Strategic Research Agenda

WssTP, a common vision for water innovation

The European Water Platform

Publication 2010

The water and wastewater services play a major economic role
in European countries,
providing close to 600,000 jobs
for more than 70,000 water services operators.
It is also worth noting the importance of investments
in infrastructure assets,
with more than 3.5 Mio. km of drinking water networks,
more than 2.2 Mio. km of wastewater networks
and almost 70,000 wastewater treatment plants.
Investments in the sector represent overall
more than 33,000 Mio. € annually.
The turnover for this sector is around 72,000 Mio. € annually.

Our vision

"By 2030 the European water sector is the leading centre of expertise for providing safe, clean and affordable water services while protecting nature. The sector applies a variety of new integrated approaches to solve diverse and interlinked problems. It uses efficient and sustainable technologies which enhance the social, economic and environmental well-being of the community as well as the health and well-being of the planet and its peoples."

(WssTP Vision Document)

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A Vision for Water

Europe as a leading centre of expertise

The world market for water and wastewater amounts to appr. €300 Bn. in 2010 with growth rates varying between 5 and 20 % in the various subsectors in the coming decades

A Strategic Research Agenda for our future

WssTP: the European Technology Platform for Water

In March 2000 the European Council set out the Lisbon Agenda, now referred to as the 2020 Strategy, for the European Union (EU), which aims to make the EU "the most dynamic and competitive knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment". The creation of the European Technology Platforms (ETPs) is one concrete measure translated from the goals of the 2020 Strategy.

The Water supply and sanitation Technology Platform (WssTP) is the European Technology Platform for Water. It was initiated by the European Commission in 2004 to stimulate collaborative, innovative, visionary and integrated research and technology development strategy for the European water sector and to meet the objectives of the 2020 Strategy.

Water and sanitation is a sector where services in Europe are provided by tens of thousands of public and private bodies of all sizes (>75.000), with numerous organizations involved in research in all aspects of the water cycle. WssTP is federating the research and technology development efforts of the European water sector (water utilities, industries, academics and research centres) in order to support the competitiveness of European water sector and services and to accelerate the implementation of new approaches, methods and technologies.

Our vision

The core of WssTP vision (WssTP Vision Document, October 2005) is that by 2030 the European water sector will be the leading international centre of expertise for providing safe, clean and affordable water services while protecting nature. The sector applies a variety of new integrated approaches to solve diverse and interlinked problems. It uses efficient and sustainable technologies which enhance the social, economic and environmental well-being of the community as well as the health and well-being of the planet and its peoples.

About WssTP organisation

WssTP was created in 2004 and registered in 2007 as a non profit international association under Belgium Law. It grew from 11 initial founders to 56 registered members organised in three colleges: industry, water users/utilities, and academics/research institutes.

EXECUTIVE BODIES

The executive bodies of WssTP include the General Assembly of registered members, a Secretariat (Liaison Officer) and an elected Board constituted of representatives from the three colleges.

PILOT PROGRAMMES

A Pilot Programme is an organisational structure that addresses a major European water problem and covers the pre-competitive phase of generic research and the enabling of technology development, as well as the competitive phase of practical application through a number of specific implementation cases executed by commercial consortia.

Each pilot programme has been working with the stakeholders from those representative Implementation Cases to define the needs and identify the matching research, development and technology demonstrations.

TASK FORCES

“Task Forces” have been being developed since 2009 as working groups handling cross-cutting issues of several Pilot Programmes. Three topics were set up on “Climate Change”, “Managed Aquifer Recharge” and “Sensors and Monitoring” in 2009. In 2010, two new groups were created on “Membrane Technologies for Water Applications” and “Water and Energy”. The vision and the will of WssTP is to develop these activities that enable to provide recommendations on R&D needs for those specific topics.

PILOT COORDINATION COMMITTEE

The Pilots Co-ordination Committee (PCC) is in charge of co-ordinating matters between Pilot Programmes and the Task Forces, ensuring their work is planned in accordance with the Strategic Research Agenda and the principles of Integrated Water Resource Management.

MSMG

The Members States Mirror Group (MSMG) is an associated body of WssTP. Interested Member States, Associated Candidate Member States and EU Research Framework Programme (FP) Associated States participate with one delegation each in the MSMG. The MSMG aims at linking the activities of the WssTP with national agendas and initiatives.

WssTP
A common vision for water innovation

How was the SRA written?

The major goal of the Strategic Research Agenda (SRA) is to develop the long term vision of WssTP for the water sector and to identify the research priorities to tackle present and future challenges. To comply with our role and our mission as the European Technology Platform for water, the WssTP commits to providing key recommendations to boost the competitiveness and growth of the European water sector. WssTP therefore engaged an open process organised on one hand on the consultation of its members and contributors and on the other hand on a public open and transparent consultation of interested stakeholders.

This present document was based on the first SRA published by WssTP in 2006 after intensive consultation. To prepare this updated edition, WssTP organised an internal review throughout its operational bodies: the Pilot Programmes and Task Forces but also the Board and the Member State Mirror Group. More than 680 individuals contribute to the work of the WssTP of more than 25 countries and 200 organisations; 221 individuals directly contributed to the update of this document. A second phase consisted in launching an open and public consultation by Internet inviting comments and suggestions broadly from stakeholders involved in water activities or interested in the future of the water sector. WssTP also invited specifically DG RTD, DG ENV and the European Environment Agency to comment on the SRA and finalised the actual content of the SRA based on all comments received. The stakeholder-driven approach to developing a research agenda empowered all stakeholders (private and public) to define the future of research, and to share the actual research and implementation activities. The SRA may be used as input for the definition of the 7th and 8th Framework Programmes, but also to facilitate a further coordination of research programmes in and between Member States.

The scope of the SRA

While the SRA acknowledges the importance of a system's approach and need for integrated solutions, WssTP appreciates that the SRA does not cover water in all its various uses and services and is somewhat biased towards technology and pollution control and less on ecosystem protection and management. Although the research agenda was analysed with the European perspective to address European challenges, it also tackles global issues such as the adaptation of the water sector to climate change.

WssTP decided to recognise the approach of Integrated Water Resources Management (IWRM) as an overarching concept. This systems approach reconciles at the river catchment scale the needs of water supply, sanitation, water use in agriculture and industry and water needs in ecosystem, supported by the local framework of laws, regulations, and translated into practices. To make this leap forward, WssTP will include research on water technologies in a social and economic context across all water users and their supply chains.

Ensuring implementation through a strong commitment and an active network

A consistent and focused approach of WssTP is to ensure the progress on the SRA implementation and to endeavour that the Vision becomes a reality. The success depends on the commitment of stakeholders and their involvement to further collaborate for water research. The implementation of the Strategic Research Agenda will need to foster the development of demonstration cases implying a need to find financial support. The main source of finance will be from industry, end client financing and research organisation, but this needs to be complemented by a variety of public financing mechanisms at national and European levels. The latter will involve utilising channels such as ERA-Net, COST actions, Life+, Eureka and Framework Programme collaborative projects. Clearly, implementation will build on existing knowledge and ongoing research. To avoid the risk of duplication, it is important to link ongoing activities to the implementation of the European Research Areas and activities of the European Commission and national members' states. Within each pilot programme, commercial consortia consisting of various types of stakeholders will carry out projects at demonstration cases, i.e. locations with representative and complementary water challenges to resolve. This activity will be facilitated by the PCC in close co-operation with the Member States Mirror Group.

FOCUS ON...

Integrated Water Resources Management

What is the IWRM ?

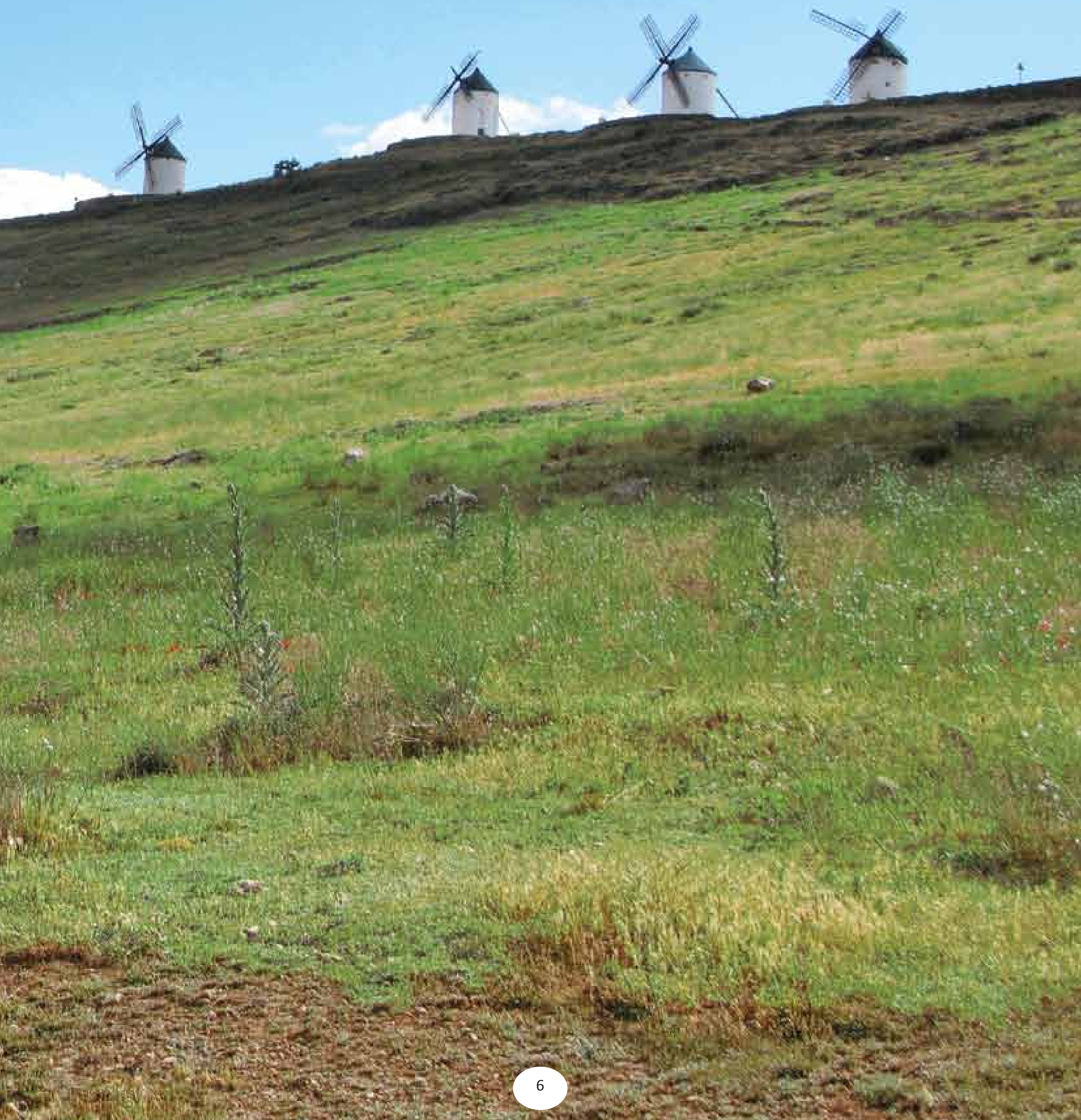
According to the Technical Committee of the Global Water Partnership , the IWRM is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. As such, the IWRM is a comprehensive, participatory planning and implementation tool for managing and developing water resources in a way that balances social and economic needs, and that ensures the protection of aquatic ecosystems for future generations. Beyond the participatory approach between several water users or industries, IWRM calls for more emphasis on regional or transboundary water supply challenges at the scale of river basins, including socio-economic development and governance perspectives.

2

Global Drivers

Coping with global trends

**Water is a basic commodity essential to life.
In some regions, its abundance and purity is coming under extreme pressures resulting from global trends.**



Water:
a necessary but low cost good

Water is fundamental for life, not only for direct consumption (potable water) but also for sanitary and health requirements, and for the production of food or basic industrial goods and commodities. Even though water is so central and absolutely necessary to the existence of any society, it is a low-added value good with production costs in industrialised countries typically below 1 EUR/m^3 for potable water and below 2 EUR/m^3 for treated wastewater. In developing countries and regions with extreme poverty (i.e. living with less than 1 USD a day) a substantial lower cost is required. The investment and operational costs associated with the collection / distribution and treatment of the municipal drinking water and wastewater and water resource management need to match with the limited financial window of this low cost product.

Global trends

Major global drivers affect the water sector and its challenges. Those challenges, if addressed proactively and responsively, could offer tremendous opportunities.
These drivers are (i) demographic growth and urbanisation; (ii) globalisation and wealth growth; (iii) spatial and temporal pressure (coastal cities, tourism); and (iv) climate change. They are already taking place and can be measured and quantified as consequences of the growing industrialisation and the technical progress of the mankind. They are rapid and measurable on a human scale, i.e. their increasing impacts can be perceived from one generation to one other.

Demographic growth and urbanisation

The earth, home of 6.7 billion people in 2010, about 8 billion by 2030 (+80 million per year in 2010).

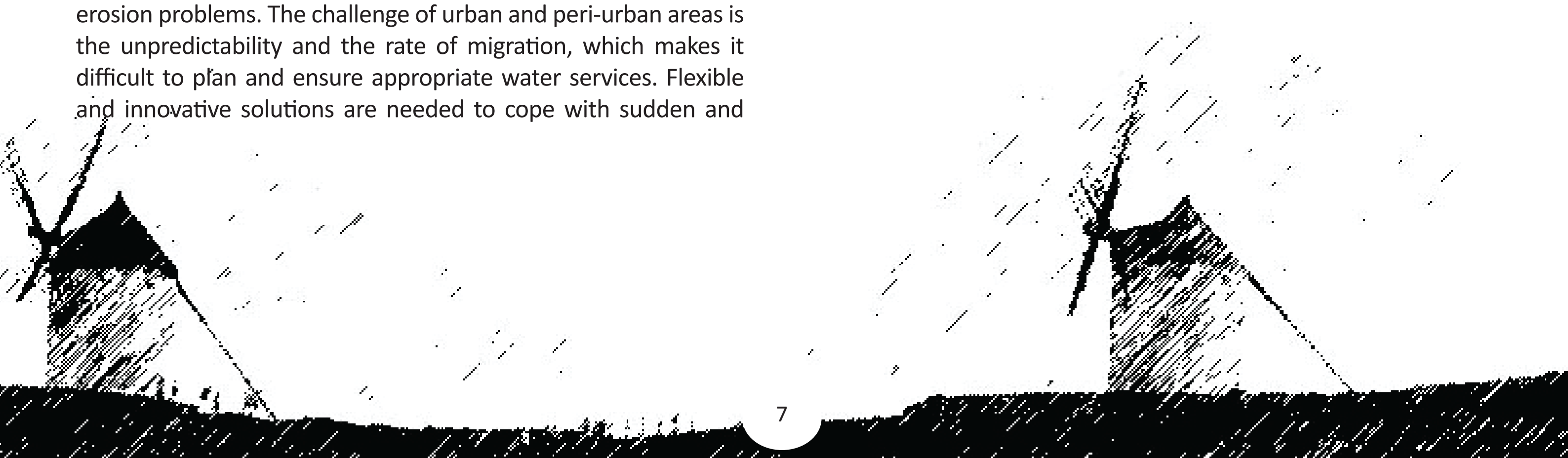
The total population of the EU 27 countries has augmented from 400 million in 1960 to 497 million in 2007 (Eurostat, 2008a). The rising population naturally increased the water requirement over this period and the EU27 population is expected to grow to 521 million by 2035 (Eurostat, 2008b). These trends will put pressure on water resources and management.
More than in Europe, at the global level, rapidly increasing urbanisation is one of the most distinctive changes of the 20th and early 21st centuries. All over the world people are moving away from rural areas towards the cities. In many cases, this migration is triggered by poverty resulting from large scale destruction of natural resources e.g. deforestation, overgrazing and resulting erosion problems. The challenge of urban and peri-urban areas is the unpredictability and the rate of migration, which makes it difficult to plan and ensure appropriate water services. Flexible and innovative solutions are needed to cope with sudden and substantial changes in water demand for people and their associated economic activities in many regions of the world.
The migration also raises issues about safe food supply and its associated water requirements, due both to the concentration and increase of demand, and to the competition for land in peri-urban areas where urbanisation pressure pushes away agriculture, even from areas with high agronomical potential, but also providing opportunities for safe re-use of treated wastewater by peri-urban agriculture or landscape irrigation.

Increasing globalisation and wealth

Together with population growth and urbanisation, growth in globalisation and wealth is forcing rapid changes such as industrialisation and extensive agriculture in association with changing food consumption patterns leading to a dramatic increase in high-quality water consumption. The increase in wealth of low income countries increases water requirements in consumption habits favouring products and services with higher water footprint (meat-rich diets, more commodities, more packaging, more electricity, water demanding bio-energy etc.).
Frequently, this demand for water cannot be satisfied by the locally available water resources, while the discharge of insufficiently treated wastewater increases costs for downstream users and has detrimental effects on aquatic systems. The increased water demand and wastewater production leads to issues of water allocation and competition between the water users (domestic, industry, agriculture and environment).
Wealthy consumers in urban areas tend to be more critical and well informed, and expect a safer and higher quality of service. This requires increased security and monitoring as well as emergency systems.

Spatial and temporal pressure (coastal urbanisation, tourism)

In the Mediterranean region, international tourist numbers have risen from 58 million in 1970 to more than 228 million in 2002, with France, Spain and Italy combined about 75% of the current influx (UNEP, 2005). Up to 80 % of tourist stays in the region are concentrated in the period from May to September when water availability is at a minimum and water stress peaks (EEA). Tourists tend to concentrate locally in coastal areas which at the same time contains natural systems that provide more than half of the global ecosystem goods (e.g. fish, oil, minerals) and services (e.g. natural protection from storms & tidal waves, recreation), exacerbating the tensions on water demands, allocations and cross-impacts between water users.



Focus on the "Global warming" driver

There is a general consensus on the fact that climate change is happening as a result of anthropogenic greenhouse gas emissions and changes in land use (deforestation, urbanisation…).

Recent observations confirm that the mean temperature in Europe has increased by 1.0 ºC compared with pre-industrial times (the global warming is 0.8 ºC). Projections from several General Circulation Models indicate further temperature increases, between 1.0 – 5.5 ºC in Europe by the end of the century. Changes in precipitation show more spatially variable trends across Europe, but annual precipitation patterns suggest an exacerbated difference between a wetter northern part and a dryer southern part (EEA-JRC-WHO, 2008).

These changes will affect the availability of water, especially in summer, and will increase the areas that suffer from water stress (Mediterranean region and some parts of Central and Eastern Europe) (Alcamo et al., 2007). Apart from impacts in the water quantity and availability (increased frequency and intensity of extreme events, emphasized temporal and spatial rainfall variability…), climate change may worsen the water quality and it can have economic impacts (need for additional investment to adapt infrastructures) and social consequences (conflicts over diminished water resources, migrations, loss of territory…).

There are two approaches to cope with climate change impacts: mitigation and adaptation. While mitigation aims at reducing the causes and the negative impacts, adaptation aims at learning to cope with the changes, by e.g. changing water consumption habits. The water sector needs to address a combination of both strategies (energy efficiency vs. system resilience).

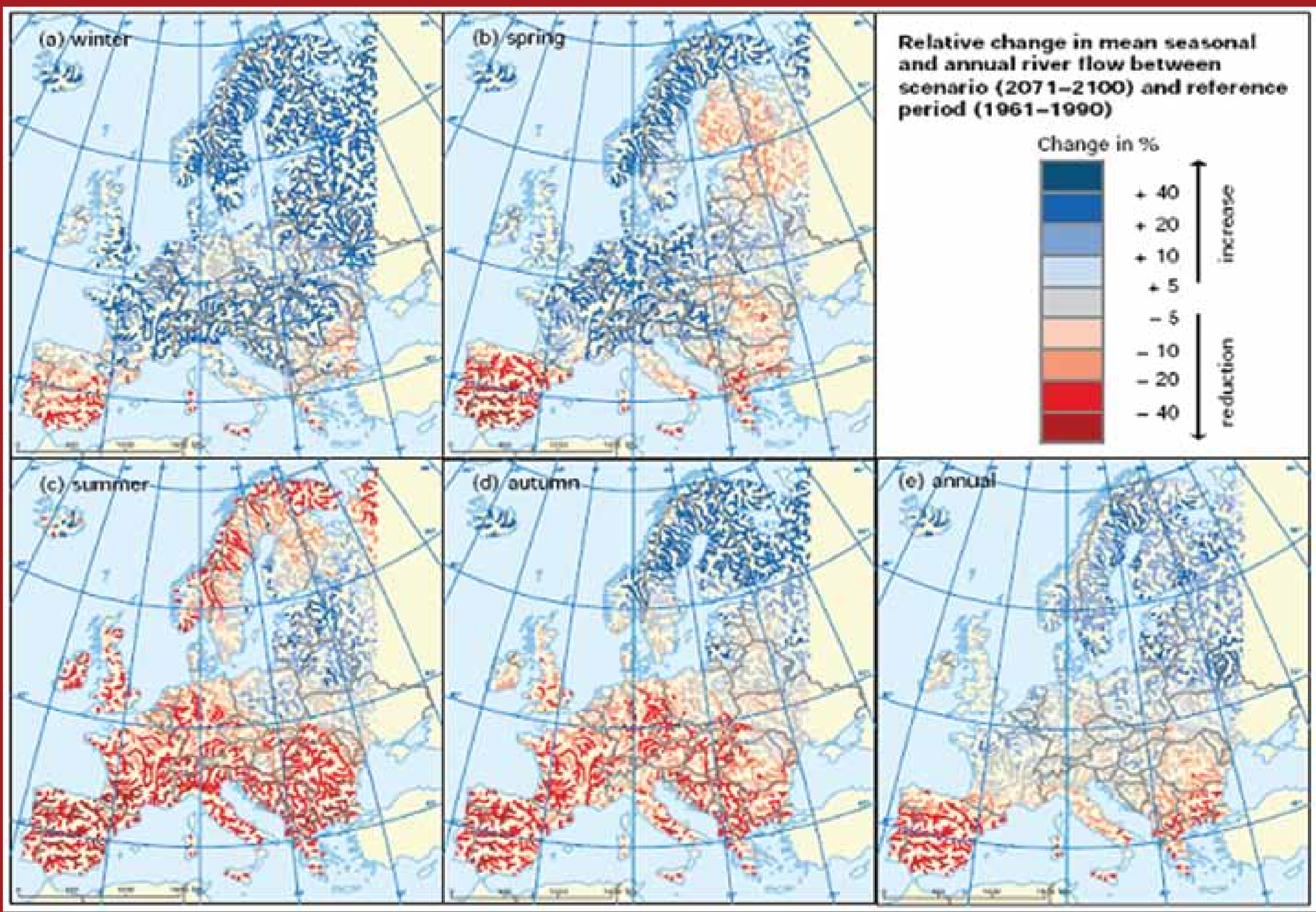


Figure 1: Projected changes in mean seasonal and annual river flow between 2071-2100 and the reference period 1961-1990, simulations with LISFLOOD driven by HIRHAM-HadAM3H based on IPCC SRES A2, Dankers and Feyen, 2008a (EEA-JRC-WHO, 2008, p.94)

3

Major challenges

Facing a growing demand with less resources

1 person out of 6 does not have access to clean water
1 person out of 3 does not have access to sanitation.
The global population threatened by floods and droughts will increase from 1 billion today to 2 billion in 2050. (United Nations University)

Coping with increasing water stress (quantity & quality)

In the past years, the topic of water scarcity and drought has risen to the top of the European agenda: the 2007 Communication of the European Commission on Water Scarcity & Droughts stated that water stress as structural imbalance between water supply and demand affects 130 million inhabitants (30% of population in Europe) in Southern Europe but also in Northern countries such as Belgium, Denmark, Germany, Hungary and the United Kingdom.

Recent analyses predict that by 2050, 3 billion people will suffer from water scarcity and that worldwide about 200 km3 storage capacity will be required by 2025. As a consequence, it is expected that water related conflicts should increase worldwide. In March 2008, the EU Report ‘Climate change & international security’ drew the map of potential threats related to exacerbate situation of water scarcity and drought in numerous regions of the world.

Similarly, the current global trends will seriously impact or endanger the quality of the water bodies, both surface and groundwater, resulting in detrimental effects on the aquatic life and ecosystems, but also on potentially adverse health effects, and the related economic downturns. In Europe and worldwide, efforts will be required to preserve the physical, chemical and ecological status of the water bodies.

Reducing impact of extreme events (droughts and floods)

Simulation scenarios predict that climate change will increase the frequency and amplitude of acute and short term hydro climatic events such as droughts and floods and therefore increase the economical and social consequences of those events.

Floods are one of the most important hazards in Europe regarding both economic and life loss. In 2002 , the direct costs of flooding amounted to €13 billion (EC, 2007) and it has been proved that the annual number of reported floods and damages in Europe increased during 1972-2002 period (Guha-Sapir et al., 2004). The consequences of more severe and frequent floods will be exacerbated in plain and valley areas by intensive land use including uncontrolled urbanisation, but also in coastal low lying areas such as the Netherlands by the risk related with the sea level rise following global warming.

According to the EU Report ‘Water Scarcity and Drought’, increased drought was observed in the past 30 years, affecting 100 million inhabitants (20% of population) in 4 events since 1989. The report concluded that in the past 30 years, drought events had a cost of €100 billion to the European economy (€8.7 billion only for the drought of 2003).

At the European level, work is being undertaken to develop indicators for water scarcity and drought as well as criteria for droughts management plans and a European Droughts Observatory. The European Commission is also in the process of conducting a Policy Review based on the 2007 Communication on Water Scarcity & Droughts to be released in 2012.

Managing aging or lacking infrastructure

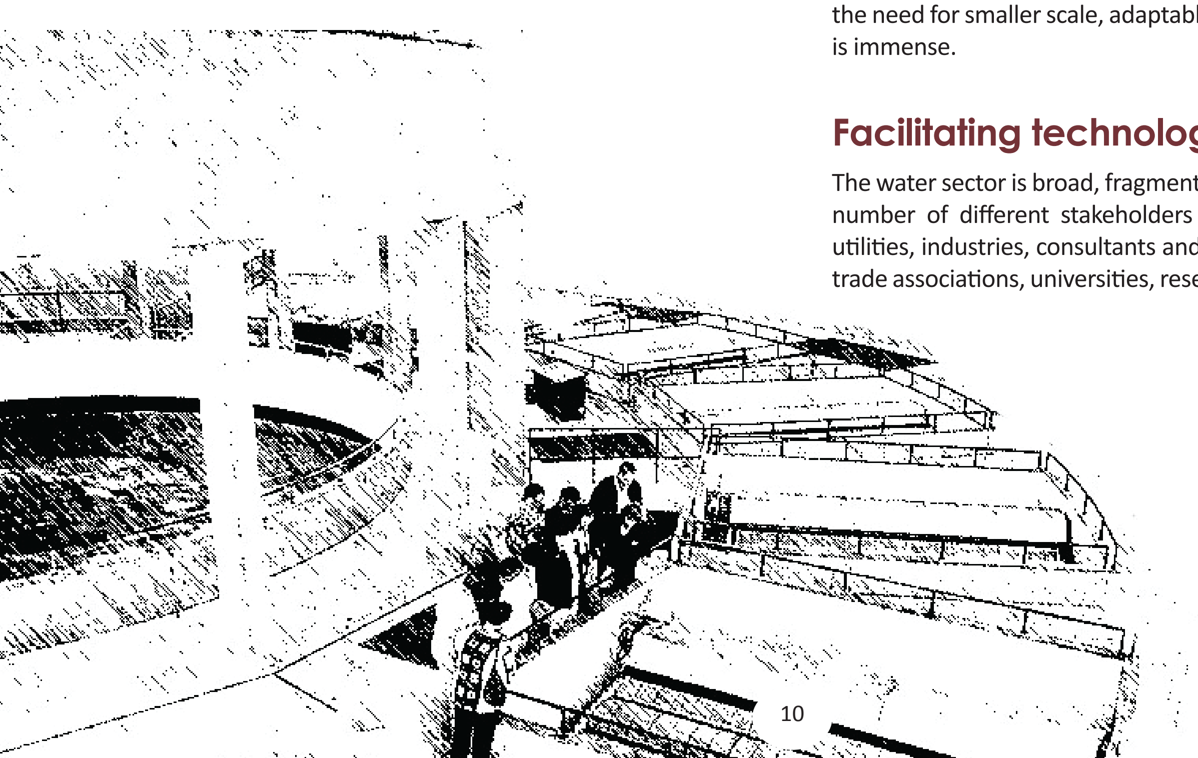
Two challenges dominate, i.e. aging infrastructures in high revenue countries and lacking infrastructures in low revenue countries.

Urban areas around the world suffer from old and deteriorating water infrastructures that are very vulnerable to failure due to aging, damage from excavations or over-loading. It is a technological and financial challenge to maintain and upgrade them in such a way that quality water can continue to be delivered to all sectors and wastewater can be adequately collected and treated. The International Water Association (IWA) suggests an annual pipeline replacement rate of at least 1.5% in order to stabilise the leakage level in a water distribution system and containing the loss of “non-revenue water”. The World Business Council for Sustainable Development estimates that the total costs of replacing aging water supply and sanitation infrastructure in industrial countries may be as high as $200 billion per year.

On the other side, many regions in low income countries of the world, and/or in rural or peri-urban areas, are not equipped today with central water supply and sewer networks. The financial needs to install basic facilities in these regions are high. The historical solutions of central infrastructures, proven in high income countries, may not always be technically appropriate or financially optimised in other circumstances. While existing water reuse options have to be further developed and implemented, the need for smaller scale, adaptable, local infrastructure systems is immense.

Facilitating technology transfer

The water sector is broad, fragmented and diverse. It consists of a number of different stakeholders from public institutions and utilities, industries, consultants and service providers, NGO’s and trade associations, universities, research entities and citizens. The



variety of actors and interests is a key challenge to build a strong European research for the water sector and to transfer and apply the outcomes of the research to local and regional users. As an ETP, the WssTP is a useful tool to accelerate knowledge and technology transfer, facilitating the coordination and communication efforts, enhancing synergy effects and mobilizing resources. In order to increase the industrial, commercial and societal impact of R&D projects, it is of paramount importance to involve stakeholders in the process of designing R&D projects and to make sure that the projects are of practical use. Methodologies for economic analysis of measures and impacts of R&D projects (such as patents, market development, societal impact) should be used to optimise the R&D investment.

As the federating body, the WssTP has built a network of experts to address the full spectrum of research, from basic to applied research through effective demonstration to successful commercialisation and will oversee efficient knowledge transfer along the whole knowledge chain, overcoming the traditional fragmentation of the water sector. It supports effective engagement with a range of businesses, regulators and academic institutions, as well as collaboration with public and private entities.

Establishing an “Enabling Framework”

In Europe and in other regions of the world, the smooth and efficient implementation of systemic integrated and site-specific integrated water solutions to solve the major water issues will require the establishment of an appropriate “Enabling Frame-work”.
The two aims are to ensure the proper consideration, under-standing and inclusion of social, economic, climatic, environmen-tal, political, legal and regulatory concerns in the decision process used for selecting global and site-specific water solutions and to identify, understand and break the major barriers for cross cutting issues impeding the deployment of integrated water solutions at the local, regional, national or transnational level, namely: efficient and transparent governance structures including appro-priate institutional framework and compliance with regulations and directives, public and political acceptance, financing of infrastructure and water value pricing.

It is accepted that monetary value assessment allows benefit-cost-analysis for policy guidance and thus ranking of alternative prevention, restoration and mitigation policy options. The total economic value includes the direct use values (irrigation, energy resource, etc.) but also the indirect use values (nutrient retention, storm protection, etc.) and other values (biodiversity, etc.), and may help devising sound water pricing and allocations to achieve efficient and sustainable water resources management.

The establishment of an “Enabling Framework” should include:

- Developing risk assessment and risk mitigation strate-gies to ensure the optimisation of the solution selection process, the public and political acceptance and the compliance with legal constraints
- Developing harmonised frameworks of Decision Support Systems taking into account specific local expertise as well as social, environmental, economical and political aspects. The harmonisation of procedures will rationalize and facilitate the decision-making process.
- Streamlining education and the training process is essential in order to break the public and political acceptance barrier (update water managers and stakeholders in general about best-practices and latest progresses).

The Millennium Development Goals for Sustainable Water Supply and Sanitation Services in Developing Countries

International efforts are required for the regions superposing acutely the challenges faced by the water sector. The United Nations adopted the Millennium Declaration on the 8th of September 2000. For the water sector, the goal 7 targets “environmental sustainability” and especially to “halve by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation”. The same goal on water supply and sanitation was agreed by the delegates to the 2002 Johannesburg Summit.

Facts:

- In 2002, an estimated 1.1 billion people lacked access to a safe water supply and 2.4 billion to improved sanitation.
- The Third World Water Forum (17th March 2003, Kyoto) highlighted the fact that there are a further 3 billion people who only use pit toilets, flush toilets, or sewers without any treatment before discharge to the environment
- Africa has 38% of its population unserved by safe water and 40% by sanitation; the figures for Asia are 19% and 52%, and 15% and 22% for Latin America and Caribbean.
- Over the next 25 years, the urban populations of Africa and Asia will almost double; the urban populations of Latin American and the Caribbean will increase by nearly 50%.
- The provision of full water and wastewater connections and primary wastewater treatment to the urban population would entail an annual cost of US$ 17 billion for water and US$32 billion for sanitation.

Enabling research and development of technologies that could also be applied to contribute to MDGs inside and outside Europe.

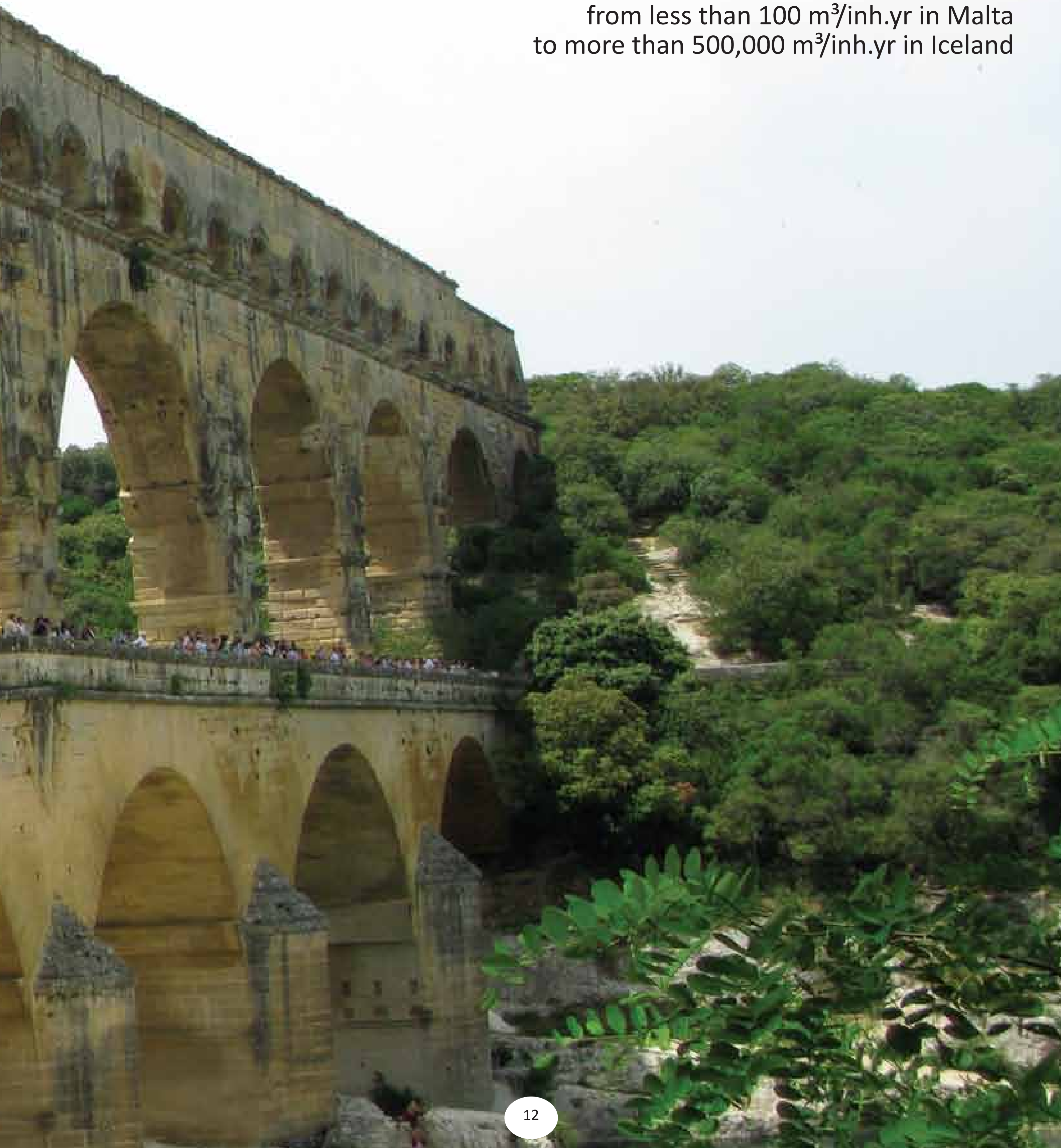
- Research into sustainable application of system solutions in water supply and sanitation that are embedded in the local MDGs context. Make solutions more sustainable in the sense of operational life time, not solutions that are abandoned within a very short time frame and create technology graveyards in MDGs countries.
- Include participatory approaches, bottom up rather than top-down technological solutions. Investigate active learning societies to make solutions and their implementation more sustainable within the political and socio-economic context.
- Research into the small urban water cycle including new concepts as no-mix toilets and re-use of water and human and animal excreta and nutrient recovery for food production. Energy recovery from human and animal waste.
- Adaptation of water supply and sanitation solutions in MDGs areas to be more robust and able to cope with the impacts of climate change e.g. flooding and drought.
- Research into hydro-soil erosion to minimise both its contribution to water pollution and instead have additional positive impacts in terms of water availability.
- Research into alternative and simple water purification technologies that can be used in critical condition in both developing and developed countries inside and outside Europe.

4

Water in Europe

Coping with global trends

The water availability among European countries is highly variable ranging from less than 100 m³/inh.yr in Malta to more than 500,000 m³/inh.yr in Iceland

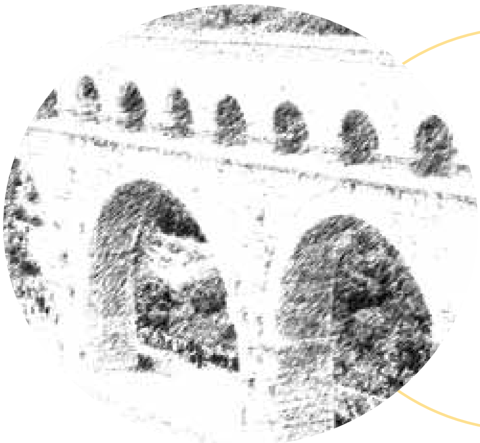


A Few facts on water in Europe

At least thirty European river basins located in thirteen Member States are impacted by water scarcity. At least 11% of the EU territory and 17% of the EU population have been affected so far by water scarcity situations.

It is estimated that in the south-eastern regions of Europe about 65% of the annual precipitation occurring in the plains is transferred by evapo-transpiration, 10% carried as surface runoff to the sea through rivers, and 25% percolates into the soil and is stored as groundwater in the aquifers.

According to recent Water Framework Directive and Daughter Directives implementation reviews, 20 % of European surface waters are seriously threatened, 60 % of its ground waters are overexploited and 50 % of its wetlands have 'endangered' status.



The Water Framework Directive

In 2000, the European Commission endorsed the Water Framework Directive (2000/60/EC). The WFD commits European Union member states to achieve good qualitative and quantitative status of all water bodies (including coastal waters) by 2015. It is a framework in the sense that it prescribes steps to reach the common goal based on integrated risk assessment and management rather than adopting the more traditional limit value approach. It rationalised the Community's water legislation by replacing seven of the "first wave" directives: those on surface water and its two related directives on measurement methods and sampling frequencies and exchanges of information on fresh water quality; the fish water, shellfish water, and groundwater directives; and the directive on dangerous substances discharges.

The Water Framework Directive (WFD) commits European Union Member States to achieve good qualitative and quantitative status of all water bodies (including transitional and coastal waters) by 2015.

The Directive defines 'surface water status' as the general expression of the status of a body of surface water, determined by the poorer of its ecological status and its chemical status. Thus, to achieve 'good surface water status' both the ecological status and the chemical status of a surface water body need to be at least 'good', i.e. recovery to pristine conditions defined in the absence of anthropogenic influence. Ecological status refers to the quality of the structure and functioning of the aquatic ecosystems of surface waters. The Directive requires Member States "to encourage the active involvement of interested parties" in the implementation of the directive.

The WFD calls for integrated water resource management at the scale of river basins. The overall goal of the WFD represents a shift from a paradigm focused on the exclusive uses of water. The goal is to ensure that the water demands of natural systems are

environmentally balanced with the agricultural, industrial and domestic needs of societies. In particular, the WFD requires "the promotion of sustainable water use based on a long term protection of available water resources", controlling the negative environmental impacts that water users can have upon the water cycle. At different steps in the cycle, water will be considered as a valuable finite natural resource while wastewater can be considered as a source of beneficial compounds.

The need to conserve adequate supplies of a resource for which demand is continuously increasing is also one of the drivers behind what is arguably one of the Directive's most important innovations - the introduction of pricing. Adequate water pricing acts as an incentive for the sustainable use of water resources and thus helps to achieve the environmental objectives under the Directive. Member States will be required to ensure that the price charged to water consumers - such as for the abstraction and distribution of fresh water and the collection and treatment of waste water - reflects the true costs. These costs include in most cases a high percentage of fixed costs due to investment in infrastructure.

Despite the anticipated impacts of climate change on water quantity and quality, adaptation to climate change is not addressed explicitly in the Water Framework Directive.

Greening the European economy with water

In the context of the Water Framework Directive and the mitigation policies against climate change, the European water sector has strong assets to contribute to the European "Green economy", supporting regions and cities in their quest to maintain Europe's global leadership in the field of green technologies.

The financial crisis pushed further the need for cooperation and creating synergies in research and technology development (RTD) on green economy to tackle simultaneously environment and sustainable growth, jobs and competitiveness. Innovation should be based on Life Cycle Assessment to develop RTD focusing on eco-innovation and demonstration cases that will open new markets.

5

Concrete Steps

Implementing the vision

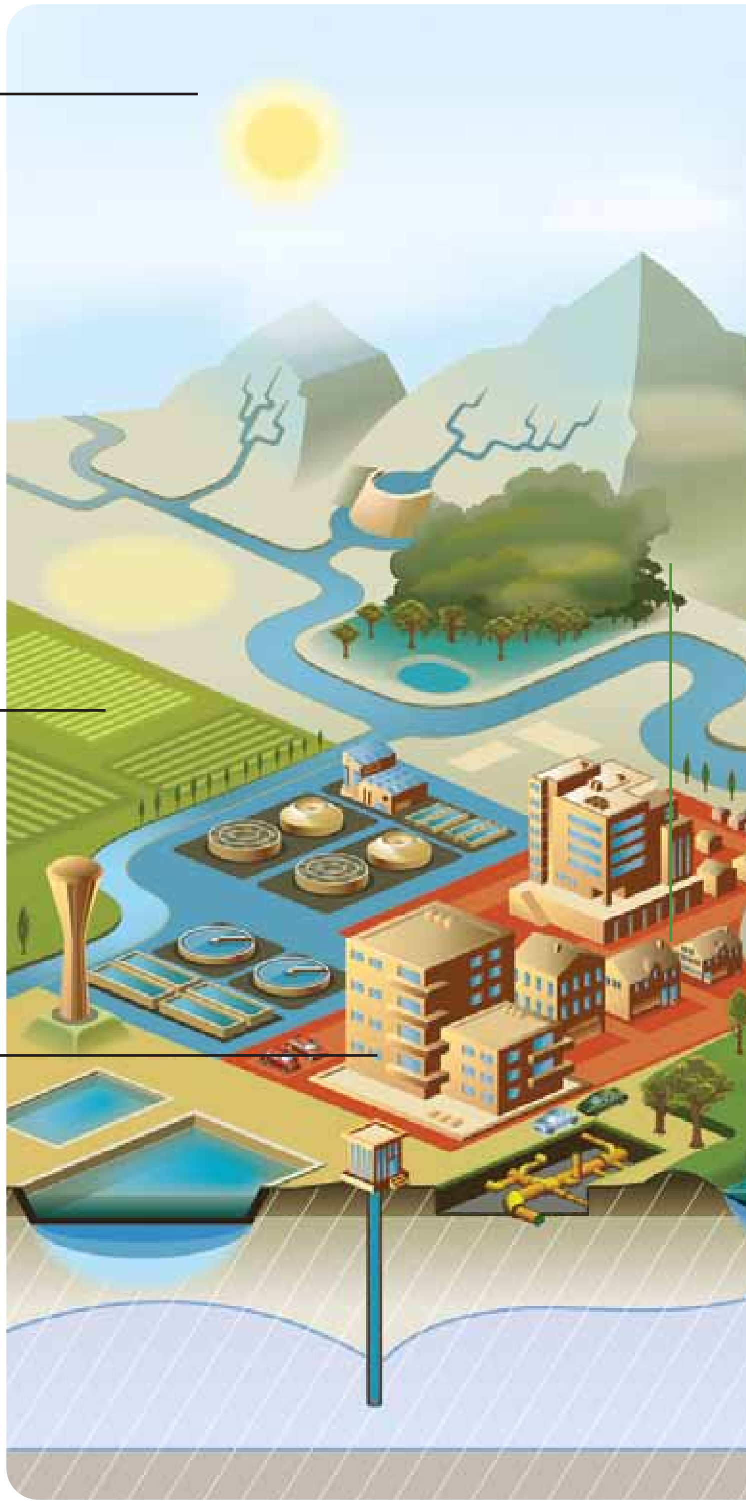
Defining the Strategic Research Agenda for water innovation

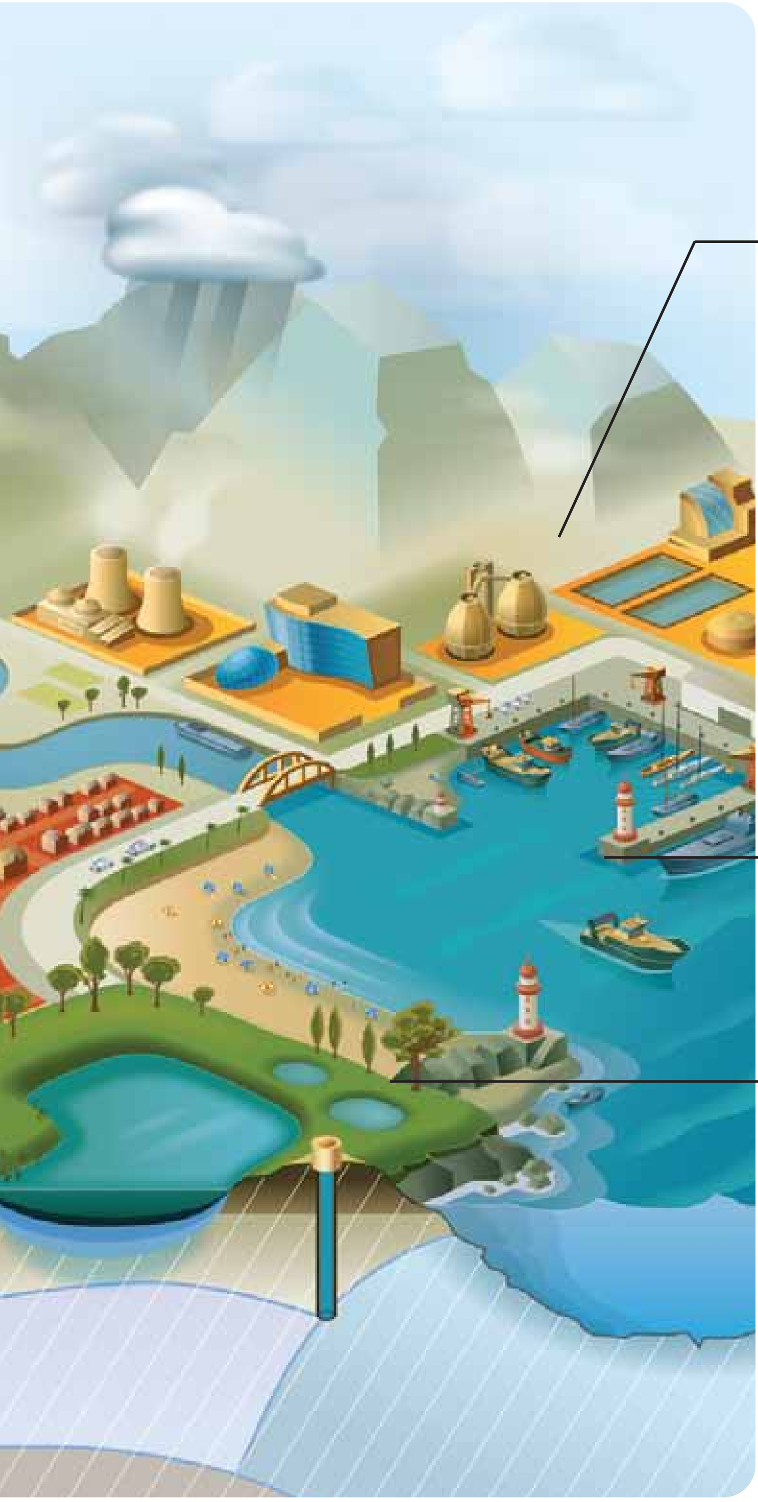
To answer those precedent key challenges, the WssTP has defined a Strategic Research Agenda based on a common vision for water innovation. Six pilot programmes (PP) were defined embracing key challenges from generic research and enabling technology development, prototype development and piloting, up to demonstration cases, each with a different area in focus. They cover a large portion of the spectrum of the water cycle issues without aiming to provide the solution to all European water problems.

PP 6:
Adaptation to hydro-climatic extremes (droughts and floods)
Managing risks and adapting water management to extreme events
In recent years, the average estimated cost of droughts in Europe was 6.2 billion Euro/year, with a high of 8.7 billion in 2003. Costs of flooding due to extreme precipitation and run-off amount to figures in the same order of magnitude. As a consequence of global warming hydro-climatic extremes are anticipated to become more frequent and severe in magnitudes highlighting the needs for efficient adaptation (including preparedness and emergency and disaster management) even further.
p. 34

PP 3:
Sustainable water management and agriculture
Making the best of innovation for an integrated water management in agriculture
Agriculture is a significant user of water in Europe, accounting for around 24 % of total water use. The challenge of sustainable use of water in agriculture focus on the key issues of irrigation, water reuse, and nutrient pollution but also water supply and demand balance.
p. 25

PP 2:
Sustainable water management in and around urban areas
Enhancing urban water services through efficient water management
More than 50% of the world population lives in urban areas. Urban areas, especially large or densely inhabited ones, raise specific issues with regard to water management. Urban areas require developments to manage efficiently the water services, safeguarding the public health while protecting the water resource and the aquatic ecosystems, and reducing the energy consumption and the carbon emission of the system.
p. 21





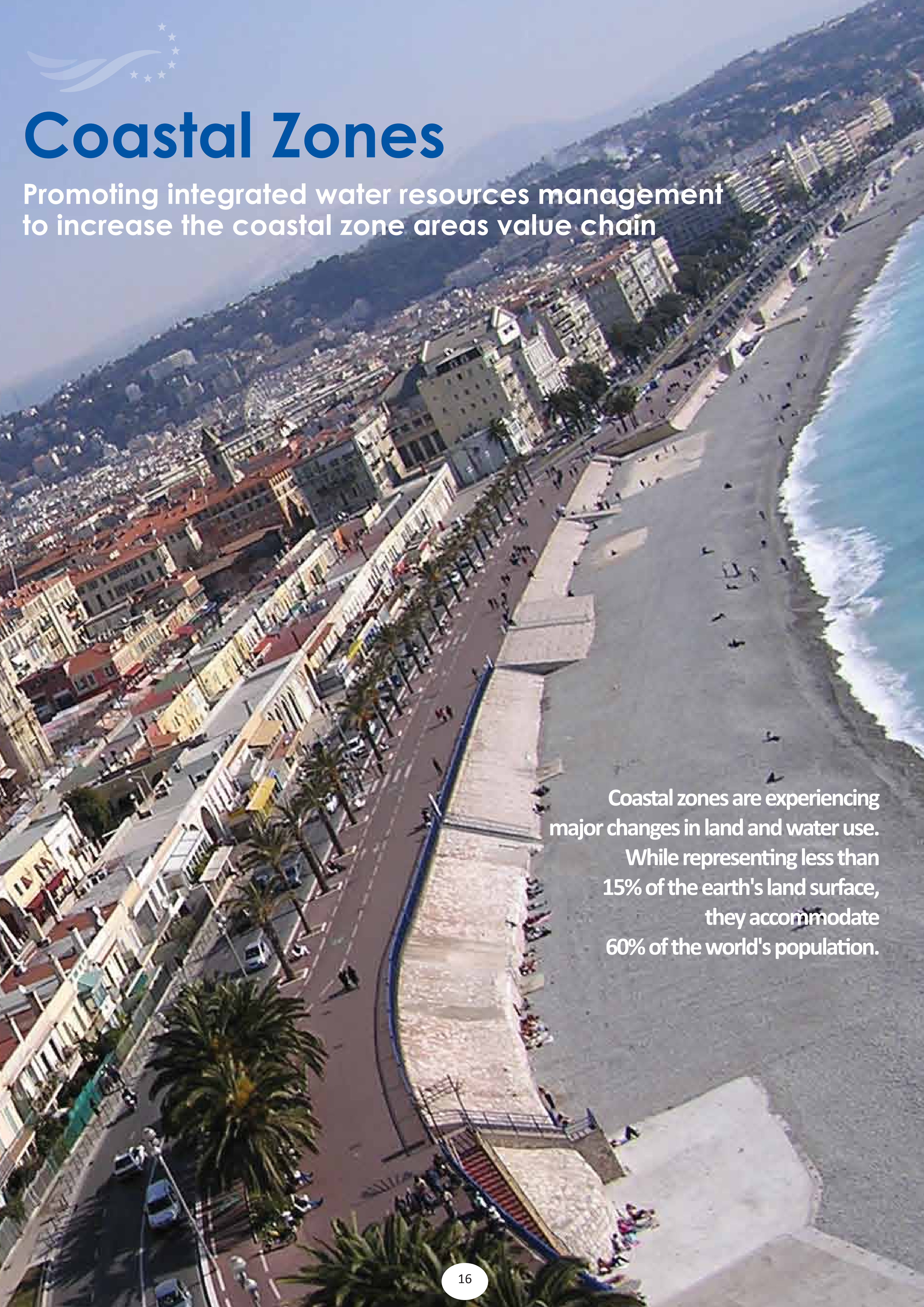
PP 4:
Sustainable water management for industry
Promoting a sustainable management of water in all industries
The industrial sector is of great economic importance, where water related cost can reach up to 25% of the total production cost. The main challenges are to promote a sustainable use of water in industries processes while ensuring efficient management and possible recovery of other resources required in the production such as raw materials or energy.
p. 28

PP 1:
Mitigation of water stress in coastal zones
Promoting integrated water resources management to increase the coastal zone areas value chain
With the highest concentration of people, coastal zones represent 61 % of the world's GDP that is heavily dependent on water related resources. Addressing the associated pressures is made difficult not only by the variety of water body types but also by the large number of stakeholders, policies, legislation and conflicting interests.
Forecasts predict further degradation of coastal zones, making it a socially and economically relevant focus area in need of specific applied science, technology and policy solutions.
p. 16

PP 5:
Rehabilitation of degraded water zones (surface and groundwater)
Stimulating ecological processes and systems for an environmental water management
Numerous rivers such as the Guadalquivir, the Tirjo, the Rhine or the Elbe are subject to water exploitation, and 60% of European groundwater bodies are overexploited. To cope with the challenges of degraded zones on both ecological and chemical level calls for development of innovative technologies, among with ecological processes, to solve complex problems in water management.
p. 31

Coastal Zones

Promoting integrated water resources management to increase the coastal zone areas value chain



Coastal zones are experiencing major changes in land and water use. While representing less than 15% of the earth's land surface, they accommodate 60% of the world's population.

Mitigation of Water Stress in Coastal Zones

Coastal economy represents the biggest sector of the economy in countries with a coastline and it is also the most complex

Coastal Zones are where surface water, groundwater, transitional 'brackish' and coastal water interface at scales where changes in the river basin affect this interfacing, the related biota and human activities. This explains why transitional and coastal waters are part of the Water Framework Directive (WFD).

It is the area with the greatest variety of water bodies - including temporary water bodies - that play an important role in the water cycle, in the ecosystems (major nursery systems) and in the mitigation of climate change impacts. Groundwater resources are either located in complex hydro-geological structures or local and shallow aquifers where water stress and saltwater intrusion often occur. If Coastal Zones are a buffer against sea and ocean impacts, they also inherit the upstream water inflow and the consequences of the measures taken in the related river basins.

The increasing anthropogenic pressures (increase in permanent settlers, tourism but also expanding trans-oceanic transport and fast growing aquaculture productions) affect water resources negatively by decreasing groundwater recharge and increasing surface water run-offs, floods, saltwater intrusions and the overall pollution or degradation of water and water dependent ecosystems more than in any other type of environment.

More and more cities are located on coastlines, generating a variety of pressures driven by the demand for water, energy, space, sanitation and infrastructure. The OECD recently estimated that with some 3,000 billion US$ of assets at stake in coastal port cities about 5% of global GDP is at stake in context of flooding and storm surges. Due to the close link between population development and natural resources, population is expected to increase faster than the overall in an even much narrower band of the coast while the coastal zone contains natural systems that provide more than half of the global ecosystem goods (e.g. fish, oil, minerals) and services (e.g. natural protection from storms & tidal waves, recreation).

Taking into account the present mitigation measures and the global or climate change forecasts, further degradation of coastal zones is predicted, making it a socially and economically relevant focus in need of specific research and technology development (RTD) and policies.

Challenges

Implementing integrated water resources management in coastal zones is particularly challenging but justified by the complexity of the water systems as well as the large number of stakeholders, policies, legislations and conflicting interests. In spite of legislation and policy implementations since the 1970s (e.g. Bathing Water, Groundwater, Drinking Water, Fish Water & Shellfish Water Directives between 1975-1980), a number of surface water and groundwater bodies will fail to meet the EU Water Framework Directive (WFD 2000/60/EC) objectives by 2015.

Water issues in coastal zones have generated the development of alternative water supplies that raise a number of new challenges that also need to be addressed. For example, desalination plants are a fast growing new source of freshwater along the coastlines with specific intake and discharge needs. At the same time, water injection in aquifers for storage and restoring due to impedance of recharge by surface modifications or saltwater intrusion mitigation is still limited. Additionally, there are measures that can be taken to reduce the consumption and losses of resources even if it is acknowledged that they will not be sufficient to maintain the economic growth in coastal zones.

The complexity of this environment and thus the level of required integration are greater than for inland waters. At an environmental science level one cannot dissociate hydrology, biota and the hydrodynamics of sediments. At a political and economical science level one cannot dissociate water from the socio-economical context, legislation, regulation and overall governance, in coastal zones any more than in other environments.

Research and Technology Development

While the focus is on Research and Technology Development (RTD) for freshwater resources - supply & sanitation - solutions need to take into account the social and economical impacts of the proposed solutions demonstrations for targeted coastal area as a whole, investigating the short term and long term as well as the direct and indirect costs and benefits by determining the cause-effect relationships or increasing resilience of water bodies. Indeed, human activity causes and effects on water are not independent and can only be addressed by an integrated perspective. RTD fostering and implementation in this context requires an adequate participative and legislative framework for integrated and sustainable water cycle management. This can be addressed by coupling the IWRM process to Cost-Benefit Analysis (CBA) or Cost-Effectiveness Analysis (CEA) for water management.

The following major RTD needs have been identified to support the implementation of the WFD and Daughter Directives:

- Sufficient fit for purpose data, based on defining common requirements for accuracy of measurements across data users. Finer characterization and monitoring systems to assess water (mainly groundwater) abstraction and recharge and to better assess the ecological status of surface and groundwater as reported in the current key outcomes of WFD and daughter directives deployment. This is to include developments and

proof-of-concept in terms of novel geophysical and hydro-geophysical modelling and inversion algorithms.

- Seamless data integration at a systemic level, with propagation and dissemination of results. There is a need for the development of web-based enterprise information management solutions (i.e. scalable, flexible systems where different levels of inputs and outputs are possible by a variety of users at different locations for best metadata capture) with an open standard architecture and flexible design to access new and existing databases to organize data and present integrated results for technical analysis and report generation (specifically transboundary water bodies).

- There is a need to develop a European coastal zone freshwater bodies classification and matching alert system based on key physical and economical identifiers in terms of land use changes, water inflow changes and increasing groundwater extraction rates for the analysis. This classification is to assist water managers in the selection and implementation of salt water intrusion mitigation measures, to ensure sustainable freshwater resources.

- There is a need to further develop guidance or triage tools and methodologies for water managers - often regrouped under the term "scenario-builders" - which when regrouped form the decision support systems that help evaluate the balance between the technical, societal and economical aspects of the possible solutions while integrating the various levels in uncertainty and sensitivity.

- There is a need to implement managed aquifer recharge field pilots in coastal aquifers to test and validate parameters and indicators fulfilling the needs of water managers and policy makers and define the technical and economical feasibility of this technique based on the key uses such as rehabilitating aquifer recharge, inter-seasonal storage enhancement or saltwater intrusion barriers.

- There is a need to develop Coastal ecohydrology methodologies for sustainable water resources management and flexible in-situ bioremediation, to restore and maintain at a catchment scale water circulation, nutrient cycles and energy flows and enhance the carrying capacity of ecosystems against human impacts.

- There is a need to reassess Mediterranean coast karst groundwater resources in the light of the Messinian salinity crisis to develop, manage and protect them based on a systemic approach. Indeed, during the past decades many projects were focused on the karst management and protection, in particular KATRIN, COST 65, COST 620, COST 621 and MEDITATE. However, none of the projects attempted to summarize the major areas of knowledge (and knowledge gaps) and technique concerning the karst groundwater resources in all the Mediterranean countries.

- Finally, for coastal zones that are more and more dependent on tourism, there is a need to find water and wastewater technological solutions to keep the tourism industry competitive in a global economy. In short, actions need to be identified aimed at minimising the costs that are passed to the visitors. Coastal regions are large energy consumers. Sustainable water and energy use could be achieved, for example, by the identification of opportunities and development of tools to increase energy efficiency in this highly fluctuating context (seasonality specific to coastal zones), to generate renewable energy within the coastal zone water cycle by innovative integration of technology such as the energy valuation of waste, wind farms or technologies using tides, currents or wave energy. With high population concentrations close to shore and the needs of industries such as shipbuilding and harbour activities, coastal zone water and energy relations require more attention.

As an example, the regions with high seasonal fluctuations in population that need to meet seasonal peak water and energy demands are investigating the possibilities of generating energy from biomass (e.g. microalgaes), waste or wastewater sludge. This seasonality is specific to coastal zones.

Demonstration Cases

Key stakeholders at the following locations have been involved to identify the issues, translate them into potential needs and identify the possible solutions and RTD topics. These locations are potential implementation cases for subsequent RTD and demonstration activities:

Guadiana Estuary and Ria Formosa coastal lagoon, Algarve Region, Portugal

The region hosts 14 million nights stay per year, concentrated in the dry season (in many municipalities - 200 % increase of population) and targets 100 Golf courses by the middle of next decade.

Need

– Increase water supply & reuse, safe quality water, preserve unique lagoons, mitigate salt water intrusion and floods, integrated water resources management.

RTD topics

- Demonstrate Aquifer Storage and Recovery using various sources of water including reclaimed water to validate feasibility and legislations.
- Ecohydrology engineering with appropriate alert systems to enhance the carrying capacity of water ecosystems.
- Novel geophysical and hydro-geophysical modelling for finer characterisation of water bodies.

Southern Adriatic Dinaric Coast (South of Slovenia, Croatia, Bosnia-Herzegovina, Serbia, Montenegro, Albania, North West of Greece)

Dinaric countries share common water bodies in a region dominated by carbonated aquifers. Water uses include drinking water, hydroelectric power generation and fish farming.

Need

Water supply for power plants, drinking water, irrigation and develop tourism. Monitor contamination and overpumping, mitigate salt water intrusion, rehabilitation of degraded zones, transboundary management of water.

RTD topics

- Web-based information management solution to access new and existing databases to organiSe data and present and share the integrated results for technical analysis and report generation: Transboundary water management tool.
- Improve the quantitative and qualitative assessment of available freshwater resources, especially in the Dinaric karst aquifer systems, for sustainable exploitation, integrating:
  - o Mapping karst vulnerability to pollutions from urban, agriculture and industry: protection tools and associated legislation and policies.
  - o Monitoring systems adapted to coastal carbonates to assess recharge, abstraction, implement protection and management practices as well as contingency plans.
  - o Salt water intrusion mitigation technologies in karstified carbonates.
- Evaluate inter-seasonal freshwater storage possibilities into existing aquifers, including the evaluation of impacts on marine ecosystems and coastal quality of water.
- Improve agriculture irrigation technologies.

Adour-Garonne basin & Gironde estuary, France

The basin and estuary are part of one of Europe's major complex multilayered aquifers. In the estuary the intermingling of freshwater rich in alluvium and silt with saltwater causes clay particles to flocculate, generating a muddy plug acting as a pollution trap, especially for heavy metals, that are often reactivated by the water turbulences.

Needs

Assess climate change impacts on water resources, refine water bodies characterisation & models (pressures and status), role of aquitards, alternative water resources and reuse, optimise water supply and demand, water quality and ecosystems: ecohydrology and bioremediation.

RTD topics

- Decision Support Systems for resources management based on key indicators (Quantitative & Qualitative).
- Ecohydrology and bioremediation taking into account water, sediments and hydromorphology.
- Aquifer storage and recovery in a low enthalpy context.

Region of Barcelona, Llobregat delta, Spain

The Llobregat delta consists of shallow aquifers and vulnerable surface water with a long historical presence of industry, transport, urbanisation, landfills and seawater intrusion.

Need

Integrated management of surface water, wetlands and groundwater bodies, monitor impact of reclaimed water and desalination onto aquifers, improve water quality in wetlands and shallow aquifer (WFD), rehabilitation of aquifers.

RTD topics

- Control response (pumping and quality) of salt water intrusion barrier.
- Risks assessment due to microbial activity in water recharge sites.
- Research on salt water intrusion.
- Water supply and demand scenario builders & decision support systems.
- Optimisation of resources management to supply standard quality of water to the various users (wetlands, human consumption, irrigation urban open spaces…).
- Monitoring and dynamic modeling of artificial recharge & natural infiltration.

Damour region, Lebanon

In the region of Damour sewage network exist but there is a lack of sewage treatment plants. Water resources rely on rivers and vulnerable carbonated aquifers where the construction of dams is not necessarily a good option.

Need

Sewage treatment, water act and protection (from agricultural, urban & industrial pollution) perimeters in carbonated context (vulnerability mapping), regulations implementation enforcement, salt water intrusion mitigation, inter-seasonal water storage.

RTD Topics

- Aquifer Storage and Recovery adapted to coastal karst systems.
- Carbonate characterisation and monitoring tools.
- Salt water intrusion characterisation and mitigation techniques.

Izmit bay, Turkey

The bay of Izmit is highly industrialised, e.g. petrochemistry, pulp, chemistry, fertilizer, and a refinery. The busy harbour sees transportation of hazardous toxic wastes and the '99 earthquake provoked a refinery fire.

Needs

Integrated pollution prevention, identify alternatives & reinforce legislations related to heavy ship transport (contamination during loading - unloading, ship accidents, ballast discharge, fire, explosion, toxic discharge), environmental protection, remediation.

RTD Topics

- Integrated land/sea/pollution prevention planning tool.
- Degraded zones rehabilitation techniques, including filtration and decontamination processes.
- Load discharge alternatives.
- Legislation & policy integration and adaptation.
- Decision Support Systems.

Rivers Rhine, Meuse, Scheldt delta, The Netherlands & Belgium

The main concerns are related to the climate change impacts on a heavily populated region that largely depends on inflow from upstream countries. The salination phenomena and the quality of drinking water supply are main concerns.

Needs

Climate change impacts & adaptation, decrease land subsidence, land use planning, salination process understanding improvement, improve water bodies' quality by reducing the pressures, improve chemical and ecological monitoring. There is a need to better understand the response of the coupled groundwater-surface water systems and related ecosystems to the salination and drought induced by climate change.

RTD topics

- Salination remediation technologies.
- ASR for water supply and land subsidence.
- Climate change related risk to groundwater: Delta Alert for Groundwater Resources (DGAR) classification in which the present and future vulnerability of (major) coastal zone will be outpointed.
- Identification of hydrological and hydrogeochemical effects of sand suppletion to coastal beaches.
- Artificial recharge with wastewater to combine the prevention of saltwater intrusion with wastewater reuse.

With additional supporting cases:

- Syracuse, Italy
- Plaine du Roussillon, Pyrénées-Orientales, France
- Venice lagoon, Italy
- Andalucía, Málaga and Almería, Spain
- Thessaloniki Chalkidiki Coast, Greece

FOCUS on cross cutting issue

Managed Aquifer Recharge

Managed Aquifer Recharge (MAR) comprises a wide variety of systems in which water is intentionally introduced into an aquifer. The objective is i) to store excess water for times of less water availability (especially in arid and semi-arid regions), ii) to introduce an (additional) barrier for purification of water for a specific use, iii) or to reduce the risk of intrusion of impaired water (e.g. in coastal aquifers). In the frame of alternative water resources to balance water supply and demand, MAR can act as a technique which could enable the efficient use of water resources that are currently not captured (e.g. storm water, high flows from springs, flood waters, treated sewage effluent), but also which could protect existing water resources.

Against the background of growing urbanization and industrialization worldwide as well as predicted climatic changes the sustainable use and conservation of groundwater representing 98 % of the world's ice-free freshwater resources is of greatest importance. Over-abstraction of groundwater for drinking water and irrigation has already now resulted in a wide-spread decline in water levels resulting in increased energy consumption for pumping, saltwater intrusions and land subsidence especially in regions vulnerable to water scarcity and drought. Managed aquifer recharge (MAR) is a tool to support natural groundwater replenishment for drinking water, irrigation or industrial use and to achieve the goals of the EU water framework directive by an optimized regulation of the water cycle at basin scale.

Research needs were identified in the field of defining criteria for recharge in terms of minimal water quality requirements and developing simplified models to allow rapid and easy evaluation of MAR feasibility. This will improve the easy and broad implementation of the MAR technology as a helpful tool for local or regional Integrated Water Resources Management.

Urban Areas

For an effective and adaptive management of urban water systems

Since 2007, more than 50% of the world population lives in urban or peri-urban areas. Sustainable urbanisation models could be a solution to the environmental challenges of the 21st century.

Sustainable management of the water cycle in and around urban areas

Approximately 50% of the population of the European Union live within urban areas. These range in size from larger towns with perhaps 50,000 inhabitants to the major conurbations which may be home to many millions. Flexible and innovative solutions are needed to cope with such substantial changes in water demand for people and their associated economic activities.

Urban areas vary greatly, in their relation to water resources and uses. This diversity depends on:

- Climate and topography
- Quantity and quality and seasonal variability of nearby water resources
- Size and population of the area, industries and the pace and history of urban growth
- Characteristics of the different parts of the urban and surrounding areas
- Seasonal variability of population, activities, and water uses
- Economic and social conditions
- Condition and capacity of infrastructure and surface assets

Existing and emerging urban areas therefore raise specific issues in terms of water management.

1. The population density within the area and the variety of water uses mean that there can be chronic, seasonal or permanent imbalance between water demand and availability. This leads to pressure on the environment from water abstraction, from the treatment and discharge of waste water and from the concentration of run-off during rain events.

2. Urban water systems are necessarily complex and concentrated within limited space. This means that complex management tools are necessary to resolve conflicts between water system requirements and more general land management.

3. Protection of the environment, inhabitants and the urban infrastructure from water related risks such as flooding and drinking water pollution require safe, robust and integrated solutions

4. Water and waste treatment processes in urban areas have in the past adopted energy intensive technologies to minimise footprint and reduce costs. Increasingly climate change agreements will require the use of more energy efficient systems.

5. Urban areas by definition present some unique issues and also others that overlap with rural and coastal areas. These overlap areas differ from country to country and depend on population distribution and the nature of the suburban development.

Challenges

The main and all embracing water issue facing urban areas is to reconcile the need to meet an increasing demand and to meet more exacting quality standards in an economic and sustainable manner. The demand is seldom predictable in the medium or long term and operating circumstances are constantly changing.

The water related EU-legislation of particular relevance to Urban Areas are:

- The Water Framework Directive and its Daughter Directives setting environmental quality standards for groundwater and for surface waters
- The Bio-solids Directive (which encourages re-use whilst strengthening environmental controls)
- The Landfill Directive (which also encourages re-use of bio-solids)
- The Urban Waste Water Treatment Directive (which designates sensitive surface water bodies and means to protect them)
- The Drinking Water Directive (which sets 48 microbiological and chemical parameters to be met throughout the EU)

Within this overall scenario there are numerous more detailed challenges involved in the provision of water services to a modern urban area.

Balancing Supply and Demand

There is a tendency for population to migrate to cities and their suburbs from rural areas, increasing local requirements for domestic water. It will be vital to balance demand and supply of water within the urban area, maintaining a fair balance between the use of water in urban areas and in the surrounding, or downstream areas.

To satisfy this increase in water demand without major impacts on the environment calls for sustainable solutions within a framework of integrated water resources management.

Public Health

In developed countries this risk tends to have become forgotten because in urban areas there are seldom public health problems caused by the public water supply. However it will always be a primary concern for water utilities. It is important that when responding to the changing requirements of a modern city the integrity of a water supply or sewer system is not compromised. The water quality supplied to customers must always be safeguarded.

Safe drinking water and safe sanitation in less favoured rural areas

There is EU legislation in place for the quality of drinking water from water supplies serving more than 50 persons (Drinking Water Directive) and for the collection and treatment of waste water from settlement areas of more than 2000 inhabitants (Urban Waste Water Treatment Directive). However, there is no obligation to provide public drinking water supply, and no obligation to ensure safe sanitation in smaller settlement areas. As a consequence, outside the scope of application of these Directive still hundreds of thousands of European citizens lack access to safe drinking water and safe sanitation, and are for the foreseeable future not able afford traditional approaches for drinking water and waste water. The challenge will be to provide within reasonable timelines affordable solutions for safe drinking water and safe sanitation for these sectors of society.

Safeguarding the Environment

One key challenge is to meet new and existing environmental standards such as those required by the Urban Waste Water Treatment Directive (UWWTD) and the Water Framework Directive through the implementation of new technological developments while minimising of the environmental footprint of water operations.

Accommodating Extreme Events

The change of weather pattern and more extreme hydro-climatic events presents a major challenge to water services in urban areas.

• Changes will be needed to the water supply system to accommodate the change in seasonal patterns and the increased likelihood of droughts.

• Provision of storm run-off areas will be required in urban developments to reduce the risk of flooding and the inundation of sewer networks and wastewater treatment works.

• Forecasting and decision support systems will be needed both for long term planning (impact on water quality and quantity) but also for short term real-time management of extreme events.

Infrastructure

There is a need to manage or renew very old assets, particularly below ground. Replacement of large sewers that can be over 100 years old can cause major disturbance to life in a modern city.

Research and Technology Development

For the various challenges related to water services in urban environment, RTD needs will include:

Balancing Supply and Demand

• Development of water saving concepts and technologies
• Methods of customer education promoting efficient use of water (EUW)
• Advanced metering technologies to promote EUW
• Develop tools to understand, predict and manage demand
• Alternative Water Resources
o Identification of potential sources
o Reduction of the environmental impact of desalination plants
o Development of other advanced technologies to permit the re-use of waste water
o Treatment systems for rainwater harvesting
• Definition of water quality requirements for various uses
• Determine the impacts of water demand and supply management options

Public Health

• (Microbiological) Risk Assessment and management tools "from resource to tap" for assuring drinking water quality
• Sensors and monitoring systems to detect low levels of chemicals and microbiological contamination in river water or distribution systems
• Improved processes for removal of microbial pollution (including virus) and emerging contaminants

Safeguarding the Environment

• Methods to monitor and remove point source and diffuse chemical and biological pollutants, including emerging/priority contaminants
• Develop water and wastewater treatment systems having reduced energy and chemical usage
• Develop better methods and tools to determine environmentally sustainable river flows
• Decision support systems for the implementation of the sustainable management of bio-solids in urban areas
• Develop processes to produce energy and usable products from bio-solids and other residuals

Accommodating Extreme Events

• Modelling tools for integrated risk assessment and management of urban flooding and pollution
• Integrated, quality based real-time storm water management systems

Infrastructure

• The development and introduction of easily accessible below ground pipe channels

- Gain an understanding of scaling, corrosion and bio-fouling and corrosion of below ground assets and develop suitable methods for identification and remediation
- Develop advanced, non-disruptive methods for maintaining and replacing underground assets
- Asset management tools for sustainable maintenance and upgrade programmes and for integrated design of networks and decentralized processes

Enabling Framework

- Identify most appropriate, risk management, IWRM tools and Decision Support Systems (DSS) for various water industry applications
- Gain agreement on standardised approach for the above
- Research the relative importance of the barriers to the implementation of integrated water solutions
- Identify the most appropriate knowledge transfer and education methods

Implementation Cases

Key stakeholders at a number of locations have been involved to identify the issues, translate them into potential needs and identify the possible solutions and Research and Technological Development needs. These locations are potential sites to implement subsequent RTD and demonstration activities: As examples:

Berlin: Large conurbation characterised via semi closed water cycle through bank filtration and artificial infiltration. Current R&D topics are:

- Impact of global changes on water cycle
- Risk management associated with water resource management (aquatic environment, human health …), in particular with regards to trace organics
- Optimised water services (energy efficiency, asset management and leakage control, alternative sanitation systems etc)

London: Suffers from problems of aging infrastructure because of its early urban development: leakage and quality issues related to the water supply network are coupled with increasing water scarcity from changing rainfall patterns and population pressures in south-east England. It is intended to use London as an example to develop:

- Smart metering to provide real-time data on water consumption and costs for the benefit of customers and operators
- Solutions for demand management to minimise the reliance on expensive technological equipment to satisfy demand.

Madrid: Fast developing city situated in water stressed area with high summer temperatures. The case will be used to develop:

- Integrated resource management techniques
- Demand forecasting and management

Prague: Used as a basis to develop:

- Augmented environmental protection measures in line with EU standards
- Cost effective solutions to upgrading assets

Utrecht: The city requires a new waste water treatment plant and this requirement will be used to facilitate a programme on:

- Integrating a WWTP into a modern urban environment
- Methods to remove priority substances from sewage

Gothenburg:

- Different surface water are used for water production.
- Focus on risk management and reducing risks due to microbial pollution with long experiences of early warning system
- Co-operation with strong research group at University

Other cities that have contributed include Barcelona, Eindhoven, Utrecht, Genoa, Istanbul, Gliwice, Lisbon, Lyon, Paris, Oslo, Simferopol and Aarhus.

FOCUS on cross-cutting issue Sensors and Monitoring

Real-Time monitoring and control systems have been deployed over the last few decades in water and wastewater plants and big facilities, for real-time optimized operation, alarms management, energy optimisation, quality control, crisis management. But these technologies were neither mature nor cheap enough to be deployed in large quantities in water and wastewater networks. The evolution of electronics, telecommunications and battery technologies is now changing this paradigm. This is a major evolution for water business which has to be handled carefully by water utilities and water companies for the benefit of the final consumers and a better protection of the Environment.

District metering, on-line leak detection, automated meter reading through fixed networks, all those new businesses are not far from being mature and lead the water industry to start evolving from lack drought of data to what we could call a new “flood of data”. This revolution will not stop and is rapidly moving forward due to new generations of on-line sensors. There is here a real research need for assessing how far micro and nano sensors will really fit the water industry requirements and how easy and economical feasible it is to massively deploy those new sensors in water and wastewater networks and facilities.

Regarding Environmental monitoring the combination of existing and new sensors with satellite-based monitoring systems (GEOSS) should also be investigated, as it will require multi-sources data management and the organisation of seamless data bases.

A new revolution has already started and is leading water utilities and water companies to adapt their practices and organisations to get ready to develop and manage Networks of Sensors for appropriate applications. But, the water industry is not yet ready to deploy those systems, and another research need consists is being able to understand their total environmental and economic cost of ownership (impacts on operational and maintenance business processes and organisations).

Agriculture

For a sustainable and local management

Most of European agriculture is directly dependant on rainfall.
But 6,7% of land is irrigated.
Agricultural production is inextricably linked to water supply.

Sustainable water management and agriculture

Worldwide, agriculture accounts for two thirds of all water used, mainly for irrigation. In Europe agriculture accounts for 24% of water abstraction, and up to 73% in southern Europe.

The water sector together with the agricultural sector are looking for solutions to achieve sustainable water management. There is a need for a better understanding of main issues, challenges, constraints and uses of water in agriculture. It is necessary to develop and implement technologies and methods that will make it possible to secure water supply for agriculture, to increase water use efficiency and to improve water resources protection. In addition to society's expectation to improve water management agriculture also faces increasing demand for a secure food supply, globalization, price volatility and climate change.
The vision for the agricultural sector is that:

- Agriculture will be able to produce sufficient and safe food and other agricultural products at reasonable prices in a sustainable way
- Agriculture will use water more efficiently, and will make better use of non-conventional water resources
- Agriculture will further improve environmental protection while producing food and other commodities
- Agriculture will increasingly benefit from new water technology, equipment and facilities

Challenges

The following challenges will be addressed:

1. The implementation of the Water Framework Directive (WFD) which has an impact on water related investments and current management practices in agriculture (see for example the concept of full water pricing introduced in the WFD)
2. Increasing water scarcity and drought in many regions of Europe and a rising number of floods and heavy rain events which affects agricultural production
3. Balancing water supply and demand at local level which is crucial and needs the collaboration of many stakeholders
4. In agriculture the effect of climate change is reflected by water availability. There is a greater need for adaptation to changing climate making use of innovative approaches to reduce vulnerability

Priority must be given to the following three topics related to water and agriculture requiring RTD activities:

- Irrigation: technology and irrigation management, improved cropping practices

- Water reuse: linking technologies and legal framework, determination of required water quality for different agricultural purposes, fostering the reuse of urban effluents in water scarce regions

- Nutrients and pesticide management: measures to reduce inputs and to address leakage and run-off through hydro morphology or agricultural practices, while tapping the potential of nutrients resource from urban water schemes such as biosolids

Research and Technology Development

For the various challenges related to water management in agriculture, RTD needs include

- Improvement of water use efficiency at different levels (local, regional, farm level). This requires a) the development of new water management tools, such as integrated models and decision support systems, improved monitoring and b) the improvement of water productivity while making use of improved irrigation technology and innovative production methods.
- Safe use and reuse of water in agriculture and its long-term impact on the environment. This calls for the design of new technologies and management methods for e.g. 'cascading' systems and safe reuse of treated wastewater seeking for ecological and economical benefits.
- Reduction of diffuse and point source pollution caused by agrochemicals, mineral fertilizers and manure. This will require the development of cost-effective, easy-access and adaptive technologies including manure separation and treatment technology, precision farming, regulated drainage and an adapted management of buffer strips.

Main recommendations

1. Need for locally adapted solutions linking new or improved technology with appropriate management of water quality and quantity
2. Innovative solutions in agricultural water management taking into account the diversity of European agriculture regarding natural conditions, farm size and types
3. Need to adapt existing technologies to agricultural production systems to facilitate the use of technologies developed for industrial purposes supported by advice to farmers concerning their use.

FOCUS on cross-cutting issue Water reuse

The water sector in Europe, as well as in many other parts of the world, is in a transitional phase with unique opportunities for water reuse for agricultural, industrial, urban and other purposes. Reuse should be implemented on a larger scale as a sustainable practice within a framework of integrated water resources management. Hochstrat et al. (2006) estimated that between 2000 and 2025, in Europe alone, the utilisation of treated municipal wastewater could more than double, growing from 750 million m³ per year to 1,540-4,000 million m³ per year.

In general, water reuse is more a question of the scale and size of the reuse cycle as the water cycle is impacted by human activities at many points so that pristine water bodies are hardly to be found in Europe. Reuse addresses key topics such as irrigation of agricultural land, urban water, water in industry, groundwater recharge, the use of treated waste water and technologies to ensure the necessary quality of the specific water source and application.

Recent EU projects demonstrated that the reuse of treated wastewater is becoming an issue and a great challenge for the sustainable development in Europe, in particular in the central and southern Europe and the Mediterranean region. Projects demonstrated that water reuse can be a low cost solution to face decreasing water availability from rainfall and to face water scarcity, thus contributing to the objectives of the WFD and Millennium Development Goal. Moreover, depending on the application, water reuse can be an efficient local adaptation and mitigation solution to climate change. Nevertheless, several issues, barriers and impediments to the widespread implementation of water reuse were identified, including the adequate pan-European regulation.

Industry

For a resource oriented management of water based processes

In the EU, energy production accounts for 44 % of total water abstraction, primarily serving as cooling water.

Sustainable water management for industry

Water is of prime importance for the industrial sector

It is used in a variety of ways for transport, cooling and heating, cleaning, washing and also as raw material and product. Major water using and/or discharging industries include pulp and paper industry, textile, leather, oil/gas, chemicals/pharmaceuticals, food, energy, mining and metal.

For industries, water is of great economic importance, as water related cost can reach up to 25% of the total production cost.

There is a need to develop and implement technologies and methods, in support of the vision that water for the industry is not a consumable or utility anymore, but a highly valuable asset: a vital element used in close conjunction with production processes. The definition and application of water qualities up to their specifications is an important part of this sustainable water use; the focus is not only at the water use between the walls of the factory, but also in relation to other users of the water system, like the municipal and agricultural sectors. Finally the development in industries, using more biomaterials, lead to significant changes, making them more and more water dependant factories.

Challenges

The key European directive relevant to water issues in industry is the IPPC Directive 96/61/EC (1996) which governs how industries must prevent and control emissions of pollutants to the environment. Best Available Techniques (BATs) for industrial wastewater treatment are central in the implementation of the directive.

For facing the increasing water stress and water costs in a sustainable way industry's challenges of today are:

- To define and use water quality fit for use
- To close the water cycle, leading to a zero discharge system
- To develop sustainable use of resources (discharge, waste, energy), incl. recovery of high added value products from water, energy production from wastewater.
- To address the element 'water in industry' as part of the total water system
- To address protection of environment, health and safety, also including WFD demands and emerging/priority contaminants

These challenges are closely related to each other. For water reuse and closing the water cycle the water quality demands should be known, water and energy (re)-use are often coupled and environmental, health and safety aspects are part of all the challenges. Therefore an integrated approach is necessary.

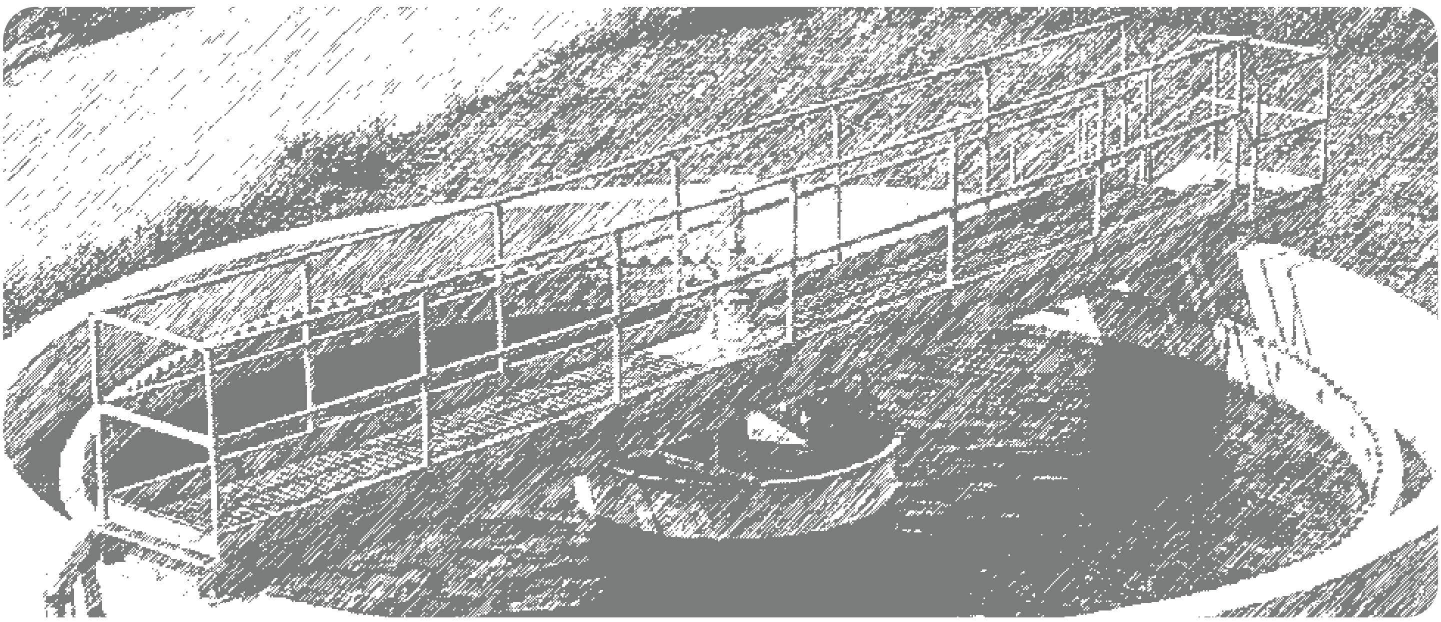
The following topics are of particular interest:

- Development of a sustainable water system as part of sustainable production (factory of the future)
- Industry as part of the total water system and far going cooperation with the urban and agricultural sectors
- Besides technological challenges there are other challenges, for example on societal level in relation to acceptance and perception

Research and Technology Development

For the various challenges related to water management in industry, RTD needs include

- Closing the water cycle. The insight in water quality demands needs to be improved by placing more focus on the production processes.
- 'On-line monitoring systems for improved water quality control, and increased health and safety.
- New energy efficient advanced water saving and treatment technologies including small scale systems and processes for the removal of specific pollutants such as the priority substances.
- Energy and resource / raw material recovery technologies. Reducing both environmental impact and total life cost of industrial water systems should be guide the technological developments.



Demonstration cases

Demonstration cases defined until now were oriented towards specific sectors or more general problems in water intensive industries (chemical, textile, pulp and paper, food and mining). Many research questions are gathered in the FP7 Integrated Project AquaFit4Use which started in 2008, with a strong focus at water system within wall of the factory, but also with the other following approaches:

- Integrate the water management within the production process of the industry
- IWRM approach: integrating the water management in industrial sites together with the local environment (agriculture, WWTP, etc)

Future demonstration cases will be focused on the two approaches:

1. Sustainable water use as part of sustainable production (factory of the future)
2. Industrial water use as integrated part of the local water system

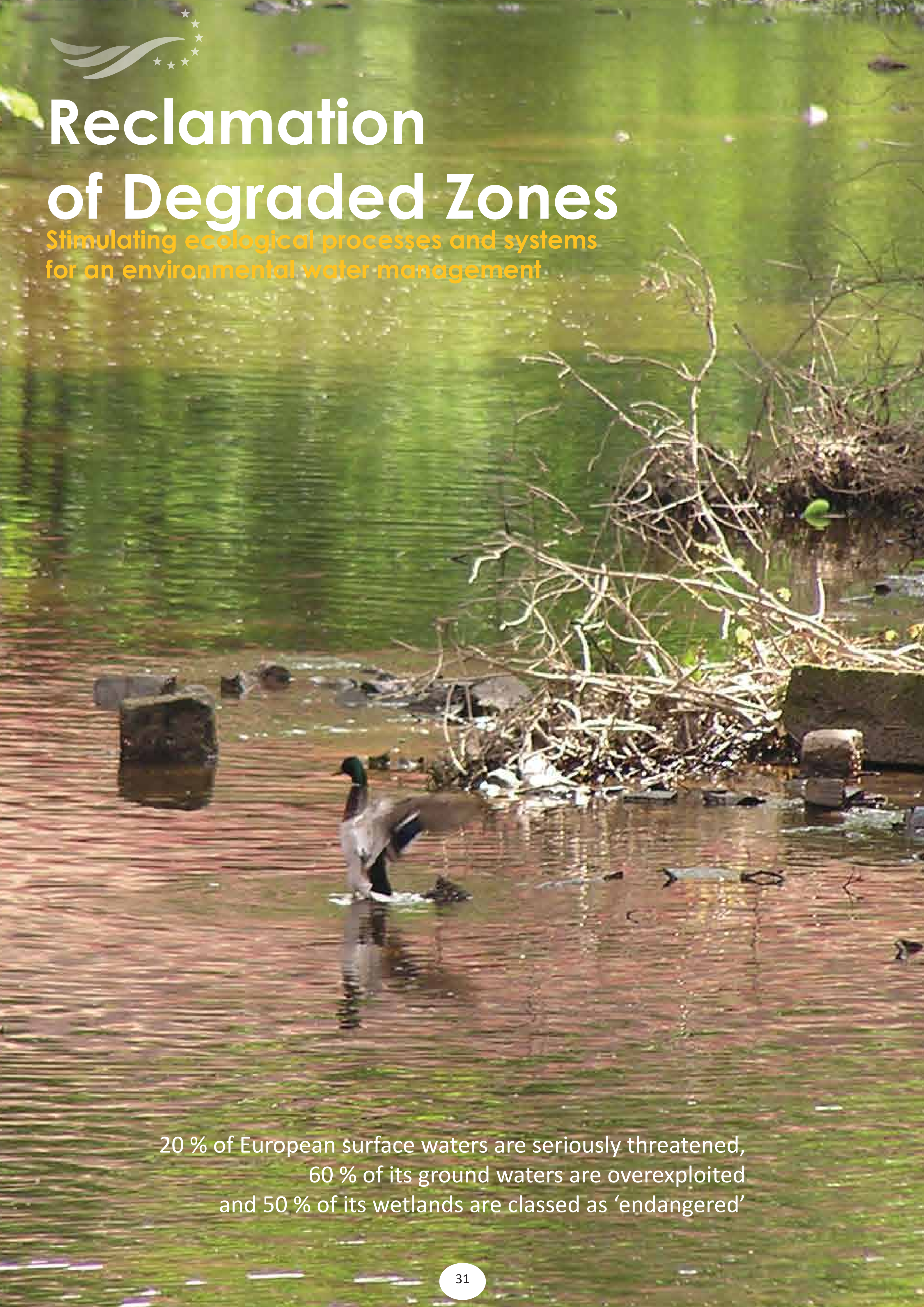
In the first approach there will be more focus on the water using (and producing) processes in the different industries. Close cooperation with other European Technology Platforms is needed. In the second approach more thematic oriented cases will be developed also dealing with other issues, like energy reuse, aquifer recharge, and water cascading.

FOCUS on cross-cutting issue Water and Energy

Important interactions exist between water and energy. Energy is needed for water supply (domestic, industry and agriculture) and wastewater treatment. In return, water is a crucial component in the production of power (cooling towers, hydropower), and renewable energies are often related to water and or the presence of water bodies with embedded energies (geothermal power, heating pumps, tidal and wave power, osmotic power, bioethanols etc). In industries the optimisation of the water cycle is very often associated with energy reduction when reusing water with low or high temperatures.

In addition, there is another strong interaction of water and energy with climate change. Indeed, extensive use of fossil energy is one of the main causes of global warming. On the one hand, climate change will impact severely on water management practices, but on the other hand, energy crisis (depletion of fossil energy) and needs for low carbon emission (Post-Kyoto policies) will drive up energy prices and will call for energy efficient water technologies and even perhaps wastewater schemes with neutral or positive energy balance. Also implementation of the Water Framework Directive will require additional treatment measures and existing solutions all require additional energy. In the UK, energy consumption in the water sector has doubled since 1990 as a result of the Urban Waste Water Treatment Directive and Drinking Water Directive due to the required additional treatment. Further increases are likely, resulting in a "pollution displacement" from water bodies to the atmosphere. Therefore there is an urgent need to conciliate the Water Framework Directive and the European "Energy Package" and to find optimum and low energy measures which will best protect water bodies while minimising the impact on global warming. There are many examples of costly enhancements to wastewater treatment that deliver questionable environmental benefits, inter alia: a spot compliance regime, effluent disinfection, odour control, nitrogen removal and sludge pasteurisation. The materials and chemicals used in water and wastewater treatment will also come under increasing scrutiny because of their carbon footprint. Finally, in order to improve the energy balance of wastewater schemes in industries or municipalities, biogas producing anaerobic and fermentation processes are expected to be more systematically used.

The interaction between water, energy and climate change will also impact current heating practices in households, as 89% of carbon emissions in the municipal water cycle are related to domestic water heating (excluding space/central heating, briefing note of UK Environment Agency). For example, in regions with hard water, water softening may have an overall positive energy balance, improving the energy transfer for heating in household appliances. Another dimension relates to the production of biodiesels from crops as intensive agriculture for the production of biofuels will increase the pressure on the water sector through higher agricultural water demand and aggravated phenomena of eutrophication, erosion and sedimentation. Biodiesels of 2nd or 3rd generation (with waste biomass or with algae) will be very useful in decoupling the energy production from the water demand, and may as well provide interesting complementarities to sanitation schemes.



Reclamation of Degraded Zones

Stimulating ecological processes and systems for an environmental water management

20 % of European surface waters are seriously threatened,
60 % of its ground waters are overexploited
and 50 % of its wetlands are classed as 'endangered'

Rehabilitation of degraded water zones (surface and groundwater)

European rivers and lakes are of great importance for our economies and our well-being, but more generally they support crucial ecologies that make up our natural environment. Since the industrial revolution human pressures have increased with rapid economic growth, urbanisation and uncontrolled exploitation of our water systems. Rivers have been dammed, lakes have been used as dump sites, and coastal waters have been used as seemingly unlimited sinks for the effluents of our cities. As a consequence many of our waters have been degraded.

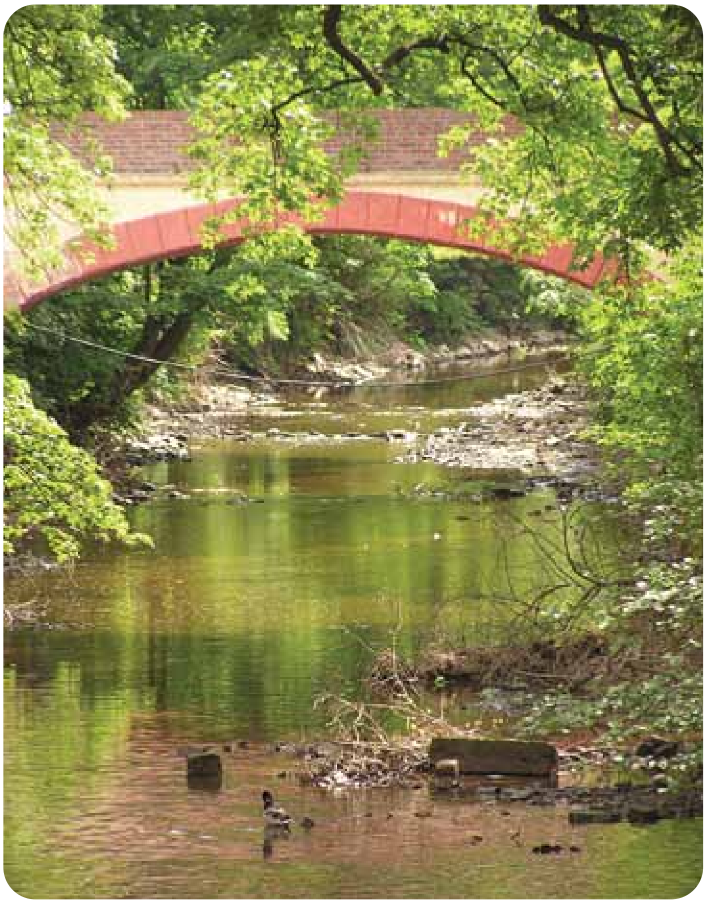
Since the introduction of the Urban Wastewater Treatment Directive much has been done to reverse this situation. At the launch of the Water Framework Directive (WFD) 20 % of European surface waters were seriously threatened, 60 % of its ground waters were overexploited and 50 % of its wetlands had 'endangered' status. Today all European countries are working to find the methods and the means to implement the WFD and recover the original ecological status of all European water bodies.

In particular the situation is serious in the Member States in Eastern Europe, mainly due to lack of treatment, over-exploitation, lack of environmental legislation and/or lack of enforcement of the legislation in the past. These countries expect rapid economic growth and it is imperative that this growth is matched by appropriate environmental planning. Some areas in Western Europe have similar needs as they transform from traditional manufacturing industries to more service based societies with greater emphasis on human well-being as a key factor for future economic development.

Challenges

Although many policies have been developed and implemented for preventing impacts on water in the last decades, integrative responses need to be designed and policies have to come to more efficient synergies to address the complexity and variety of challenges that threaten water. Among others, the following issues are still yet underestimated or not sufficiently addressed in all EU countries to assure safe and well managed water resources for the next decades:

- Lakes: Monitoring of eutrophication, restoration and management of water systems affected by toxic algal blooms (incl. cyanotoxins issue)
- Landfills: Numerous landfills are abandoned and/or do not comply with state of the art technical specifications. They represent a clear threat for groundwater and surface water quality.
- Brownfields: Former industrial areas located in urban and suburban areas. They represent a challenge for urban planners (integrate them in urban development plans) and a potential threat for human health and the environment (potential source of contamination due to former industrial activity).
- Urban environments: Technology challenge for enabling water supply (infrastructures for water treatment and water supply) – Need to implement mitigation strategies, water recycling. High water consumption, water contamination through human activities (industrial, domestic, recreational etc.)
- Mining areas: Potential sources of water contamination. Necessity for rehabilitation strategies and technologies.
- Agriculture: Need to implement mitigation and adaptation strategies of agricultural impacts. High water consumption, modification of natural balance, perturbation of aquatic ecosystems, diffuse contamination, development of remediation technologies and adaptation strategies.
- Adaptation strategies to climate change: Planning the creation of "potpolders" as buffer zones for floods. Adaptation strategies to climate change in tune with reclamation strategies. For example phyto-remediation. (CO2 capture)
- Mitigation strategies for climate change: Mitigation strategies for Climate Change have transversal effects. Thinking about sustainable (low CO2 emission, renewable energy consumption, self sustaining techniques) remediation technologies for degraded water zones.
- Health related contaminants as a consequence of population growth – and accelerated urban concentrations: Need of technology R&D for tackling water contamination (improve/adapt existing infrastructure to address this issue). Technologies for contaminated areas' remediation, Passive and active technologies.
- Runoff resulting from soil sealing through urbanisation: Need to implement mitigation strategies. Transversal issue – Land planning policy. Reduced water infiltration in addition to high groundwater consumption results in highly modified groundwater bodies (scarcity) and rapidly changing river flows (floods) and mobilisation of contaminants from point sources – Need to implement mitigation strategies.
- Planning harmonization: Transversal issue. As a mean to mitigate pressures on the environment and adapt political models to global change (Governance, infrastructures and technology issues). As a frame for managing degraded zones – take advantage of intelligent and sustainable land planning for integrating degraded zone reclamation, e.g. recreational areas demand or economic development in urban environment situated in "brownfields" are an opportunity for addressing degraded zone reclamation together with urban planning and land-use management



Research and Technology Development

Development of techniques:

- Survey the state of degraded water sources systems and study the transfer of contaminants and contamination limit values.
- Derive the cause-effect relationships that have led to the degraded state.
- Develop risk assessment tools, also predict ecotoxicological risks of multiple and chronic exposures
- Generate information that can support transparent decision making between all stakeholders.
- Plan scenarios for system restoration, covering physical, ecological, social and economic benefits and costs.
- Develop appropriate treatment technologies to ensure that discharges to the environment can reliably meet the required standards.
- Mitigate specific adverse impacts.

Development of optimal strategies and Decision Support Systems

- Provide 'lessons-learned' and 'best practice' guidelines for possible application in similar cases in Europe and outside Europe.
- Guide optimal investment strategies and/or optimal allocation of water resources.

Development of integrated forecasting and Early Warning Systems

- Use real-time data, integrating hydrological parameters, pollution loads, temperature, water quality (chemical, microbiological etc.).
- Develop contingency plans for various stakeholders.
- Monitor progress in implementation on a wide variety of parameters.
- Monitor compliance with regulations, including EU directives.

Implementation cases

The demonstration cases will address following overarching issues:

- The requirement for cross border co-operation between countries and all involved parties.
- Ensuring the active participation of all stakeholders, including NGOs and local communities, in water management activities.
- Balancing the interests of the environment with the interests of those who depend on it.

FOCUS on cross-cutting issue Ecohydrology

Enhancing the capacity of natural systems

In the context of the European Water Framework Directive (WFD) and its Daughter Directives, river basin management districts call for integrated solutions to achieve and maintain for sustained use the ecological and chemical status of water bodies. This represents a shift from a paradigm focused exclusively on the uses of water.

Ecohydrology is a scientific concept applied where problem solving needs to consider elements of the following disciplines:

- Hydrology, that studies the occurrence, distribution and movement of all waters on the earth, both in time and space, their biological, chemical and physical properties, their reaction with their environment including their relation to living beings;
- Ecology, the interdisciplinary study of the interactions between organisms and their environment;
- The combined application of both, taking into account both scientific and engineering aspects for an integrated and sustainable management of water.

The solutions combine the hydrodynamic processes (taking into account morphology and morphodynamics) as well as the hydrochemical and hydrobiological processes, and the functioning of the ecosystems to reach both the sustainable use of water resources and the protection of the aquatic ecosystems.

Ecohydrology adds to the WFD perspective since it considers:

- Groundwater-surface water interactions which are important for supporting ecological processes and habitat requirements of aquatic and wetland ecosystems.
- The role biota and ecological processes can play in the improvement of water quality and the sustainability of the water resources.

Moreover, synergistic effects of various measures from upstream land management to downstream flow regulation stabilise and improve the quality of water resources.

Controlling the interactions between biota and water is particularly relevant to the support of health of rivers, estuaries, lagoons or coastal waters. The interactions between groundwater and surface water can maintain rivers base flows, wetlands and habitats, or stimulate the capacities of the unsaturated zone. The capacity of ecosystems can maintain, restore or enhance water and sediment quality affected by, for example, pollution, eutrophication, toxic blooms, or invasive species, ultimately providing a sustainable solution for human needs.

Ecohydrological applications can be considered as complementary solutions to treat wastewater effluents, control nutrient cycles or mitigate the contamination of water bodies by flood or storm water.

Research and technology development projects propose the identification of independent criteria to enable the assessment of sites in need of ecohydrological solutions and the development of cost effective monitoring and modeling tools for the application of natural solutions encompassing the entire value chain.

Hydro Climatic Extremes

For an effective and adaptive management of urban water systems

At least 11 % of Europe's population and 17 % of its territory have been affected by water scarcity over the past thirty years.

Adaptation to hydro-climatic extremes (droughts and floods)

In summer 2007 Spain suffered from severe drought while UK was facing major floods.

Recent events such as the summer floods in the UK of summer 2007 and the severe drought in eastern Spain during the same period continue to provide clear evidence of the need for a proactive integrated management of extreme hydro-climatic events. That Europe is both exposed and vulnerable to these types of hazard is widely recognized and water-related disasters must be addressed across Europe.

Floods and droughts cannot be prevented but their socio-economic impacts can be reduced by short-term mitigation, preparedness and long-term planning.

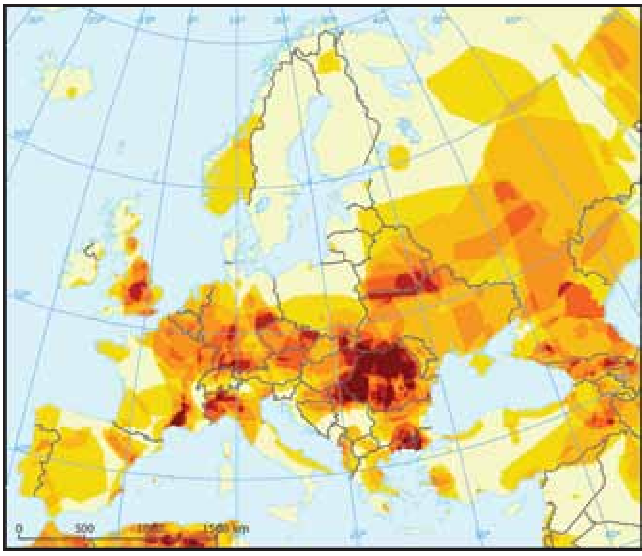
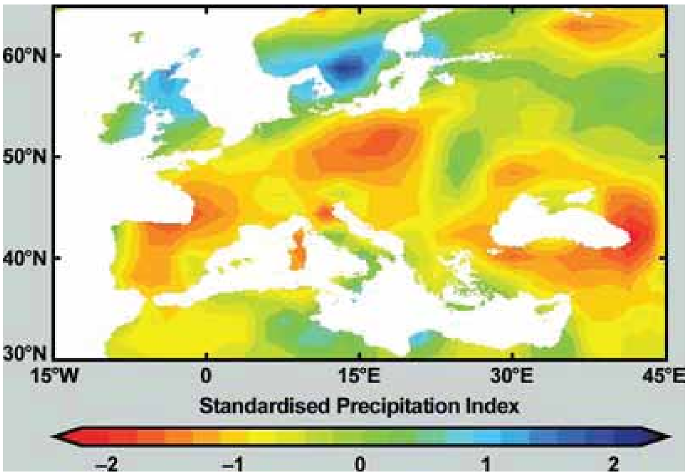


Figure 2: Occurence of flood events in Europe in 1998-2008 from the EEA website www.eea.europa.eu Copyright EEA, Copenhagen 2008

Climate change in Europe is expected to magnify regional differences in Europe's water resources. The most vulnerable industries, settlements and societies are generally those in coastal and river flood plains and those in areas prone to extreme weather events, especially where rapid urbanisation is occurring. Proactive management to cope with extremes is needed not only to better manage current risks but to also address future risks.

Figure 3: The extent and severity of the 2003 drought across Europe. From EURAQUA, Towards a European Drought Policy, 2004



Challenges

The management for hydro-climatic extremes must address a number of challenges:

- Hydrological response is highly variable reflecting the wide variety within and between catchments depending on land cover, topography, geology, soil type, vegetation, etc.
- Hydro-climatic extremes include flash floods, landslides, river, groundwater and coastal flooding, hydrological and climatic droughts, forest fires, destruction or modification of habitats, etc.
- Hydrological extremes impact many sectors and interests, including cities, agriculture, land-use planning, floodplain management, water resources and water quality in the surface and subsurface, ecological status, fisheries, tourism, public health.
- Hydro-climatic extreme events can have catastrophic impacts, are highly visible and often costly events.
- Droughts and large-scale floods occur across large regions including several countries and responsibility for managing floods may reside at different levels in different countries, from national organisations, regional authorities to local municipalities and city councils.
- The meteorological community and the hydrological community need to be brought together to both predict and manage hydro-climatic extremes.
- Addressing short term forecasting and operational water management together with the expected impact of climate change and dealing with uncertainties in scenarios and modelling.
- Addressing the problems of predicting hydro-climatic extremes and managing their impacts over time scales that typically range from hourly and daily to seasonal, decadal and greater and spatial scales from global to regional to catchment scales.
- Hydro-climatic extremes may significantly impact aquatic ecosystems and biodiversity, and could prompt changes in the way these systems are managed.

Research and Technology Development

For forecasting extremes

- Seasonal forecasting
- Drought forecasting and monitoring
- Combined forecasting of water resources and water demands
- Forecasting using uncertainty estimation and data assimilation of traditional & new measuring techniques

For long term planning/management of extremes

- Quantifying combined hydro-meteorological uncertainty in climate change impact assessment, climate proofing and adaptation
- Optimisation of water uses and saving and the management of multiple water users
- Exploiting new remote sensing (satellite, doppler radar, wireless sensor and other measurement) for forecasting and monitoring

- Integrated modelling across surface water and groundwater, coastal and fluvial systems, hydrological and meteorology, water and sediment transport
- Risk-based decision-making and planning tools including socio-economy, effective communication and conflict resolution

For future drought and flood management

- Improved climate models for long duration, extensive droughts and high intensity localized rainfall events
- Multiple hazard management – heat waves, droughts, water pollution, landslides, flash floods, ice floods, coastal floods, etc.
- Changes in extreme distributions (flood & droughts) under climate change and land-use change addressing the complex relation between climate mean values predicted by climate models and hydrological extremes.

Demonstration cases

The three following Demonstration cases are exemplary of typical issues.

Upper & Middle Odra

The Odra River basin is subject both to frequent and often catastrophic fluvial flooding and to hydrological droughts governed by its location and continental climate. It is a transboundary river with headwaters in the Czech Republic, flowing through Poland and along the border between Poland and Germany into the Baltic. Flash flooding occurs in the southern mountainous tributaries in the Czech Republic. Key management issues include water supply, flood management, short-term and long-term forecasting, reservoir and structure operation, and river ice formation.

Upper Guadiana Basin, Spain

Located in the centre of Spain, the Upper Guadiana Basin can be considered as a prototype of semi-arid Mediterranean catchment. The intensive water abstraction for agricultural purposes from aquifers in the basin and the importance of the associated wetlands and natural reserves are currently critical water management issues. The alternation of dry and wet periods is a characteristic of the climate of the Upper Guadiana with extreme droughts, both in intensity and length, being of special interest. However climate change is expected to alter this pattern, with longer drought periods and more intense and extreme precipitation.

The Thames River Basin, UK

The Thames flows through London and therefore it is important to understand the impacts of extremes on critical infrastructure. The long discharge record provides clear evidence of climatic variations in the flood flows during the 20th century. At the same time it is subject to water stress and both extremes are expected to be exacerbated by development pressure and climate change.

FOCUS on cross-cutting issue Adaptation to Climate Change

Climate Change can exacerbate the increasing drought risk in some parts of Central and Eastern Europe and especially in the Mediterranean region. Economic loss due to 2003 drought was €11,6 Bn in twenty European countries (EC, 2007). Even though it is not possible to achieve a 100% reliable system, there are effective measures that can be implemented to reduce vulnerability to water scarcity in those regions.

Floods are one of the most important hazards in Europe regarding both economic and life loss. In 2002, the direct costs of flooding amounted to €13 Bn (EC, 2007) and it has been proved that the annual number of reported floods and damages in Europe increased during 1972-2002 period (Guha-Sapir et al., 2004). Climate change, combined with land use changes, is very likely to raise the frequency of heavy rainfall events, increasing the risk in areas that already were vulnerable to floods. Thus, it is very important to carry out strategies to improve flood protection and risk management.

The foreseen climate change impacts that will affect extreme events are:

- Drier and hotter summers that will increase frequency and duration of droughts
- The increase of the number and intensity of extreme precipitation events that will intensify the risk of floods and worsen water quality, due to an increase in the load of pollutants washed from soils
- Increased rainfall intensities that can lead to more soil erosion and, as a consequence of it, this can cause a decreasing in reservoirs' storage capacity. More intense precipitations will also produce more overflows in the sewer systems.

Main R & D needs related to hydro-climatic extremes and climate change that have been identified are:

- Early warning systems: forecasting is mostly oriented to floods but may be developed also to predict drought periods. More work is needed to improve the spatial precision and increase the lead-times (time to react) of these systems in order to facilitate public preparedness.
- Climate models at regional or local scale: current global climate models cannot capture the full range of scales that take part in the modelling process of the climatic phenomena and then, improved downscaling techniques are needed (considering smaller scales, micro-topography, and additional features as land-use and vegetation covers).
- Evaluation of uncertainty: projections of climate change are subject to uncertainties and they are larger when referred to predict precipitation extremes. Longer series of data and probabilistic predictions are required to evaluate the increasing trend in the frequency and intensity of storms.
- Land management practices: flood plain restoration and river banks stabilisation can be a sustainable solution to increase protection against floods. These practices include: widen floodplains to detain more water, replacement of crop farming in risk zones for grassland field to reduce economic loss and hold back water, etc.
- Asset's resettlement: measures like removing or protecting assets from high risk flooding areas must be further studied through work with satellite imaging for example. Cost-benefit analyses may be carried out to assess costs of resettlement in front of those for protection measures and thus, take decisions from the results.
- Risk information availability: mapping of risks is already required by the Floods Directive by the end of 2015. Methodologies to take into account impacts of climate change need to be developed and implemented.

6
One Way Forward

A way forward

Beyond the Strategic Research Agenda of the European Technology Platform for Water

The Strategic Research Agenda: a roadmap of R&D needs on water issues

This document presents the Strategic Research Agenda developed by the members of WssTP (Water supply and sanitation Technology Platform), the European Technology Platform for Water. Led by industry, this platform integrates the input from the European industry, utility stakeholders, universities and research organisation representing most of the EU countries.
The intention of this document, based on the first Strategic Research Agenda published by WssTP in 2006, is to identify the main challenges faced by the European water sector and to provide recommendations on priorities for research and technological developments needed to address those challenges. This agenda should support the European water sector to become the leading centre of expertise for providing safe, affordable, sustainable water and sanitation within the context of integrated water resources management.

This report was prepared by members and contributors of the WssTP, and, as mirrored by the structure of the document, particularly throughout the 6 Pilot Programmes (PP) and related Task Forces:

- PP1 "Mitigation of water stress in coastal zones"
- PP2 "Sustainable water management in and around large urban areas"
- PP3 "Sustainable water management and agriculture"
- PP4 "Sustainable water management for industry"
- PP5 "Rehabilitation of Degraded Water Zones (surface and groundwater)"
- PP6 "Adaptation to Hydro-Climatic Extremes (Drought and Floods)"

While the SRA acknowledges the importance of a system's approach and need for integrated solutions, WssTP appreciates that the SRA does not cover water in all its various uses and services and is somewhat biased towards technology and pollution control and less on ecosystem protection and management. Although the research agenda was analysed with the European perspective to address European challenges, it also tackles global issues such as the adaptation of the water sector to climate change.

Promote innovation and address major challenges of water management in Europe

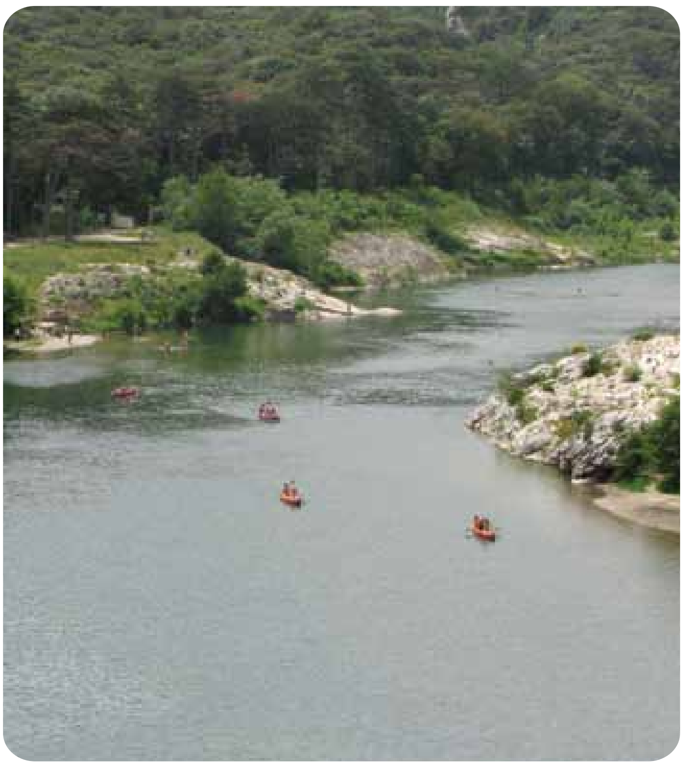
The SRA set up by WssTP highlights key priorities for the European water sector to face the major technical and societal challenges of Europe with regards to water. It is urgent to develop low-carbon technologies and concepts to produce water, to treat wastewater or process water, and to balance water supply and demand while protecting aquatic ecosystems, reducing environmental impacts on water resources within the concept of integrated water resource management. Life-cycle approach should be promoted in water management to identify the processes and approaches with lowest environmental impact.

WssTP would like to highlight the importance of encouraging innovation to develop new markets opportunities and technologies in the field of water management. Boosting research and innovation means to identify needs and gaps, to extend bottom-up and market driven development by developing a user approach, and to support coordination activities between all the stakeholders from the water research community.

WssTP will continue its work to provide strategic recommendations to the European Commission and to develop a common vision for water innovation. It will support the activities of its 6 Pilot Programmes including the set up of demonstration cases and research projects answering the needs identified in the Strategic Research Agenda. Involving today more than 200 European organisations among with more than 50 corporate members and 700 individuals, WssTP will seek further participation and commitment of industrial, academic and utility stakeholders of the European water sector to reach a common vision for water innovation.

WssTP will further encourage research and technology development based on the cooperation with other ETPs, but also any other pan-European initiatives addressing water management such as Euraqua, EuroGeoSurvey, various ERANET initiatives, Eureka or Joint Programming Initiatives, and will seek coordination with national initiatives with the view of reaching a consolidated SRA across Europe. The other main mission is to strongly involve the European industry in developing and financing projects and demonstration cases that will ensure the growth of the European water sector.

The Strategic Research Agenda of the European Technology Platform for Water is a dynamic document. WssTP will continue to adapt its activities upon short, mid and long term challenges for water and will provide new updates every few years as needed with updated recommendations of the European water sector to the European Commission and other European or national bodies. Any water professional is welcome to participate in the activities of the European Water Platform and to contribute to the evolution of the Strategic Research Agenda and to the development of Research and Technological Development projects and demonstration cases that will strengthen the European water sector.



ANNEXED DOCUMENTS

Members of WssTP

College A: Industry

AFRE
Spain
www.afre.es

AGBAR
Spain
www.agbar.es

ANIMA
Italy
www.anima.it

AQUATEAM
Norwegian Water Technology Centre AS
Norway
www.aquateam.no

BRODRENE DAHL
Norway
www.dahl.no

GRONTMIJ
the Netherlands
www.grontmij.com

LONZA COLOGNE AG
Germany
www.lonza.com

NALCO
The Netherlands
www.nalco.com

NORIT N.V.
The Netherlands
www.norit.com

SCHLUMBERGER WATER SERVICES
The Netherlands
www.slb.com

SUEZ ENVIRONNEMENT
France
www.suez-env.com

UIE
Union Nationale des Industries et Entreprises de l'Eau et l'Environnement
France
www.french-water.com

UKWIR
U.K. Water Industry Research
United Kingdom
www.ukwir.org

VEOLIA ENVIRONNEMENT
France
www.veolia.com

College B Academics, Research Centre

AIDICO
Spain
www.aidico.es

BRITISH GEOLOGICAL SURVEY
United Kingdom
www.bgs.ac.uk

CEIT
Spain
www.ceit.es

CEMAGREF
France
www.cemagref.fr

CENTRE FOR ECOLOGY AND HYDROLOGY
United Kingdom
www.ceh.ac.uk

CETAQUA
Centro Technológico del Agua
Spain,
www.cetaqua.com

CRANFIELD UNIVERSITY
United Kingdom
www.cranfield.ac.uk

CSTB
France
http://international.cstb.fr/

CTM
Spain
www.ctm.com.es

DANISH WATER FORUM
Denmark
www.danishwaterforum.dk

DELTARES
The Netherlands
www.deltares.nl

DHI
Denmark
www.dhigroup.com

DVGW
Germany
www.dvgw.de

EUROPEAN MEMBRANE HOUSE
France
www.euromemhouse.com

FHNW – UNIVERSITY OF APPLIED SCIENCES
NORTHWESTERN SWITZERLAND
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www.geus.dk

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United Kingdom
www.hrwallingford.co.uk

IRSA-CNR
Italy
www.irsa.cnr.i

IWA PUBLISHING
International Water Association
United Kingdom
www.iwahq.org

JOANNEUM RESEARCH FORSCHUNGSGESELLSCHAFT
Austria
www.joanneum.at

KWR
The Netherlands
www.kwrwater.nl

KOMPETENZ ZENTRUM WASSER BERLIN
Germany
www.kompetenz-wasser.de

LABEIN TECNALIA
Spain
www.labein.es

LEITAT
Spain
www.leitat.org

SINTEF
Norway
www.sintef.no

SWEDISH ENVIRONMENTAL RESEARCH INSTITUTE
Sweden
www.ivl.se

TNO
The Netherlands
www.tno.nl

VITO
Belgium
www.vito.be

WATERPOOL
Network of Competence Water Resources Management
Austria
www.waterpool.org

College C
Public Utilities, water users

AEAS
Asociación Española de Abastecimientos de agua y Sanamiento
Spain
www.aeas.es

AGUAS DE PORTUGAL, SGPS SA
Portugal
www.adp.pt

AQUAFIN
Belgium
www.aquafin.be

CANAL ISABEL II
Spain
www.cyii.es

COPA COGECA
Belgium
www.copa-cogeca.eu

DANVA
Danish Water and Waste Water Association
Denmark
www.danva.dk

EUREAU
European Association of National Water and Waste Water Associations and Users
Europe
www.eureau.org

FEDERUTILITY
Italy
www.federutiliy.it

GRAND LYON
France
www.grandlyon.com

KOMMUNE OF OSLO
OSLO WATER AND SEWERAGE WORKS
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www.vav.oslo.kommune.no

NORSK VANN BA
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http://norskvann.no/

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