) Estimation of residential water demand: a state-of-the-art-review, Journal of Socio-Economics, 32,.81-102

Arbués, F., Barberán, R., and Villanúa, I. (2004). Price Impact on Residential Water Demand: A Dynamic Panel Data Approach. Water Resources Research, 40 (11)

Ayuntamiento de Zaragoza. Proyecto de márgenes y riberas urbanas del río Ebro. http://www.zaragoza.es/contenidos/grandesproyectos/riberas_del_ebro.pdf

Barberan, C.A. (2008). Los costes de los servicios urbanos del agua. Un análisis necesario para el establecimiento y control de tarifas. Hacienda Pública Española / Revista de Economía Pública. 186-(3/2008): 123-155 Instituto de Estudios Fiscales. http://www.ief.es/documentos/recursos/publicaciones/revistas/hac_pub/186_CostesUrbanosAgua.pdf

Candidatura de la MI Ciudad de Zaragoza. Premio Capital Verde (2016). http://www.zaragoza.es/contenidos/medioambiente/ZGZVERDEES/ZaragozaGreenCapital2016.pdf

Cheong, L.C. (1991). Unaccounted-for Water and the Economics of Leak Detection. 18th Int.Water Supply Congress and Exhibition, Copenhagen, 123(8), 709--718.

Fundación Ecología y Desarrollo. Zaragoza ciudad ahorradora del agua. 50 buenas prácticas. http://www.agua-dulce.org/htm/portada/50BP/

German Bes, Concha. Abastecimiento de aguas de calidad para Zaragoza. El timo de Yesa. https://grupo.us.es/ciberico/archivos_acrobat/sevilla1germanbes.pdf

Guidelines for water loss reduction. A focus on pressure management. http://www.agua.unam.mx/assets/pdfs/novedades/Manual%20_WLR_ENG_low.pdf

Kayaga, S. (2013). Tariff structures and incentives for water demand management. Proceedings of Institution of Civil Engineers - Water Management. https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/14499/1/wama1200120h.pdf

Kayaga, S:, Sainctavit, L., Smout, I.K., and Bueno, V. (2008). IWA. Conference Papers (Civil and Building Engineering). Partnerships for enhancing the water-saving culture in Zaragoza, Spain. https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/6668/1/Smout%201.pdf

IWA Water Loss Task Force – Assessing non-revenue water and its components. http://www.iwapublishing.com/pdf/WaterLoss-Aug.pdf

IWA Water Loss Task Force – Managing leakage by District Metered Areas: a practical approach. http://www.iwapublishing.com/pdf/Water21_February_2004_-_Water_Loss.pdf

Lucea, J.G. (2010). Criteria used to design the water tariff, unpublished internal document, AYTO, Zaragoza, Spain.

Savenije, H., and van der Zaag, P. (2002). Water as an economic good and demand management: paradigms with pitfalls,. Water International, 27 (1), 98-104.

Smits, B., Buemo Bernal V., and Celma J. (2010). Zaragoza: taking pride in integrated water management in the city. http://www.zaragoza.es/contenidos/medioambiente/switch/Zaragoza_City_Assessment_2010.pdf

Smout, K., Muñoz Trochez, C. (2010). Adapting the Economic Level of Leakage concept to include Carbon Emissions, and Application with Limited Data. https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/6669/1/Smout%202.pdf

SWITCH, Final Report. Sustainable Water Management in the City of the Future - Final Report http://www.switchurbanwater.eu/outputs/pdfs/SWITCH_-_Final_Report.pdf

SWITCH in the city. Putting urban water management to the test- http://www.switchurbanwater.eu/outputs/pdfs/SWITCH_in_the_City.pdf

SWITCH Final Report, Sustainable Water Management in the City of the Future. http://www.switchurbanwater.eu/outputs/pdfs/SWITCH_-_Final_Report.pdf

Saragossa, 50 examples of efficient water use in the city. http://paginas.fe.up.pt/~mjneves/publicacoes_files/data/es/ponencias/por_autor/pdf/10045.pdf

SWITCH Zaragoza, Spain. Reducing water demand and establishing a water saving culture in the City of Zaragoza.

http://www.switchtraining.eu/fileadmin/template/projects/switch_training/files/Case_studies/Zaragoza_Case_study_preview.pdf

SWITCH - Deliverable D3.1.4. Documentation of tools and case studies on innovative water demand management.http://www.switchurbanwater.eu/outputs/pdfs/W3-1_CZAR_RPT_D3.1.4_Tools_and_Case_Studies.pdf

Appendix 4 Detailed of interviewees

Case-study	Institution	Name	Reason for interviewing	Date of interview
Aarhus	DHI (+ 50% Aarhus Water)	Anders Lynggaard-Jensen	Project manager of the technical innovation project	08/09/2014
Aarhus	Aarhus Municipality, Head of Centre for Environment and Energy	Claus Nickelsen	Project owner	27/10/2014
Aarhus	Aarhus Municipality, Innovation Manager	Jan Beyer Schmidt-Sørensen	Strategic role for innovation uptake in the water sector	27/10/2014
Aarhus	Aarhus Municipality, Environmental Section	Kaj Vestergaard	Core technical person since the inception of the project	27/10/2014
Aarhus	Aarhus Water	Henrik Frier	Relevant section head, currently in charge of operations	27/10/2014
Aarhus	Aarhus Water	Claus Møller Pedersen	Departmental manager, previously working for Krüger, core person in the establishment of the project	27/10/2014
Aarhus	Krüger	Nikolaj Möller	Core technical person in innovation uptake	29/01/2015
Emscher	EGLV (Dept. Strategic river management)	Ekkehard Pfeiffer	Responsible for stormwater management during Lake Phoenix planning	6/10/2014
Emscher	Phoenix See Entwicklungsgesellschaft	Ursula Klischan	Director of LP Entwicklungsgesellschaft, project coordinator of Lake Phoenix	29/10/2014
Emscher	City of Dortmund (Urban drainage agency)	Georg Sümer	At the environmental agency during Lake Phoenix development, now operating Lake Phoenix	11/11/2014
Emscher	City of Dortmund (Urban planning agency)	Norbert Kelzenberg	Architect who drafted Lake Phoenix	08/01/2015
Emscher	NABU Dortmund (NGO)	Dr. Erich Kretzschmar	Environmental NGOs involved in Lake Phoenix project	21/01/2015
Emscher	EGLV (Dept. water management)	Klaus Juchheim	Responsible for several Future convention on stormwater projects; coordinated the rainwater decoupling at Zeche Ewald	16/10/2014
Emscher	RAG Montan Immobilien GmbH	Benedikt Schmoll	Leading the development of brownfield areas in the Emscher region	7/11/2014
Emscher	EGLV (technical manager)	Dr. Emanuel Grün	Linked development of Zeche Ewald with Future convention on stormwater	09/01/2015
Emscher	RAG Montan Immobilien GmbH, Project leader Zeche Ewald	Bernd Lohse	Responsible for development of Zeche Ewald	12/01/2015
Emscher	City of Herten (councilor for building and construction, deputy mayor)	Volker Lindner	Responsible for development of Zeche Ewald	13/01/2015
Ebro	ZINNAE	Marisa Fernández	General Manager	7/11/2014
Ebro	ECODES (NGO) manager	Victor Viñuales	Main responsible of the “Zaragoza water saving campaign”	7/11/2014
Ebro	Director of the Zaragoza Environmental and Sustainability City Council Department	Javier Celma	Main responsible of the Zaragoza city Hall Environmental and Sustainability Department. Envisioned the “Zaragoza water saving campaign”	10/11/2014
Ebro	Technician at the Zaragoza Environmental and Sustainability City Council Department	Victor Bueno	Zaragoza municipality technician involved in water management and infrastructure improvement	10/11/2014
Ebro	University Professor	Pedro Arrojo	Director of the NGO “Fundación Nueva Cultura del Agua”	10/11/2014
Ebro	University Professor	Ramón Barberán	Responsible for designing the Zaragoza new water tariff	22/12/2014
Ebro	Responsible of the Zaragoza Taxes and Public Prices City Council Department	Joaquín García Lucea	Responsible of approving and coordinating the new water tariff	02/01/2014

Appendix 5 Filled-in guides

The following presents the results against each question of the governance assessment tool for each case-study. Five tables are provided, presenting results against each main criteria of the analytical framework:

1. Levels and scales
2. Actors and networks
3. Goals and ambitions
4. Strategies and instruments
5. Responsibilities and resources

1. LEVELS AND SCALES

	Aarhus	Zaragoza	Emscher
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?	The following administrative levels were relevant for innovation uptake for the Aarhus case: European: To define water quality targets for the project, the municipality adopted standards from the WFD and BWD (Möller et al 2014). As presented by the persons interviewed, the water quality standard of the BWD drove the design of the project. Although the project was not motivated directly by the EU Water Framework Directive (WFD), the WFD focus on a catchment-scale may have contributed to the catchment-scale approach. It is likely that the model of the upper catchment used in the bathing water warning system was developed as part of a WFD-motivated basin planning effort. While EU research support is not an administrative activity, it is also worth noting that the development costs of some of the innovations introduced in the project were supported by the EU FP7 research project PREPARED. National: No single Ministry in the Danish government is responsible for water supply and sanitation, which is considered foremost a local government responsibility. According to most of the interviewees, the national authorities stated their support publicly, in the local press etc., but they were never really active in the innovation uptake. On the other hand, the Danish government has the initiative called "State of Green" that takes the form of a public-private partnership and seeks to establish Denmark as a leader in environmental planning and so-called "green development". This was seen by some as an important part of the backdrop to the project. As noted in chapter 1, Aarhus aims to be a "Green City", with a focus on environment conservation, sustainability and development of green technology and solutions, aiming for a lead position in the country's "green economy". The Danish Environmental Protection Agency is responsible for environmental policy, and acording to one interviewee, the national authorities were approached directly as regards standards for climate change adaptation. They national authorities were, however, reluctant to engage actively. The impression held by the interviewee was that they are reluctant to offer guidelines or recommendations, since such efforts usually are met with expectations and requirements for funding from the municipal level. The initiative when it comes to climate change adaptation has therefore for a large part been left with the municipalities, and in the Aarhus case relating to the above-mentioned climate change scenario was a decision taken by the local actors themselves. Regional: Since 2007 the previous county level administration (Amts) in Denmark has been replaced by five Regional councils. The Regional councils are responsible for the use and protection of water resources, including extraction permits for large abstractions, and for monitoring the water quality of recipient water bodies	Municipal: Water and sewerage services are publicly provided and managed by the Municipality of Zaragoza, with responsibilities in planning and operating facilities. Regional government: Water Institute of Aragón: funds planning and implementation of water infrastructures; Ebro River Basin Confederation: in charge of planning, constructing and operating major water infrastructure, as well as preparing and implementing management plans for the river basin, including those for the Water Framework Directive National government: Ministry of Environment; Office for Infrastructures	*Lake Phoenix* Multiple levels were relevant for the innovation uptake. When looking at the EU level, we find that especially the WFD is important: Improving the hydro-morphology, necessary to meet the aim of a good ecological quality for the WFD (which was the interest of EG). Most important levels in this case are the regional and municipal levels (district councils, EGLV etc.). The national level is less important for the realization of LP. The hydrological scale of interest for the urban planners of the city of Dortmund was only the area which was to become a lake. The hydrological scale of interest for EG was the whole Emscheroberlauf/upper Emscher section which was considered to assess flood risk under various scenarios (with and without flood retention basin or lake). In addition, the lake was planned to function as a hot spots of ecological development, where wetlands and biotopes can develop without spatial restrictions (with the idea that via the "ripple effect" and links between the various hot spots a colonization of flora and fauna along the entire waterways is expected). *Zeche Ewald (Herten)* Multiple levels were relevant for the innovation uptake. When looking at the EU level, we find that especially the WFD is important: inspired by/in line with this directive the stream water quantity has to be considered (one of the arguments of why the decoupling of rainwater was considered advantageous for the blue ribbon). Most important levels in this case are the regional (EG, i.e. regional water association) and municipal level (city of Herten). The relevant hydrological scale is the area of ZE as well as the water bodies Resser Bach and Schellenbruchgraben.

	Aarhus	Zaragoza	Emscher
	(rivers, sea etc.), including authorizations to discharge wastewater. However, the regional level did not play any active role in the innovation uptake in the Aarhus case. Municipal: The municipal councils are responsible for the planning, administration and supervision of all water suppliers and the water supply infrastructure in Denmark. In the studied case, Aarhus municipality funded the project and was the principal driver. Aarhus Water is the public utility responsible for water, storm-water, and sewerage in the built-up area of Aarhus and had responsibility for implementing the project. At the start of the project, Aarhus Water was a department with the municipality, but in 2006 it became an independent company wholly owned by the municipality. The responsible unit in the municipality is the Centre for Environment and Energy (CEE), under the department for technical operations and environment (Afdeling for Teknik og Miljø). The environmental section at CEE has responsibility for the watershed of the Aarhus River and Lake Brabrand beyond the built-up area of the city and participates in the project by operating the catchment rainfall-runoff model that is part of the bathing water warning system.		
Were important administrative levels missing? To what effect?	According to the interviewees, the previous county level administrations (Amts) mentioned above used to play a more active role in water management, while the regional councils are less involved. In the case of the old Aarhus Amt, most of the staff that used to work on water management were hired and proceed with similar work tasks in the municipal administration and Aarhus Water. One interviewee said that the water specialists of the old Aarhus Amt and the municipality used to be *"at war",* thus indicating that development in the water sector became easier with the new structure, but he did not relate this specifically to the studied project. Within the city of Aarhus, there are no townships or administrative units below the municipality level, and none of the interviewed stakeholders felt that any administrative levels were missing.	It appears that Spain had a sophisticated multi-level administrative framework that covered local, regional, river basin and national scales. However, evidence from one interview and some documents indicates that the divided urban water management system in Zaragoza may have hindered a pro-active, efficient and coordinated action on the city's infrastructure.	All involved
Were there conflicts or synergies between administrative levels?	As mentioned above, the effort to develop Aarhus as a "green city" is aligned with the "State of Green" initiative. The BWD provided a water quality standard that drove the design of the project. The EU Water supply and sanitation Technology Platform (WssTP) played a role indirectly for discussions on technological solutions as well as sourcing of research funding.[3] There were, in other words, some synergies, although the strongest impact and lead role was taken at the municipal level. None of the interviewees mentioned anything to suggest that there were conflicts between administrative levels.	As mentioned under the first question, the 1990s and early 2000s are defined by strong tension between National government and the Aragon regional government regarding water transfers. In response, Zaragoza Municipality and the Regional government found synergies for promoting the WSCP. More recently, the National government has aligned his support for water saving by funding ZINNAE.	*Lake Phoenix* Mostly there were synergies, as all actors involved were supporting the realization of the project *Zeche Ewald (Herten)* Synergies existed between EG and the city of Herten, because both had advantages of rainwater decoupling. Also the companies hiring the real estates will have advantages (reduced discharge fees + sustainable appearance of the property/area)
Was it possible for one administrative	Since national authorities did not engage very actively, there was	The Municipality has taken a leadership role (together with	*Lake Phoenix*

[3] WssTP website: http://wsstp.eu/.

	Aarhus	Zaragoza	Emscher
level to take leadership for innovation uptake?	ample room for the municipality to take leadership. The high level of local autonomy in Denmark also made it possible to finance the innovation locally, so there was no dependence on other levels for funding either.	ECODES, an NGO –see section 2.2), but has relied on funding (and therefore policy support) from the EU and regional governments.	Although EGLV is leading the Emscher Conversion planning process and coordinating the implementation process, the PHOENIX See Entwicklungsgesellschaft took leadership in realizing the Lake Phoenix project because it was put in place by the city of Dortmund with the task of developing the area. Herewith, the Lake Phoenix project is as interesting example of the set-up of the overall Masterplan: serve as an umbrella, but leave initiative and power, if necessary or useful, to others. However, partly contradicting information was obtained from the interviews concerning the initial phase of Lake Phoenix – whether the city of Dortmund or EG inititiated the idea of a lake. It seems that the city of Dortmund intended to develop the area in a meaningful way and produced a draft of a lake including a restored Emscher - as they knew that EG will restore the Emscher in any case as part of the Emscher conversion. EG supported this idea of a lake – using it as a retention basin and ecological hotspot – and including it into the Masterplan, which did at that time not yet include the Emscheroberlauf. When LP was integrated into the Masterplan it resembled a "normal" Masterplan project, in which EG restores the Emscher (core area) and in collaboration with the cities develops the connecting area (integration area). *Zeche Ewald (Herten)* The city of Herten took leadership in developing the area in general because it was their task and they had a special interest in re-creating jobs and reactivating the site. EG provided the idea to disconnect the rainwater and supported the project (with knowledge and funding), but the planning offices and the project association Ewald planned and realized the measure. The ideas were pushed forward by the project association, but the "fathers of success" were several.
Was there a strong impact from a certain administrative level?	The first discussions leading up to the project were held in the city council in 2005, with more detailed discussions and planning efforts resulting in an outline of the final solution by 2006. There was a direct budget allocation from the city council, based on what they wanted to achieve, and by 2007 the final integrated solution was approved. It appears, thus, that the driving force was at the municipal level. That Aarhus Water was part of the municipality up to 2006, when the water utility was established as a separate enterprise, is an important background here. There were and are continued close relations between the municipality as project owner and the partners executing the project.	The main administrative level that was relevant for Zaragoza's urban water management initiatives (i.e. WSCP and ZINNAE) was the municipal level. In addition to the WSCP and ZINNAE, the Municipality implemented a major reform of the local water tariffs. However some interviewees (rightly) highlight that the council was slow in promoting water savings in their own activities in the 1990s and 2000s. It now takes a more pro-active stance within the ZINNAE initiative and through the recent Bylaw (2010).The Regional (in particular from mid 2000s, the Water Institute of Aragón) and National governments (in particular the Ministry of Environment) were/are also important sources of funding for the Water Saving City Programmes and ZINNAE. In particular, the National government specifically supported financially the creation of business clusters such as ZINNAE. The regional and national scales did not promote water saving policies in Zaragoza, except in an indirect way: the late 1990s and early 2000s saw tensions between the regional and national governments over possible water transfers from the Ebro to the south of Spain. Documentary evidence and interviews strongly indicate that the water saving approach of Zaragoza Municipality was a response to the water supply approach promoted by the national government. The European level was also a key source	*Lake Phoenix* The city of Dortmund, especially the major and council were those taking the crucial decisions when necessary. *Zeche Ewald (Herten)* City of Herten and the project association Ewald (put in place by the city of Herten) where it concerns the general development of ZE. EG, in person of Dr. Grün, gave the initiative by providing the idea to link the construction of the "Blue Ribbon" (which was part of the overall plan of developing the area) to rainwater decoupling in the long-standing area.

	Aarhus	Zaragoza	Emscher
		of funding for the WSCP and the ZINNAE via the Regional Development Funds and the Cohesion Funds. Additionally, interviews suggest that the requirement from the WFD for cost recovery and a water saving approach played a role for justifying the changes in tariffs . The Ebro River Basin Confederation did not arise as a major played in both documents and interviews.	

2. ACTORS AND NETWORKS

	Aarhus	Zaragoza	Emscher
Which actors were involved in the uptake of the innovation? Why? Which actors were only involved as affected by, or beneficiaries of, the innovation?	Public administrative actors are presented in 2.1. At this point we have to distinguish between the development of the overarching, integrated solution to manage water quality in the river and harbour and support the restoration of the river in the old city centre, and the sub-project to develop the system of real-time monitoring and control and the warning system for bathing water quality, which is our main focus in this study. Most of the interviewees traced the start of the overarching project to a vision forwarded by a local politician around 2003/2004. The politician faced the risk of not getting re-elected and was looking for a popular cause that might strengthen his position. He remembered how a particular section of the river used to be seemingly clean, nice and teeming with activity in his childhood days, and promised his voters that he would bring those things back. Around the same time, a local entrepreneur applied for permission to rent out kayaks for recreation on the river, but the municipality had to turn the application down since the water quality was too bad. This created negative media attention, which was embarrassing to the Municipality. At the same time, the City of Copenhagen had recently completed a harbour restoration that included the development of attractive bathing areas, and Aarhus had ambitions to emulate this success in its own harbour area. DHI had already been involved in the project in Copenhagen, and the water and sanitation experts in Aarhus municipality were tossing ideas with DHI and other development partners, so as one interviewee put it; *"Something was already going on,"* but the innovation only kicked off once you got someone with a strong vision, which *"related to an area people can understand easily."* A group of individuals including Claus Nickelsen, Claus Möller-Pedersen, and Kaj Vestergaard, who all were working for the municipality at the time, as well as Anders Lynggaard-Jensen of DHI, worked together to develop a proposal for a new solution. It appears that this happened quite informally in the initial phase, but later as a formal assignment. As one of the interviewees from the municipality explained; *"We were asked to find out if it could be done. "We" meaning the Centre for Environment and Energy and DHI. What does it take to deliver safe waste water for use as bathing water?"* Like any other major change in a city landscape, the overarching project was a subject of debate between a wide set of stakeholders. Restoration of the river has had a huge impact on the city centre, in terms of traffic, trade, recreation, etc., and there have been forces working for and against the changes among city planners, merchants, house-owners, and others. Improved water quality in the harbour has been related to development of new residential areas near the water, and according to one interviewee this aspect was associated with debates about the spatial distribution of social "classes", or different income categories, across urban zones, with worries that the new water front residential areas would be mainly for well-to-do people, and so on. However, all emphasized that on the whole, the water quality and river restoration project had broad popular support. There was no resistance as such, and the interviewees could not mention any stakeholders arguing against the project. The suppliers providing services and components, such as new trunk sewers,	Administrative/public actors are presented in section 2.1. Politicians. Two non-governmental organizations actors are frequently mentioned in the reviewed documents: *Ecología y Desarrollo* (Ecodes) promoted by Victor Vinuales with WSCP and ZINNAE; *Fundación Nueva Cultura del Agua* promoted by Pedro Arrojo Agudo with WSCP. Academic –University of Zaragoza: Pedro Arojo with WSCP, and Ramón Barberán and Joaquin García Lucea with water tariff change. Other actors: Semi-public investment bank; Water users themselves (e.g. households, large scale consumers) played a role by buying and installing water saving technologies on their premises; Professionals involved in domestic water use (builders, property agencies, promoters, architects, plumbers, distributors, manufacturers) in promoting uptake.	*Lake Phoenix (Dortmund)* Great number of actors involved in the uptake of the innovation: district councils; EG as water association of the Emscher catchment; PHOENIX See Entwicklungsgesellschaft/Lake PHOENIX developmental corporation (i.e. a 100 % subsidiary company of the public utility company (Stadtwerke Dortmund DSW21) which again is owned by 100 % by the city of Dortmund); major and council of the city of Dortmund; city of Dortmund agencies: urban planning office, urban drainage office; expert engineering offices, external project manager, consultants. Genehmigungsbehörde/authorizing agency (Bergrecht/mining law, Wasserwirtschaftsbehörde/water management agency, Abwassertechnik/ wastewater engineering, Landschaftsentwicklung/environmental planning), Träger öffentlicher Belange/public agencies, Kommunen/municipalities, Stadt mit Ämtern/city administration (Stadtentwässerung/urban drainage, Umweltamt/environmental agency, Bergamt/mining agency), Straßenverkehr/road traffic, Hösch (land owner)!, partly the land tenants (lease contracts of other companies were also on this area). Actors affected/benefited by the innovation: 1) the inhabitants of Dortmund received a new recreation area, the city was generally upgraded and made more attractive; 2) NGOs benefitted from LP , because a new ecosystem in the middle of the city was created as a new habitat for flora and fauna and with high biodiversity. *Zeche Ewald (Herten)* EGLV was fixed partner due to tradition and history, because RAG and the municipality of Herten are associates of EGLV, and thus, were traditionally always in dialog concerning water aspects. This owes for EGLV criteria and interests, like the Emscher conversion, to always be in their mind, even if EG was not “sitting at the table”. Despite this relationship the linking of the blue ribbon with ZVR was made quite late, so that (additional) funding from ZVR for the design/creation of the blue ribbon was not possible anymore. This is probably due to the fact that ZVR was only signed and published in 2005, and thus, this specific topic was not yet present to the project consortium. Project association Ewald (composed of the city of Herten and RAG Montan Immobilien GmbH): planned and conducted the development of Zeche Ewald and the decoupling measure - city of Herten: markets the real estates of the 2nd phase development, i.e. on the western side of the “blue ribbon” Beneficiaries: the citizens of Herten/public, the companies that have their offices on this newly developed area; economy, landscape associations/associations for the protection of historical monument, project offices. It was realized at an early stage, that the general redevelopment of ZE was a collective task and not to be realized as a classical ppp-project (public-private-partnership) but as a project association. [...] We discovered project associations as models of success and, in the following projects, applied this structure (Ewald was the first one). Project associations are also ppp projects, as they involve both public and private partner. But the project association established for the overall ZE development differed in that there was no legal partnership agreement in the beginning and no fixed conditions of investment, and thus, also

	Aarhus	Zaragoza	Emscher
	storage tanks and disinfection units, were mainly involved as affected by the innovation. All residents of Aarhus (and one could also say of nearby communities relying on the city's services) have benefitted from the improved water quality and attractions associated with the restoration of the river, which now is presented as a main attraction of Aarhus, to residents as well as visitors The project to develop of the system for real-time monitoring and control and the warning system for bathing water quality (in Danish: Samstyringsprosjektet) was distinct from the project to develop the overarching integrated solution, in that it was organized as a technological development project on its own. There was a competitive tender process where DHI and Krüger formed a consortium and became the winners over two other consortia. The work has formally been a partnering project, carried out by DHI and Krüger for Aarhus Water. DHI (Danish Hydraulic Institute) is an international research and consultancy firm with 1200 employees, specializing in water environments. Krüger A/S acts as consultant and contractor, as well as supplier of equipment, services, and solutions for the water sector. It is a subsidiary of Veolia Water Technologies, and manages the parent company's activities in Scandinavia, Finland, Poland and the Baltic countries.		no entry in the commercial register. This spared administrative effort. Later on (in 2003), a special/personal (*"nicht juristisch fundiert"*) contract was signed. "The legal form does not matter, it is important to work together collectively." The "landscape park Hoheward" is a collaborative project between RVR, the city of Recklinghausen, the city of Herten, and RAG (not RAG MI!) and was also organized as a project association. A link to ZE was made via the city of Herten who was participating in both project associations. Actors that were only affected or benefited from the innovation: None, all of them were actively involved. However, as explained below, a distinction should be made between the general development of ZE (characterized by relatively active public participation), and the decoupling efforts in (very little public participation).
What forms of dialogue (e.g. public participation, expert fora, etc.) existed between actors? Were they informal or institutionalised?	The forms of dialogue regarding the overarching project and the planning that went ahead of the technical innovations seem to have centred on the city council and its meetings. According to the interviewees, the political discussions were all over and done with in relation to the overarching project, before the sub-project and the technical innovations we focus on here were taken on board. As the innovations did not involve any major physical changes in the city, and were not particularly costly or in other ways controversial, there was not much public dialogue on these aspects in particular. That Aarhus *"is not a very big city"* and that there are close relations between individual water management experts in the municipality, Aarhus Water, Krüger, and DHI was considered important by most interviewees. According to one key actor, this was *"decisive"* as far as the successful innovation uptake was concerned. It is most often the people you know well you consult or throw ideas with, he said, and the way he saw it, smooth, informal communication was a characteristic of the process. The key actors also appear to have been working strategically in other forums. In an early phase, Anders Lynggaard-Jensen of DHI played a key role in the EU Water supply and sanitation Technology Platform (WssTP), and was already then thinking of the project, working consciously to promote topics and call texts relevant for Aarhus/Aarhus Water. He was among the main contributors to the call text that emanated in the PREPARED project, which provided funding and a forum for technical discussions regarding some parts of the overarching project in Aarhus. The EU project SWI was also an important forum, where Krüger and others already had worked on the central algorithm in the solution selected for Aarhus during this project. Aarhus Water initiated the planning project for the monitoring and warning systems, and asked DHI and Krüger to work together and combine their expertise. While smooth, informal communication was important, the interviewees also emphasized that the dialogue was open and straightforward. As one put it; *"we had very good control – everything had to*	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 "*Congreso Ibérico sobre Planificación y Gestión del Agua*" (academic congresses held in Zaragoza in 1998 and subsequently held every two years across Spain). Zaragoza municipality started to foster dialogue 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*. The WSCP, and possibly the water tariff change, benefited from the Agenda 21 related public discussions. Indeed, interviews indicate that the existence of a structure public fora for debating water issues locally helped build trust and agreement on the need for water savings. Set up in 2010, ZINNAE is an institutionalised fora of firms,	*Lake Phoenix (Dortmund)* The public could get informed and could participate via the public plan-approval procedure. The public: planning documents were publicly accessible and objections could be made – which was also made use of. "[...] The status and process was explained in order to take the citizens along the process and to react to concerns or problems, such as dust and noise." The final outcome of the project was not a critical aspect, but the several-year-construction was a burden to the residents. Via citizens participation, the two main topics were i) how the residents were affected, and ii) about the number of planned houses. At first, NABU only learned about LP via the press. Later during the planning approval process, when the plans were to be developed, NABU as public interest group was involved. So they got to see the plans in quite an early state. They were involved in parallel to the planning approval process. [NABU was] asked for feedback. Some meetings were very official via the advisory board of the lower landscape authority; some meetings were in-formal with everyone invited who might contribute. *Zeche Ewald (Herten)* Informal forms of dialogue: Informal public participation, regular project meetings with expert planning offices For the citizens of Herten, the ZE area was beyond the actual city, and thus, not consciously present in people's minds. We realized that in order to be able to market the area later on, it had to come into the citizens' consciousness. "The citizens had to be taken along" in order to identify what interest and aims they have. The development of Halde Hoheward and the connection between Zeche Ewald and the Halde was a result of this. Public participation results in acceptance and hope. Ewald is now in the consciousness of the citizens and is integrated. Forums of dialog were workshops, public processes, public drafting process, non-

	Aarhus	Zaragoza	Emscher
	be sharp, with respect to tender competitions, agreements, etc… [One of our lead persons] was especially good at, and took responsibility for these things – to make sure that everything was done according to the law." Once the solution was approved by the city council, the project that led to the uptake of the innovation was put into a competitive tender process. DHI and Krüger formed a consortium in order to give a bid on the tender and became the winners over two other consortia. The work has been done as a partnering project. The project had a steering committee with representatives of the three partner companies, but there were no conflicts or other major issues requiring active involvement from this committee. As key actors in the project put it, they knew what the objectives were, but not exactly how to get there, so there was a very close collaboration between the three partners throughout the project, whereby *"all got wiser along the way"*. The importance of good personal relations was strongly emphasized regarding this level, too. – *"Whenever we wonder about anything, we just pick the phone and ask"*, said one interviewee. Another mentioned that the model for the harbour is more detailed than the rest, and made it a point that this happened simply as an agreement with an individual representative of the municipality, without any formalities to go with it. Information to the public about the monitoring and warning systems has been handled by Aarhus Water and the municipality, mainly through the internet.[4] In the phase where the main infrastructural elements were constructed the project received considerable media attention, and the municipality made it a point to invite the public in to see the newly-constructed features, amongst other by arranging a concert in the largest retention basin before it was filled with water. However, none of the persons interviewed were able to explain about any specific communication or awareness-building strategy, and they did not consider these aspects important to the innovation uptake.	research institutions and local and regional administrations that have grown and matured through the activities of WSCP. 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 pretends to attract innovative activity from Spain and worldwide and a new variable to be introduced with this initiative is energy efficiency linked to the urban cycle of water. In addition, 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 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).	formal dialogs (history association, citizens). The public was involved in the overall development but not specifically in the decoupling. The participation started when the shutdown of the mining operations became official. Discussion with the regional public about options for a future utilization of the area followed. Public participation was part of the drafting process for the concept for the Halde as well as for the former mine. For example, in hearings, the public presented their suggestions as information to the landscape planners (e.g. horizon astronomy/"Horizontastronomie" resulted from citizen's suggestions). For ZE, participation of the citizens took place only during the draft planning, where they could look over the shoulder of the planners. The drafts were then first presented to the public and discussed before a jury decided about the winner. In addition to the general public, the professional public was involved via the engagement of the University of Berlin (TU Berlin) who drafted a joint concept/consideration of the Halde and the mine area. This was the impulse for further planning of a combined concept. Later on, public participation was also conducted on the concrete operative land-use and building planning. However, the main conceptual decisions on the overall concept had been taken before – also with public participation (different ways of participation: consultation on the overall planning concept in the beginning. Then, consultation/information about concrete operation (=building) and later on, it was only informing the public) As an official decision on the Future convention, an informal commitment was agreed upon by the representatives of the Emscher cities instead of a formal contract. This had several advantages: Whenever necessary, the latest data and information as well as specifically adapted methods can be used rather than only generally accepted and standardized methods. Preconditions of such an informal convention are that it is only successful on the basis of a common goal and a convincing concept and continuous dialogue. Institutionalised forms of dialoge: The actors involved are at the same time members/associates in the EGLV council/association (EGLV law). This has the advantages that having the cities, municipalities, mining companies, and industry companies as members of EG allows an integrated consideration of all problems or interests of these groups.
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?	The response to this question from all the interviewees was that yes, all relevant actors were involved, and it was possible for new actors to be included in the process through the city council meetings and the associated public hearings. The bidding process was also open. On the other hand, the importance ascribed to close interpersonal relations and informal communication may suggest that some parts of the process took place in smaller and more closed fora, where it may have been more difficult for new actors to be included. When asked if/why no universities or research institutes were involved in the process, most of the interviewees responded that they did not see this as relevant, as the innovation was implemented through "hard-core" technology development that was unlikely to be augmented significantly by the participation of academic researchers.	Citizen and academic movements and the creation of several venues of public participation across the 1990s and 2000s (see question above) suggest that past fora were inadequate before the 1990s 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 lacks 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. Several factors may explain the lack of engagement.	*Lake Phoenix (Dortmund)* All relevant actors were involved in the project. [interviews] Also the public was involved from the beginning on. NGOs were involved parallel to the planning approval process. The plan is actually subdivided in several spatial/zoning plans, each of which is being presented to the public interest groups and approved by the politicians. In the frame of the legal regulations the NGOs were invited and asked for feedback. Some meetings were very official via the advisory board of the lower landscape authority; some meetings were in-formal with everyone invited who might contribute. NGO NABU, however, stated that they weren't involved at the very beginning of the plan development [What is missing is that the NGOs are asked for their opinions in the initial phases. "Once a plan has been produced and printed – even if it is the first draft – it is difficult to suggest changes.] and after

[4] See http://www.aarhusvand.dk/ and http://www.youtube.com/watch?v=pHqm8v55R9k.

	Aarhus	Zaragoza	Emscher
	If we consider the technical development project, only the original partners and no further actors were included. Without specific needs for external expertise, the partners preferred to share the funding and tasks as agreed in the bid to tender.		the initial phase [we were even ignored.] *Zeche Ewald (Herten)* Yes. However, for ZE, participation of the citizens took place only during the draft planning, where they could look over the shoulder of the planners. During the draft planning phase the degree of participation was consultation whereas later on it was more on the level of informing the public.
How would you describe the strength of interactions (e.g. history of working together) or opposition between actors?	There was a history of long-term collaboration between the municipality and DHI, as well as between the municipality and Krüger. Many of the core technical experts knew each other very well, having worked together on various projects and from different positions in the involved institutions over the years. To illustrate the level of interconnectedness: Claus Nickelsen of Aarhus municipality had previously worked for DHI. Claus Möller-Pedersen previously worked for Krüger, and Anders Lynggard-Jensen previously worked for Aarhus municipality. Aarhus Water used to be part of the municipality, and preceding the project to develop the real-time control and warning systems there was a planning project by the same three actors. Here, Aarhus Water specifically asked DHI and Krüger to work together and combine their expertise. Historically, Krüger and DHI have always been both competitors and partners. Both already had Aarhus Water as quite a big client, but had never worked together in projects for Aarhus Water (which at that time still was a department in the municipality). During and inside the project the actors supported each other – although outside the project DHI and Krüger had their usual competition. As one interviewee put it; *"The project demonstrated that human relations can overcome company barriers"*. During the project, some felt the role of staff from Aarhus Water evolved from a client role to active involvement and participation. However, others indicated that Aarhus Water was more of a development partner in the early stages, but took a stricter *"customer"* approach at a later stage. All emphasized that personal relations were good throughout, and that the overall collaboration went well. That the partners (DHI and Krüger) were two local offices collaborating – not one or both of them being main offices of their respective companies – was considered to have contributed positively, as the partners had a common interest in sorting things out together locally.	It is clear from documents and interviews that, following the water crisis of the 1980s and 1990s, the 1990s represents the crucial moment when actors started to formally work together through the SCIP. A key driver for more local and regional collaboration was the opposition to the national plan to transfer water to the south of Spain. Interviews and documentary evidence indicate that the implementation of new water tariffs was accompanied by minimal social opposition. Interviewees stressed that this was thanks to the established public debate that occurred over 7 years (since the first WSCP). The strength of interaction continues with the various projects described in Step 1 and through ZINNAE. Currently, Zaragoza can build on a well-established network of local stakeholders involved in urban water management, in particular through ZINNAE. Interviews suggest that collaboration was strongly promoted by two persons (see answer to question on policy entrepreneurs below) in the NGO ECODES and the Municipality. There is evidence from interviews that, despite willingness, pro-active participation by firms as well as other sections of the Municipality was/is not as high as expected. For example, several interviewees stated that construction workers (e.g. plumbers, building companies, etc.) did not pro-actively install water saving devices on new or renovated buildings. Similarly, the council, despite policies and plans promoting water savings, did not actively implement changes in its operations (parks, cleaning of streets, etc). A Bylaw was passed in 2010 to overcome through regulations this lack of investment. Finally, ZINNAE is composed currently of 22 partners in 2010, now 27 – while the target is 40. Interviewees indicate a lack of strong participation from private firms.	*Lake Phoenix (Dortmund)* No oppositions between the actors existed. A history of working together existed between EG and the city of Dortmund, between the city of Dortmund and Stadtwerke (Stadtwerke had already developed another area), between EG and the district councils, and also between the NABU and the city and with EG. *Zeche Ewald (Herten)* history of working together: EG & city of Herten as well as RAG MI & city of Herten had a history of good collaboration. tradition of cooperation between EG and the Emscher cities due to the association concept: city representatives take part in EG council meetings
Were there actors with a mediating role?	No specific information to report on this point, see the next section.	Documentary evidence and interviews strongly indicates that ECODES had a significant role in mediating the public debate. It is suggested that NGOs such as ECODES hold more credibility amongst citizens when promoting societal change.	*Lake Phoenix (Dortmund)* The financial contribution of EG had an important mediating role. Also the Entwicklungsgesellschaft who had to bring the project forward, needed to act as mediators to find compromises between different interests. *Zeche Ewald (Herten)* The project association Ewald was the central player, as it consisted of both the city of Herten and RAG MI, both the main actors involved. ZE represents a project in which all parties involved, but not one actor in particular, had a mediating role. For instance, the cruccial link between the project association of Halde Hoheward and the project association of ZE was made via the city of Herten who was participating in both project associations; RAG MI had a big

	Aarhus	Zaragoza	Emscher
			interest in developing the area successfully (their task), and thus, made efforts in finding consense in order to proceed with the project; EG made the other cruccial link between the blue ribbon and ZVR, acting like a mediator in this case. The city of Herten was mentioned to have been a good and motivated partner, wanting to advance the project.
Was there a strong influence or pressure from one or more specific individual actors ("policy entrepreneurs") and/or coalition of actor) towards supporting/preventing innovation uptake?	The above-mentioned vision of a lead conservative politician, who wanted to restore a particular kind of "Leben" along Aarhus River, became quite influential, coinciding with the "Green City" and "State of Green" initiatives and the BWD. The core technical experts in Aarhus Municipality, in dialogue with their long-term development partners in DHI and Krüger, were able to draw on this vision and encourage the city council to address *"a larger geography"*. At an individual level, Claus Nickelsen (Aarhus Municipality) and especially Claus Möller-Pedersen (Aarhus Water, previously Aarhus Municipality) played important roles. Claus Möller-Pedersen was credited by several interviewees as the one who insisted that DHI and Krüger should cooperate, as well as for selecting a partnering form of contract, that many felt was prerequisite to the close and fruitful collaboration. Anders Lynggaard-Jensen, who was the lead person from DHI and acting project manager during a critical phase, also played an important role throughout the initial planning and execution of the project. Lynggaard-Jensen's engagement in the Water supply and sanitation Technology Platform (WssTP) was important. He was among the main contributors to the call text that emanated in the PREPARED project, which provided funding for parts of the overarching project in Aarhus. Kaj Vestergaard from Aarhus municipality was also mentioned as an individual driving force. Most interviewees also mentioned that representatives of Krüger were important, but they did not focus on any person in particular.	Interviews and documentary strongly suggest that two individuals respectively in ECODES and the Municipality had a significant role in promoting WSCP and ZINNAE. 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 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 include: Building the evidence base: move from words to facts in order to convince large number of people; Prioritisation over time: first on domestic issues, then on broader issues; Use of "symbols" to build interest/support: Zaragoza International Exhibition, "100,000 commitments"; Use of regulations to systematize uptake: 2010 bylaw to upgrade water distribution networks when any infrastructure works on streets are made; Issue linking: need better water quality in Zaragossa, "if we are going to spend money in an infrastructure to bring water, let's use it properly and don't waste it"; Building a discourse: "kind of epic, an initial challenge, a collective dream were citizens understand that every individual action has a meaning, a course and a direction"; Being simple with measurable targets: "saving 1.000 million liters", using indicators; Building collaboration: building trust, manage egos, value all positive initiatives; Multiple forms of language: based on logic, emotions, fear; Gaining broader/international support/legitimacy: Agenda 21; Time and education: raising awareness, leave time to think and adopt, target children and women ; Use of pilots: well defined, enthusiastic group of actors willing to adopt new practices, and advocate the benefits; Use of symbolic agents: use of social facilities/change agents as more trustworthy (than e.g. municipality). It appears from interviews that combination of a NGO promoter (to build citizen support) and a promoter inside the institutions (Municipality) (to build political support) was key to promote the demand approach. In addition, the two actors insisted on their respective respect, agreement on key values and trust –elements that were key to maintain the relationship over the 20 years of collaboration. It appears important that the NGO did not take a "blame and shame" attitude towards institutions. Some evidence that Pedro Arrojo from Fundacion Nueva Cultura is a prominent environmentalist and professor (vice dean of the Economics Zaragoza University, winner of the Goldman Environmental Prize for Europe). He contributed notoriously to oppose the government National Hydrological Plan 2001 which promoted water transfers between river basins and regions	*Lake Phoenix (Dortmund)* Yes. Throughout the plan development several individuals clearly stood out, were willing to take risks, and believed in the project. Examples are the major of Dortmund, who believed in the idea, published the idea, and assured that a feasibility study was conducted. *Zeche Ewald (Herten)* EG, in person of Dr. Grün, gave the initiative by providing the idea to link the construction of the "Blue Ribbon" (which was part of the overall plan of developing the area) to rainwater decoupling in the long-standing area. His involvement didn't mean that he claimed the plan, on the contrary, he had the strength "to let go" the idea so others could take it forward.

	Aarhus	Zaragoza	Emscher
		across Spain. The NGO played a role in raising awareness on alternative solutions to water supply approach as part and in parallel to the WSCP. Changes in water tariffs were led by the Municipality based on WSCP work. However, they sub-contracted the University of Zaragoza to lead onto the review and proposition of new tariff structure and levels.	

3. GOALS AND AMBITIONS

	Aarhus	Zaragoza	Emscher
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?	In the beginning of the 1990s debates began about the advantages of a car-free city centre in Aarhus, and in this connection the obvious thing was to re-open the river. Two parts of the river were re-opened in 1996 and 1998 respectively. The 'green city' and the new integrated water management solution seem to have been closely linked to a broader and more long-term ambition as regards city development. – *"It started as a political thing, in the city council,"* said one interviewee; *"They wanted kayaking in the river, swimming in the harbour, as in Copenhagen. But it was basically about decent water quality, from there to open up a buried islet, and then into the bigger project. So in a way it was irrational, started with city planning, not with water…"* A report from Aarhus municipality regarding water quality improvement in Lake Brabrand, Aarhus River and the harbour (Aarhus municipality 2006) puts emphasis on cultural services and recreation both around Lake Brabrand, the river and Aarhus harbour, as well as protection of the natural environment around Lake Brabrand, which is a EU Habitat area. The vision, as described in the report, was mainly one of improved recreational opportunities, but also economic gains for house- and landowners along the water fronts, and economic gain for the municipality, through increased attractiveness and possible increase of land values. The politician with the initial vision lost the elections, but through his ambitions the grounds had been prepared for the river restoration project. To use the words of a different interviewee; *"The fruits were reaped by others and the vision was slightly changes, framing the project as a climate change adaptation project."* In its Youtube presentation of the new solution, Aarhus Water presents it as a fancy high-tech investment for the future, to keep the city and its people safe and comfortable in a changing climate situation.[5] This may also be related to the green city initiative, where promotion of local green industry seems to be a central component. The goal to achieve bathing water quality in the harbour was quite ambitious and quite different from the status quo as the citizens experienced it before the innovation uptake. It may, however, also be seen in relation to a similar project in Copenhagen, and the perception that Aarhus should not lag behind the capital when it comes to green technology. The innovations in focus were small parts of the 50 million EUR project, where most of the budget went into infrastructure. The amount spent on monitoring and control was not controversial and resulted in considerable savings on infrastructure costs	The supply-side approach, through the construction of water reservoirs and water transfers, thereby securing additional supply of water resources, was at the core of the *Plan Hidrológico Nacional 2001* developed by the Spanish Government since the late 1990s. The plan, with a total planned cost of > 24.000 million Euros, consisted, amongst other measures, in constructing more than 100 reservoirs and transferring water from the north of Spain, in particular from the Ebro river basin, to the south. The demand side approach was constituted with an array of perspectives. Changing water use patterns of urban households and businesses, including behaviour change and uptake of water efficient devices, was the focus of the early actions (WSCP). Changes in water tariffs were associated with mainly three perspectives. The first one was associated with a lawsuit led by citizens which believed the structure and levels of tariffs disproportionately impacted certain users (in particular large families). The second one expressed the need to change tariffs to better incentivise water savings. The third one was that the tariffs were opaque, and did not appear to secure cost recovery of urban water services –a criticism linked with the implementation of the WFD which from the early 2000s put renewed emphasis on the cost-recovery principle of water services. Saving Municipal water became one of the focuses in the early 2000s including changing water use patterns (through WSCP), reducing urban leakage, and renovating urban water infrastructures. Leakage management was explored and implemented (notably via the SWITCH project). Leakage entails reducing pressure, especially on nights to minimize leakages, as well as to identify those infrastructures to be replaced.	*Lake Phoenix (Dortmund)* Lake Phoenix could be considered as a multiple-purpose project par excellence. It was supposed to serve as a biodiversity hotspot, as a flood retention basin, as a place for local recreation, water sports, and sports along the lake shore. Furthermore, it should make the area, and thus, the city more attractive for both people and businesses. status quo: A large area turned into industrial wasteland in 2001 after shutdown of the steelworks industry --> goal: urban development, using the area as high quality and attractive recreation area and as driver for real estate and business, water retention basin and restoration of the Emscher. Due to the realization of the lake, the area witnessed not only a dramatic spatial and ecological transformation but also major social changes, including the arrival of wealthier residents. *Zeche Ewald (Herten)* For the general development of Zeche Ewald, the actual tasks were to re-create jobs. Linked to this was the aim to reactivate this industrial location. Additional aims were a qualitative urban design and development, sustainable development, and the creation of the best possible development on the area by making use of the location, the long-standing buildings, and the large-scale. In a second step, it was aimed at a new development in concert with the Halde Hoheward and the area surrounding it. Economic aspects: creating jobs; no mono-structural development, but to stand on several pillars (create a resilient area which is not sensitive to crises, i.e. does not lead to new structural change problems, if one of the several branches of business is subjected to an economic crisis); ecological requirements. Plus, the IBA gave initiative to the change to supporting SME. It was an impulse to integrate aspects like landscape and ecology and it was inner consciousness for responsibility. And it was the link to the Emscher conversion. Summarizing, ZE was supposed to be turned into a high-quality, sustainable, and self-supporting area with multi-purposes. For this, it should also have an attractive design in order to structure the whole area as well as to integrate ecological quality – which was aimed at by an attractive water course on the area. This idea resulted in the blue ribbon. The decoupling measure at Zeche Ewald was conducted because the “blue ribbon” needed to be provided with fresh water. In general, the ZVR aims at a relief of the canalization, an improvement during low flows, and a contribution to flood control during heavy rain. A strong synergy exists between the goals flood control, rainwater management, adaptation to climate change, compliance with water framework directive, urban development, increase in biodiversity & and environmental education (e.g. water related topics in schools). status quo: abandoned coal mine --> goal: development of a new multi-functional, high quality, and future-oriented business area, providing new

[5] http://www.youtube.com/watch?v=pHqm8v55R9k

	Aarhus	Zaragoza	Emscher
	because of the bathing water warning system. Key actors emphasize that the monitoring and warning system is saving a lot of money for Aarhus City, since the BWD permits one non-compliant event per year if a warning system is in place, without which would be required additional infrastructure costing 25 million EUR. The implemented solution does not represent a radical departure from existing infrastructure, as it uses existing infrastructure components and augments these with new components that could be considered standard grey infrastructure solutions (CSO storage tanks, wastewater disinfection, etc.). Indeed, it could be argued that the solution represents an innovative effort to increase the effectiveness of standard infrastructure components through integrated operation.		jobs. Status quo: blue ribbon was planned, but water provision was still an open question --> goal: idea of using fresh rainwater was welcome; associated goals were (mainly of relevance for EG): a) infiltration for flood control, b) infiltration for groundwater recharge and to compensate for water level fluctuations in streams; c) infiltration to decrease water volumes in combined sewer channels.
To what extent did views/arguments /positions support each other, and to what extent were they in competition?	As presented by most interviewees, nobody was against the idea of improved water management and improved water quality. Indeed one of the success factors to the innovation uptake seems to have been that key actors were able to link the various arguments in such a way that they supported each other – urban development, green focus, attracting and keeping good tax payers, recreation, real estate values, improving water quality, climate change adaptation, promoting the Danish water sector – as arguments for a new, integrated water management solution.	The competition between supply (traditionally supported by public bodies) and demand (traditionally supported by environmentalists) approaches is a long-standing debate. At national level, this conflict was crystallized around the *Plan Hidrológico Nacional*, and was ultimately by the two main political parties to gain support in national elections (left-wing defended the demand approach while right-wind defended the supply approach) – thereby attaining a high degree of polarization. The *Plan Hidrológico Nacional* received significant resistance across the country and was ultimately abrogated in 2005. There were questions of regional sovereignty, as well as concerns on the environmental impact of water transfers in the Ebro basin. It is important to highlight that the debate was highly politicized so it didn't help to reach agreements, and, as a consequence, both approaches were more in competition than complementing each other. The Regional governments of the North, including Aragón in which Zaragoza is situated, strongly opposed the transfer of water resources to the south of Spain. The strongest opponents however were environmental NGOs and several high profile academics who saw the building of reservoirs and water transfers as a way to provide water for unsustainable development paths (in particular intensive agriculture). There is strong evidence from documents and interviews that Zaragoza's WSCP was a reaction against the National Plan and other plans to build more reservoirs to show that a demand approach increasing water efficiency and savings was possible ("leading by example") and put pressure on southern regions and intensive water users. Changing household water use and fostering the uptake of household water saving technologies was therefore consensual between NGOs, regional and Municipal (in particular the Environmental and Sustainability Department) public actors. Interviews suggest that private actors, in particular the construction sector (plumbers, etc.) were less supportive and did not pro-actively install such technologies. Interviewees indicated/believed that changes in water tariffs were rather consensual. The new tariffs were based on three principles which aimed to meet the requirements of the different views expressed (see answer to question above): equitable distribution of costs (single vs multiple household members), cost recovery in the long run (operation and capital costs for varying levels of use) and incentive to consumers to save water. A number of knowledge generation and dissemination tools were used before the reform (see below). Interviews suggest that the Municipality was more pro-active with leakage reduction than with renovating urban water infrastructure. One difficulty was to obtain political commitment for such investments since they are "not visible" to the general public and little political gain can be obtained. Interviewees commonly regretted the lack of change	*Lake Phoenix (Dortmund)* On the whole, the positions of the different actors involved were in line with each other. All parties expected to realize their goals by transforming the former industrial area into a lake [The interests of Lake Phoenix Entwicklungsgesellschaft (developing are for marketing real estates), EG (large lake area to allow for flood retention, good water quality, large floodplains) were each supporting single aspects of the project and in concert served to develop the overall project]. When looking at the exact dimensions and further details of the plan, the actors, at times, had serious discussions. For instance, PHOENIX See Entwicklungsgesellschaft was strongly aiming at marketing the area in a profitable way in order to re-finance the project. Thus, they were interested in obtaining as much real estate area as possible. EG instead needed area to develop a lake large enough to assure flood retention and sufficient area to create a near-natural bed for the Emscher river and its floodplains.This resulted in a conflict of area, but a compromise could be made. There was a discussion if the part between lake and Emscher could be turned into a bike path. Now access in all this area is prohibited along the Reed bed (20-30m from the shore), allowing a much quieter natural area then on the other shore side, where the bike path is next to the lake. This was a result of NABU`s initiative. *Zeche Ewald (Herten)* Arguments supported each other, since there are several advantages resulting from rainwater decoupling that complement each other. The necessary investment in a decoupling project is a competing argument at the first glance, but the cost saving in the next years allows for amortization.

	Aarhus	Zaragoza	Emscher
		in urban water use practices (e.g. cleaning streets, watering parks) until the late 2000's when a Bylaw was finally taken. Finally, much of the focus of water infrastructure investment in the Ebro in the 1990s and 2000s was the extension of the Yela reservoir on the basis of improving urban water quality for Zaragoza. One interview strongly criticised the Yela project, stating that the money could have been better allocated to upgrading the network, and arguing that the Yela project real objectives were to increase water supply for irrigation. The example of the Yela reservoir to provide Zaragoza with safe drinking water is a good example of a supply side solution still being adopted locally in the 2000s.	
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 uptake?	The very first alternative considered for improving the water quality in Aarhus River and the harbour was a trunk sewer solution. A proposal at around 50 million EUR had already been proposed for such a solution, but then, said one of the interviewees from Aarhus Water; *"we asked ourselves why have only one main pipe channel? It would be better with basins or pools, a more advanced and adaptive solution… This would be one of the first places in the world where one would get an integrated solution with everything integrated in one monitoring system, so the idea caught on very quickly. The main background was the desire to live up to the EU bathing water directive."* The main compromise that was made was that Krüger and DHI, who otherwise did not collaborate on projects for the municipality, explicitly were asked to come up with a solution together, combining their respective areas of expertise. In the process leading up to the selected solution, five alternative proposals were made, all of good quality. The chosen solution would provide bathing water quality in Lake Brabrand and the harbour, as well as greatly improved quality (though not necessarily bathing water quality) in Aarhus River itself. This solution had the estimated cost of about 50 million EUR. The most expensive proposal that was brought forward had a cost of 67 million EUR. The difference was that the 50 million solution included an advanced monitoring and optimization tool with a warning system for the bathing water quality, which resulted in considerable infrastructure cost savings. A point made in several of the interviews was that with the new EU bathing water directive, and also due to more restrictive national requirements, a warning system for bathing water quality had to be included as one of the basic conditions in the project. This, in turn, affected the dimensioning of the retention basins. 3-4 alternatives solutions for this were explored. They were founded on the same basic principles, but involved different sizes and locations for the basins. – *"By 2006,"* said one interviewee; *"we decided that it would take 7-8 new waste water retention basins. The best option would have been to separate everything, but that was not possible. So it was decided to develop an improved joint sewage for the whole city centre."*	The WSCP together and the existence of several water-related institutions at Municipal (Agenda 21 commission) and Regional (Aragón Water Institute) and river basin (Conferedación) during which consultations occurred suggest that actors were encouraged to present, discuss and re-assess their perspectives. It appears that no particular perspective dominated the process (at least in terms of the mixed results on water savings in households vs Municipality and the Yela reservoir, see answer to the previous question). The two core change agents (see section 2.2) argued that the success of their collaboration was in part due to the compromises made between them and the avoidance of blame and shame attitude from the NGO. They also believe that the lack of political associations (left-right) with the WSCP and other water saving initiative, and the support built amongst citizens and key social actors in Zaragoza through the WSCP helped to reduce controversies (e.g. on the need to change water tariffs) and the political polarisation that could have occurred. The two core agents mentioned a number of strategies they used to challenge others' views: - Building a discourse: "kind of epic, an initial challenge, a collective dream were citizens understand that every individual action has a meaning, a course and a direction" - Multiple forms of language: based on logic, emotions, fear - Use of "symbolic ideas" to build interest/support: Zaragoza International Exhibition, "100,000 commitments" - Issue linking: need better water quality in Zaragossa, "if we are going to spend money in an infrastructure to bring water, let's use it properly and don't waste it"	*Lake Phoenix (Dortmund)* The most significant compromises that were made in the development of Lake Phoenix are related to the size of the lake and Emscher floodplain, and hence the area (not) available for housing. Arguments for the (minimum required) size of the lake and the floodplain were technical (based on studies related to flood retention and sufficient area to create a near-natural bed for the Emscher river and its flood plains), while arguments on the size of the housing area were financial – as the marketing was part of the project funding. *Zeche Ewald (Herten)* The idea of rainwater decoupling of the long-standing areas was probably introduced at a later stage in the process, which is a kind of re-assessment of own perspectives.
Did new knowledge of the	As noted above increasing awareness of urban lifestyles, the value placed on recreational opportunities, and the influence of	The WSCP was strongly based on the view that water savings had to be promoted with evidence, and by providing concrete examples; an idea that is also embedded in ZINNAE	*Lake Phoenix (Dortmund)* An industry area developed into a service area, recreation suddenly came

	Aarhus	Zaragoza	Emscher
system (e.g. ecological, social, economic) play a role in making the case for innovation uptake?	such dimensions on the attractiveness, demographic and economic development of modern towns was one factor motivating the overall project and thus impacting on the innovation uptake in its early phase An increasing focus on climate change adaptation and the above-mentioned climate change impact scenario also played a role in making the case for innovation uptake. This perspective also seems to have been a significant influence when it came to the choice of technology. Last, but not least, the prospect of saving money by including an advanced monitoring and control system to meet the requirements in the BWD was a factor working in favour of the innovation uptake.	(being at its core a space for testing ideas and prototypes). Interviews also suggest that setting measurable targets (e.g. "saving 1.000 million liters", using indicators) is important to show concretely the improvements made possible by taking pro-active action. For interviews, water tariff reforms were implemented with minimal discontent. Interviewees suggest that knowledge and debate generated via the WSCP and the stakeholder dialogues that accompanied the tariff review (lectures, dissemination of academic report, presentations to citizens and councillors) significantly helped in building consensus. Since the reform, the Municipality has developed an "auto-explaining 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. 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*	into focus. Attractiveness is necessary – and this is a new trend. New knowledge was important for the realization of LP, for instance, new knowledge about lakes (lake quality) was necessary for EGLV. *Zeche Ewald (Herten)* More than new knowledge we find that upcoming trends/new ways of thinking played a role in this project. For the redevelopment of ZE (general) relevant in this respect are the mentioning of: New values related to non-monostructuring; The IBA identified the cities and buildings of the Ruhrgebiet as "treasures and cathedrals of the area" with the effect that the industrial areas were not anymore considered as burdens, but as chances; When looking at the creation of the blue ribbon and decoupling the following new ways of thinking are relevant: The reasonable dealing with water and ecology. Awareness of problems with canalization (during low flow and during rain events) -> separate rainwater and wastewater; Awareness of necessity to separate stormwater from combined sewer -> separate rainwater and wastewater; Experience with rainwater management in various conditions and types of sites was acquired by EG and transferred to other cases in the region.
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?	After the initial proposal for a solution in 2006, there was a more detailed feasibility study, or planning and analysis project *("Analyseprosjektet"),* financed directly by the city council. This project lasted for around 6 months, and had a budget of 268 000 EUR. The analyses in the project were based on climate change scenarios for the next 50 years. They included a special program to measure water quality and establish a baseline before the project, and investigation of how new channels in the harbor might affect the currents and flow patterns in the area. There was no stakeholder analysis as such, and no cost-benefit analysis or other detailed economic investigation prior to initiating the project. 50 million EUR rather became a reference based on the original proposal of a trunk sewer solution. The project was defined as a development project in the competitive tender; the project team did not know the exact solution to the challenges concerning the control and warning system, but these emerged during the project. In other words, the project team knew the target, but not the exact path to get there; this was found through discussions within the project team. The warning system was implemented because the BWD allows one non-compliant event per year if such a system is in place; otherwise, the system must be designed so that the expected frequency of a non-compliant event is once every four years. This has a quite significant influence on the necessary volume of the designed CSO retention tanks. Here, it was estimated to reduce required investment in infrastructure by approximately 25 million EUR. According to one interviewee this was done by some level of cost-benefit analysis, but none of the other persons interviewed remembered or could provide reference to a specific analysis of this kind.	The WSCP was accompanied by 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, hospitals). The Municipality externalised the review of water tariffs to the University of Zaragoza, who had been previously engaged in promoting the water saving agenda. Ex-ante and ex-post research studies to set water tariffs were developed by the University of Zaragoza to figure out among others, water price elasticity and average basic minimum household demand (i.e. common good) (Arbués, and Barberan, 2005). These studies influenced the design of new water tariffs. Leakage control technologies have been the focus of research projects. Technologies associated with Active Leakage Management through District Metered Areas for example 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 (Smout, 2010). 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 guiding/supporting Municipal, 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). ZINNAE was created to facilitate the testing of innovations, and 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).	*Lake Phoenix (Dortmund)* No direct pilot studies existed. However, single subprojects of the Masterplan served as pilot studies for further single projects. Thus, the first projects that were the basis for the Masterplan and can be seen as pilot projects.The overall Masterplan developed from the perception, that those single subprojects needed to be brought together and linked. A feasibility study and economic assessments were performed by expert consultants. Water quality models (P, N, and eutrophication), integrated models, hydrological models, hydraulic models. *Zeche Ewald (Herten)* A first model area for learning about which size and type of area can be decoupled was the Berne catchment. It was realized that if 15% discharge from the combined sewer was decoupled, we had an improvement and would save money (smaller pipes). Parameters like proximity to streams, open spaces, soil type were assessed, maps were produced. These maps help the EGLV in providing realistic consulting [for ZVR projects in the area in general. Such consulting, however, was not necessary in the case of the ZE decoupling activities]. This, and several other decoupling projects conducted in the Emscher region as part of ZVR, served as pilot/demonstration projects.

4. STRATEGIES AND INSTRUMENTS

	Aarhus	Zaragoza	Emscher
Which strategies and policy instruments were relevant for the innovation uptake? Did they reflect a regulative, incentive, communicative, or technical approach?	The overarching Municipal Plan acts as the most important planning instrument for urban development and green space enhancement for Aarhus, and was therefore relevant for the innovation uptake. The Municipal Plan of 2001 was the relevant version during the most critical phases of the innovation uptake, while the following version came out in 2009. The current version is of 2013. The municipal Wastewater Plan was obviously most relevant. The Wastewater Plan 2006-2009 has a section dedicated to hygienic water quality in Aarhus River and the plans and ambitions for the integrated wastewater solution the studied innovations forms part of. The above-mentioned special report on Improvement of water quality in Lake Brabrand, Aarhus River and Aarhus Harbor (2006) was also of central importance. The three plans mentioned above take mainly a technical approach. Also relevant to the innovation uptake were two strategic documents with a more communicative approach. Vision of the Aarhus River (2007) presents the visions for Lake Brabrand, Aarhus River and Aarhus Harbor, with a focus on urban development, recreational and aesthetic aspects. There is also a visionary plan named Water Vision 2100, issued in 2010, which is mentioned in more recent presentations of the project. Since 2014, Aarhus municipality has a Climate Adaptation Plan, but there were no special plans on this topic available in the period of the innovation uptake. At the time the studied project was executed, the municipality did not have an explicit strategy to foster innovation and development in the water sector. The key actors interviewed all stressed the importance of informal communication and a shared focus among individual experts on developing good solutions – that is, they indicated that there mainly was a technical approach. Said one interviewee; *"There was not special innovation or enterprise development angle to the project. Today we aim more consciously for innovation projects. Not to "help", but for our own benefit. You could even talk of a paradigm shift. There's more willingness to risk, focus on putting the right people together, allowing room for capacity-building within R & D projects."* This kind of shift was noted by several interviewees. Some related it first and foremost to changes in the culture of Aarhus Water following its establishment as a separate business entity, while others presented it as part of a more general trend to focus on business innovation in the municipality. On the other hand, most of the interviewees stated that they saw the preference for partnering contracts as an important strategy to nurture close and fruitful development partnerships. That employees of DHI, Krüger and Aarhus Water were in the project together, sharing responsibility for the results and sitting side by side by the computer to do the coding, etc., was considered to be critical both as regards the technological results and the sense of involvement and ownership on the side of the municipality and Aarhus Water. Aarhus Water always insists on partnering in R&D projects, to place the project at the centre and build the necessary openness and trust between the partners. The project to develop the real-time control and warning system started with a joint workshop, and Claus Möller-Pedersen made it clear that DHI and Krüger had to collaborate very closely as partners. In the interview, he quoted himself as having said at the workshop; *"now, you've*	The first major initiative for encouraging water savings and the uptake of water saving technologies was WSCP. Phase I (1997-2000) of the project mainly consisted in an awareness-raising campaign targeted to households. Phase II (2000-2003) targeted other sectors, 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. pocket guides distributed among the city's major water consuming sectors, more than 10.000). 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. The Municipality prioritised water as a key area of work in the Municipal Strategic Plan 1996-2010 as part of its process for developing its local Agenda 21. The formal start of the Agenda 21 was in 2000 when the municipality of Zaragoza committed to the Aalborg Charter and the Hannover Principles for sustainability. The "Plan for improving the water supply quality and management" (2002-2009) promoted in particular two basic policy instruments for fostering uptake of water saving technologies amongst water users: communication campaign (mainly through the WSCP) and through a new tariff model (see answer to question below). The Municipality build several partnerships with research institutions, to investigate the potential of the tariff reforms (see below), ways to improve the efficiency of urban water network (SWITCH research project, see section 2.3), and build partnerships with firms (ZINNAE). ZINNAE in particular is seen as a mechanism to build economic added value out of previous initiatives on innovation development (on water and energy saving). It works as a platform to foster new ideas, initiate new projects, maintain cooperation between private, public, NGO and academic sectors, use city as testing ground for products to be then marketed nationally and internationally. The lack of pro-active uptake of water efficient device by the construction sector and by its own services led the Municipality to pass a regulatory Bylaw in 2010 that requires individual water meters, installation of water appliances in new and upgraded buildings, gardens must include more trees and less grass (% given), promote water reuse from swimming pool, reduced water use for street cleaning, promote alternative water resources for less quality needs (irrigation, cleaning, etc.). It is important to note that Zaragoza initiated a significant amount of activities to regenerate the city in particular through the restoration of the Ebro river banks and areas. In 2001 plans to transform the city along the Ebro river began, and these plans took special momentum through the International Exhibition which directed significant financial resources to the city. The main new infrastructures developed include: river front regeneration (including infrastructure for the exhibition), river bed and shores restoration (including improving amenity, mitigating flooding and increasing water sport opportunities), and a water park.	*Lake Phoenix (Dortmund)* The most important strategies (see also interview template): issue linking – the successful combination of various problems (flood risks; abandoned brownfield site) *and* goals (flood retention; Emscher conversion; attractiveness of the city etc.). coalition building - various parties with different problems, solutions *and* resources (knowledge, financial capacity etc.) work together timing (exploitation of a window of opportunity) – Emscher conversion coincided with the abandonment of the brownfield site. Framing (communicative): the lake was successfully framed as a solution to various different problems (including the attractiveness of the city for economic recovery and settlement of new business and inhabitants; flooding; water quality; etc.). These approaches are specifically relevant for the project Lake Phoenix. They do, however, also represent general approaches and characteristics of the Masterplan. Additionally, the approaches listed below are of importance for the Masterplan: Communicative approaches: - "Emscher dialogue" (starting 2001, every 1-2 years) for discussions between EG, planning offices, environmental agencies, companies, representatives of the cities; - "workshop New Emscher valley" for discussions also with architects, urban and landscape planners; - exchange with other European cities within research project "SAUL"; - Masterplan links knowledge of many actors into a network *Zeche Ewald (Herten)* - regulative: The federal state of NRW supported the idea „new horizons" and funded it via the ÖPEL program (90% funding). Because the concept for ZE „land layers" became part of the overall/joint concept „new horizons", it was possible to also fund it via ÖPEL. - incentive: provision of freshwater for "blue ribbon", cost reduction (for wastewater), funding for infiltration measures (by federal state and by EGLV), guidance and consulting via EGLV, water resource management know how, adaptation to future climate - communicative: idea, guidance and consulting via EGLV - technical: experience and know-how on infiltration measures by EG

	Aarhus	Zaragoza	Emscher
	just got to find out (agree on) how to do this. I don't want to hear any more."		
In particular, what pricing policy and financial cycle arrangements existed? What costs did they include (e.g. capital, maintenance, resource, environmental)?	Danish legislation requires full cost recovery for both water supply and sanitation (break-even principle). In 2009, the average price for water and wastewater including taxes (VAT and green taxes) was DKK 52.30/m³ (6.80 EUR) – one of the highest tariffs in the EU. It consists of 24% for water, 48% for wastewater and 30% for taxes (DANVA 2012). The total price of water measured in fixed prices increased by 32% between 1996 and 2006. Nevertheless, a household's average expenditures for tap water and wastewater accounted for only about 0.13% of its total income. This share has remained constant, mainly because water consumption declined while tariffs increased. Water prices vary a lot from one supplier to another depending on costs. According to the interviews, the budget for the project was financed by an increase of the water price paid by consumers, which was decided by the City Council before the project started. There was a small, gradual tariff increase – 0.26 EUR per cubic water - which was not controversial, since it was for a good (blue/green) cause.	Until 2002, water tariffs in Zaragoza were set on basis different than cost recovery and efficient use. Political motivations were main driver for setting tariffs which had a monthly fixed fee depending on the stated category of the street and a volumetric incremental charge with 134 steps based on average pricing which was lower than marginal price. It was reasonable to assume that consumers couldn't be fully aware of such a complex tariff structure. Additional problems for this old tariff were that didn't account for water service full financial cost recovery; was not considered to be equitable and didn't provide proper incentives so as to use water efficiently (improper prices and not simple to forecast billing due to its structure). During Phase I of the Water Saving City project (1997-2000), households were offered the opportunity to buy low consuming appliances on a campaign discount of about 20 % - 30 % on market price. By 2002, a new pricing schema was designed based on a new tariff and the setting of subsidies for consumption reduction. Pricing was set to account for full financial cost recovery, including capital, operation and maintenance costs, and treatment costs (i.e. Wastewater Treatment Plant). The new tariff was designed (based on previous studies) with a fixed fee (proportional to the diameter of the service pipeline) and a three steps variable charge depending on monthly consumption. The first two blocks are based on household use (not discouraging use) while the last one is designed to account and deter significant and not reasonable per capita consumption. In addition and in order to deal with large family households, a special and optional tariff for households with more than 6 individuals was offered based on per capita terms. The subsidy was set to be provided to households which reduced consumption by more than 40%. This subsidy was implemented through a 10% rebate in household's billings. If in the following years an additional 10% yearly reduction was achieved, a similar rebate was maintained.	*Lake Phoenix (Dortmund)* The city of Dortmund bought the area from Thyssen Krupp company. The acquired area was, thus, transferred to the Stadtwerke in order to not have it in the city's budget. EG would have built a Flood Risk Basin for 10 Mio EUR, but since these 10 Mio EUR did not have to be spent, they were invested to build the lake. Marketing high quality real estate was a direct finance mechanism for re-financing the project. *Zeche Ewald (Herten)* - financial cycle: "Companies decouple their areas mostly only for financial reasons (to decrease discharge fees). In more detail, if rainwater of an area is discharged together with wastewater in the combined sewer system, the respective owner of the area has to pay discharge fees according to the size of the sealed/built-up surface area. If part of this area is decoupled and rainwater is allowed to penetrate the soil or enter a water body, this results in reduced costs for rainwater discharge. - funding for decoupling projects within ZVR: funding budget (60-80 % of the area of each subproject received funding) by EG, personnel resources, data resources - funding via ÖPEL program - pricing policies: cost separation for wastewater and rainwater
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?	The opportunity to finance the project locally, through a small, gradual increase in user tariffs, seems to have facilitated the process. One of the interviewees even saw it as an important driver. The ambition to be a "green city" and the plans and instruments above were facilitating the innovation uptake. However, none of the interviewees mentioned them as particularly important enabling factors. The rather emphasized the quality of relations among local actors and the impact of their more practical choices and strategies during the process, such as the partnering form of contract.	The WSCP was effective in achieving its stated objective: raising awareness of Zaragoza citizen. Some interviews view the acceptance of the water tariff reform as a consequence of this success. Water savings amongst household were achieved, although it is difficult to apportion the cause to behaviour change or to the uptake of water saving technologies. The program also reinforced political support and therefore public funding for water saving initiatives, although it had limited success in fostering upgrading of the urban water infrastructure. Projects over the last 20 years were effective in creating local expertise in water saving, in terms of public policies, communication strategies, and technological innovations –as expressed by ZINNAE. ZINNAE aims to foster innovation uptake via collaboration between public, private and citizen sectors on technological development, pilot testing and market them nationally and internationally.	*Lake Phoenix (Dortmund)* Above mentioned strategies all facilitated the innovation uptake. Additional factors for success seem to be: Good relations & Trust (what helped was that various of the partners involved had a positive history of collaboration). Communication – "many levels of dialog and broad topics discussed in detail jointly". Project management (external); Ownership of the plan (the creation of the lake was everybody's idea); Individual drivers/policy entrepreneurs who believe in the project and are able to bring it forward *Zeche Ewald (Herten)* Important strategies/factors for success that facilitated the innovation uptake: Good relations & Trust (what helped was that various of the partners involved had a positive history of collaboration); Framing: The blue ribbon is framed and presented as an important solution to upgrade an area. The linking with ZVR as a solution, among other things, to the problem that the solution blue ribbon needs water. The formation of a project association on a collaborative basis Linking: the successful combination of various problems (flooding; bad image district) *and* goals (green areas;

	Aarhus	Zaragoza	Emscher
			decoupling etc.) for ZE as a whole, but also for the blue ribbon. Two projects that can reinforce each other (ZE & ZVR) (given that the project served various goals, funding was provided by various parties and from various domains (water, ecology; transport). Individual drivers/policy entrepreneurs who believe in the project and are able to bring it forward.
How did pricing policies and financial cycles faciltate innovation uptake? To what extent were they effective in supporting and/or raising resources for innovation uptake?	According to several interviewees it was quite easy to get the funding, due amongst other to the episode with the person who wanted to rent out kayaks and the physical visibility of the improvements one wanted to achieve. The total cost of the project to develop the real-time control and warning systems was around 2 million EUR. A small part of the funding (approx. 200 000 EUR) was gained through participation in the EU project PREPARED. Financing was not a barrier in this case, and the ready availability of funding at the local level contributed to the successful execution of the project and the innovation uptake.	There is no evidence from this research that water tariff reforms have led to greater uptake of water saving technologies in household. In fact the 2010 Bylaw is an expression of the lack of pro-active uptake as well as current projects in ZINNAE to further explore ways to increase uptake. One challenge with reduced water use in Zaragoza is the reduction on the generation of financial resources for re-investing in (and upgrading) infrastructure (lower water bill means less financial resources). The effect of the reform has been to increase water bills in order to fill this resource gap and increase cost recovery. On 2008, according to Ramón Barberán Ortí (Zaragoza University), 90% of the costs were cover by the tariffs. On 2002 it was just 76,2%. However, some interviewees noted that cost-recovery remains problematic. Also some evidence from interviews indicates that the tariff structure and levels result in unequal share (household users pay less than their fare share compared to industrial users). This may result in good incentive on large industrial water users to uptake water efficient devices, but is less effective on household users.	*Lake Phoenix (Dortmund)* #1: A solution was only possible with the investor involved and with EG (who invested 70 Mio EUR into LP) being in the middle of a conversion process anyway. The most important financial explanation for the success of the project is that the re-financing by marketing of real estate made the project profitable. The lake as an development option "won" the profitability study, because this project plan was economically superior to an alternative development of the area (e.g. industry park). Alternative possible solutions would have been usual industrial parks, as is commonly done in other brownfield restorations. *Zeche Ewald (Herten)* Aim to achieve 15% decoupling within 15 years as agreed in the committment --> incentive for city of Herten. Also for the cities and municipalities, ZVR offers the finanical incentive by funding decoupling measures for public areas and buildings (schools, churches, etc.), with even higher funding rates in the beginning (80% in the beginning, 60% later on). Further advantages for the municipalities in the adaptation to future climate (more extreme weather events like heavy rain which can result in high costs of repair), reduced costs for maintaining/renewing communal wastewater channels (they can be dimensioned smaller), urban design and attractiveness, and cooling factor during urban heat waves. Funding for infiltration measures --> incentive and facilitation for city of Herten. Guidance and consulting via EGLV --> facilitation for city of Herten. The additional costs were with RAG MI, which leads to hurdles and discussions within the company but here, also the additional value has to be considered. --> This added value is a future-oriented development according to the optimal state of technique and ecologic challenges. And this again is an entrepreneurial challenge.
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?	As indicated above, the strategies and instruments supported each other well. The plans and objectives for the wastewater system in Aarhus worked well with the ambitions of the urban planners to develop the city centre and the old harbour area. There were clearly synergies between these plans and the national strategy associated with the "State of Green", intended and highlighted through the stated "green city" approach. A perhaps more unintended synergy are found in the impact of the abolishment of the old county administrative level (Amts), which seems to have increased local autonomy in water management and facilitated the innovation uptake in this case.	Interviewees noted several times that the focus on raising awareness helped to build support for new water tariff. New water tariffs were later stage accompanied with additional awareness raising (auto-explaining bill), especially important given the increase in the cost of water bills. New water tariffs with emphasis on cost recovery increased resources for upgrading water infrastructure, but this may have been limited due to reduction in water consumption. Investment into the Yela reservoir probably limited the resources available for water demand reduction by Zaragoza Municipality (upgrading infrastructure). The 2010 Bylaw aims to overcome the limitations of awareness-raising programmes in incentivising the construction sector to install water	*Lake Phoenix (Dortmund)* All strategies and instruments supported and complemented each other. *Zeche Ewald (Herten)* They supported each other, advantages for all actors.

	Aarhus	Zaragoza	Emscher
	The privatization of water utilities, which in the Aarhus case took place in an early stage of the innovation uptake also seems to have had an impact. According to some interviewees this was positive in that the utility as a commercial enterprise became more focused on growth and innovation and therefore engaged more actively in the development process. However, others claimed to see a more negative impact, in that Aarhus Water turned from a partner in development and more into a customer demanding a specific deliverable, and that this had a negative influence on the collaboration and results in the later stages of the project. Some interviewees noted that a focus on innovation on the side of the national government may have contributed indirectly: As a lot of funding from the state is put into international collaboration, Danish institutions are encouraged to try and take some of this back, by applying for EU funding for projects such as PREPARED and SWI. However, it was also noted that most of this came only after the most critical stages of the innovation uptake in this case, and promoting innovation in the water sector was not a stated objective of the project.	efficient device.	
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?	According to one interviewee, user-financing of the kind found in this project is *"a bit unique"* in Denmark. It was possible because the project to develop the real-time control and warning systems was related to the bigger, integrated solution, so that the 10-15 million EUR extra for monitoring and control to make better use of the new systems did not matter. As regards most other projects in Denmark, one normally relies on national funding, which also is quite good. On a more general note, the same interviewee mentioned the availability of national funding as a driver of innovation in the water sector.	Several Municipal plans were developed and implemented throughout the 20 year period covered by this study. These plans had different focus, including supporting the WSCP and water tariff reforms. The WSCP was set in four phases, each of which had its specific focus and targets. Water tariffs were adjusted by 2002 in order to influence household behaviour to encourage water savings. They need to be re-adapted in order to cover costs, but they need to go through a similar process as in 2002. In 2010 a Bylaw was adopted to overcome the limitations of WSCP. While these processes present some adaptiveness in the Zaragoza water social-ecologic system, they took years to occur, and the possibility of adjusting was through a combination of local leadership and using different instruments.	*Lake Phoenix (Dortmund)* Apart from financial explanations mentioned above, it should be noted that for the realisation of the overall Masterplan there was a one-time payment for revitalization of wastewater systems (in addition to the annual contribution of the associates). *Zeche Ewald (Herten)* The financial instrument of the ZVR of funding decoupling measures as well as the lower rainwater discharge fees resulting from completed decoupling measures both represent ways of facilitating innovation uptake. Plus, ZVR has two funding phases, that aim at promoting a fast realization of measures in the area (80 % funding in the beginning, 60 % later on).

5. RESPONSIBILITIES AND RESOURCES

	Aarhus	Zaragoza	Emscher
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?	During the process of innovation uptake, the water utilities have been separated from the municipalities in Denmark, and given different roles. The municipality as the main owner is responsible for the water supply, while the supplier has become the operating actor. A paradox thereby created is that the municipality is now the body to approve discharges from the water company, which they themselves own. As regards the warning system for water quality, the water company provides the information – to the municipality, which issues the warnings. The transition of Aarhus Water from a municipal department to an independent entity seems to have influenced the project. In the initial phase, it may have been an advantage that the utility was part of the municipal government: That Claus Möller-Pedersen was the responsible authority as well as in charge of operations at that time *"made everything easier,"* said one of the interviewees from the municipality. On the other hand, there is a more active attitude to innovation now, when Aarhus Water has been established as an independent company and is thinking more like a business corporation. According to one of their representatives, there is more focus on efficiency, capacity-building, growth, and one is able to work without the bureaucracy that goes with public management, with more freedom and more incentives to save for oneself as a private company.	See levels and scales	*Lake Phoenix (Dortmund)* PHOENIX See Entwicklungsgesellschaft: assignment to develop the area. City of Dortmund via Stadtwerke: owner of the area. EG: owner and manager of the Emscher river and floodplains, operator of the lake, responsible for water quality. Important factors for success seem to be: clear division of tasks, responsibilities and expertise *Zeche Ewald (Herten)* EGLV & city of Herten are responsible for sewage system. EGLV: responsible for water quality of Emscher tributaries & for achieving good ecological status in the Emscher tributaries to comply with WFD. Project association Ewald: planned and conducted the transformation. City of Herten was committed to the Future convention on stormwater and had to achieve 15 % rainwater decoupling within 15 years.
What technical, financial, knowledge, social, cultural (e.g. norms, values, symbols, artifacts) resources were available/used to encourage innovation uptake?	Cultural: The vision by a lead politician to restore a particular kind of life or common lifestyle, atmosphere *("Leben")* along Aarhus River, the concepts of Aarhus as a "green city" and Denmark as a "State of Green", and values associated with environmental-friendly outdoor recreational activities such as kayaking, fishing and bathing were used actively by the key actors to encourage innovation uptake. Knowledge, standards: The BWD, plus new national requirements as regards bathing water quality. Inputs from EU projects SWI and PREPARED. Also knowledge based on MEDSAM, a collaboration between Krüger and University of Aalborg on radar technology. High capacity /knowledge levels in Aarhus municipality and Aarhus Water, making joint technology development an important motivation both on the side of the involved individuals and their respective organizations. DHI and Krüger's positions as lead knowledge institutions in their respective fields. Focus on climate change impacts and adaptation strategies. Social: Long-established personal networks and relations of trust between key actors. Ambition of Aarhus to have one of Denmark best water companies. Focused therefore, on partnering and innovation in total projects. Being a prepared customer, taking an economic, strategic perspective, willingness to take risks. Financial: That Aarhus municipality and later Aarhus Water made funding available from the start was an important driver.	Technical: much evidence that Zaragoza has developed local technical expertise on water saving policies and technologies. No evidence on the level of expertise in the 1990s. Knowledge: Zaragoza University had prominent water economists which helped e.g. assess water tariffs options. ZINNAE aims to maintain the level of expertise and knowledge attained in the city/region, and market it nationally and internationally. Social & cultural: from low in the 1990s (with evidence that a supply approach was dominant as interviews suggest that plans to create additional reservoirs existed, e.g. story with over-estimating future water needs to justify supply development) to strong with an acceptance for new water tariffs, the organisation/strong participation in the UN Water Decade and international exhibition on sustainable development (theme: water). Financial: the Zaragoza Water Saving City had a total awareness campaign cost since 2002 of about 2.500.000 Euros. ZINNAE: central government (200,000EUR for 3 years) , funding from municipality, project funding and partner funding (e.g. Firms with annual turnover lower than 300.000 EUR: 300 EUR/year; Firms with annual turnover higher than 300.000 EUR: 1.200 EUR/year).	*Lake Phoenix (Dortmund)* Technical: EG had knowledge in how to restore the Emscher river and its floodplains. Financial: Lake Phoenix Entwicklungsgesellschaft knew how to market the real estates knowledge: experience in urban development of brown fields Social/Cultural: the multi-purpose project – aiming for blue, green, and leisure development fitted well in the spirit of the times. *Zeche Ewald (Herten)* technical: knowledge on rainwater decoupling is present at EG financial: financial resources are available (EG assessed the amount of financial resources that could be saved with 15 % rainwater separated from the sewage system in the whole Emscher region and provides this amount for exactly those measures necessary for the 15 % rainwater decoupling.) knowledge: knowledge on rainwater decoupling is present at EG and with the city of Herten from former decoupling projects social: social interest in more attractive city and water bodies within the city and beyond as well as in generally positive development of the city and the region.
Were there any "missing" types of mandates or types of resources for enabling innovation uptake?	No, not really. As we have seen, some interviewees suggested that there was no explicit focus on fostering innovation at the time the project was initiated. The initial political vision was applauded by the national minister for the environment at the time, but beyond this, national resources were also not much involved. However, this seems not to have hindered but rather to have enabled innovation uptake at the local level, in	Evidence is available in documents and interviews that the economic crisis had a significant impact on the level of commitment of private and public partners on the upgrade of infrastructures and on collaborative projects such as ZINNAE.	*Lake Phoenix (Dortmund)* No

	Aarhus	Zaragoza	Emscher
	combination with the high level of local autonomy.		
Did the allocation of roles and resources create cooperation or struggles on innovation uptake?	Overall, the allocation of roles and resources, by way of the creation of Aarhus Water and the design of the partnering project, facilitated cooperation in the innovation uptake. There were, however, indications that the allocation of roles and resources within project to develop the real-time control and warning system had both positive and negative aspects. Here, the form of management was such that Krüger had the financial project leader, while the technical project leader was from Aarhus Water. The person in the latter position was burdened with administrative tasks and according to some, did not have time to see all technical details. She also went on leave and was replaced by a technical manager from DHI in a critical phase, so that *"some things were lost in confusion"*. It was also suggested that some remaining technical challenges could have been better resolved if the partners had shared the same priorities and been more focused on how the solution would work in practice, and that the attitude from Aarhus Water changed slightly during the project; that they became less focused on joint development and started seeing the solution *"more as something they bought"*. However, the overall impression here too, was that the project was rated as a success, and that relations continue on good terms.	Evidence is available in interviews that the Municipality could have benefited from greater internal communication and a coordinated external communication strategy. Evidence is available in interviews that the administrative fragmentation of Zaragoza urban water management may have hindered the promotion of an integrated approach and the effective implementation of change. ZINNAE faces limitations as industrial clusters may be negatively seen by companies (reduction of power and leverage).	*Lake Phoenix (Dortmund)* No, the roles and the resources were complementary resulting in a situation in which there was always and at all stages cooperation between the partners. *Zeche Ewald (Herten)* No. "In a project association it is very important that not one is the funder. This would result in dictating. It has to be balanced."
Could roles, responsibilities and resources be adjusted to support innovation uptake? In particular, did capacity-building play role in innovation uptake?	As we have seen, roles, responsibilities and resources were adjusted to support innovation uptake. That the technical project leadership was transferred from Aarhus Water to DHI and back in the course of the project period is one example. That additional funding was brought in through PREPARED is another example. Capacity-building in a formal sense, by way of training or education, was not part of the process. Most of the interviewees stressed that Aarhus Water is a partner/customer with strong capacities, so there was no need for special educative or capacity-building efforts. However, we have also seen the emphasis on how all partners *"got wiser on the way"*, and how the joint capacity-building inherent in partnering projects as *"total projects"* was considered to contribute to the successful innovation uptake.	Pilot studies in WSCP and ZINNAE and investment in research projects (SWITCH, water tariffs) are an indication that capacity-building is an important component of innovation uptake in Zaragoza. However, no evidence is available on the internal processes to e.g. the Municipality.	*Lake Phoenix (Dortmund)* Everyone learned from the project, because constructing a lake on a former brown field was quite new. Expert engineering offices were assigned for the technical constructions. *Zeche Ewald (Herten)* No
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?			*Lake Phoenix (Dortmund)* Yes *Zeche Ewald (Herten)* Powers and resources were strong enough.

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