

Regional Document

# EUROPE

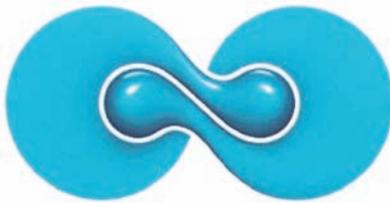


5<sup>th</sup> WORLD WATER FORUM  
İSTANBUL 2009



BRIDGING  
DIVIDES  
FOR WATER

**5<sup>th</sup> WORLD WATER FORUM**  
I S T A N B U L 2 0 0 9



BRIDGING  
DIVIDES  
FOR WATER



*The Voice of Water*



**European Regional Process**

## **WARNING:**

The European Regional Document has been prepared by the European Regional Coordination Committee with the contribution of a large number of organisations and individuals as listed in annex 1.

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Active cooperation between all stakeholders is of the utmost importance in addressing today's water challenges, not just in Europe, but all over the world. Furthermore, our challenges can't be resolved by the water sector alone - other sectors including energy, finance and agriculture have to be involved more closely in the debate.

All stakeholders – and more generally the public - need to be aware of the water challenges to understand the urgency of addressing them. Active participation of stakeholders in the decision-making processes is needed to create a strong basis for implementation of the necessary measures.

In the year of the 5<sup>th</sup> World Water Forum, the Czech Republic - situated at the roof of Europe, with its waters draining through rivers into three different seas - is presiding over the Council of the European Union. The European Union represents a significant part of Europe and is composed of 27 independent sovereign countries - 27 different societies, histories, cultures, traditions and approaches. As the priorities of all member states are equally important, an active cooperation and mutual understanding is essential for a successful functioning of such a heterogeneous coalition.

A similar principle should be applied when addressing the complex challenges the world faces today. Water is an important component of the environment; it shapes our planet and nearly every aspect of our lives. A competition among different players for limited water resources and increasing water quality concerns have brought more attention of policy-makers to water management.

I welcome the European Regional Process for the fifth World Water Forum as a continuous process in which European stakeholders from all sectors actively work together in addressing Europe's water challenges. Only when bringing all stakeholders together can we succeed in solving the problems we are facing.

Jan Dusik MSc.

Deputy Minister of the Government of the Czech Republic

# FOREWORD



The European Regional Coordination Committee is very pleased to present the European Regional Document for the 5th World Water Forum. This document is the first result of an intensive 1.5 year European Regional Process in which hundreds of European organisations and individuals worked together on identifying and addressing eight major themes that represent Europe's main water challenges (climate change, water and energy, water scarcity and drought, and sanitation) and key ingredients for solutions (a water vision for Europe, basin management and transboundary cooperation, research and financing).

The last World Water Forum, in 2006 in Mexico, concluded that there was a clear need for a more structured cooperation on water in Europe, and the 2006 Regional Document expressed the conviction that the group gathered to produce that document had laid the foundations for future European cooperation both within the region and beyond its borders. The large group of organisations and individuals contributing to this year's European Regional Process (see annex 1) shows that cooperation in Europe has indeed strengthened over the last few years. This stronger cooperation will provide a basis to further build on in the near future.

This European Regional Document gives an overview of the challenges Europe faces and the European solutions developed to address them. It provides key messages that can benefit other regions and recommendations to address the remaining challenges in Europe. However, neither this Regional Document nor the 5th World Water Forum will be the end of the European Regional Process. We aim to continue our cooperation and build on the progress and results achieved over the last year and a half, living up to the theme Bridging Divides for Water.

We would like to take this opportunity to thank all those who have been involved in the European Regional Process, those who participated in the dozens of events and congresses related to the Process and those who contributed to the Regional Document. We trust we will be able to continue working with you in addressing the challenges Europe faces on water in the near future.

The European Regional Coordination Committee

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# EUROPEAN REGIONAL DOCUMENT



# Executive Summary for the European Regional Document

To share the messages of the European Regional Document as widely as possible, the executive summary is available in a number of European and global languages. These summaries are available at the Forum or online at: [www.ewp.eu/ERD-summary](http://www.ewp.eu/ERD-summary)

Europe has most of the elements in place, in terms of water infrastructure and institutions, to support sustainable development and economic growth. However, numerous questions remain, such as how to adapt to climate change, how to upgrade aging infrastructure for urban water supply and sanitation, how to turn wastewater into a resource, and how to improve water and energy efficiency throughout the water cycle.

The European preparatory process for the 5<sup>th</sup> World Water Forum identified eight thematic areas of critical importance to Europe's future. Some of these areas represent challenges for Europe (and many other regions): climate change, the water-energy nexus, water scarcity and droughts, and sanitation. Others – the Water Vision for Europe, basin management and transboundary cooperation, finance, and water research and technologies – represent elements of a solution. The regional document addresses these thematic areas in detail.

## Key ingredients for a sustainable water future

Each of the thematic chapters defined specific messages and lessons for Europe and the world. While most of these are theme specific, the following ingredients appeared again and again in the chapter recommendations:

- **Cooperation between sectors, stakeholders, countries and regions.** This was by far the strongest message: Europe needs greater cooperation at all levels.
- **Incentives for more efficient and sustainable use of water resources.** Part of the answer lies in raising public awareness – people need to understand why and how they should contribute; part lies in targeted financial incentives, such as appropriate taxes and tariffs; and part lies in well-defined legal and regulatory instruments.
- **Better information to support decision-making at all levels** – from the policy maker to the person turning on the kitchen tap. Water research and data needs to be accessible, understandable and relevant to the needs and concerns of its users.

- **New, more holistic ways of thinking about water challenges.** This means, for example, shifting:
  - from a focus on climate change mitigation to an integrated approach that involves mitigation and adaptation actions;
  - from a focus on managing surface water supplies to managing demand and applying smart supply solutions that consider the quality and quantities of water required for different uses and the range of water resources available;
  - from end-of-the-pipe, one-size-fits-all sanitation to context specific solutions that are sustainable and resource efficient; and
  - from ad hoc approaches to urban water management to more coherent and far-sighted ones that take into account changes in demographics and climate.
- **Education and training** for the next generation of water professionals.

## Challenges for Europe

### Climate change: Encouraging action on adaptation

Under climate change scenarios, parts of Europe will become dryer – which will have implications for water availability and quality; a few will become wetter – which will have implications for water and flood management; and most will be subject to more extreme events – droughts and floods. Thus far, efforts to address climate change have focused on mitigation. But it is becoming increasingly clear that mitigation will not be enough, adaptation is also needed. If countries begin taking action now, they will reduce costs in the long-term.

Europe is in a position to take a leading role on adaptation, as it did on mitigation. Many countries now have programmes aimed at identifying and adapting to the risks of climate change, but most are still in the early stages of enacting legislation and planning and implementing adaptation actions. Greater regional cooperation has the potential to speed progress through sharing of best practices, joint development and agreement on climate change scenarios, and more coordinated approaches in transboundary river basins. The EU Water Framework Directive (WFD) and the UNECE's (United Nations Economic Commission for Europe) convention on transboundary watercourses and lakes provide platforms for cooperative approaches.

## Water and energy: Improving efficient use of resources

Water plays a critical role in sustainable energy production, and vice versa, but current technologies and management approaches are poorly coordinated across sectoral boundaries and inadequate to solve the world's water and energy problems – problems which climate change will only exacerbate. New and innovative technologies and coordinated policies are needed to reduce the energy footprint of water supply and treatment, and to reduce the water footprint of energy production.

European governments need to apply an integrated decision-making and management approach to address the water-energy nexus, making use of assessment tools such as water and energy footprinting. Quantitative knowledge about the links between water and energy is still insufficient. In the future, the complex

### Tools for creating more water aware societies

Water decision makers at all levels – from policy makers to water users – need to understand the challenges and their urgency, for example the implications of climate change or the need to reduce water consumption. From such understanding can flow informed stakeholder dialogue on policies and priorities, support for implementation of measures, and improved solutions through inclusion of local knowledge.

Tools to achieve more water aware societies include:

- Footprinting, scenarios and voluntary schemes for standard setting and labelling can “translate” data and make it accessible/understandable.
- Regional, national and local level water partnerships can serve as neutral platforms for debate and knowledge sharing.
- Networks that bridge divides between public and private, between researchers and policymakers, between government and civil society, and between the water sector and other sectors – finance, energy, agriculture, etc. – can foster the kinds of collaboration that are critical to addressing water challenges.
- Awareness raising campaigns such as the International Year of Sanitation can unite people behind common goals and provide momentum for actions.
- Outreach to media and other opinion-shaping organisations can educate citizens and signal priority issues to policy makers.
- Champions and “water leaders” can serve as role models – providing good examples of sustainable water management – and help communicate best practices.

interactions and tradeoffs between water, energy, agriculture and climate change will become increasingly important as countries make difficult choices on alternative energy resources such as biofuels and hydropower. Businesses, governments and the public need to be better informed. In particular, well-informed consumers can be a driving force for positive change.

## Water scarcity and drought: Promoting better planning and management

While water scarcity and droughts may not be as severe in Europe as in many regions – in terms of impacts on human health and economic development – they do represent a serious and growing threat. In recent years, droughts have had an estimated total price tag of around 6 billion Euros per year for EU countries. Under conditions of water scarcity and drought, it can be difficult to meet water demands while at the same time not compromising on environmental standards.

To address water scarcity, which is predicted to increase in many European countries due to climate change, Europe needs to promote greater water efficiency and water awareness among its citizens and greater cooperation in the management of transboundary water resources. In addition, to mitigate the impacts of droughts, countries and river basins need drought management plans that include threshold-based measures and water use priorities defined through participative processes. Europe is also working towards an early warning system and the definition of common indicators to monitor both water scarcity and drought.

## Sanitation: Ensuring sustainability and supporting reuse

While the majority of Europeans are connected to sanitation and wastewater treatment systems, there are still many who remain unserved by improved systems, particularly in Eastern and South Eastern Europe and the Caucasus. Within the EU, more than 20 million citizens do not have access to proper sanitation systems – most of them living in rural areas and small communities.

To address this situation European legislation needs to encourage innovation, not prescribe fixed solutions. Technologies, capacity building, and financing are needed to support local wastewater management. Sustainability (economic and environmental) and resource efficiency, in particular the reuse of water and nutrients, are the future of sanitation in Europe.

## The way forward for Europe

### Developing a coherent strategy to address water challenges

A coherent strategy would give guidance to the many activities and initiatives taking place in Europe – thus avoiding conflicts, duplications and contradictions and ensuring better cooperation and exchange of best practices. Such a strategy should build on existing frameworks and efforts, for example the WFD, the UNECE Water Convention, and more recently the Water Vision for Europe process (see box).

The strategy should focus on:

- Harmonising policies and promoting cross-sectoral cooperation.
- Defining target-based objectives that unite stakeholders from different sectors.
- Building networks for knowledge sharing and platforms to promote stakeholder participation.

The strategy should also consider groundwater resources, not just surface water, and take into account Europe's diversity – in terms of its institutional arrangements and its geography.

The need for integrated national and regional strategies is also apparent at the level of specific challenges, for example:

- Climate change strategies that address mitigation and adaptation in an integrated way.
- Drought management plans that also consider water scarcity and climate change.
- Water efficiency plans that also consider the safe use of treated wastewater and the efficient use of other resources, e.g., energy and nutrients.

### “A Water Vision For Europe”

As a part of the European preparation for the 5<sup>th</sup> World Water Forum, the Aquawareness Programme launched a process to develop a Water Vision for Europe. The objective was to promote holistic approaches to problems, cross-sectoral awareness and solutions, and to define a set of common goals that Europe can unite behind.

The results of this process will be presented at the Forum and to the incoming EU Commission in fall 2009. The European Water Partnership, the coordinator of Aquawareness and the European preparatory process, is undertaking a vision mapping process to identify obstacles to reaching the Vision and possible actions to overcome them.

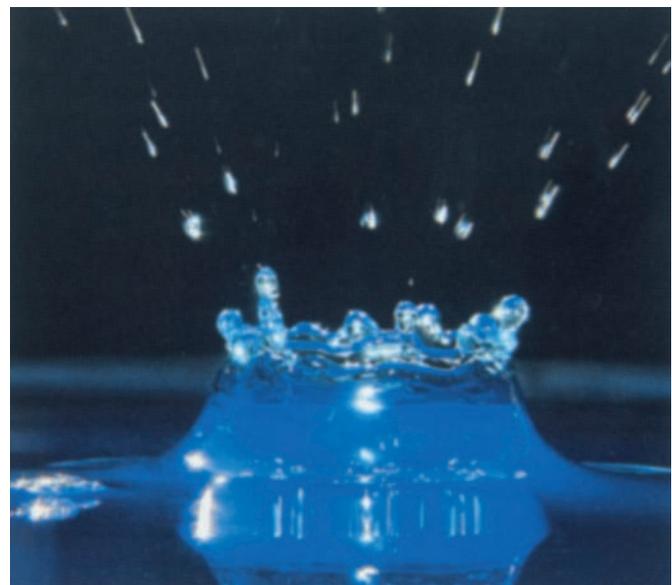
### Integrated river basin management and transboundary cooperation

Droughts, floods, pollution, water scarcity and climate change do not respect political or administrative boundaries and must be tackled at the river basin scale. Because many of Europe's basins are shared – some 40 major rivers, 40 lakes and more than 100 aquifers – addressing these challenges requires strong transboundary cooperation. The EU's Water Framework Directive is an effective instrument for finding and implementing appropriate solutions – both within and across international borders. Transboundary cooperation is also facilitated by the UNECE Water Convention and the region's many international agreements and river basin commissions, but many more are needed, particularly for shared aquifers.

Good river basin management also involves the cooperation of stakeholders – who need basin-based platforms for dialogue – and financing, for example through the collection of basin water taxes and the establishment of financing basin organizations. Europe's experiences in basin management and transboundary cooperation offer many lessons that could be useful for other countries. Mutual learning, cooperation and capacity building programmes should enable Europe to share its experiences and to learn from the experiences of other regions.

### Research: Extending networks

Although Europe has a strong research capacity and relatively good data collection and monitoring, there are still areas for improvement. There is a need for more data in areas such as the impacts of climate change and the impacts – on ecosystems and human health – of trace concentrations of pharmaceuticals,



personal care products and industrial chemicals that are becoming increasingly ubiquitous in our water supplies. More research is needed in areas such as water reuse and carbon neutral desalination technologies, implementing IWRM, and water-energy-climate links.

Greater research cooperation both within Europe and outside needs to be promoted to make better use of the research potential and avoid duplication of effort. Cooperation on the research level can also be a driver for further cooperation on other levels. Integrated information systems such as WISE (Water Information System for Europe) and EMWIS (the Euro-Mediterranean Information System on know-how in the Water Sector) provide web-based platforms for exchanging information and knowledge among researchers and water professionals.

### Financing: Taking a pro-active approach

Financing is an issue that cuts across all of the themes identified in the regional process; sustainable models are needed for financing climate change adaptation, extension of improved sanitation in rural areas and upgrading of aging urban systems, and actions to improve water efficiency in the face of growing water scarcity and droughts. Given the need for new investments and the challenge of sustainability, it is more important than ever to adopt a proactive and sector-wide approach to the financeability of the water sector, in particular, to promote the perception of the water sector as low-risk and facilitate access by utilities to low-cost, long-term debt.

In the EU-12 and beyond, sector consolidation is a logistical necessity for the implementation of the required investments and absorption of grants over relatively short transition periods. When used to create win-win scenarios to overcome political barriers to necessary sector restructuring, grants can promote operational consolidation, cost-effective regional solutions and long-term efficiency gains.

Water efficiency is a critical element of addressing water scarcity and potential climate risks as well as the long-term viability of water utilities. However, there is a need to pay proper attention to the cost structure of water utilities in order to make the objectives of cost recovery and water efficiency work together. Raising tariffs to cost recovery levels against a backdrop of increasing financial needs will raise affordability issues in some parts of Europe. Targeted subsidies for the poor and minimum levels of service have the potential to facilitate higher overall revenues, by isolating some of the most contentious issues in the general debate over tariffs and taxes.



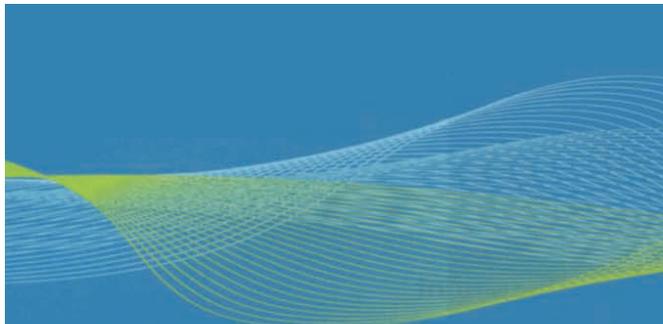
### Europe's experience in defining and implementing regional legislation

Europe offers comprehensive examples of regional legislation, specifically the EU's Water Framework Directive and the UNECE Water Convention. The UNECE convention offers a framework for international cooperation and tools and good practices for transboundary management. The WFD offers operational frameworks for basin management and transboundary cooperation and tools for harmonising practices between countries.

The WFD is based on some key principles that could be useful for other regions seeking to strengthen management in shared basins:

- public participation, management and planning on a basin level;
- the definition of deadlines and measurable objectives;
- the development of appropriate monitoring and exchange of information between countries; and
- the introduction of the cost recovery principle.

An integrated system for common and transparent reporting on WFD implementation is being developed at the European level, and lessons are already being documented and made available through WISE. If ratified, the UN Watercourses Convention could provide a platform for cooperation and knowledge sharing between Europe and other regions.



# 1

## Introduction



This document – the European Regional Document for the 5<sup>th</sup> World Water Forum – is the result of a challenging and intensive process preparing the European contribution to the 5<sup>th</sup> World Water Forum in Istanbul. It describes the European Regional Process, summarising Europe’s challenges (which are also shared with many other regions) and possible solutions. It contains recommendations on the way forward for Europe and lessons from European experience that could benefit other regions.

By no means, however, is this report meant to be the end result of the European Regional Process. The momentum the World Water Forum creates should be used to take steps forward on major initiatives already underway in Europe. Building on the messages and recommendations contained in this document, the Process participants will continue working on the eight major themes, bridging divides between all sectors – government, business, NGOs and research – and between the various initiatives undertaken in Europe.

*The European Regional Process brings together a very large number of stakeholders from all sectors and all regions of Europe. However, such an open process cannot claim to include all opinions and perspectives in Europe and therefore the contents of this document cannot be seen as representing the European viewpoint, nor do they necessarily represent the viewpoint of all the participants in the European Regional Process.*

*Each of the thematic chapters was written by organisations with extensive experience in the theme, with the support of European networks. They represent the perspectives of the authors of the documents, aiming to both trigger debate and provide a base to further build on in addressing the water challenges in Europe.*

*Throughout the text, examples are given of activities taking place in Europe. Although these examples, which were provided by participants in the Process, give an indication of the breadth of European experience, they should in no way be considered comprehensive.*

## European Regional Process: Setup and objectives

At the 2007 European Policy Summit on Water, the World Water Council requested the European Water Partnership to take on the role of European Regional Coordinator for the 5<sup>th</sup> World Water Forum. The European Regional Process was officially launched in February 2008 at a meeting in Brussels. At that first meeting, the participants – representing a wide-range of experiences and viewpoints from across Europe – agreed on an initial list of eight themes identified as the main areas of action for Europe to move forward. These themes helped give shape to the entire process and are each addressed separately in the thematic chapters of this document.

The meeting in Brussels selected a regional thematic coordinator for each of the themes and identified the initial members of the consortia who would, over the coming months, work to identify the main challenges and solutions under each theme and formulate key messages and recommendations to address these challenges. The consortia brought together all sectors involved in water – Government, NGOs, Business and Research.

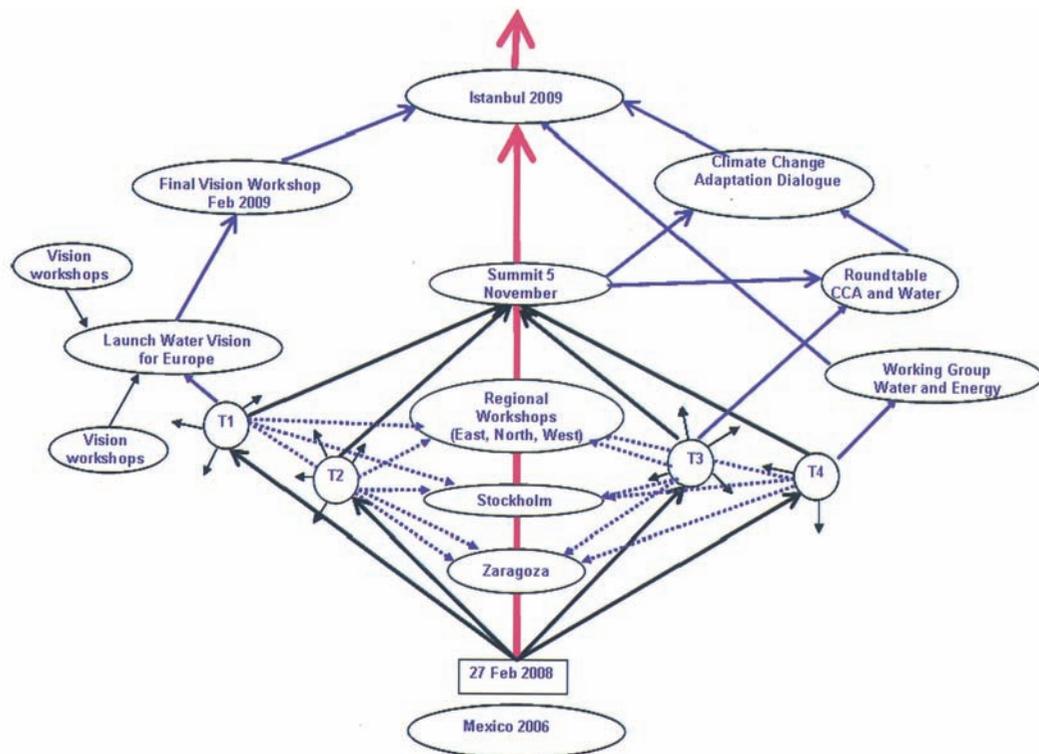
While developing the European thematic contribution to the World Water Forum, a main objective of the European Regional Process was to ensure the geographic representation of Europe. Within the European Regional Process, Europe is defined by the definition of the Council of Europe. The representation of all countries and regions in Europe was a recurrent theme in the whole Process, and throughout 2008 and 2009 a number of workshops were organised to ensure this, including:

### The eight themes of the European Regional Process

Future of Water – Water Vision for Europe (chapter 3)  
 Climate Change and Adaptation (chapter 4)  
 Water – Energy and Climate (chapter 5)  
 Water Scarcity and Droughts (chapter 6)

Sanitation (chapter 7)  
 Basin Management and Transboundary Cooperation (chapter 8)  
 Water Research (chapter 9)  
 Finance (chapter 10)

Graph: Visual representation of the European Regional Process



- Southern European Workshop of the European Regional Process, Zaragoza, Spain – 8, 9 July 2008.
- Regional Preparatory Meeting of the 5<sup>th</sup> World Water Forum, Sibiu, Romania. Organised by the International Network of Basin Organizations (INBO) – 1-4 October 2008.
- Central and Eastern European Workshop of the European Regional Process, Budapest, Hungary – 8 October 2008.
- Subregional Preparatory Meeting towards the 5th World Water Forum, Kremenchug, Ukraine. Organised by the Ukrainian Sustainable Development and Ecological Education Center – 10 and 11 October 2008.
- Nordic Regional Workshop, Copenhagen, Denmark, 8,9 January 2009.

The results of each of these workshops are available at the European Regional Process website: [www.ewp.eu/erp09](http://www.ewp.eu/erp09).

### Subregional Preparatory Meeting, Kremenchug, Ukraine

The Ukrainian Sustainable Development and Ecological Education Center organised a subregional meeting to prepare for the 5<sup>th</sup> World Water Forum. The Meeting was set up to discuss the implementation of the Millennium Development Goals in terms of access to clean water, ensuring human rights for water, and defining the roles of education, knowledge, youth and capacity building in the process.

The meeting brought together participants from Ukraine, Byelorussia, Moldova and Turkey and resulted in a Communique, which is available in Annex 3.

Furthermore, a large number of European workshops and conferences where either organised specifically for, or were dedicated to, the themes of the European Regional Process. These conferences are mentioned in the thematic chapters.

### The European Water Partnership

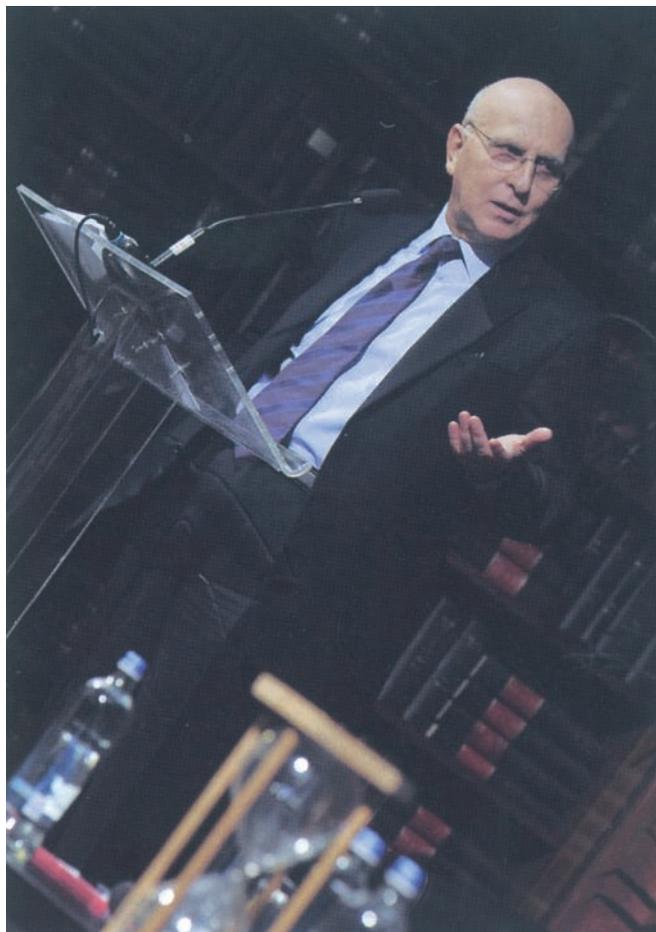
The European Water Partnership (EWP) is an independent non-profit organisation, working to develop solutions to address the urgent water challenges in Europe and the rest of the world. It harnesses European capacity and develops initiatives to achieve the Water Vision for Europe:

“We have achieved sustainable water resource management and universal access to modern and safe water supply and sanitation because we value water in all its dimensions - in its economic, social, environmental and cultural importance.”

[www.ewp.eu](http://www.ewp.eu)

## European Policy Summit on Water

On 5 November 2008 the European Policy Summit on Water took place for the third consecutive year. These Summits, which bring together stakeholders both from within and outside the traditional water sector, build and disseminate knowledge on important topics related to water and work to raise the profile of these issues on the political as well as the public agenda. This year, the event was fully dedicated to the European Regional Process and the discussion focused on three of its major themes: Climate Change Adaptation, Finance, and Water Scarcity and Droughts.



*EU Commissioner of Environment Stavros Dimas addressing the European Policy Summit on Water*

The event was a huge success, with over 350 participants engaging in lively discussion with the three high-level panels consisting of representatives from business, governments, NGOs and research. The Summit generated a number of important results and messages, including:

- Europe should be more present in the global discussions on water, an area where so far it has been absent.
- Europe should take a leading role on climate change adaptation, similar to the role it took on mitigation.

- Europe needs stronger and more focused cooperation on climate change adaptation, both within Europe and with other regions.
- The financial sector and the water sector need to be better integrated.

These messages are addressed in more detail in the thematic chapters of this document.

## Main results - Bridging Divides for Water

The European Regional Process brought together many European initiatives and activities on the eight major themes, further increasing cooperation between them and *bridging divides* between sectors, countries and initiatives. It generated a lot of momentum in the European water sector and involved more stakeholders in addressing the water challenges, also from outside the traditional water sector. Specific outcomes of the increased cooperation include:

- The facilitation of a stronger and more focused cooperation on climate change adaptation.
- The set up of better cooperation between and integration of the water and energy sectors.
- Better integration of the financial and water sectors.

Furthermore the Process facilitated the development of a common goal for the European Water Sector: The Water Vision for Europe, which is described in chapter 3.

### Bridging divides for water

- Representing stakeholders in all Europe – connecting EU and non-EU countries
- Bringing together the various sectors involved in water – governments, NGOs, business and research
- Bringing together the numerous initiatives on water around Europe
- Setting up clear goals to unite stakeholders – a Water Vision for Europe

## Structure of the European Regional Document

The aim of this European Regional Document is to provide concise information on water in Europe – the challenges and solutions, key messages to benefit other regions and policy recommendations to address the remaining European challenges. Chapter 2 of the Document gives statistical information on water in Europe. The thematical part of the document (chapters 3 to 10) addresses the eight major themes. This part starts with the Water Vision for Europe as a common goal the European sector could work

towards on each of the themes. Annex 1 provides a full list of European organisations contributing to the European Regional Process, while Annex 2 provides a list of documents on water in Europe.

## European Regional Session

The European Regional Session will take place on Tuesday 17 March from 1430 – 1900.

The Session will be divided into two parts, addressing the challenges Europe faces within its borders and the role Europe can play in addressing global challenges. Within this structure the results of the European Regional Process will be discussed. Furthermore the Session will launch the Water Vision for Europe.



# 2

## Regional Overview



This chapter gives an overview of Europe based on a number of statistical indicators. Within the European Regional Document, Europe is defined using the definition of the Council of Europe. The map below shows which countries are included in this definition. The data in this chapter gives information on the population of the countries, urbanisation, national income, pressure on water resources, water availability, drinking water coverage, toilet/sanitation coverage and water pricing.

A large amount of data is available in Europe, especially within the countries of the European Union. However, due to the institutional and regional differences within Europe, comparable data for the whole of Europe proves sometimes difficult to find.





## Population and growth rate

Countries	1a	1b
Albania	3.2	-0.7
Andorra	0.1	0.7
Armenia	3.1	0.5
Austria	8.4	0
Azerbaijan	8.7	0.1
Belgium	10.7	0.2
Bosnia-Herzegovina	3.8	0
Bulgaria	7.6	0.5
Croatia	4.4	-0.3
Cyprus	1.1	0.1
Czech Republic	10.4	0.1
Denmark	5.5	0.2
Estonia	1.3	-0.1
Finland	5.3	0.2
France	62	0.4
Georgia	4.6	0.1
Germany	82.2	-0.2
Greece	11.2	0.1
Hungary	10	-0.4
Iceland	0.3	0.8
Ireland	4.5	0.9
Italy	59.9	0
Latvia	2.3	-0.4
Liechtenstein	0.04	0.4
Lithuania	3.4	-0.4
Luxembourg	0.5	0.3
Malta	0.4	0.2
Moldova	4.1	-0.01
Monaco	0.03	0.9
Montenegro	0.6	0.3
Netherlands	16.4	0.3
Norway	4.8	0.4
Poland	38.1	0
Portugal	10.6	0
Romania	21.5	-0.2
Russian Federation	141.9	-0.3
San Marino	0.03	0.3
Serbia	7.4	-0.4
Slovakia	5.4	0
Slovenia	2	0.1
Spain	46.5	0.2
Sweden	9.2	0.2
Switzerland	7.6	0.2
FYRM	2	0.2
Turkey	74.8	1.2
Ukraine	46.2	-0.6
United Kingdom	61.3	0.3

Source: PRB's World Population Data Sheet

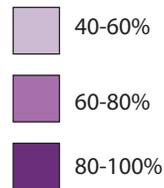
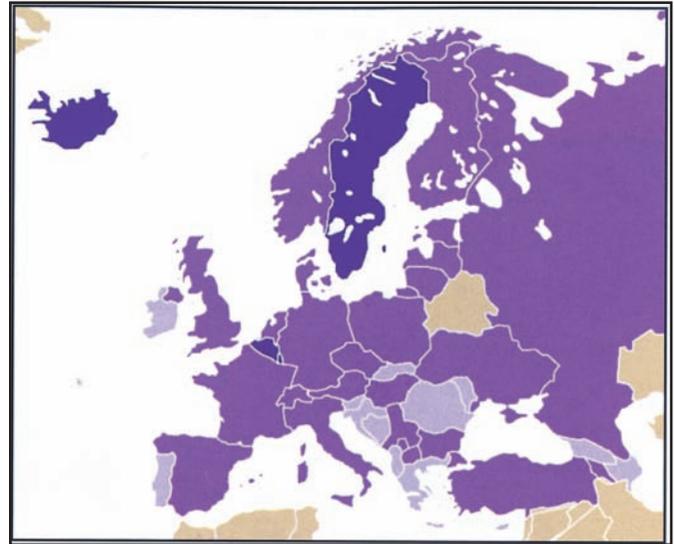
1a Population in millions (2007)

1b Population growth in %

The average population is 17.35 million, the average growth rate is 0.14 %

## Population living in urban areas

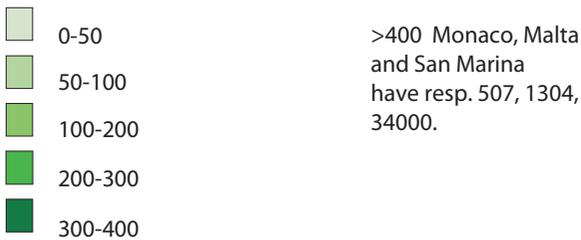
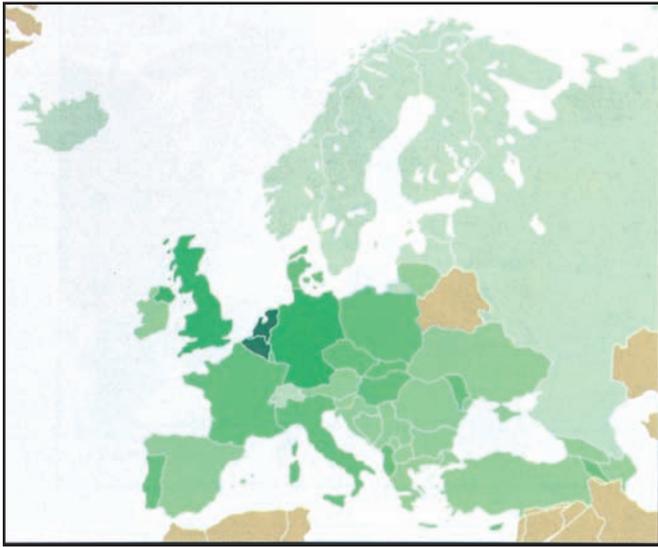
The map shows the percentage of the European population living in urban areas (2008)



Source: The Kaiser Family Foundation, GlobalHealthFacts.org. Data Source: Population Reference Bureau, 2008 World Population Data Sheet

## Population density

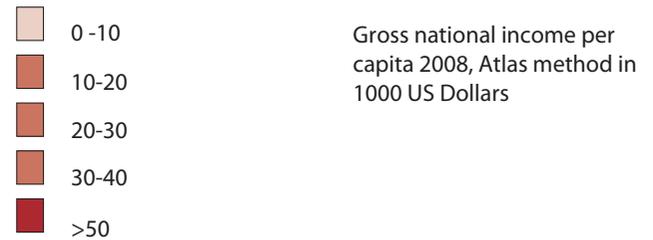
The map shows the number of inhabitants per square kilometer (2008)



Source: *The Kaiser Family Foundation, GlobalHealthFacts.org. Data Source: Population Reference Bureau, 2008 World Population Data Sheet*

## Gross national income

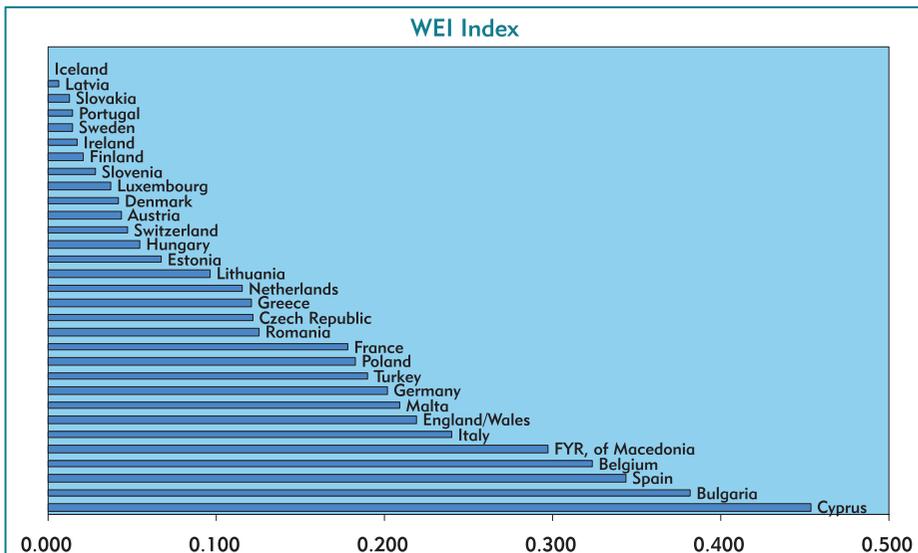
The map shows the gross national income per inhabitant, measured in 1000 US Dollars (2008)



Source: *World Development Indicators database, World Bank, revised 17 October 2008*

## Pressures on water resources

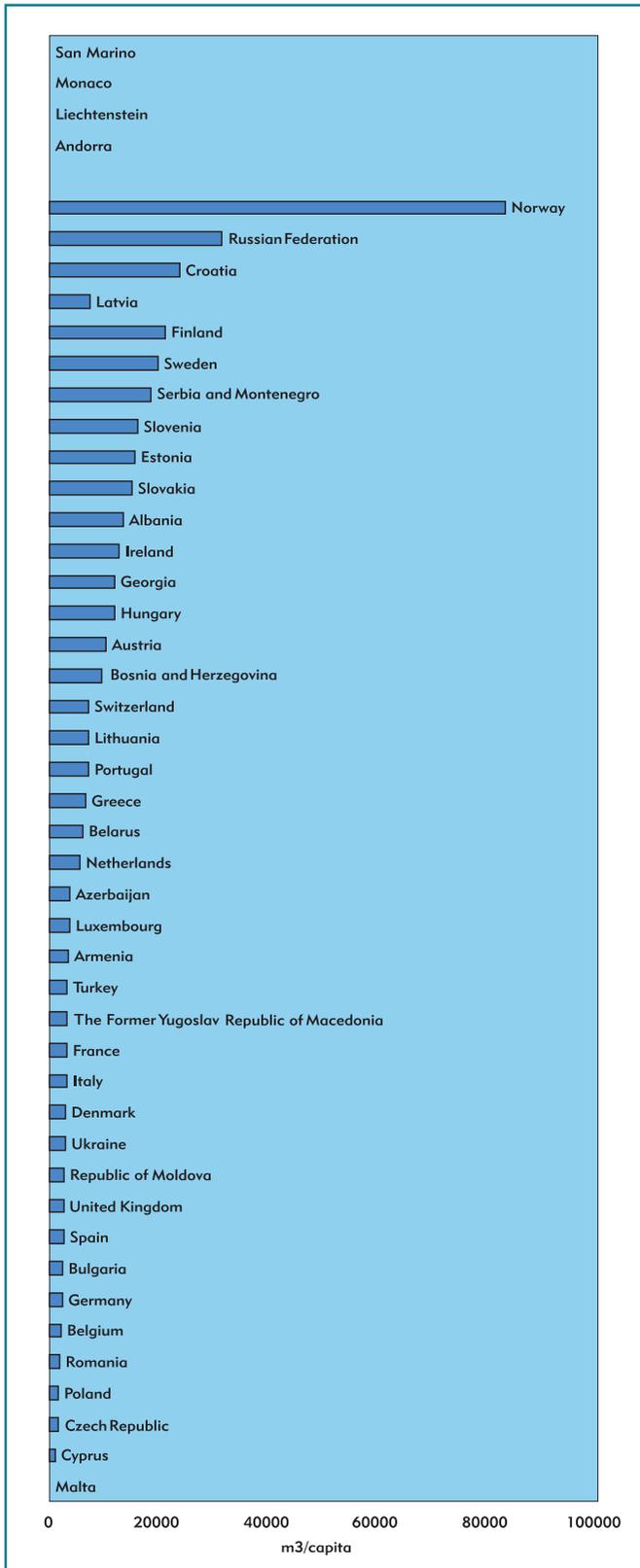
The table shows the pressure on the water resources in the European countries by giving the percentage of the available water being used. (2008)



Source: *EEA-ETC/WTR based on the latest available data from Eurostat data tables (extracted on 06/2008): Renewable water resources (million m<sup>3</sup>/year), Long Term Annual Average (LTAA) & annual water abstraction by source and by sector (million m<sup>3</sup>/year) - Total freshwater abstraction (surface + groundwater). No data available for Albania, Croatia, Bosnia-Herzegovina, Serbia and Montenegro*

## Water availability

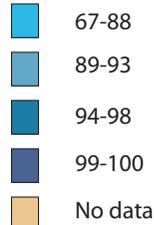
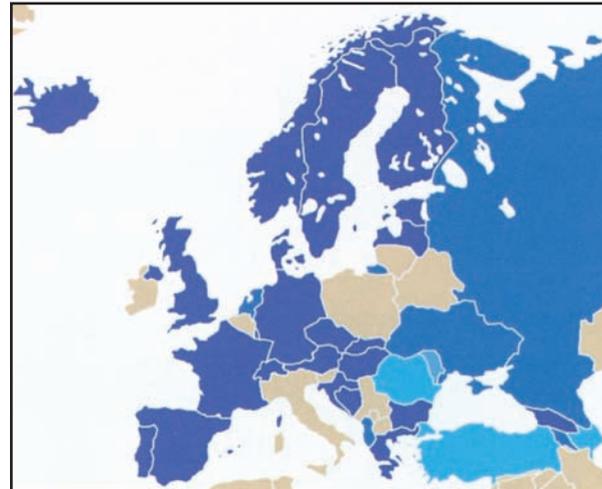
The table shows the water availability in the European countries by giving the m<sup>3</sup> of fresh water available per inhabitant. (2004)



Source: European Environmental Agency

## Improved drinking water coverage

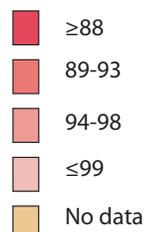
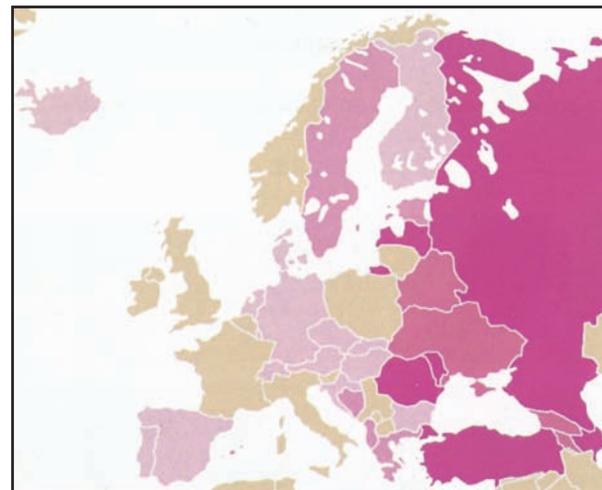
The map shows the percentage of the population with improved water coverage. (2006)



Source: ESRI 2004, JMP 2008, Cartography and design: Institute for Hygiene and Public Health, University of Bonn, 2008

## Toilet / sanitation coverage

The map shows the percentage of the total population with access to improved sanitation. (2006)



Source: ESRI 2004, JMP 2008, Cartography and design: Institute for Hygiene and Public Health, University of Bonn, 2008

## Water pricing in European cities

There is currently no overview available on water pricing in the European countries. Furthermore, using an average price per country will not provide a detailed picture for the whole of Europe. Instead, the graph below gives information on the water pricing for all the capital cities in Europe.

Country	City	Water + wastewater fixed costs in \$	Water variable costs in \$	Wastewater variable costs in \$(where charged separately)	Total sales tax in \$	Sum in \$
Armenia	Yerevan	0.00	0.41	0.07	0.10	0.57
Austria	Vienna	0.13	1.78	1.37	0.33	3.61
Azerbaijan	Baku	0.00	0.00	0.00	0.27	0.27
Belgium	Brussels	0.00	3.76	0.59	0.26	4.61
Bulgaria	Sofia	0.00	0.53	0.21	0.15	0.89
Croatia	Zagreb	0.00	0.00	0.00	0.13	0.13
Czech Republic	Prague	0.00	1.50	1.28	0.25	3.03
Denmark	Copenhagen	0.45	6.50	0.00	1.74	8.69
Estonia	Tallinn	0.40	0.00	0.00	2.24	2.64
Finland	Helsinki	0.29	0.84	1.46	0.57	3.17
France	Paris	0.00	3.88	0.00	0.20	4.08
Georgia	Tbilisi	0.00	0.00	0.00	0.51	0.51
Germany	Berlin	0.00	3.03	3.76	0.21	7.00
Greece	Athene	0.08	0.78	0.53	0.18	1.57
Hungary	Budapest	0.00	0.99	1.40	0.48	2.86
Iceland	Reyjavik	1.43	0.00	0.00	0.00	1.43
Ireland	Dublin	0.00	0.00	0.00	0.00	0.00
Italy	Rome	0.00	1.28	0.00	0.13	1.41
Latvia	Riga	0.00	0.00	0.00	0.28	0.28
Lithuania	Vilnius	0.40	0.00	0.00	2.24	2.64
Luxembourg	Luxembourg	0.30	3.15	2.05	0.16	5.66
Moldova	Chisinau	0.00	0.38	0.00	0.00	0.38
Netherlands	Amsterdam	0.36	2.16	0.00	0.15	2.67
Norway	Oslo	0.43	2.10	0.00	0.63	3.16
Poland	Warsaw	0.00	1.28	1.66	0.21	3.14
Portugal	Lisbon	0.38	0.64	0.52	0.08	1.61
Romania	Bucharest	0.00	0.00	0.00	0.16	0.16
Russian Federation	Moscow	0.00	0.01	0.00	0.14	0.15
Serbia	Belgrade	0.00	0.06	0.00	0.09	0.15
Slovakia	Bratislava	0.00	1.11	1.08	0.42	2.60
Spain	Madrid	0.53	0.67	0.54	0.12	1.86
Sweden	Stockholm	1.35	0.15	0.00	0.37	1.87
Switzerland	Zurich	1.38	1.81	2.04	0.23	5.47
Turkey	Istanbul	0.00	2.10	0.16	0.18	2.44
Ukraine	Kiev	0.00	0.49	0.00	0.49	0.97
United Kingdom	London	0.70	1.93	0.94	0.00	3.57

Source: Global Water Intelligence / OECD, Global Water Tariff Survey 2008

\* The benchmark tariff used is 15m<sup>3</sup> per month per user. It is calculated on the basis of taking the total water bill for a customer using 15m<sup>3</sup>/d of water including all fixed and variable charges and divided by 15 to get a notional tariff per cubic meter.

# 3

## The Future of Europe's Water – A Water Vision for Europe



Europe has many of the necessary elements in place to solve its water challenges: strong legislation, innovative technology, and well-trained water professionals. However, challenges remain and progress would be greatly accelerated if Europe could pool its knowledge and resources.

A coherent European Strategy with clear goals and concrete objectives would provide focus for European activities and encourage greater cooperation. The Water Vision for Europe, developed as part of the preparatory process for the 5<sup>th</sup> World Water Forum, could provide a basis for such a Strategy.

Europe benefits from a privileged situation on water resources and has made important progress on water management, infrastructure, technologies and legislation over the past decades. However, major challenges remain that could threaten Europe's sustainable development and future economic growth. Water scarcity, droughts, floods, access to modern and safe sanitation, increasing energy demand and pollution are growing concerns in countries all over the continent. Global challenges such as climate change, population growth and urbanisation further intensify the problems.

Most of the elements to address these challenges are in place in Europe. However, to make full use of them, Europe needs a strategic approach and clearly defined objectives that unite all stakeholders from the different sectors – governments, business, NGOs and research. A coherent strategy and shared objectives will mobilise people around common values for joint action. It is only through joint action that we can find solutions and ultimately attain sustainable water management and use in Europe.

### Aquawareness – A Water Vision for Europe

Europe needs new ways of working together. Exchange of knowledge and ideas is crucial to create an atmosphere of trust between different partners. Additionally, more and improved information on what stakeholders, specifically citizens, can practically do is essential. An inclusive process, gathering all European stakeholders, will enable the expression and discussion of the water challenges, reflecting Europe's diversity and regional priorities, to ensure Europe can overcome its water challenges and play a forward looking role in addressing the worldwide water crisis.

A change in thinking is essential in order to stimulate action among political decision makers, business and citizens. This change should support the shift from supply management to demand management coupled with supply solutions that consider the quality and quantities of water required for different uses and the range of water resources available – surface water, groundwater, treated wastewater, etc.

Europe has developed a large number of good and innovative policy instruments, management practices, and technologies, but implementation is often slow and incomplete. The reason behind this seems to be mainly the mindset and the low level of awareness of the stakeholders – not just of the problem but of the potential solutions as well. Today many stakeholders do not know the water situation in their region, city or river basin. Neither do they know how they can contribute practically to more efficient and sustainable use of limited resources. Furthermore, incentives to change behaviour are often missing. More awareness and

accessible, relevant and understandable data and information are clearly needed; legislation and technology alone won't be able to address the challenges.

The need for increased awareness and common values and objectives was clearly felt within the *Aquawareness* programme and provided the driving spirit for creating a **Water Vision for Europe**. The Vision provides a lighthouse for sustainable water management, setting concrete objectives that can provide a foundation for concrete projects – both to raise awareness and to enhance sustainable water management.

The Vision provides a good starting point for development of a European strategy. It has galvanised a joint discussion on water by bridging sectoral boundaries and inviting all stakeholders to reflect on Europe's future. The result of this exercise is a vision of Europe in 2030 where:

"We have achieved sustainable water resource management and universal access to modern and safe water supply and sanitation because we value water in all its dimensions – in its economic, social, environmental and cultural importance."

The Vision contains clear objectives and commitments and provides guidance on joint actions to solve Europe's water problems and contribute to global solutions.

## Aquawareness

The Aquawareness initiative was setup by the European Water Partnership (EWP) in 2008 to raise awareness on the current water challenges among all actors (governments, NGOs, businesses and citizens) and to support the development and implementation of sustainable water management.

*Aquawareness* consists of two main programmes:

The **European Water Awareness Programme** aims at raising awareness and initiating a culture of efficient and sustainable water use among citizens, industrial and agricultural users. It promotes enhanced information, education and training and presents adopted and applicable measures for sustainable water use.

The **Water Stewardship Programme** aims at supporting the development and implementation of adopted instruments for sustainable water management. It bridges barriers between sectors, promotes water as an integral part of policy and business agendas and promotes the creation of knowledge and transparency on production and consumption patterns.

Increased awareness among all stakeholders, particularly consumers, will provide an incentive for businesses and governments to move towards sustainable water management and to clearly communicate their efforts to the public. Increased water awareness therefore lays the groundwork for increased water stewardship.

[www.ewp.eu/aquawareness](http://www.ewp.eu/aquawareness)

## Set up of the Water Vision

The basic text of the Water Vision for Europe was elaborated in an open multi-stakeholder process and was launched at a high profile event at the European Parliament on 30<sup>th</sup> June 2008 (see box). The Aquawareness Programme and the Vision are supported by the European Commission, the European Parliament, the Slovenian Presidency of the European Union (first half 2008) as well as leading multinationals and NGOs.

The initial text of the Vision provided a basis for discussion. After the launch, a regional consultation process was started across Europe. The water challenges are different in the various regions of Europe; the regional consultation process ensures this diversity is reflected in the Vision. This bottom-up involvement is crucial for achieving a broad ownership and joint commitment to the Vision's aims.

Four workshops were organised to discuss and highlight the priorities of the regions:

- Southern Europe, Castellon, 3<sup>rd</sup> December 2008
- Northern Europe, Copenhagen, 8<sup>th</sup> & 9<sup>th</sup> January 2009
- Central Eastern Europe, Vienna, 26<sup>th</sup> January 2009
- Western Europe, Brussels, 4<sup>th</sup> February 2009

The workshops have enriched the Vision with regional priorities, challenges and solutions. These meetings also facilitated the exchange of expertise and knowledge. The Western European Workshop hosted the final workshop of the regional consultation, bringing together the results of all the regional workshops.

The 5<sup>th</sup> World Water Forum marks the end of this regional consultation process. In Istanbul, the Water Vision for Europe, including the region-specific views and opinions will be presented as a European contribution to the Forum's aims. The Water Vision, together with the feedback from the discussions at the World Water Forum will be incorporated into a guidance document and presented to the incoming European Commission in autumn 2009.

In addition to the Water Vision for Europe process, a project has been setup within *Aquawareness* to focus on the views and opinions of the next generation. Children around Europe will be invited to reflect on the future of Europe's water, declaring the Youth Water Vision for Europe. The results will be presented to the incoming European Commission and Parliament in an event in the European Parliament in Brussels.

## Launch of Aquawareness and the Water Vision for Europe

On Monday 30<sup>th</sup> June 2008 the Water Vision for Europe and the Aquawareness Programme were launched at the European Parliament in Brussels, Belgium.

Aquawareness enjoys the support of the European institutions as well as leading multinationals and NGOs. As Hans-Gert Pöttering, president of the European Parliament, put it:

*"In the name of the European Parliament I strongly welcome the initiatives that have been launched in this conference today: the European water vision for the twenty-first century and the Aquawareness programme. Awareness of the current water situation in the Europe Union and its challenges, as well as a vision for the future of Europe's water, are crucial drivers in order to strive for a sustainable water management."*

Stavros Dimas, EC Commissioner for the Environment, highlighted the relation with the EU Communication on Water Scarcity and Droughts:

*"Aquawareness is an excellent and timely initiative, responding directly to the challenges highlighted in the Commission's Communication and its necessary follow-up with all stakeholders."*

At the event, the Water Vision for Europe was symbolically handed over in a bottle to the representatives of the three European Institutions – the Commission, the Parliament and the Presidency. The many participants – representing all sectors – contributed to the Vision by giving their comments and suggestions in written form.

## The way forward to reach the Vision

In addition to the regional workshops, a vision mapping study has been initiated within the Aquawareness programme in order to establish a baseline, identify areas where progress is being made and where there are major obstacles to achievement of the Vision. As a result of this study, a map will be created indicating the actual activities and projects that are already contributing to the achievement of the Vision aims. This map will also provide information on missing or overlapping actions. On the basis of the Vision mapping, policy recommendations will be included in the Vision document to be presented to the European Parliament.

The Vision mapping will be a continuous effort – an ongoing tool for elaborating the status quo on where Europe stands on water issues and where there are still gaps to be filled – thus providing valuable information and guidance for decision makers and investments.



## The Hague 2000 – Global Vision for Water in the 21<sup>st</sup> Century

During the 2<sup>nd</sup> World Water Forum in the Hague (2000), a global Vision for Water in the 21<sup>st</sup> Century was launched, together with a Framework for Action. This Vision was set up to alert the public and politicians to the fragile status of the world's water resources.

The global Vision for Water was prepared by the Global Water Partnership (GWP) under the guidance of the World Commission for Water in the 21<sup>st</sup> Century. It was developed in a broad-based, multistakeholder process and is based on a large number of regional Visions around the world. In Europe, regional visions were developed in the two regions where the GWP is most active: Central and Eastern Europe and the Mediterranean.

The issues highlighted in the European regional visions were often taken up into national strategies. For the European regions, an analysis of progress is envisaged after 2010.

*"Every human being, now and in the future, should have enough clean water, appropriate sanitation and enough food and energy at reasonable cost. Providing adequate water to meet these basic needs must be done in a manner that works in harmony with nature."* (Global Vision for Water in the 21<sup>st</sup> Century)

[www.gwpforum.org](http://www.gwpforum.org)

## The right to water

One of the legacies of the fourth World Water Forum was the intensification of a heated and controversial debate over the recognition of water as a human right and common good. A large number of associations and individuals asked their elected representatives to include water as top priority in the political agenda and to adjust national and international legislation accordingly. Europe has not ignored the call and has plunged into the debate by tackling the issue from different angles and becoming an inspiring source for several movements.

At present, due to its intrinsically ethical, political and economic implications, the debate is still very much open and the international community is actively engaged. Within the Water Vision process, the EWP is ready to contribute to the elaboration of a World Water Protocol. As stated in the Vision: "Water is an essential human need and we recognize the access to basic water supply and sanitation as a human right".

## Importance of education

A need identified by many European conferences and initiatives is the need for improved education and capacity building. Improved education is needed for three reasons: (1) education is a major driver for awareness, (2) capacity building and human

resources management are the basis for the improvement of water management, and (3) there is a growing shortage of trained water professionals in Europe. Action is urgently needed to make sure Europe has the human resources to address its water challenges. In the Netherlands for instance, research has shown that if no action is taken, the water sector will lack around 8,000 trained professional to fill the most urgent vacancies in water technology in 2011. For the total water sector this figure rises to 16,000 (see box).

According to a 2006 survey conducted by the the French Ministry of Ecology, the French water sector currently represents 113 000 jobs in total and needs an annual recruitment of 5000 until 2010. This survey also identified remedial actions to make the sector more attractive to potential job seekers and to improve the link between the training offered and the employment requirements (<http://eaudoc.oieau.fr/spip.php?rubrique61>).



French national water training center

### Generation Blue, Austria

Generation Blue is an interactive water information platform for young people aged between 13 and 19, which was initiated by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management. For the past four years, this project has been working with young people, teachers and schools to encourage sustainable use of water and participation in environmental activities as well as providing information on job possibilities within the water sector.

Within *Aquawareness*, the concept will be extended into Generation Blue International, involving European countries and regions into cross-national activities.

[www.generationblue.eu](http://www.generationblue.eu)

### Human Capital Water – The Netherlands

The Dutch water sector is renowned for its expertise worldwide. Yet, finding enough well-qualified water professionals is proving to be more and more difficult. The shortage of – mainly technically – skilled personnel is expected to grow even further in the coming years as today's water professionals retire and the demands on the sector increase. The demand for water professionals does not meet the supply: there are not enough students who choose an education in the field of water.

To remedy this situation, water sector organizations need to cooperate with education institutes to increase focus on water issues and attractively present opportunities the water sector has to offer in curricula, at all levels of education. The programme Human Capital Water, coordinated by the Netherlands Water Partnership, aims to interest more young students in education and careers in the field of water.

[www.nwp.nl](http://www.nwp.nl)

### Training centers for water professionals in Europe

Around Europe, there are a many national and international training centers for water professionals. In France, for instance, the French National Water Training Center (CNFME), operated by the International Office for Water, manages 6,500 trainees (engineers, technicians, elected officials) and 550 training courses every year in France and overseas ([www.oieau.org/cnfme](http://www.oieau.org/cnfme)). It also provides support for creation of such training centers in foreign countries, including Poland, Mexico, Kenya, Nigeria, South Africa, Saudia Arabia, Morocco, Algeria and others. On this basis, an International Network of Water Training Centers (INWTC) was created in November 2008, the secretariat of which was entrusted to the International Office for Water ([www.inwtc.org](http://www.inwtc.org)).

In the UK, the Chartered Institution of Water and Environment Management (CIWEM) certifies training programmes and makes awards of Chartered Status for Engineers, Scientists and Environmentalists ([www.ciwem.org](http://www.ciwem.org)). In Germany, DWA (Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall) provides a wide programme of training events for operational staff ([www.dwa.de](http://www.dwa.de)).



# 4

## Climate Change and Adaptation



Mitigation efforts are not going to be enough to address climate change. There is growing recognition in Europe that adaptation actions are needed as well. Some countries have already put in place legislation on adapting to climate change. Others have yet to formulate a national position.

Europe can take a leading role in climate change adaptation, as it did in mitigation. There are many examples of adaptation actions in the region. To move forward, Europe needs to encourage more regional cooperation and exchange of best practices. A European Water Vision and a set of shared climate change scenarios could provide a foundation and a common direction.

*This chapter has been coordinated and written by the European Water Association ([www.ewa-online.de](http://www.ewa-online.de)). It builds on the wide range of information available and the many comments received during the process. A full list of case studies of climate change adaptation in the European water sector could not be included here; the case studies cited in this chapter have been collated from the comments received. The authors would like to thank all the contributors to this chapter, who are mentioned in Annex 1 of this document.*

*Four events within the European Regional Process contributed to the content of this chapter: The Zaragoza Workshop on 8 and 9 July, the workshop in Budapest on 8 and 9 October, the European Policy Summit on the 5<sup>th</sup> of November and the Nordic Workshop on 8 and 9 January.*

### Impacts of climate change on the water sector

The water sector is already vulnerable to changing weather conditions and climate change is likely to pose additional challenges. The impacts of climate change and the importance of adaptation in the European water sector have been documented elsewhere (e.g. OECD 2008, EEA 2004, EEA 2008, European Commission 2007, UNECE 2008) and so are not rehearsed in detail here.

The impacts of climate change in the water sector will not be uniform across Europe. The following regions of Europe are likely to be particularly vulnerable (EEA 2008):

- Southern Europe, the Mediterranean Basin and Central Asia – temperature increases and reduced precipitation in areas already coping with water scarcity and resulting water quality impacts.
- Mountain areas – temperature increases will lead to widespread melting of snow and ice, altering river flows and water resources.

- Coastal zones (particularly low lying delta areas) – sea level rise and storms pose a risk to infrastructure.
- Densely populated floodplains – increased risk of storms and intense rainfall leading to flash floods and damage to infrastructure.
- Scandinavia and Northern Russia – precipitation increase, the larger part of which will be in the form of rain instead of snow, altering river flows and water resources.
- The Arctic region – temperature changes will be higher than in any other place on Earth.

## Overview of key issues for Europe

This chapter covers adaptation in EU member states and the non-EU regions of Europe. The impacts of climate change are likely to be similar in EU and non-EU countries but the institutional setting is different. For the EU member states, most legislation now comes from the EU and a number of directives will have to be modified in the coming years to take into account the challenges of climate change.

Addressing climate change requires a ‘two-pronged’ approach: mitigation to limit the magnitude and rate of change, and adaptation to deal with the residual impacts and opportunities. The majority of climate change legislation and activity at a European and national scale has been concerned with mitigation rather than adaptation, for example: the European Climate Change Programme, including the EU Emissions Trading System; the European Performance of Buildings Directive; and targets on greenhouse gas emissions and renewable energy. However, policy makers are becoming increasingly aware of the need to adapt to the unavoidable consequences of climate change.

Europe is in a position to take a similar leading role on climate change adaptation as it did on mitigation. Since the 4<sup>th</sup> World Water Forum, the region has made considerable progress in this area. A number of countries now have programmes aimed at identifying and adapting to the risks of climate change, but progress in enacting legislation and planning and implementing adaptive actions has been uneven. Reasons why some European countries have yet to consider climate change adaptation in their policies include: lack of resources (human and financial), absence of international legislation, a perception that mitigation is more important, and lack of awareness of the need for adaptation.

Currently, the European Commission is interested in the collection and dissemination of best practices from across Europe (rather

than promoting one or another Member State’s practices as a model), but it has to set up stronger and more focused cooperation on this subject – cooperation that also involves the private sector.

To promote this kind of cooperation, it may be necessary for the European Union to adopt a set of common climate change scenarios. Whilst there are a number of projects in Europe that are producing scenarios (e.g., ENSEMBLES, PESETA, PRUDENCE, SCENES), there is no agreed set that can be used to drive and monitor European adaptation policy.

As Europe moves forward in addressing climate change, it is important that mitigation and adaptation should not be seen in isolation from each other for a number of reasons:

- There are synergies between adaptation actions in the water sector and mitigation that could be exploited. For example, technologies are now available that convert biogas generated at water treatment plants into energy.
- Adaptation should not conflict with the mitigation agenda. For example, desalination may be considered as an adaptation option in areas where water is scarce, but it is energy intensive and unless associated with a zero-carbon power source, it will have a negative effect on mitigation objectives. Adaptation actions need to be screened to ensure they will not have adverse effects on greenhouse gas emissions.
- The impact of mitigation actions on adaptation in the water sector also needs to be considered. This is increasingly happening. For example, in the EU the growing of biofuels, which can be water intensive, will now have sustainability criteria built in that include full life cycle analysis. Water consumption is part of this, and the resulting demand on water resources will be considered.



## Examples of national adaptation plans and programmes within Europe

Since the 4<sup>th</sup> World Water Forum, a significant amount of research into the impacts of climate change on the water sector has been carried out and a considerable number of adaptation plans, strategies and programmes have been initiated. The following examples are not comprehensive; rather they represent the breadth of activity currently underway.

**United Kingdom:** The UK is the first country to include adaptation in national legislation on climate change. Its Climate Change Act of 2008 requires the Government to report at least every five years on the risks to the UK of climate change and publish a programme setting out how these will be addressed. The 2008 legislation builds on the groundwork laid by the Climate Impacts Programme (UKCIP). Established in 1997 to help coordinate scientific research into the impacts of climate change and facilitate adaptation, the UKCIP publishes climate change scenarios (modelled by the UK Met Office Hadley Centre) and works with businesses and organisations to help them assess how they might be affected by climate change.  
(<http://www.ukcip.org.uk/>,  
<http://www.metoffice.gov.uk/research/hadleycentre/>,  
<http://www.defra.gov.uk/environment/climatechange/uk/legislation/>)

**The Netherlands:** The Dutch national adaptation strategy, Adaptation, Spatial Planning, Climate (ARK), involves four Dutch ministries, together with three research programmes dealing with climate change, spatial planning and water management. The strategy has a strong focus on integrating climate change adaptation with spatial planning. The country's flood management policy also reflects this focus. A new Delta Act, based on key recommendations on flood protection and flood risk management for the next century, will provide the legislative anchor for the improvement of water security in the face of climate change. (<http://www.klimaatvoorruijnte.nl>, <http://www.deltacommissie.com>)

**Portugal:** The SIAM project (Climate Change in Portugal: Scenarios, Impacts, and Adaptation Measures), which was launched in 1999, and its successors, SIAM II and CLIMAAT, have provided an up-to-date and integrated vision of the impacts of climate change in ten sectors. Further research and follow up action is on-going at the local, regional and national level, both in the private and public sector. In parallel, the Portuguese Government has recently launched a National Strategy for Climate Change Adaptation and has selected the water resources domain as one of its priorities. (Santos et al 2001)



**Spain:** The Spanish Climate Change Adaptation Plan was established in October 2006 with the aim of integrating climate change adaptation (mainstreaming) into the planning strategy of socio-economic sectors and ecological systems. To support the Plan, research is underway to model water resources under different climate scenarios, assess the impact of climate change on water demand (irrigation, urban supply and industry), and model the ecological status of water bodies using bioclimatic envelope models.

**Germany:** The German Federal Environmental Agency runs the KomPass centre on global warming and adaptation. The centre offers several services including support to the Federal Ministry for the Environment in strategic planning of adaptation measures; compilation and synthesis of climate change research outcomes; networking between economy, administration and science; and provision of climate change relevant data.  
(<http://www.anpassung.net>)

**Romania:** In Romania, an Environment Ministerial Order at the beginning of 2007 set up an interdisciplinary working group to address climate change adaptation. One of the main tasks of the working group was to prepare the national guidance document on adaptation to climate change. The goal of the document is to identify, based on available economic resources, measures necessary to limit the impacts of climate change in Romania. The document identifies climate change impacts, the degree of vulnerability of key sectors and adaptation measures in these sectors. (<http://unfccc.int/resource/docs/nap/romadd1.pdf>)

Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan): Vulnerability assessments have been carried out in Central Asia and have identified natural resources (including water availability and quality), national economies and the public health sector as particularly vulnerable to the impacts of climate change. National adaptation measures in the CA region currently focus on:

- Research on climate change impacts and development of adaptation measures;
- Improvement of observation networks and environmental monitoring;
- Improvement of data collection, interpretation and dissemination;
- Enhancement of weather forecasting, climate modelling and early warning systems for natural disasters and extreme events;
- Capacity building to strengthen institutional, technical and human resources to promote adaptation and research; and
- Implementation of specific projects on adaptation in priority areas.

Hungary: The costs associated with impacts of climate change are estimated to reach HUF 150-180 billion (600 – 700 million Euros) a year, close to 1% of GDP. In response, the Hungarian Ministry of Environment and Water together with the Hungarian Academy of Sciences launched a three year project in 2003 to provide scientific support for the establishment of a national climate policy focusing on adaptation. Based on the recommendation of the project, the Hungarian Parliament adopted a resolution on a *National Climate Change Strategy 2008-2025* in March 2008.



## Progress within the European Union

The European Environment Agency reviewed necessary adaptation actions in the water sector at a country level in the EU and compared this to existing or planned activities. Those countries with the highest levels of implementation of necessary actions include Belgium, France, Germany, Cyprus, Slovakia, Spain and the UK. Those countries with a large number of necessary actions that have not yet been planned include Austria (drought/low flow protection), Denmark (all areas), Estonia (flood protection and coastal zone), Ireland (flood and drought/low flow protection), Slovenia (drought/low flow protection) and Sweden (flood protection and coastal zone) (EEA 2007).

At the EU-level, a number of directives will have to be changed in the coming years to take into account the challenges of climate change. There are many EU Directives and policies that interact with climate change adaptation including the Habitats Directive, the Common Agricultural Policy, the Integrated Pollution Prevention and Control Directive and the Marine Directive. However, this chapter considers those that most directly affect the water sector. Proposed new EU Directives also need to be screened to identify how climate change may impact delivery and how their implementation may affect climate change mitigation.

There is already considerable experience of transboundary cooperation within the European Union (see Basin Management chapter). But in order to facilitate transboundary cooperation on climate change adaptation within the European Union, Member States need access to standardised data sets and information on climate change. A set of common European climate change scenarios would assist countries in planning for climate change and will be vital for ensuring transboundary cooperation.

## European Commission on adapting to the impacts of climate change

The European Commission published a Green Paper highlighting the impacts of climate change on various socio-economic sectors across Europe and setting out four lines of priority actions:

- Early action to develop adaptation strategies in areas where current knowledge is sufficient.
- Integrating global adaptation needs into the EU's external relations and building new alliances with partners around the world.
- Filling knowledge gaps on adaptation through EU-level research and exchange of information.
- Setting up a European advisory group on adaptation to climate change to analyse coordinated strategies and actions.



The Green Paper will be followed by a White Paper in 2009. The actions identified will focus on:

- Human capital, e.g., awareness raising, capacity building and research.
- Green infrastructure, e.g., working with nature, land use and management, forestry, improving the Common Agriculture Policy and Common Fisheries Policy.
- Grey infrastructure, e.g., climate proofing existing and future infrastructure.

An study will accompany the White Paper to assess the impact of climate change on key sectors and three cross-cutting issues (water, biodiversity and land use) and identify adaptive actions.

## Water Framework Directive (WFD)

The WFD subsumes former water legislation into a new overarching programme to deliver long-term protection of the water environment and improve the quality of all waters, including groundwater, surface waters and associated wetlands (Environment Agency 2008, see also Basin Management chapter). Despite the obvious links between climate change impacts and the state of the water environment, adaptation to climate change is not addressed explicitly in the WFD.

However, adaptation measures will be included as part of the implementation, starting with the first planning cycle for 2009. In addition, the WFD's step-wise and cyclical approach is well suited to handle the challenge of climate change. Achieving WFD objectives that improve the resilience of aquatic ecosystems and the rational use of water resources will also support adaptation to climate change.

The Common Implementation Strategy for the WFD recently carried out a survey to evaluate how countries are planning to include climate change adaptation in their first River Basin Management Plans (RBMPs). According to the survey, 18 countries said they will include adaptation measures in their RBMPs. Most of these are 'win-win' or 'no-regret' measures in areas such as water use efficiency, land use planning, flood management, diffuse and point source pollution and hydromorphological pressures (Horvath et al. 2008). However, only 10 countries plan to carry out a 'climate check' on their Programme of Measures (PoMs) – indicating a need for Member States to carry through a commitment to adaptation in their RBMPs into the PoMs. The Common Implementation Strategy Strategic Steering Group will be producing a guidance document on climate change adaptation and the WFD in 2009.

## Floods Directive

The European Directive on the Assessment and Management of Flood Risks (the Floods Directive) requires Member States to assess if water courses and coast lines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk (European Commission 2007). In preparing flood risk maps and management plans, Member States should take into consideration long term developments, including climate change. There are synergies between the Floods Directive and the WFD that are likely to result in benefits for adaptation.

## Urban Waste Water Treatment Directive

The Urban Waste Water Treatment Directive aims to protect the environment from the adverse effects of urban wastewater discharges. The Directive will need to consider the impacts of climate change, for example lower flows in receiving waters, which may increase the risk of pollution since discharges will be less diluted.

## European Parliament Declaration on Climate Migrations

This declaration was adopted at the conference on Climate migrations organised in the European Parliament, Brussels, on June 11<sup>th</sup> 2008. It considers the effects of climate change, in particular rising sea level, the phenomenon of desertification, floods and heat waves on the living conditions of populations insofar as they may generate degradation, disappearances of territory and increased pressure on natural resources such as water. The Declaration recommends a number of actions for addressing migration issues in Europe. (<http://www.efmsv2008.org/article/655>)

## Progress in non-EU countries

Under the United Nations Economic Commission for Europe (UNECE) Water Convention, the adaptation actions in the water sector in the SEE (South East Europe) and EECCA (Eastern Europe, Caucasus and Central Asia) countries were reviewed (UNECE 2008). Bosnia and Herzegovina, Croatia and The Former Yugoslav Republic of Macedonia in SEE responded to the survey, and Armenia, Azerbaijan, Belarus, Georgia, Kyrgyzstan, Moldova, Ukraine and Uzbekistan in EECCA. The survey revealed that countries are aware of the need for certain adaptation measures, but many of these have not yet been planned and implemented. However, most countries have already planned and/or implemented some general adaptation measures; these concern awareness raising and involvement of the public, institutional measures and integral risk management, and information campaigns in cooperation with public health authorities.

Adaptation to climate change is mostly targeted at specific sectors or through specific projects rather than at the national planning level. The answers to the questionnaire reflect an overall technical approach to cope with climate change effects, often directed at structural measures. It suggests that more attention should be targeted to non-structural measures like legislation, insurance and integration of climate change considerations into development planning at all levels. The survey also revealed that neighbouring countries often use very different scenarios with contradictory impact assessment results, for example those bordering the Black Sea.

## Institutional co-operation

The UNECE Convention of the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) is designed to address issues across the European region but has wider relevance. In 2006, the Task Force on Water and Climate was established under the UNECE Water Convention. Together with the Task Force on Extreme Weather Events (under the Protocol on Water and Health), it is responsible for developing a guidance document for the European region on adapting to climate change (UNECE 2008). The guide aims to provide advice to decision makers and water managers on how to assess impacts of climate change on water quantity and quality; how to perform risk assessment, including health risk assessment; how to gauge vulnerability; and how to design and implement appropriate adaptation measures. It is designed to be used in a transboundary context but will also be relevant to national policy and planning strategies. It is expected to be finalized and formally adopted in November 2009 at the next Meeting of the Parties to the Water Convention.

## Flood protection

Flood protection is one area where many countries are considering adaptive actions. Both the Netherlands and Hungary have moved from an approach that focused on strengthening and heightening dikes to an approach that also includes developing flood storage areas.

In the Netherlands, this takes the form of the “giving space to rivers” philosophy – setting aside large water retention areas, as in the photo shown here, which often provide ecological and recreation benefits. Hungary is improving flood protection along the River Tisza by constructing reservoirs for flood water storage, increasing the discharge capacity of the flood bed, and ecologically revitalizing the floodplain area.

## Climate change impact and adaptation R&D

A considerable amount of research into climate change and its impacts on the water sector has been undertaken in Europe (see Research chapter). Major projects include:

- Projection of Economic impacts of climate change in Sectors of the European Union based on boTtom-up Analysis (PESETA) (<http://peseta.jrc.ec.europa.eu/>).
- Adaptation and Mitigation Strategies: supporting European climate policy (ADAM) (<http://www.adamproject.eu/>).
- Water Scenarios for Europe and for Neighbouring States (SCENES) (<http://www.environment.fi/default.asp?contentid=300867&lan=EN>)

There is a need for further research and knowledge to support decision-making – particularly in the areas of data, modelling and forecasting. Planners, operators and decision makers in all economic and social sectors need scientific data in usable formats.

## Spatial planning response to physical impacts ESPACE (European Spatial Planning: Adapting to Climate Events)

Concentrating on water management issues, ESPACE was one of the first projects to focus on increasing awareness of the need for spatial planning systems to adapt to the impacts of climate change and one of the first to begin to provide some of the necessary policy guidance, tools and mechanisms to incorporate adaptation into planning systems and processes.

One of the final outputs of Phase 1 of the project was a set of 14 recommendations for incorporating climate change adaptation into spatial planning, including taking a long term view of spatial planning, assessing both vulnerabilities and opportunities associated with climate change and integrating climate change adaptation into organisations. (<http://www.espace-project.org/>)

## Guidance on flash flood management, Central and Eastern Europe

The increasingly variable climate in Europe has seen rising numbers of extreme flood events in the last decades in the Danube, Odra and Elbe river basins. The most deadly floods are those with short lead times; flash floods. The World Meteorological Organization (WMO) and the Global Water Partnership (GWP) have responded by formulating and advocating an integrated approach to flood management embedded in the context of Integrated Water Resources Management. ([http://www.apfm.info/pdf/pilot\\_projects/APFM-CEE-Synthesis\\_web.pdf](http://www.apfm.info/pdf/pilot_projects/APFM-CEE-Synthesis_web.pdf))

## Transboundary mapping of water resources

The World-wide Hydrogeological Mapping and Assessment Programme (WHYMAP) was launched in 1999 to contribute to world-wide efforts to better study, manage and protect freshwater resources. The programme aims to collect, collate and visualise hydrogeological information at a global scale. The outputs of the project can be used in combination with the output of climate change scenarios to identify European groundwater resources vulnerable to the impacts of climate change. (<http://www.whymap.org/>)

## Financing adaptation

The impacts of climate change are likely to be expensive: global weather losses increased from \$8.9 billion to \$45.1 billion per year between 1977 and 2006 (Bouwer et al 2007). However, implementing adaptation actions are also likely to cost large sums of money. Where will this money come from? There are a few specialised funds, most aimed at assisting less developed countries. Private investments and insurance can contribute. However, these sources are likely to provide insufficient. Adaptation needs to be mainstreamed into existing investment programmes (see Finance chapter)

Investment decisions need to consider the link between adaptation and socio-economic scenarios/development and look for 'win-win' actions where possible. There has been some research into the costs and benefits of adaptation (e.g., Stern 2006) but further work is needed. The cost of implementing adaptation actions needs to be balanced against the benefits in terms of damages avoided, reduced insurance premiums and health and well-being.



## Conclusion and recommendations

### Lessons learnt

The project examples presented in this chapter and others undertaken in the European water sector suggest several best practice elements and principles:

- Research should meet the needs of stakeholders and decision makers;
- Adaptation strategies should be holistic – focus on all aspects of the water cycle and inter-related sectors – and seek to deliver resilient communities, ecosystems and economies.
- Adaptation action should address socio-economic impacts of climate change as well as physical impacts.
- Adaptation and mitigation should be integrated to increase synergies and minimise adverse effects.
- Adaptation actions should be flexible enough to respond to future changes, deal with uncertainty and not foreclose future adaptation options.
- Early action on adaptation will reduce the long-term cost associated with climate change.

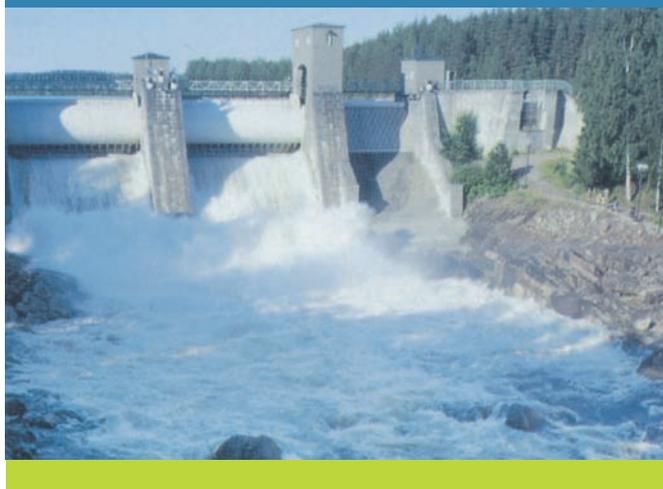
A number of recommendations have been made throughout this chapter:

- Europe should take a similar leading role on Climate Change Adaptation as it did on mitigation.
- New legislation or European Directives should be screened to identify how they interact with climate change adaptation – how climate change impacts may affect delivery and where there are win-win opportunities for climate change adaptation.
- Adaptation actions should be screened to ensure they will not have adverse effects on greenhouse gas emissions.
- The impacts of climate change will not respect political borders and significant transboundary co-operation will be required to deliver adaptation.
- The European hydrological monitoring network should be reviewed and improved in order to meet the challenge of adapting to climate change.
- A set of common European climate change scenarios should be developed in order to reduce the variance of results that are emerging from current models.
- The EU should prepare an overarching long term plan for water management in Europe covering the next 20 to 25 years and focussing on water resources and treatment, used water recovery, flood management and biodiversity. This should link to the Water Vision for Europe described in Chapter 3.



# 5

## Water, Energy and Climate



Water plays an important role in a sustainable energy production, and vice versa, but the current technologies and management approaches are poorly coordinated across sectoral boundaries and inadequate to solve the world's water and energy problems. Climate changes are only going to exacerbate the problems. New and innovative technologies and coordinated policies are needed to reduce the water footprint of energy production and to reduce the energy footprint of water supply and wastewater treatment.

European governments need to apply an integrated decision-making and management approach to address the water-energy-climate nexus, making use of assessment tools like water and energy footprints. Research allocations and policies should encourage the generation of quantitative knowledge on water and energy links and support development of new water and energy efficient technologies. Governments, businesses and specifically consumers need to be better informed and aware of the impacts of their decisions.

### Introduction

The links between water, energy and climate are complex. Understanding these links is of increasing importance. Within the EU-30, the total energy consumption is expected to rise by 50% till 2025; the amount of water needed in energy production is expected to rise by 130% over the same period.

*The Chapter Water, Energy and Climate has been coordinated by the EWP and written by Henrik Larsen (DHI Water Policy), Karen Hussey (Australian National University) and Adriana Hulsmann (KWR Watercycle Research Institute, EWP).*

*The contributors to the chapter are listed in Annex 1*

Energy production requires a lot of water, mostly for cooling. Supplying water requires large amounts of energy for treatment and transport and during consumption (heating). Water use and energy consumption impact climate, and changes in climate have an impact on water availability and water quality. Owing to the growing scarcity of both water and energy, potential impacts on economies are large, and they are largely underestimated.

In the period since the 4<sup>th</sup> World Water Forum in Mexico, many activities have been taking place in Europe on the linkages between water, energy and climate. Many conferences and symposia have addressed the issue, but one element is still clearly missing: an integrated and sustainable approach to water and energy policy and management.

This chapter describes the linkages between water, energy and climate; highlights some of the technologies available to address the resulting challenges; and discusses the needs and benefits of an integrated approach to water and energy policy-making and planning.

## Awareness of energy, water and climate interactions

Awareness of the challenges inherent in managing the interactions between energy and water is increasing in Europe. The interdependency of both scarce resources has become evident, not only in countries that have a high energy dependency and simultaneously suffer from water scarcity and droughts, but also for countries that face pressures on their energy production systems due to variable water supplies.

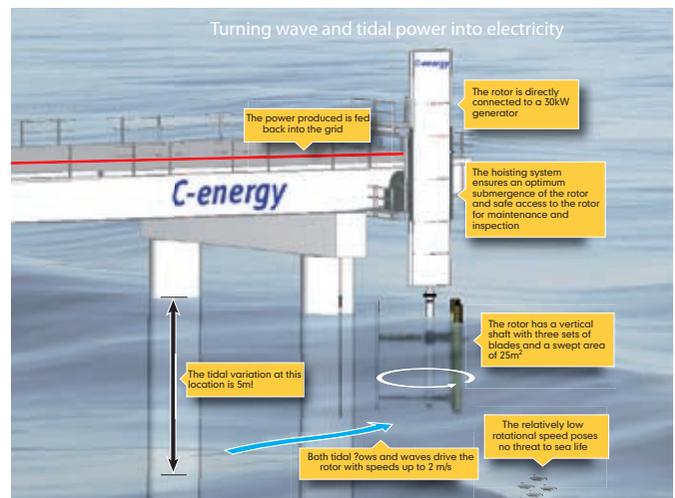
However, to reduce the negative effects stemming from the water-energy-climate nexus, even greater awareness is needed, and it needs to be translated into action.

- **Policymakers** need to be aware of water-energy-climate linkages when formulating policy in all three of these areas.
- **Researchers** need to be aware as they search for renewable energy sources and alternative sources of freshwater, such as desalination technologies.
- **Businesses** need to be aware of the water and energy used in their production processes. Some are already beginning to take action. Leading companies have an opportunity to push progress by setting an example of good water and energy stewardship and convincing other companies in the supply chain to follow their lead.
- **Consumers** also need to be more aware. The consumer is, after all, one of the major driving forces behind the market for water and energy. If consumers implement water saving measures, this will not only directly affect water and energy use in their homes, but will also have a huge cumulative effect on the energy needed to produce the water and treat the wastewater. The reduction in energy needs in the water cycle will in turn mean water savings in the energy cycle.
- The **energy sector** needs to be brought more into the debate.

## Linking energy, climate and water

In traditional methods of energy production water is mainly needed for cooling, but energy can also be produced using water as a source. Examples are hydropower, tidal power, and producing energy from the salinity difference between fresh and salt water. Alternative energy sources such as biofuel production also use significant amounts of fresh water.

In traditional water systems, energy is required to pump the water from underground aquifers or from surface sources. Water stress and climate change are encouraging increasing use of alternative water sources such as salt and brackish water and wastewater. The processes to make these sources usable, such as desalination, require energy intensive technologies. Also the demand for higher quality water imposed by EU legislation requires more treatment steps and thus more energy consumption.



## Example of energy production using tidal power

In industry and in households a lot of energy is added to water through heating. This energy most often goes to waste because the hot water is discharged into the sewer system. Recovery of this energy could be an option, but the resulting lower wastewater temperatures could adversely affect the efficiency of wastewater treatment processes.

The topic of water and energy also touches upon an important conflict between two core issues for the environment: the conflict between environmental protection and renewable energy. This is apparent most clearly in the biofuel and hydropower discussions.

## Climate change

In the current debate on climate change the linkages between water and energy are often overlooked, even though both the water and the energy sector play a significant role in changing the climate and are the first and hardest hit by the impacts of climate change. Climate change has a strong impact on our water resources, both on the availability, quality and the often competing demands for scarcer fresh water resources.

A vast increase in energy consumption is anticipated for the European water sector, due to population growth, impacts of climate change on source water, intrusion of sea and brackish water with sea level rise, and more stringent water quality requirements. The United Kingdom estimates a doubling of the energy consumption by 2015 to meet the WFD water quality requirements (GWRc 2008). This last example shows the clear need for an integrated approach and cross-sectoral coordination.

## Footprinting as a tool to quantify and address challenges

Many scientists are currently measuring climate, energy and water footprints. The contribution to climate change can be expressed as the climate footprint, which is mostly reported as CO<sub>2</sub> equivalents resulting from direct emissions of Green House Gasses (GHG) or indirectly through energy and materials used. Related concepts are the energy and water footprints: the amount of energy or water directly or indirectly required to produce a good or service.

Water footprints, and the related concept of virtual water, are key tools for addressing challenges and facilitating transparent decision-making processes on water and energy.

Tony Allen, the 2008 Stockholm Water Prize winner, originally used the term “embedded water”, which was later replaced by “virtual water”. The virtual water content of a product is the volume of water used to produce it, measured at the place(s) where it was actually produced. By importing a good, for example, coffee, a country is also importing an amount of virtual water.

Thus by importing water-intensive products, countries can lessen pressure on their own water resources. And in situations where, for example, a country with irrigated agriculture and a high-evapotranspiration rate, instead of growing a crop domestically, imports that crop from a country with rainfed agriculture and a relatively low evapotranspiration rate, there are potential overall water and energy savings in the production process. However, this has to be balanced against the amount of energy expended in transportation.

### Water footprint examples

1 beer – 75 litres of water  
1 apple – 200 litres of water  
1 slice of bread – 40 litres of water  
1 hamburger – 2400 litres of water  
1 cotton shirt – 2700 litres of water  
1 kg beef – 15500 litres of water

Source: [www.waterfootprint.org](http://www.waterfootprint.org)

Footprinting can be used in various ways. First of all it can be used to gain insight into the respective contributions in the domestic water cycle. KWR Watercycle Research Institute inventoried the climate footprint of the whole water chain in the Netherlands. The exercise showed that the contribution to the climate footprint in domestic premises was the highest in the whole cycle.

Footprinting can also be used to determine a baseline and measure improvement in reducing the impact on the environment and climate through focussed action. Amsterdam Waternet, the water supply and sanitation utility, calculated its climate footprint, and then found ways to reduce its GHG emission by more than 50%. The United Kingdom uses footprints to improve its decisionmaking processes. Studies by the UK Environment Agency proved that a country’s climate footprint can be reduced by demand management measures such as awareness raising and installing water meters.

### Technological challenges

There is a very real need to provide both innovative and ready-to-use technologies and solutions to decrease the energy consumption in the domestic water cycle as well as to obtain more energy using less water, particularly in renewable energy processes.

### Energy for water

There are already available technologies and solutions for reducing the water sector’s contribution to climate change. Examples already mentioned are: reducing energy usage, production of energy from waste, and using renewable and alternative energy sources. Decision making processes should make use of the footprinting tools already available and identify better demand management solutions such as awareness-raising amongst consumers.

New and innovative technologies are also needed to reduce the climate footprint and to make it possible to use alternative water resources and to retrieve energy and nutrients from wastewater sources (see Sanitation chapter). The energy consumption related to treatment processes is likely to increase, due to population growth, more stringent regulations and more advanced (and energy-intensive) treatment processes. The possible use in the future of alternative water sources (e.g., sea water) will also result in higher energy consumption. Thus improving the energy efficiency of drinking water production is a major and worthwhile challenge.

Several technological solutions are available or under development (see Research chapter). Examples of energy efficient technologies for the production of drinking water include: low-pressure UV/H<sub>2</sub>O<sub>2</sub> advanced oxidation (Ijpelaar et al 2007), advanced membrane systems using low-pressure membranes, and AiRo processes using air and water cleaning to control membrane fouling. Energy-intensive desalination processes to produce drinking water continue to be developed, but new techniques, such as the membrane distillation technology Memstill, are much less energy-intensive than the conventional reverse osmosis process.

Other developments address:

- The optimisation of drinking water production and distribution processes.
- The use of new demand models that provide stochastic residential demands per individual home.
- Pressure reduction in water supply systems to reduce the energy used in pumping (however this measure should not result in increased infiltration to the system or discomfort with the end users).

Reducing the emission of methane in groundwater abstraction is another possible way to shrink the water sector’s climate footprint. If it can be made technically and economically feasible, harvesting the methane from large-scale groundwater wells with high methane concentrations could be a win-win situation.

In sewerage and wastewater treatment, substantial energy savings can be achieved, for example by introducing source-separated sanitation (eco-sanitation). Separated urine and black water collection systems (that use far less drinking water) show a positive energy balance. Other favourable water cycle concepts include storm water separation, (re)use of the ‘embedded’ energy (warmth) of water, and central softening.

Considering that countries that suffer water scarcity and droughts are characterized at the same time by high levels of solar radiation, the role of solar sea water desalination technology should be seriously considered

Although the measures described above are promising, it is at the household level that the largest reduction in energy consumption can be achieved. There is an urgent need for technological solutions to reduce water usage and energy consumption in homes.

## Water for energy

Technologies related to oil and gas refining processes, thermoelectric power plants, the industrial sector, mining processes, etc. are being developed that consume less water and avoid any adverse impacts on water quality.

Although thermoelectric plants do not consume large volumes of water, the availability of water can be critical to their operation. In many countries, new power plants are planned only after thorough analysis of the current and future water availability. Practical technological solutions aim to reduce the consumption of water and to minimise the dependence on water resources.

Hydro-electric generation can also be affected by the reduction of water resources, but technologies exist that can produce hydroelectric energy even when countries are suffering scarcity or droughts. Pumped storage hydroelectric plants store energy in the form of water pumped from a lower reservoir to a higher one during night, when demand for electricity is low. During peak demand, water is released to generate electricity. Wind energy can be coupled with the hydropower plants for pumping.

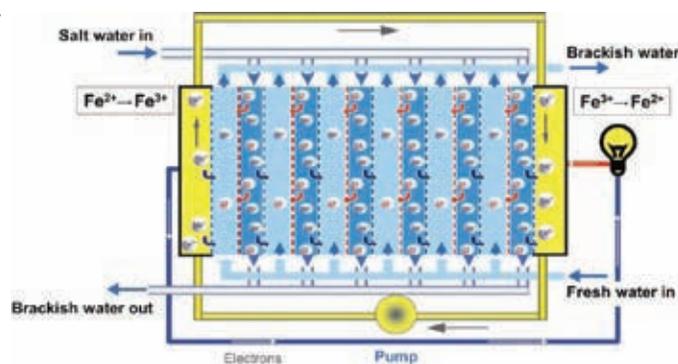
The transition to a low carbon economy will directly affect water and energy production. New technologies are crucial in achieving the European Commission's objectives. The EU Energy Policy of increasing the biofuels in transport fuel to 10% by 2010 will spur development of a new generation of technologies to reduce the amount of freshwater for growing and refining biofuels and ethanol. There will be a direct translation of innovative solutions from this sector to the farming one, which is interested in providing more food while reducing its water consumption and not increasing energy costs.

## Blue Energy

There is significant potential to obtain clean energy from mixing water streams with different salt concentrations. This salinity-gradient energy, also called blue energy, is available where fresh water streams flow into the sea. The global energy output from estuaries is estimated at 2.6 TW, which represents approximately 20% of the present worldwide energy demand.

Large amounts of blue energy can also be derived from natural or industrial brines. Two of the most frequently used processes are pressure-retarded osmosis and reverse electro dialysis. Research on blue energy is being conducted by a number of institutes in Europe, including Wetsus in the Netherlands.

[www.wetsus.org](http://www.wetsus.org)

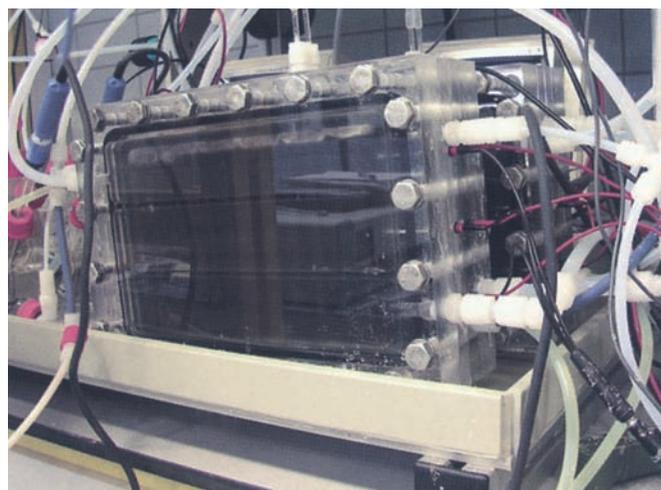


Blue Energy

## Microbial fuel cell – from waste to power in one step

Microbial fuel cell (MFC) research is a rapidly evolving field. Microbial fuel cells are devices that use bacteria as the catalysts to oxidise organic and inorganic matter and generate current. An MFC converts chemical energy, available in a bio-convertible substrate, directly into electricity. Bacteria can convert a huge variety of organic compounds into energy, which they use to grow and to maintain their metabolism. An MFC harvests a part of this microbial energy in the form of electricity.

[www.microbialfuelcell.org](http://www.microbialfuelcell.org)



Microbial fuel cell

## Oil from algae

Wageningen University Research is currently investigating the possibility of using algae as a source for the production of biofuel. Oil from algae could offer a good alternative to other biofuel sources since it does not compete with human food production. The research aims to further develop the technology for this second generation of biofuels and to integrate it with the production of proteins for food CO<sub>2</sub> fixation and wastewater treatment.  
[www.wur.nl](http://www.wur.nl)

New technologies are needed that save significant amounts of energy or are even able to net produce energy with, for instance, bio-electricity formation from wastewater and electricity production from advanced mixing of salt and fresh water. To achieve a break-through in these fields, multiple disciplines have to be combined, for instance: electrochemistry, membrane technology and biotechnology. There is also the issue of saving energy in current water treatment processes like wastewater treatment and desalination. Fields like electrochemistry, crystallization, membrane separation, and adsorption can be combined to achieve this. Examples of new and promising technologies are given in the textboxes.

## Integrated management: Opportunities and challenges

Driven by the three imperatives of security of supply, sustainability and economic feasibility, the energy and water sectors have undergone rapid reform in recent years. In the European Union, as elsewhere, the introduction of highly developed management strategies in the energy sector has affected the structure, ownership and regulatory arrangements of that sector. The introduction of extensive water reforms, such as the Water Framework Directive, has reinforced the need for watershed management, full cost recovery and the primacy of ecological health. However, in existing policy frameworks, energy and water policies are developed largely in isolation from one another – a fragmentation that is resulting in unsustainable developments in both sectors.

Furthermore, policies adopted to grapple with the challenges of climate change have the potential to produce decisions that exacerbate water-energy challenges. The issue of biofuel production is the most obvious example (addressing an energy problem by potentially creating a water problem), but the inherent trade-offs in hydropower plants, desalination, and wastewater treatment are also examples. Of course, in some cases trade-offs that have a negative impact on water resources for the benefit of other interests are unavoidable, but these decisions should at least be made on sound evidence, with the benefit of a comprehensive risk assessment and a considered approach.

At the heart of the problem is a lack of policy integration: the energy, water and 'climate' sectors are highly developed within themselves, but only limited effort is made to account for, and manage, the links between them. Ultimately, policy-makers and natural resource regulators need to be able to answer four key questions:

1. What is the impact of water policies and regulations on energy supplies and demands?
2. What is the impact of energy policies and regulations on water demands and availability?
3. How do policies aimed at climate mitigation and adaption affect policies developed in the energy and water sectors, and, specifically, the energy-water nexus?
4. What kind of regulatory framework is necessary and

feasible to minimize the negative trade-offs in the energy-water nexus in both public-sector planning and private enterprise?

Within the existing regulatory framework, the private sector, in turn, needs to be able to answer the following questions:

1. What are the energy and water footprints in our process and production techniques?
2. How can we reduce our energy and water footprints, e.g., through technological innovation, altered processes, alternative suppliers, consumer education initiatives?
3. What are the likely impacts of new regulations, standards and incentives related to the energy-water nexus on our production processes and how can we best plan for them?
4. What role can our company play in the development of new policies and frameworks aimed at minimizing the energy-water footprint?

The challenge for policymakers and industry alike is to develop effective policies, processes and analytical tools that integrate the energy-water nexus into policy and investment decisions. There is also a challenge for the research community to further develop agreed methodologies for the calculation of footprints and to establish such footprints for different products and processes.

## The need for data: Footprinting and Life-Cycle Analysis

Footprinting for water and energy use provides the most fundamental information required to better understand the energy-water nexus. Put simply, "you can't manage what you can't measure", or as Professor Hoekstra, creator of the water footprint concept and scientific director of the Water Footprint Network, put it:

...the interest in the water footprint is rooted in the recognition that human impacts on freshwater systems can ultimately be linked to human consumption, and that issues like water shortages and pollution can be better understood and addressed by considering production and supply chains as a whole.

Thus, over the last 5-10 years, interest in footprinting has grown exponentially with the spiralling costs of both energy and water, the increased awareness of water scarcity and the implications of a changing climate. The availability of easily accessible data on energy and water consumption allows policymakers and industry to make informed decisions about what infrastructure to support or invest in, or which technologies or strategies are so energy or water intensive as to outweigh any benefits. For instance, early work in the United States has mapped water consumption in all the major energy supply options, so that the water footprint of thermoelectric power generation can be compared against biofuel and ethanol production, traditional oil and gas refining, and hydroelectric generation.

Data on energy footprints in the water sector are scarcer. Again, early work in the United States has addressed this issue, but more

work is needed in order to scope the potential for energy savings in the water sector.

Life-Cycle Analysis (LCA) is another related tool with great relevance for the water-energy nexus. LCA helps assess the environmental impacts and resources used throughout a product's life, from raw material acquisition through production, use and disposal. An ISO standard has been developed for LCA – providing a framework, terminology and some methodological choices.

LCA can help companies to identify where in their production process water and energy efficiencies can be achieved. For instance, Daimler established that a high proportion of energy and water consumption in the production of diesel engines lay in the metal processing work required in the production of wheel-carrier assemblies. By altering the process of metalwork from one which required lubricants (oils) and coolants (water), to dry metal processing, the company was able to reduce its CO<sub>2</sub> emissions by 80% in that part of the product cycle, and reduce its water consumption by 900 tons per year.

However, some impacts in a life-cycle are more difficult to assess than others, so that, for instance, a LCA might be able to quantify the impacts of a product in terms of CO<sub>2</sub> emissions and/or water consumption, but it might not be able to assess the impact on water quality and land-use. In addition, in traditional LCA no consideration is given to when and where a given impact is taking place, so, for example, the total water consumption or emissions might be calculated, but the assessor doesn't necessarily know where (and when) in the system they are occurring. The question of timing is particularly important in relation to water management, since the source of water and timing of use will have varying impacts on the environment, the quality of the water after its use in the production cycle, and its availability for other uses.

Ultimately, footprints and life-cycle analysis will be weighted against other factors such as cost-benefit analysis, risk assessments, and social considerations in the decision-making process.



## Strategic Environmental Assessment

While life-cycle analysis and footprinting are invaluable in identifying where energy and water consumption is at its greatest (or least), this data on its own will not provide the long-term strategic solutions that are required for sustainability.

The development of management strategies to deal with the energy-water nexus varies according to the level of government, the breadth of the plans or projects to be implemented (for instance, the introduction of a subsidy for low-water use shower heads in comparison with the development of a desalination plant as part of the expansion of a major city), and the extent to which those projects are 'stand-alone' or integral to larger, more complex developments.

For national governments and supranational entities like the EU, the challenge lies largely in: developing long-term infrastructure planning that incorporates the links between energy and water and setting up regulatory frameworks in which all economic actors, whether they be regional and state governments, industries or individual consumers, must consider the energy and water implications of their choices. Figuring out how these challenges are to be addressed is a momentous task, but much has been learned over the last two decades and, arguably, we already have many of the tools needed to develop solutions.

One such tool is strategic environmental assessment (SEA). The main purpose of SEA is to facilitate early and systematic consideration of potential environmental impacts in strategic decision-making. It is intended to be used on policies, plans and programmes. In the EU, the 2001 SEA Directive is already recognized as an important tool in support of decision-making. Unlike environmental impact assessment (EIA), which applies to site-specific projects, SEA is designed to provide higher-level strategic 'thinking' as it pertains to plans and programmes that are required by legislation or regulation.

Other tools exist that can similarly be used to take better account of the energy-water nexus. Specifically from the water sector's point of view, the extended use of Integrated Water Resource Management to deal with not only energy issues but also policies and impacts related to climate adaptation is seen by most analysts as essential.

## Public-private partnerships

Finally, in addition to initiatives such as regulation, SEA and footprinting, policymakers must also consider the potential role of public-private partnerships and voluntary initiatives by private firms, typically in the form of agreements and standards negotiated with entire industries. Examples are eco-labelling of consumer goods (e.g., the swan-label in Denmark) in the EU, and ENERGYSTAR and WaterSense in the US.

## The role of consumer behaviour and education

Reduced water consumption through more efficient and less wasteful use of water is a win-win strategy: not only does it conserve precious water resources; it also saves the energy associated with supplying and treating that water. This calls for continued awareness raising and education about the need for water savings. Both water supply companies (through reducing unaccounted for water) and end users (through choice of water-saving technologies) can influence water consumption. In order for this to take place at least two things are needed: awareness among end-users of the need to save water, and appropriate information on "eco-friendliness" of products and services. Hence, there might be scope for the use of water and energy footprint in labelling, to enable the consumer to make an informed choice. Such labelling would provide a clear incentive to develop more water-efficient products and services.

## Conclusions

Ultimately, the objective for governments is to develop a public policy framework, incorporating institutional and administrative arrangements, that enables a 'whole of government' approach to decisions on the energy-water nexus. In support of such an approach and with the help of extensive stakeholder engagement, they need to identify which assessment tools can be used, when and by whom, to make better decisions about the energy-water nexus in regional, national and international policy-making.

However, our understanding of the energy-water nexus is still in its 'early days', and much research remains to be done to adequately inform the public and private sectors. Key recommendations on how to proceed in developing an integrated approach to managing the energy-water nexus include:

- Explore further the value and applicability of water-energy footprints and similar tools for energy and water integration efforts.
- Invest in gathering energy and water data with good spatial discrimination to allow the past century to be described adequately and the next century projected.
- Identify and evaluate existing integrated policy-assessment measures and, if necessary, develop new or adapted ones, that would enable identification, specification and analysis of the water implications of energy proposals, and vice versa.
- Undertake an institutional analysis of the currently largely unconnected water and energy management systems, (1) to accurately describe these systems, and (2) to identify means of enhancing trade-offs and synergies across water and energy technology, management and policy.
- Conduct a coordinated assessment across key components of water and energy systems to assess impacts of climate change, their likely time horizons, and determine areas for technological or management change.

Europe can play a key role in the energy-water domain by encouraging coordination of research, development, and policy efforts between both the developed and developing world, with a view to enhancing our shared understanding of energy-water interactions and encourage cross-learning.



# 6

## Water Scarcity and Droughts



While water scarcity and droughts may not be as severe in Europe as in many regions – in terms of impacts on human health and economic development – they do represent a serious and growing threat. In recent years droughts have had an estimated total price tag of around 6 billion Euros per year for EU countries.

To address water scarcity, which is predicted to increase in many European countries due to climate change, Europe needs to promote greater water efficiency and water awareness among its citizens and greater cooperation in the management of transboundary water resources.

In addition, to mitigate the impacts of droughts, countries and river basins need drought management plans that include threshold-based measures and water use priorities defined through participative processes. Europe is also working towards an early warning system and the definition of common indicators to monitor both water scarcity and drought.

*This chapter is based on the work carried out by the Water Scarcity and Droughts Expert Network. This Network is the technical core of the water scarcity and droughts working group, approved by EU Water Directors in December 2006, under the Common Implementation Strategy of the Water Framework Directive. It has been led by France, Italy and Spain and the European Commission. It is thus composed of technical experts officially nominated by Member States.*

*More information on this Network and the working group can be found on the EC web site: [http://ec.europa.eu/environment/water/quantity/scarcity\\_en.htm](http://ec.europa.eu/environment/water/quantity/scarcity_en.htm)*

*In addition, other organisations and experts involved in the European Regional Process have contributed to this chapter. A full list of contributors is available in Annex 1.*



Water scarcity and droughts are becoming increasingly important issues in Europe. Although the Mediterranean countries are particularly affected by and droughts, due to their geographic and climatic characteristics, Northern Europe is not immune. Although they experience droughts less frequently, many Northern European countries are more vulnerable to the impacts of drought since they generally have plentiful water resources and thus less storage infrastructure. Recent drought episodes have affected central and northern European countries such as the UK, Norway and Hungary.

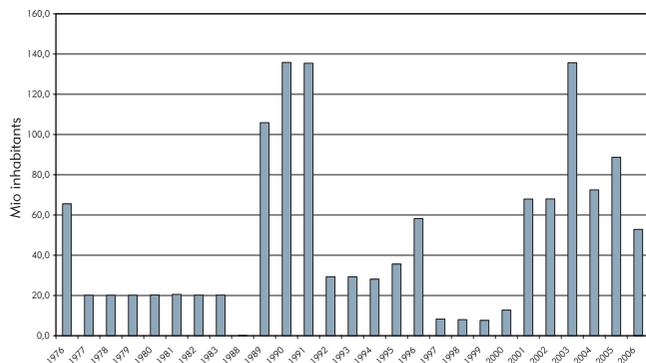


Figure 1. EU population affected by droughts in the last 30 years

Source: Water Scarcity and Droughts, In-depth Assessment Interim report, EC 2007

While drought means a temporary decrease in water availability due to, for instance, rainfall deficiency, water scarcity means that water demand exceeds the water resources exploitable under sustainable conditions. Water scarcity occurs where there are insufficient water resources to satisfy long-term average requirements. It refers to long-term water imbalances, combining low water availability with a level of water demand exceeding the supply capacity of the natural system. Droughts can occur anywhere in Europe, by definition in both high and low rainfall areas and in any season. The impact of droughts can be exacerbated when occurring in a region with already low water resources, with mismanagement of water resources, and/or with imbalances between water demands and the supply capacity of the natural system. In some regions, the severity and frequency of droughts can lead to water scarcity situations in the future, due to overexploitation of available water resources.

In addition, climate change will most likely increase the frequency of droughts and increase water scarcity in some areas of Europe (see Climate Change chapter for more detail).

## Progress since 4<sup>th</sup> World Water Forum and future steps

During the 4<sup>th</sup> World Water Forum in 2006, the European process generated a number of recommendations on water scarcity and droughts. These stressed the need to invest substantially in real-time monitoring, scenario modelling and data-collection activities to increase preparedness, improve forecasting of frequency and intensity of extreme events, and provide early warning systems. Specific recommendations included promoting innovative and comprehensive risk-management policies and measures, at the EU and country-level, related to water management and spatial planning, and advancing the stakeholder dialogues (both political and technical) that were already taking place.

Conclusions highlighted that: multi-stakeholder approaches were providing multiple benefits, including increased public support and greater risk awareness; new forms of public-private finance were being developed; and the importance of capacity building and information sharing was increasing.

Since the last Forum, several important steps have been taken. Efforts have been made to gather and provide more reliable data at the European, country, and river basin level, and beyond the EU borders, e.g., the Water Information System for Europe (WISE) and the Euro-Mediterranean Information System on know-how in the water sector (EMWIS). A prototype of a European Drought Observatory is under development at the Joint Research Centre (JRC) to provide better drought forecasting. There has also been progress towards better drought policy measures at the EU and national-level. In addition, numerous participative approaches have taken place at local and river basin scales to discuss drought impacts, as well as national awareness campaigns to promote water savings.

Despite this significant progress, there is no denying that, to address water scarcity and avoid negative impacts from future drought events, additional measures are needed. These include:

- investments to reduce water scarcity problems (which will also help to reduce vulnerability to drought);
- improvement of drought early warning systems (there are a number of pilot projects, such as the one led by the JRC);
- further data gathering and establishment and application of indicators; and
- research, for example on the long-term impacts of water scarcity and on the links between climate change and water scarcity and droughts.

## Major impacts of water scarcity and droughts

During the past years, impacts that have been associated with drought episodes include: public supply restrictions, reductions

in crop production, effects in water dependent ecosystems and loss of wetlands and decrease of recreational activities. Water scarcity results in the long-term need to assess and prioritise water demands.

Many European cities have suffered **water restrictions**. An estimated 50 million people were affected during 2003-2006. Although some restrictions directly occurred in public supply, others were linked to less priority uses such as watering gardens, washing cars, maintaining public swimming pools, etc.

The European Commission (EC) estimates the **overall economic** impacts of drought events in the last 30 last years to be around 100 billion Euro at EU level. In recent years, the average estimated cost of droughts was 6.2 billion Euro/year, with a high of 8.7 billion in 2003 (EC 2007). These hefty price tags represent only the economic costs, not social or environmental costs. These economic impacts of drought in Europe are hardly comparable to the impact in developing regions, such as Africa, which depend on natural rainfall regimes, and where drought can lead to loss of crops and hunger episodes.

Although **environmental impacts** are more difficult to assess and quantify, the examples are numerous. Past droughts have decreased river flows and levels of aquifers, reservoirs and lakes and have impacted water dependent ecosystems. Increases in forest fires and fish mortality have been reported by several European countries during drought periods.

**Climate change** is expected to have an impact on water resources and directly affect water scarcity and droughts, which could, in turn, increase costs of water treatment and sanitation (see Sanitation chapter). Average runoff in Southern European rivers is projected to decrease with increasing temperatures and decreasing precipitation. In particular, some river basins in the Mediterranean region may see decreases of 10% or more below today's levels by 2030. Changing temperatures and precipitation patterns may also change the frequency and intensity of droughts, particularly in Southern Europe and parts of Central Europe (see Climate Change chapter).

## EU Solidarity Fund aids Cyprus following severe drought

The cumulative effect of the drought in Cyprus led to serious consequences for living conditions, the economy, and the natural environment. By April 2008, the country's water reserves were near depletion. The government applied for financial assistance from the EU Solidarity Fund to help respond to the crisis, which had associated costs equivalent to an estimated 1.25% of the country's GNI. The European Commission agreed to grant €7.6 million in aid from the EU Solidarity Fund. The aid will mainly help reimburse costs of emergency measures, such as the transport of water from Greece. This is the first time the Solidarity Fund was used to provide financial aid for emergency measures in response to an exceptional drought.

## Policy initiatives

### Communication of the EC to the Council and European Parliament

The Council of Ministers of the EU launched a policy request (led by Spain and Portugal) to assess the gravity of water scarcity and droughts in Europe in 2006. This political interest translated into a first interim report assessing the situation, which was presented by the EC's DG of Environment. Furthermore, a specific working group was created within the Common Implementation Strategy (CIS) of the Water Framework Directive in 2007. This group comprised a Stakeholder Forum (mainly led by the EC) and a Water Scarcity and Drought Expert Network to deal with technical aspects (led by France, Spain, Italy and the EC).

After a drafting and discussion process within the Stakeholder Forum, the European Commission's Communication "Addressing the challenge of water scarcity and droughts in the European Union" was presented to the Council and European Parliament on 17th of July 2007 (EC 2007). This Communication establishes the need for a European Strategy based on national and EU measures. It recognises the importance of both water scarcity and droughts, and the need for undertaking European actions to reform, whenever necessary, existing policies (e.g., the Common Agricultural Policy and the Water Framework Directive), financing mechanisms and emergency assistance protocols.

The Communication underlines that water saving must become a priority, that all possibilities to improve water efficiency must be explored, and that policymaking should be based on a clear hierarchy of water needs.

In particular, the Communication identifies the following policy options:

- *Putting the right price tag on water*

Recommendations include using appropriate financial instruments and pricing that promotes water efficiency, in addition to metering systems, and cost-recovery practices. The need to use regional EU and agricultural funds to address water quantity issues is also stressed.

To achieve adequate pricing, an effort is needed to identify real water abstractions, especially in the agricultural sector, which are usually hard to quantify. Additional cooperation of farmers leading to collective action, e.g., through watershed boards, is needed to ensure that all water intakes are taken into account.

- *Allocating water and water-related funding more efficiently*

Water scarcity is already causing many countries to prioritise water demands and reconsider allocation policies. In river basins that have reached or are approaching the limit of sustainable development of their water resources, unsustainable land-planning needs to be addressed, as well as water efficiency in major water using sectors such as tourism and agriculture.

European funds and State aid offer significant opportunities to finance water efficiency, improve water demand management (adaptation measures, more water savings, monitoring systems and adapted risk management tools), but budgets are undoubtedly insufficient to duly cover all the issues (see Finance chapter)

Cyprus has taken conservation measures at household level by encouraging the reuse of grey water (i.e., from washing and washing machines) for watering gardens and flushing toilets, reducing per capita water consumption by up to 40%. In 2007, government subsidies covered 75% of the cost of the system.

- *Improving drought risk management*

This includes developing drought management plans, including mitigation and follow-up measures, and establishing early-warning systems and a European drought observatory.

- *Considering additional water supply infrastructure*

The EU considers the possibility of constructing additional water supply infrastructure, but clearly states the need to first invest in efforts to promote sustainable use, water savings and awareness.

Additional water resources can be obtained through different practices, e.g., treated wastewater reuse, desalination, reallocation, etc. Treated wastewater, in particular, can represent an important additional water resource (see Sanitation chapter). Nevertheless, it requires careful monitoring of both environmental and public health effects and setting of quality standards (e.g., for irrigating food and non-food crops).

## Use of wastewater in Mediterranean countries

Mediterranean countries demonstrate a wide use of treated wastewater:

In Spain, the legislation regulates water conditions and characteristics for the different uses of treated wastewater resources. Currently around 13% of all treated water is being reused – around 400 million cubic meters per year. Approximately 75% goes to agriculture and the rest to recreational, urban, environmental and industrial uses.

In Cyprus, 14.5 million cubic meters of recycled water are being produced from tertiary treatment. More than 50% (approximately 5% of agricultural water demand) is used for irrigation of agricultural crops, either directly or through recharge of aquifers. The rest is used for recharge and for irrigation of recreational areas (landscaping, hotel gardens, etc.). Annual water recycling is predicted to increase to 52 million cubic meters by 2012 (28.5% of agricultural water demand).

In Italy, the law introduces strict limits for the direct reuse of treated wastewater, but a large amount of treated wastewater is reused for irrigation indirectly. The treated wastewater is discharged into water bodies or into ditches and later used for irrigation.

- *Fostering water efficient technologies and practices*

Efficient technologies that allow for water and energy savings should be promoted (see Water and Energy chapter). In addition, the sectors that require large amounts of water (e.g., agriculture, manufacturing and tourism) should upgrade water management practices to increase efficiency. Irrigation modernization techniques, for example, could free up water that could be reallocated to support healthy aquatic ecosystems or make up deficiencies in public supplies.

- *Fostering the emergence of a water-saving culture in Europe*

The use of public awareness campaigns and labelling should be promoted as an effective way to provide targeted information to the public on water performance and sustainable water management practices. Quality or certification schemes can also be used to promote products that use water efficiently.

Important efforts and campaigns have focused on domestic water supply savings. Although savings might be relatively low compared to savings that could be achieved in other sectors (e.g., agriculture), they are nevertheless relevant and promote public awareness.

## Water savings in Zaragoza, Spain

In Spain, proactive water-saving programmes in several towns have led to significant results. In 1997, Zaragoza launched an overall programme to update water devices and equipment, introduce metering, and raise public awareness. Its implementation resulted in 1.2 billion litres of water savings per year and the lowest water consumption per inhabitant and per day in Spain (96 l/person/day).

- *Improving knowledge and data collection: Promoting early-warning systems*

A water scarcity and drought information system should be promoted for Europe. In addition, research and technological development opportunities should be explored and capitalized on (see Research chapter).

- *Fostering water savings*

The EC Communication on water scarcity and drought establishes a European Strategy aimed at fostering the application of recommendations in water planning and management and assessing policy and technical measures. In particular, the Strategy proposes to annually assess national and EU-level progress on specific measures to reduce water scarcity and drought impacts.

## The Euro-Mediterranean Water Strategy

Water Directors of Euro-Mediterranean countries have repeatedly expressed the need to address water scarcity and drought issues. It is expected that the "Barcelona Process: Union for the Mediterranean" project will include a relevant environmental and water component. Within this, the Union could include reducing water scarcity and drought impacts by promoting integrated water resources management, water saving campaigns, technical modernisation of irrigation techniques, and capacity building strategies. The Ministers of the region are setting the basis for a mid- and long-term Water Strategy that can include these principles (Ministerial Conference on Water Jordan, 22 December 2008).

## The UN Convention to Combat Desertification

The Commission for Sustainable Development (CSD-17) of the United Nations is working on the specific topic of desertification and drought. This topic was added to the 2008/09 cycle to strengthen consciousness of the related problems and foster international will in the application of the Convention to Combat Desertification. Several European countries, such as Italy and Greece, have developed national programmes to combat drought and desertification.

## Legislative tools and technical measures

EC and Member State's analyses of drought management policies in EU countries indicate that decision-makers usually react to drought episodes through a crisis-management approach: declaring national or regional drought emergency programmes to alleviate impacts. This is done rather than developing comprehensive, long-term drought preparedness policies or actions that may significantly reduce vulnerability to extreme events. Based on experience, drought management is shifting from a risk to a planned approach. Following is a summary of legislative and technical measures being applied to reduce water scarcity and drought impacts.

## The EU Water Framework Directive

The Water Framework Directive (WFD) mainly sets qualitative objectives, but also addresses to some extent quantitative issues. In particular, it promotes the application of appropriate measures (Programmes of Measures of the River Basin Management Plans) and includes the possibility of developing specific drought management plans. However, water scarcity and droughts could directly affect the achievement of the good ecological status demanded by the WFD. Moreover, some countries (e.g., France, Italy, and Spain) feel there is a lack of more complete guidance within the Directive on how to address these issues.

In addition, while the WFD foresees the possibility of exemptions in case of prolonged droughts, the lack of agreed indicators at the EU level to identify and quantify drought is making it difficult to achieve consensus on when and how these exemptions should be applied.

## Water Scarcity and Drought Expert Network

Within the Water Scarcity and Drought Expert Network, discussions are ongoing to determine what qualifies as a prolonged drought and under what circumstances Member States should be able to obtain exemptions under the WFD (e.g., postponing compliance deadlines or, less preferred, reducing established environmental objectives). The Network has identified technical criteria that could help in the process (e.g., river flow, aquifer and reservoir levels, precipitation, drought duration, etc.).

The Network promotes the development and application of Drought Management Plans (DMPs) as powerful tools to reduce impacts. Such plans establish early warning systems, risk maps, drought stages scales with clear thresholds adjusted to indicators, and programmes of mitigation measures. In addition, agriculture activities are highly affected by droughts, and Common Agricultural Policy instruments can help when facing drought effects.

## Planning for drought

Some countries, such as Spain, have already implemented DMPs. Spain's DMPs, developed by its river basin authorities, provide the basis for a planned drought management – establishing drought phases, describing the measures that should be progressively applied and the needed monitoring and follow-up processes. The methods and measures in the plans were agreed upon by all participating stakeholders: civil society, public administration and the scientific community.

[www.marm.es](http://www.marm.es)

As a main technical product of the Expert Network, a "Drought Management Plan Report, Including Agricultural, Drought Indicators, and Climate Change Aspects" was produced and approved by European Water Directors on November 2007. This Report establishes the basis for developing drought management plans, supplementary to River Basin Management Plans (RBMPs).

The Report identifies and assesses gaps within the WFD when dealing with droughts; provides technical recommendations to establish useful indicator systems to declare drought status; and establishes measures, in accordance with indicators status, that can be applied at river basin and sub-basin level. The DMP Report encourages public participation processes when elaborating drought plans, as a means to find agreed measures and avoid conflicts.

## Drought management in England and Wales

The Department for Environment, Food and Rural Affairs (Defra) in England and the Welsh Assembly Government in Wales have policy responsibility for the legislation that governs water resources. This includes the law relating to hosepipe bans, drought permits and drought orders works, drought planning and long term planning by water companies. During droughts, it works closely with the Environment Agency and the water companies to ensure that the public water supply is maintained and that the environment does not suffer unduly.

## Working towards common indicators

Finding appropriate and representative indicators that can show national and river basin scale problems related to water scarcity and droughts is a difficult task. It is even harder to find a set of indicators that can provide a homogenous assessment of the European situation.

In line with the EC Communication on water scarcity and droughts, the work related to the definition of indicators will continue in cooperation with the European Environment Agency (EEA). Reports based on updated data and agreed indicators will be drafted in 2009. The biggest current problem in data availability is the access to data on water abstraction and water use per river basin district. Further efforts are needed to aggregate these data from water utilities on a river basin district level as required for WFD reporting.

The recently established Water Information System for Europe, and its section on water scarcity and droughts, will be linked to the process.

## Research activities

European research projects and the collaboration among research institutes, universities, public administrations, and water authorities help to better assess and manage available water resources in a sustainable way, thus addressing aspects of water scarcity and droughts (see Research chapter). Within these projects, efforts have been focusing on:

- Characterization of drought events in space and time.
- Effects of predicted climate change on frequency and severity of future droughts.
- Development of drought indices and evaluation methods.
- Derivation of management guidelines in drought and water-scarce situations.
- Improvement of technologies to treat and manage water (e.g., wastewater reuse).
- Technological improvement and increased acceptance of modern irrigation methods to save water in the agricultural sector.
- Quantification of economic and environmental impacts caused by water scarcity and droughts (there is a lack of knowledge on the costs of damage to aquatic ecosystems from water scarcity, droughts and pollutants).

## Key messages and recommendations

Below are some key messages to address water scarcity and drought impacts in Europe. Many of these have relevance for other regions.

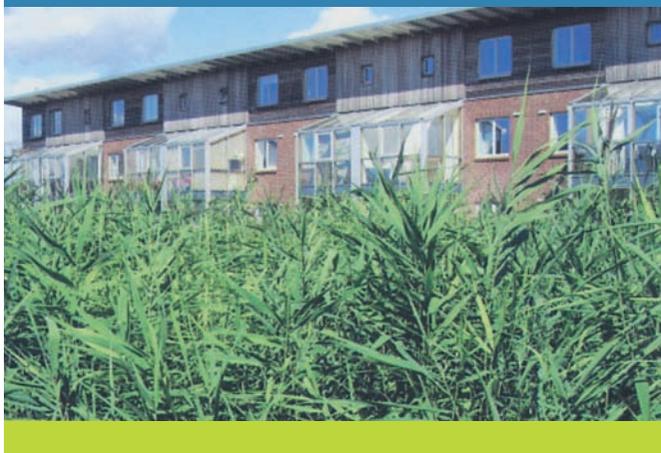
- Addressing water scarcity requires actions at local, national, international and river basin levels – in particular, increased collaboration is needed between nations to share management of water resources (rivers, lakes and aquifers) and the benefits thereof.

- Under water scarcity conditions, it is important to have a clear understanding of available water resources and existing demands and to be able to prioritize uses that have been agreed upon by stakeholders.
- To ensure a balance between water resources and demand, it is essential to promote a diversified and integrated water resources management – one which combines multiple water management tools and sources (natural flows, groundwater, rainwater harvesting, stored water, treated wastewater, and desalinated water).
- Efficient and water saving technologies should be encouraged in all cases. Modernization of irrigation techniques can be especially helpful, since agriculture is the major water-demanding sector in a number of European countries.
- Climate change adaptation measures should be linked to drought planning and management, since the intensity and frequency of drought episodes are likely to increase as a result of climate change.
- Cooperation among countries sharing transboundary waters should be promoted. Specific rules or flow regimes can be agreed upon through the river basin planning process under the Water Framework Directive, so that drought impacts are not exacerbated by mismanagement upstream.
- Public participation should be encouraged, to ensure understanding of the need to prioritise demands for water that may arise when dealing with water scarcity and drought.
- Improved data collection and assessment is needed to better plan and manage for water scarcity and droughts.
- Drought management plans should include the use of thresholds to define drought phases and establish measures according to the gravity of the episode. Thresholds would need to be established based on a well-developed monitoring system.
- Integrated management of groundwater droughts should always be promoted.
- Strengthening the knowledge/information and political/legal basis to fight and control desertification and manage drought is strongly recommended.



# 7

## Sanitation: A continuous challenge for the European Region



While the majority of Europeans have access to sanitation and properly functioning wastewater treatment, there are still many who remain unserved by improved systems, particularly in Eastern Europe, the Caucasus and South Eastern Europe. Within the EU, more than 20 million citizens do not have access to proper sanitation systems – most of them living in rural areas and small communities.

To address this situation European legislation needs to encourage innovation, not prescribe fixed solutions. Sustainability (economic and environmental) and resource efficiency, in particular the reuse of water and nutrients, are the future of sanitation in Europe.

*This chapter has been coordinated and written by the WECF - Women in Europe for a Common Future. It builds on the wide range of information available and the many comments received during the process. The authors would like to thank all the contributors to this chapter, who are mentioned in Annex 1 of this document.*

*Several events within the European Regional Process contributed to the content of this chapter: the Workshop "EU Sanitation Policies and Practices" on 29 January in Brussels, the Wageningen Brainstorming and Coordination meeting on 20 May, the Zaragoza Workshop on 8 and 9 July, the Seminar during World Water Week on 19 August in Stockholm, and the workshop in Budapest on 8 and 9 October.*

### Status of sanitation in Europe

The European region has for many years been a frontrunner in improving sanitation and wastewater systems. A key factor was the introduction of water-borne centralized systems for waste water collection and treatment as a standard. The great majority of the citizens in the European Union have access to safe sanitation. The coverage of improved sanitation is higher than 94% and public hygiene is no longer a concern for almost all EU member countries. Since the nineteenth century, surface water quality has been greatly improved in most EU countries due to the achievements of advanced wastewater management.

However, this does not mean that sanitation is no longer a challenge for Europe. Many Europeans still do not have access to improved sanitation, and, in spite of the existing wastewater treatment systems, the quality of many surface waters is negatively affected by nutrients and microorganisms from discharged wastewater.

Parts of Europe have had public sanitation systems for over one hundred years, particularly in the cities. These have been improved progressively with time as the demands for public health and environmental protection grew. However, population growth and changing demographics have put additional pressures on these aging systems, and many are now in need of replacement.

In parts of South-Eastern and Eastern Europe and the Caucasus, including the Russian Federation, sanitation systems in many rural areas, and in some urban areas, have not been improved and in some cases have actually deteriorated during the last 20 years.

Changes in regulations, population growth, energy costs and climate mean uncertainties in how to invest for the future. And risk management, which is becoming an increasingly important factor in planning, is affecting sanitation decisions as well.

### What is sustainable sanitation?

The main objective of a sanitation system is to protect and promote human health by providing a clean environment and breaking the cycle of disease. In order to be sustainable, a sanitation system has to be not only economically viable, socially acceptable, and technically and institutionally appropriate, it should also protect the environment and the natural resources.

There is no one-for-all sanitation solution that fulfils the sustainability criteria in different circumstances to the same extent. The best solution depends on the local framework and the existing environmental, technical, socio-cultural and economic conditions. Taking into consideration the entire range of sustainability criteria, it is important to observe some basic principles when planning and implementing a sanitation system. These principles were developed some years ago by a group of experts and were endorsed by the members of the Water Supply and Sanitation Collaborative Council as the "Bellagio Principles for Sustainable Sanitation" during its 5th Global Forum in November 2000:

1. Human dignity, quality of life and environmental security at household level should be at the centre of any sanitation approach.
2. In line with good governance principles, decision making should involve participation of all stakeholders, especially the consumers and providers of services.
3. Waste should be considered a resource, and its management should be holistic and form part of integrated water resources, nutrient flow and waste management processes.
4. The domain in which environmental sanitation problems are resolved should be kept to the minimum practicable size (household, neighbourhood, community, town, district, catchment, city).

Source: Sustainable Sanitation Alliance  
[www.susana.org/index.php/lang-en/vision/42-vision/53-what-is-sustainable-sanitation](http://www.susana.org/index.php/lang-en/vision/42-vision/53-what-is-sustainable-sanitation)

### European support for the International Year of Sanitation

Motivated by the UN's decision to declare 2008 as International Year of Sanitation (IYS), a group of European organisations active in the field of sanitation took the initiative to form the Sustainable Sanitation Alliance (SuSanA), an international task force to support the IYS. The overall goal of the SuSanA is to contribute to the achievement of the MDGs by promoting sanitation systems that consider all aspects of sustainability. In addition, two high level meetings focusing on the sanitation problem in the EU were organized by a group of NGOs in Brussels and Stockholm.  
[www.susana.org/](http://www.susana.org/)

## Urban sanitation in Europe

### The challenge of sustainability

In the last century, the basic concept of collecting domestic liquid waste in waterborne sewer systems, treating the wastewater in centralised treatment plants and discharging the effluent to surface water bodies became the accepted approach to urban sanitation in industrialised countries. The catastrophic epidemics of cholera, typhus and other diseases that struck many European capitals in the 19th century triggered vast sanitation work intended to drive the "miasmas" outside city limits. The Seine became the sewer of Parisians, the Thames that of Londoners, the Danube that of Budapest and the list goes on. Once major drainage of cities was started, it took a century and a half to repair the damage caused to rivers and coastal waters. Budapest's wastewater is still discharged untreated into the Danube. The city is currently building a high-tech station that will treat most of the Hungarian capital's wastewater. Given the accelerated rate of global urbanisation and the expense and time it takes to undo damage to aquatic ecosystems, urban sanitation deserves a high place on the political agenda.

Density is the key to sustainable urbanism. This does not mean ipso facto "vertical" urbanism composed of skyscrapers and apartment high-rises. Paris is the densest city in the world with more than 20,000 inhabitants per km<sup>2</sup>; Athens is not far behind. In spite of this, there are relatively few buildings with more than six stories in these two capitals. This is a little known fact and breaks down presuppositions on dense urbanism.

Density saves space, all types of infrastructure systems, e.g., mass transport, energy, water and sanitation. It must be remembered that the city dweller has a need for open natural and aquatic spaces in his daily urban existence. The French Water Agency, Seine Normandy, proposes "blue and green cuts" in the urban tissue that can serve as recreational spaces, rich in fauna and flora, and as buffer zones for sanitation and management of rainwater runoff. Especially for newly developed areas, we can adopt a logic in which it is no longer water that adapts to the city, but the city that adapts to water

### Why centralised treatment is not the only answer

Centralised collection and treatment systems have long been the preferred operational model, and the EU Urban Waste Water Treatment Directive (UWWTD) requires such systems for agglomerations with more than 2000 inhabitants. Although these conventional sewer and treatment systems have significantly improved the public health situation in those countries that can afford to install and operate them properly, it is not the only available solution and often not the most appropriate one. The high initial capital investment and the long-term fixed costs can negatively impact the sustainability of these systems. For many semi urban (and rural) areas in lower income countries in the South-Eastern and Eastern part of Europe and in the Caucasus, the conventional sewer and treatment systems are unaffordable. Finding low-cost and sustainable sanitation systems is a key challenge for reaching the Millennium Development Goals on sanitation in Europe.

It is a fact that in developing areas centralised infrastructure networks cannot be constructed quickly enough to keep up with growing populations. It is also a fact that present urban solutions are usually disposal oriented and cannot exploit the reuse potential of different “waste” streams. However, in some areas, point-of-production reuse schemes are being implemented and some treated effluents are being reused. To support and encourage such initiatives, Europe needs innovative solutions with a focus on ecological, economical and socio-cultural sustainability.

Sewerage-based sanitation may not be viable in all areas suffering from water scarcity, unreliable water supply services, lack of skilled labour for operation and management, and lack of financial resources. Instead, other systems more suited to the local environment need to be implemented. Regardless of the technology used, it must address the need to reduce environmental and ecological degradation that the discharge of untreated wastes causes to surface and ground water, and the immediate health risks to households and communities from faecal contamination.

To achieve the objectives of halting environmental degradation, protecting water supply sources, and subjecting municipal wastewater to advanced treatment (such as making nutrients available for reuse or eliminating carbon, nitrate and phosphate), may cost more in the short-term, but it will also have greater benefits in the long-term. For example, discharged nutrients that cause eutrophication of surface water and drinking water sources are at the same time a valuable resource if they are used in a proper way.

Discharge or disposal without considering the potential for reuse is a waste of natural resources – and indicates mismanagement and missed opportunities to increase ownership for and economical viability of sanitation systems. For instance, biogas generated by anaerobic digestion of wastewater or sewage sludge can be used to produce electricity. Treated wastewater can be used as irrigation water and treated sewage sludge can be used as soil conditioner on farmland – thus increasing soil fertility and aiding crop production. The WHO 2006 Guidelines for the Safe Use of Wastewater, Excreta and Greywater are promoting these new sustainable sanitation systems.

In an average French city (Paris excluded) one inhabitant “owns” about 100 m<sup>2</sup> of waterproof area. (This figure is calculated by dividing the waterproof areas of the city – streets, roofs, cement playgrounds and other surfaces – by the number of inhabitants). A rainfall of 10 mm thus causes runoff swallowed by sewers that is 20 times more than the normal flow-rate of ordinary wastewater at a given moment. This is why sustainable city planning must pay very close attention to managing rainwater runoff. Here, it is imperative to set aside “blue and green” open land. This question of excessive local flooding resulting from downpours (that has nothing to do with river levels) is a critical issue in many cities. Most cities no longer collect rainwater in combined sewers but collect and treat it separately at local level, which results in much smaller sewerage systems. Keeping the water in the city also significantly improves the local climate.

## Managing and reusing runoff water, Persicetom, Italy

Urban runoff water has become an ever more pressing problem due to the growth of cities. This water can't be discharged directly into rivers because of pollution issues, including raising sediment levels, and the increased risk of floods. Neither can they be treated by the wastewater treatment plants because of problems in the sewerage systems and the biological processes.

The municipality of San Giovanni in Persicetom has solved this problem by constructing a natural urban area for the collection, treatment and management of the runoff water. An extended detention pond has been built for the treatment and management of the runoff water collected from an urbanized area of 8 hectares. The first 5 mm of rain are treated in a forebay, which settles and treats all the suspended solids present in the water. The dissolved pollutant compounds are treated in a filter zone that connects the forebay pond and the detention pond. For limited amounts of rain, these two ponds are able to retain all the runoff water. For heavy rains, the submergible area can be used to retain the excess water for a period of 24 to 48 hours and slowly release it into the river. During the dry periods, typically in the summer, the area can be used as a green area for the inhabitants of the settlement.

Source: Roberto Farina, Luigi Petta, Italy



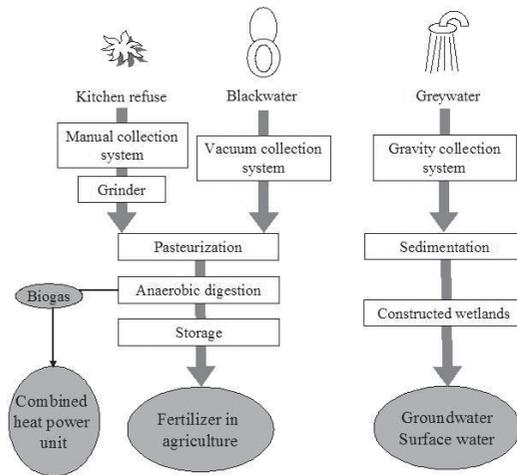
The detention pond

## Biogas and organic fertilizer from toilets: Sustainable sanitation in urban areas in Germany and the Netherlands

Flintenbreite, a housing estate of 400 inhabitants in Lübeck, Germany, is separating domestic wastewater (blackwater, greywater, rainwater) at the source, enabling various reuse options. Vacuum toilets produce roughly 5 litres of blackwater per inhabitant per day. Drinking water consumption is less than 80 litres per inhabitant per day. Kitchen refuse is collected at household level in bins and is transported manually to a central feeding unit. Other organic waste can also be added. The anaerobic digestion unit produces energy in the form of biogas and a nitrogen rich liquid fertiliser. Greywater is treated in constructed wetlands and locally infiltrated into the soil as well as the rainwater.

In Sneek, a city in the Northern part of the Netherlands, a similar blackwater system was constructed in 2006 for a housing estate of 100 people. The blackwater system is similar to the one in Lübeck, but here the blackwater is further treated to produce a dry fertilizer.

Up-scaling of the systems is planned for the coming years in Hamburg as well as in Sneek.



Schematic representation of the sanitation system



Sneek, the Netherlands

### Sanitation in small agglomerations

The European Union requires sewerage and wastewater systems for inland communities with more than 2000 inhabitants, and EU funds and grants are available to assist municipalities in setting up such systems. For agglomerations of less than 2000, it requires "appropriate treatment". What qualifies as appropriate is not clearly defined.

But in many rural regions, the major cause of groundwater and surface water pollution is inadequate sanitation with systems such as septic tanks, cess pools and pit latrines. Some EU countries have supplemented the requirements of the UWWTD with additional legislation; for example Finland has implemented legislation targeting small agglomerations without sewerage (see box).

In the countries of Eastern Europe and the Caucasus, up to 50% of the population live in settlements with less than 2000 inhabitants. In general these settlements have insufficient or no wastewater treatment systems and low capacity to implement and maintain a sophisticated system.

### Finnish legislation on wastewater treatment outside sewer networks

Sewerage systems are not a solution for sparsely populated areas such as Finland. As much as 20% of Finnish citizens are not connected to sewerage systems. Those 20% pollute six times more than all the rest together and count for the second largest source of phosphorous pollution to Finnish lakes, rivers and the Baltic Sea.

Finland has actively protected its lakes for decades and in 2004 it set up the Government Decree on Treating Domestic Wastewater in Areas Outside Sewer Networks to limit this pollution source. Instead of recommending specific treatment methods, it sets minimum standards for wastewater treatment, planning, construction, use and maintenance as well as purification standards (90% removal of BOD7, 85% of total phosphorus, 40% of total nitrogen).

By 2014 all onsite systems have to comply with the Decree. As the Decree allows a variety of technologies to be used, it has boosted technological development and enabled the set up of companies offering planning, equipment or construction services. New standards and testing methods have been developed to match the technological development of the private sector. As most of the nutrients in wastewater come from urine, the demand for dry sanitation solutions and water saving options has increased.

Source: Kati Hinkkanen, Finland



Finnish house with a dry toilet indoor



Finnish dry toilet

The countries of Eastern Europe and Caucasus have a quite high overall level of water supply and at the same time a quite low level of municipal wastewater treatment. Functional sewer and treatment systems are mainly found in big cities and towns. The tremendous cost of upgrading municipal wastewater treatment is not in harmony with available economic resources.

These areas need realistic solutions that meet the modern goals of resource, energy and cost efficiency. These could be water-less systems based on urine diversion, onsite or cluster treatment in constructed wetlands or ponds, or irrigation and other natural treatment concepts that are simple, robust, low-cost and sustainable.

In a recent publication, the Global Water Partnership of Central and Eastern Europe recommends involving key stakeholders in "Open Wastewater Planning dialogues" (GWP-CEE 2007) to find solutions for sustainable sanitation in rural areas. This publication also notes the lack of political priority to address the needs of the more than 20 million citizens in the European Union who do not have access to safe sanitation, most of whom live in settlements with less than 2000 inhabitants.

### Combining wastewater treatment and bio-energy production using short rotation plantations

The use of pre-treated wastewater in Short Rotation Plantations (SRP) for biomass production offers a resource oriented approach to sustainable sanitation. SRPs are land-use systems combining agricultural and forestry practices (agroforestry) to grow woody biomass. Trees – mostly willows in northern climates and poplars in southern climates – are harvested in 1-5 year coppicing cycles. These non-food/non-fodder crops are suitable for wastewater fertilization due to low hygienic risks and their treatment and phyto-remediation abilities.

SRPs can serve as a secondary or tertiary treatment step and additionally provide multiple benefits to local communities. Municipalities may use this approach as a low cost alternative to upgrade existing sewage treatment plants and sustainably produce bio-energy sources through cooperation with local farmers and water and energy suppliers. The farmers need reliable wastewater quality data and guarantees from sewage treatment plant operators. Groundwater monitoring and other best management practices are available to comply with environmental health standards.

Short Rotation Plantations using wastewater are currently operating in Estonia, Sweden, Ireland, Poland, Spain, Czech Republic and other countries. If provision for SRP is included in the design of new treatment systems, they can also serve as safe nutrient resource providers for biomass production right from the beginning ([www.biopros.info](http://www.biopros.info)).

Source: Anja Brüll, Grit Bürgow, Germany



Willow short rotation plantation, Sweden

## Reuse of treated wastewater

In many areas of Europe, water shortage and water scarcity are growing problems, especially in the South (see Water Scarcity chapter). In order to meet water demand, the use of treated wastewater is an option – a fairly reliable option since, outside of seasonal tourist areas, wastewater quantities remain fairly constant throughout the year.

Irrigation for agriculture, urban landscaping, sport and recreation areas is the largest consumer of treated wastewater. Other proven applications of reuse of treated wastewater are the following:

- Water for manufacturing (cooling and process water) and construction industries.
- Dual water supply systems for urban non-potable use (garden irrigation and car washing).
- Fire fighting, street washing, dust suppression and snowmaking.
- Water for creation or restoration of natural or constructed aquatic ecosystems, recreational water bodies and fish ponds.
- Aquifer recharge through infiltration basins and injection wells for water storage and saline intrusion control.
- Redevelopment of old industrial or mining sites into attractive water parks for the community to increase quality of life and land value.

In spite of the variety of possible applications, many people still do not consider water reuse an acceptable option, probably as a result of lack of knowledge.

Although the UWWTD supports the reuse of treated wastewater in broad terms, there are no formal EU definitions or guidelines on reuse. Some local or national standards unnecessarily constrain reuse applications. EU policies are very unclear, when present, and institutional capabilities to manage wastewater reuse are often lacking. However there are clear rules in the European Union governing the use of treated sewage sludge in agriculture. This practice was encouraged by a report published in September 2008 by the UN Habitat programme "Global Atlas of Excreta, Wastewater Sludge, and Biosolids Management, Moving Forward the Sustainable and Welcome Uses of a Global Resource" (UN-Habitat 2008).

A joint initiative towards wastewater reuse at EU level was taken by the MED-EUWI Wastewater Reuse Working Group (WWR-WG). The Group developed and submitted a report to the water directors at end of 2007 (WWR-WG 2007). The report presents a way forward by identifying the main objectives of a treated wastewater reuse policy and the existing barriers and constraints that will have to be overcome if wastewater reuse strategies are to gather more momentum and be adopted on a larger and more effective scale than at present. There is consumer resistance to direct re-use, although many major rivers, such as the Thames,

that are used as a source of drinking water contain significant proportions of treated sewage effluent.

## Wastewater reuse at a regional scale in the Algarve, Portugal

The region of Algarve has a limited rainfall that averages about 500 mm per year. Its capital, Faro, has the lowest number of days per year with rain (60 days) of any European city. On top of the limited water availability, tourism increases the pressure on the water resources. In some areas it accounts for a 200% increase in water use, especially in the dry season.

The Algarve also has many golf courses, which require huge amounts of water to maintain. The Aguas do Algarve, responsible for drinking water and wastewater treatment in the region, developed a wastewater reuse plan for irrigation of the golf courses. Major conclusions can be summarized as follows:

- Summer wastewater flow is enough for that season's demand. In spring and autumn, water irrigation will not be enough for all golf courses.
- The wastewater treatment level has to insure high disinfection standards and very low solids concentration.
- Wastewater Treatment Plants (WWTP) located closer to existing golf courses were included in a priority group.
- A detailed study conducted with this priority group showed that, with some upgrades, treated wastewater would comply with national water quality standards for irrigation. The plan has already received approval from the necessary regulatory agencies.

Source: Carlos Póvoa, Algarve, Portugal



## Financing and governance (see also Financing chapter)

In the EU, the huge investment costs of the centralized sewerage and wastewater treatment required by the UWWTD are usually subsidized by other sectors or by EU budgets.

New Member States, Bulgaria and Romania, have received considerable EU funding to help meet their obligations in terms of

reform and improvement of their institutions and infrastructure. The Environment Operational Plan in Bulgaria is funded with 1,395 million Euro from the EU Cohesion funds. Bulgaria has until 2015 to build 427 wastewater treatment plants (WWTPs) to meet the requirements of the EU Urban Waste Water Directive. With the current levels of funds, priority is given to WWTPs of large municipalities with more than 10,000 inhabitants and smaller municipalities on the Black Sea coast (due to regular faecal pollution of the shore and the adjacent areas).

In Bulgaria, there are 5000 towns and villages with less than 2000 inhabitants and only 2.1% of them have a sewerage system (without treatment). Therefore, almost 2 million people, or 25% of the Bulgarian population, will still lack adequate sanitation, even after this massive investment, since they are not covered by the UWWTD. A similar situation exists in Romania.

For these regions, as well as other Eastern European countries, there are subsidies missing because sanitation, particularly sanitation in rural areas, is a low political priority compared to other sectors. Additionally there is little popular demand for sanitation due to poor education, embarrassment and gender differences.

Rural households are usually left on their own to invest in, operate and maintain their own sanitation systems. An enabling framework at regional level is therefore necessary to provide local people with professional support, e.g., through wastewater associations. Sanitation should be an integrated part of regional planning, e.g., a village mayor does not usually have the knowledge required to decide on the most efficient sanitation solution. An open planning process with involvement of all stakeholders is needed to secure the long term success of the concept.

## Local production of modern urine diverting dry toilets in Tbilisi, Georgia

The local production of specialised toilets is an important step towards the acceptance and spread of new sanitation concepts. In Georgia, the first sanitation projects based on urine diverting dry toilets have been initiated in the last two years. The separately collected urine can be used as liquid nitrogen fertilizer in agriculture after a defined storage time and the faeces are sanitized according to the 2006 WHO Guidelines for the Use of Wastewater, Excreta and Greywater.

After the joint implementation of the new sanitation systems by local and international NGOs, there has been a growing demand for the specialised toilets. Since it was expensive and difficult to purchase the urine-diverting toilets, in August 2008 a local ceramic factory started producing them. The high quality of the toilets enhances their acceptance and the low price accelerates their spread throughout the country.

Source: Rostom Gamisonia, Georgia and Margriet Samwel, Germany



Urine diverting dry toilet



Dry toilet and urinal, Georgia

### Decentralised wastewater technology with centralised operation and maintenance service, Germany

In Europe, decentralized and onsite wastewater treatment in household based plants is a relevant issue. The market in the European Union for these small scale plants is calculated to be at least 10 million plants. In Germany, around 8% of the population is not connected to any sewerage network and therefore relies on onsite wastewater treatment. The households are responsible for operation and maintenance of their plants, resulting often in inadequate effluent results due to the lack of capacity in the households.

The public wastewater company Lippeverband addressed this problem by offering a full contract for construction and operation of 21 onsite plants in a settlement of 100 inhabitants where the connection to a centralized plant was too expensive. As a technical solution, a membrane bioreactor was chosen and a 10-year contract with a monthly fee for operation and maintenance with the Lippeverband was fixed. Operation and maintenance are carried out by the company on a contractual basis using remote monitoring. The purchase of a high number of equal plants and the remote monitoring decreased the costs significantly. Within all steps of decision making, planning and implementation, the households were involved, which led to the success of the project.

[www.syswasser.de/german/projects/PlanungBeratungskompetenzen/ISI\\_Oekonomisch\\_Dahler\\_Feld.pdf](http://www.syswasser.de/german/projects/PlanungBeratungskompetenzen/ISI_Oekonomisch_Dahler_Feld.pdf)

## Appropriate guidelines and regulations

The investments in and management of sanitation services in countries belonging to the European Union are largely driven by European Directives, such as the Urban Waste Water Treatment Directive (UWWTD 91/271/EEC), the Sewage Sludge Directive (86/278/EEC) and directives on water quality such as that concerning bathing waters (76/160/EEC). To move forward, this legislation must be harmonized with the global principles of sustainable development (see box).

The UWWTD has had considerable success in extending the provision of wastewater collection and treatment systems in urban settlements, but this success has been limited because the legislation predetermines technical solutions – solutions that are not appropriate for all contexts – and thus it actually hinders innovation. To reach all of the citizens currently unserved by improved sanitation, innovative sanitation concepts that are economically feasible, socially acceptable and resource oriented must be included as options. In addition, the UWWTD does not sufficiently define sustainability goals.

While the UWWTD sets emission standards for BOD<sub>5</sub>, COD and in case of sensitive areas for N and P, it does not deal with hazardous substances. These are covered by separate Directives now under the umbrella of the Water Framework Directive. The WFD sets good water status as an overall goal. Priority hazardous substances are limited by emission standards. Technical solutions are not specified, in order to support innovation and cost effectiveness.

The Integrated Pollution Prevention and Control Directive (IPPC 96/61/EG) regulates the approval of industrial plants based on an overall approach that prevents the shifting of pollution from one environmental medium to another. Resources and energy efficiency have high priority. The directive requires the application and implementation of the best available technique (BAT) and is thus very dynamic and forward-looking. To define and describe the BAT, an information exchange for all industrial sectors was established between member states and relevant sectors. The BAT reference documents (BREF) are constantly updated.

European legislation currently contains an unequal treatment of the different environmental sectors. The end-of-the-pipe approach used by the UWWTD could be replaced by the IPPC approach that follows the goal of sustainable production. This would lead to a paradigm shift – a move towards a sustainable approach to wastewater management characterized by resources efficiency. Wastewaters from households, industry and agriculture should be considered as resources independent of water content. For municipal wastewater streams, BAT reference documents could be established to detail the variety of new technical solutions and proven concepts that should be considered as options along with the conventional end-of-pipe treatment of all municipal wastewater. The 2006 WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater and the Finnish legislation provide good guidance in crafting resource and cost efficient legislation for wastewater treatment.

## Conclusions and recommendations

- The International Year of Sanitation created a momentum that needs to be continued. Sanitation must be put higher on the political agenda. This should be addressed through:
  - communication strategies aimed at political leaders at all levels and key opinion formers;
  - promotion of dialogue amongst key stakeholders, e.g., authorities, professionals, NGOs and communities; and
  - awareness raising on all levels – advertisement, promotion, targeting and other methods of market research and demand stimulation – to elevate the importance of sanitation in the public eye.
- Legislation must be target-oriented in order to support the development and implementation of efficient solutions in terms of economy and public health. The EU Integrated Pollution Prevention and Control Directive provides a possible model.
- Capacity building on sustainable and affordable sanitation systems should be in the curriculum of technical institutions and universities.
- Technical sanitation solutions should be found at the lowest possible level (e.g., household, neighbourhood, village) in an open planning process supported by technically experienced and up-to-date engineers in order to achieve a high degree of gender-balanced public acceptance and cost efficiency.
- Any European strategy or vision for addressing sanitation in the region needs to take into account that:
  - there are very big differences in the challenges facing those countries with mature water services and those that need to invest in extending service; and
  - there are big differences between the best solutions for urban and rural regions.
- Rural households cannot be left to invest in their own sanitation systems without support. An institutional framework at regional level is necessary to provide professional support, e.g., through wastewater associations. Sanitation should be an integrated part of regional planning and a village mayor or council does not usually have enough knowledge to decide on the most efficient and sustainable sanitation solution. However planning and taking decisions should be done with involvement of the whole community, taking a proper gender balance into consideration.

- The image of sanitation jobs and workers should be improved. The image of working with dirty water has always been an unappealing one. To change this perception involves not only elevating the public value of these jobs, but also increasing salaries; improving the quality of equipment and installations; and paying more attention to worker health.

### Addressing Water and Sanitation Problems - Iberoamerican Water Programme and Water Fund, Spain

The Directorate General for Water of Spain (Ministry of Environment, and Rural and Marine Affairs), as responsible for the Technical Permanent Secretariat of the Iberoamerican Conference of Water Directors (CODIA), has developed an Iberoamerican Water Programme, which includes the establishment of a Research, Testing and Training Centre for non-conventional water treatment technologies, adapted to the needs and realities of small rural and peri-urban communities in Latin America. In this sense, this Centre will also promote the exchange of information, successful experiences and appropriate water treatment technologies among countries.

In order to address the financial problems, the “Water Fund 2008-2012” was announced by the President of Spain, José Luis Rodríguez Zapatero, at the XVII Iberoamerican Summit of Heads of State and Government (Santiago de Chile, November 2007). Spain will contribute with USD 1500 million for financing water supply and sanitation projects in rural and peri-urban areas. Spain hopes this to be an appeal to the international community so that other countries will join, in line with the Declaration of Paris.

Miguel Antolín, Spain



Research, Testing and Training Centre for non conventional water treatment technologies model in Uruguay

# 8

## Basin Management and Transboundary Cooperation



Droughts, floods, pollution, water scarcity and climate change do not respect political or administrative boundaries and must be tackled at the river basin scale. Because many of Europe's basins are shared – some 40 major rivers, 40 lakes and more than 100 aquifers – addressing these challenges requires strong transboundary cooperation.

The EU's Water Framework Directive is an effective instrument for finding and implementing appropriate solutions – both within and across international borders. Transboundary cooperation is also facilitated by the UNECE Water Convention and the region's many international agreements and river basin commissions, but many more are needed, particularly for shared aquifers. Good river basin management also involves the cooperation of stakeholders – who need basin-based platforms for dialogue – and financing, for example through the collection of basin water taxes and the establishment of financing basin organizations.

Europe's experiences in basin management and transboundary cooperation offer many lessons for other countries, which should be shared through cooperation and capacity building programmes.

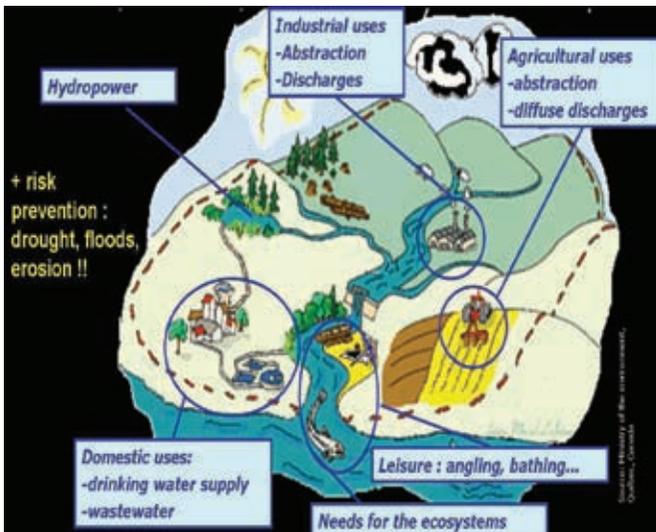
This chapter was coordinated by the International Network of Basin Organizations (INBO). INBO was created in 1994 to mobilize the experience of organizations responsible for the IWRM implementation at river basin level and to facilitate operational exchanges between them. The Permanent Technical Secretariat of INBO is operated by the International Office for Water.

INBO organized three preparatory international conferences that contributed to this chapter: a session in ECWATECH 2008 Moscow (4-5 June 2008); a session in the Water Tribune Conference of the Expo Zaragoza 2008 (8 July 2008); and an International Conference on WFD implementation, 1–4 October 2008, Sibiu, Romania (195 participants, 27 countries).

The chapter was coordinated and written by Coralie Noël (INBO, IOWater) with the contribution of a large number of organizations that are listed in Annex 1.

Since the 4<sup>th</sup> World Water Forum in 2006, Europe has advanced in the concrete implementation of Integrated Water Resources Management (IWRM). The Water Framework Directive (WFD) has become a core tool in meeting the EU's water challenges, greater experience has been gained in transboundary cooperation and progress has been made in information sharing and capacity building.

This chapter focuses on Europe as a whole since many of the challenges of basin management are the same across the continent, although institutions and legislation may differ. Within the EU, the WFD plays a driving role in basin management and transboundary cooperation, and encourages cooperation with non-EU countries as well. Furthermore, the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes addresses the whole European continent.



Challenges for basin management

## Main challenges and principles

Water management must answer to a number of fundamental challenges:

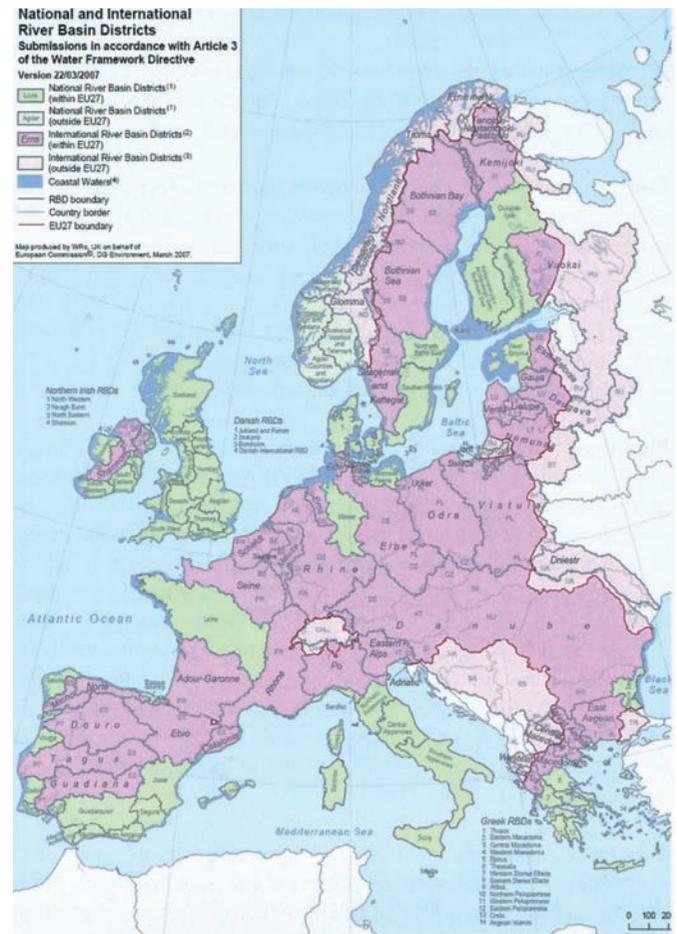
- ensure access for all to drinking water supply and wastewater treatment;
- ensure water for the development of industry, energy production, recreational activities, tourism, fluvial transport, agriculture, etc., while preserving water resources and aquatic environments; and
- prevent and manage floods and droughts and fight against erosion.

These challenges can no longer be solved individually, in a sectoral way but must be tackled by an integrated approach. Since water has no national and administrative boundaries, the river basin is the most relevant scale for water management. It is thus recommended:

- to take into account the reality of the basin as an integrated hydrological system;
- to adopt an integrated approach to meet all water use requirements while respecting aquatic ecosystems, e.g., managing surface and groundwater together and coordinating between upstream and downstream and between quantity and quality;
- to set up river basin organizations;
- to mobilize specific financial resources based on “user-polluter pays” principle;
- to engage in multiannual planning for defining priority investments;
- to organize the collection of data, the dissemination of information and the participation in the decision-making process for all stakeholders.

## The TWINBASIN<sup>XN</sup> programme: Exchanges of experience (2004-2007)

In order to build the capacity of basin organizations, INBO promotes bilateral twinning arrangements. The TWINBASIN<sup>XN</sup> project, supported by the European Commission, enabled the exchange of staff between twinned agencies and the exchange of knowledge among 150 members (Basin Organizations, Administrations, Companies, Universities, etc), through 41 completed or ongoing twinning arrangements and more than 100 missions involving 70 Basin Organizations from 42 countries. (See [www.twinbasin.org](http://www.twinbasin.org) for information on twinning arrangements and positive outcomes.)



The European river basins

### Implementation of the Water Framework Directive, an operational tool for basin management

The WFD has enabled significant progress in the dissemination of river basin management all over Europe. For the first time in history, 29 countries (27 EU countries + Switzerland and Norway) have engaged themselves to jointly manage their water resources on a river basin scale, with the same objectives, methods and deadlines.

## WFD requirements

The Directive pursues four objectives: protecting the environment; ensuring drinking water supply; ensuring water for other uses; and addressing floods and droughts. The prime objective is to protect aquatic environments, since ensuring drinking water quality and meeting other water demands will only be achieved through environmental protection.

Requirements of WFD include the following elements.

**Delimitation of “river basin districts”:** River Basin Districts must be identified, including at international level, and a “competent authority” must be designated for each. Among the 110 river basin districts across the EU, 40 are international and cover more than 60% of the EU’s territory, making international coordination one of the most significant challenges for the WFD implementation.

**An obligation of results:** to achieve “good status for surface, ground and coastal waters” by 2015. Deadline extensions or less strict objectives are possible, but they must be justified.

**Characterisation of the river basin districts:** This step, which was due in 2004, includes an analysis of the characteristics of the water resources, the delimitation of water bodies, an assessment of the water uses (pressures) and their impacts on water status, and an economic analysis of water uses. It must identify the water bodies where the environmental objectives are not likely to be achieved by 2015. A register of protected areas must be established (drinking water intakes, bathing areas, etc.).

**Planning, programming and monitoring:** A “river basin management plan” (deadline 2009) must define the main guidelines for water management in the river basin and the precise objectives to be achieved in 2015 for each water body. It is supplemented by a “programme of measures”, which identifies the necessary actions (regulations, financial incentives, contractual tools, etc.) adapted to each water body. The cyclic process of the WFD allows continuous improvement along the three successive six-year management cycles. To follow up the evolution of water status, monitoring networks must be set up (deadline 2006). An intercalibration of assessment methods must be conducted to allow comparison of the quality of the aquatic environments throughout the EU.

**Economic analyses:** Within the characterisation step, the economic analysis of water uses aims at accounting for the water pricing and the application of the cost-recovery principle of water utilities. This means integrating environmental costs, taking into account the application of the polluter-pays principle. An incentive water pricing should be adopted by the end 2010. As regards the elaboration of management plans and programmes of measures, the economic analyses are used to define the objectives and justify exemptions/delays, to select the actions (cost-effectiveness analysis) and to maximise the effects of each invested Euro. The costs can be spread out over two or three successive programmes of measures if they seem disproportionate.

**Public participation:** The directive aims at increasing the transparency of water policy and requires an active participation of the public and water stakeholders. It defines three compulsory consultation periods: before the end of 2006 for the work

programme, the end of 2007 for the identification of the main water issues and the end of 2008 for the draft management plans.

The European Commission and the EU Member States set up in 2001 a Common Implementation Strategy for the WFD, leading to the production of 17 guidance documents to date (<http://circa.europa.eu/Public/irc/env/wfd/library>).

### Concrete implementation at national and basin levels

The EU countries have now transposed the WFD into their national legislation and set up the necessary administrative arrangements: identification of the river basin districts and the competent authority for each of them and the establishment of international river basin districts. District characterisation, based on data gathering and analysis, has been carried out. Since 2006, the EU countries entered into the operational phase:

**Monitoring networks:** The pre-existing monitoring networks were reorganized and completed (monitoring sites, sampling procedures) with a “monitoring control” to follow up the general status of water bodies and an “operational control” for water bodies at risk of not achieving good status by 2015.

**Management plans and programmes of measures** are currently drawn up and submitted to public consultation and must be endorsed before the end of 2009. On-going work shows the importance of adopting a bottom-up approach, starting from the sub-basins, and of involving the local politico-administrative representatives and the economic stakeholders, since they will be front-liners for investments and concrete implementation.

### The European Centre for River Restoration (ECRR)

The ECRR is an independent network of people and organisations working to deliver ecological river restoration, as an integral part of sustainable water management and an integrated river basin approach. Identifying restoration priorities at the catchment scale requires close cooperation between stakeholders, particularly for transboundary rivers and aquifers. ECRR is helping to identify how problems can be addressed through the process of river basin management planning. ([www.ecrr.org](http://www.ecrr.org))



Developments are still needed for islands and ultra-peripheral regions of the EU (Iberian islands, French overseas Departments in the Caribbean, etc.) since they need specific reference values and assessment methods for ecological status, taking into account their particular climatic and environmental conditions, particularly for “island basins”.

**The WFD implementation will have a huge cost**, requiring an important additional financial effort based on the “polluter-pays” principle.

### The financial action plans of the French Water Agencies

France’s 1964 Water Act created Water Agencies in each metropolitan river basin. The Agencies collect incentive water taxes, with which they support studies, actions for awareness, and investments made by municipalities, industrialists and farmers. Financial Action Plans for each Water Agency are drafted by the River Basin Committees with local stakeholders. For the 2007-2012 period, these Action Plans represent a total of 11.6 billion Euros of financial support to the French River Basin Management Plans and Programmes of Measures. ([www.lesagencesdeleau.fr/](http://www.lesagencesdeleau.fr/))

**Information and participation:** The procedures for involving stakeholders are well developed in Europe, for example through basin committees. But reaching the general public beyond the usual stakeholders has required innovation: it is necessary to organize good information, to communicate in a less administrative way, to explain the decisions made and to account for the results obtained. In order to ensure consistency between basins, most countries elaborated a national framework, but the consultation should then be as local as possible.

### Development of transboundary cooperation – European experiences

Water resources in Europe are characterised by their essentially transboundary nature: in the EU there are 110 transboundary river basin districts and, in the wider UNECE region, 150 major transboundary rivers, 40 major international lakes and more than 100 transboundary aquifers.

International commissions have played an important role in managing transboundary resources for decades by facilitating information exchange, reaching decisions through consensus, preventing conflicts, etc.

Examples of bilateral/multilateral agreements and international commissions include:

**Rhine River Basin:** Starting with the 1815 Treaty of Vienna, there have been 39 treaties (14 multilateral) between the Rhine countries. The International Commission for the Protection of the Rhine (ICPR) was created in 1950 to jointly solve problems of

chemical pollution. It was then used as model for the creation of other international commissions (Elbe 1990, Meuse 1994, Scheldt 1994, Danube 1998). ([www.iksr.org](http://www.iksr.org))

**Miño, Limia, Duero, Tagus, and Guadiana River Basins:** Starting with the Treaty of 1864, there is a long history of cooperation between Spain and Portugal in these shared basins. The most recent agreement, the Albufeira agreement in 1998, addresses the balance between environmental protection and the water use needs of both countries and coordination for better knowledge and water management. ([www.cadc-albufeira.org](http://www.cadc-albufeira.org))

**Danube River Basin:** Bilateral agreements have existed since the 1950s between the former Yugoslavia and Romania, Hungary, Albania, and Bulgaria. The International Commission for the Protection of the Danube River, established in 1998, consists of 13 cooperating States and the EU. Its activities relate not only to the Danube, but also to the tributaries and groundwater resources of the entire Basin. ([www.icpdr.org](http://www.icpdr.org))

**Co-operation between Romania and Hungary:** The first transboundary agreement goes back to 1924 and the latest one came into force in 2004 to achieve good water status, prevent and limit the transboundary effects of floods, droughts and accidental pollution, develop systems for monitoring water status and ensure sustainable use of water resources, under the coordination of the Hungarian-Romanian Water Commission.

**Scheldt River Basin District:** Cooperation among France, Belgium and the Netherlands initially centred on surface water quality (Charleville-Mézières agreement, 1994). With the WFD, the work area was broadened and the responsibilities of the International Commission of the Scheldt were enlarged to include ground and coastal waters, quantitative aspects, and drought/flood management. ([www.isc-cie.com](http://www.isc-cie.com))

**The Kazakh-Kyrgyz Chu and Talas Rivers Commission:** Formed in 2006, the Commission enables Kyrgyzstan and Kazakhstan to share responsibility for water infrastructure used by both countries. The Commission sets a good example in a region where the sharing of water resources, in particular between upstream and downstream countries, is often characterized by tension and insecurity. ([www.talaschu.org](http://www.talaschu.org))

### The Organization for Security and Cooperation in Europe (OSCE)

The OSCE promotes transboundary water cooperation as one of its priority environmental activities. Its Environment and Security Initiative has launched several transboundary projects. The OSCE is supporting the Chu and Talas Commission ([www.osce.org](http://www.osce.org)).

## Contributions of the UNECE Water Convention

The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) – the only international legal framework in force for transboundary waters – provides a sound framework to achieve long-term co-operation among riparian countries. The UNECE Water Convention was signed in Helsinki in 1992 and entered into force in 1996. The European Union and 35 countries are Parties to the Convention.

The Convention sets specific obligations such as the conclusion of bilateral or multilateral agreements providing for the establishment of joint bodies. Since the management of transboundary waters cannot be divorced from the management of national water resources, the Convention requires that its principles also be applied when developing local and national policies. A guidance document is under preparation concerning adaptation to climate change (see Climate Change chapter). For more information: <http://www.unece.org/env/water>.

## The International Sava River Basin Commission

Established in 2002, the Commission represents one of the most advanced experiences of transboundary cooperation in South Eastern Europe. The Commission's functioning is based on the key principles and provisions of the UNECE Water Convention. One of its current priorities is development of the Sava River Basin Management Plan, which includes: conducting a basin analysis; identifying key water management issues, and designing a transboundary water monitoring system (<http://www.savacommission.org/>).

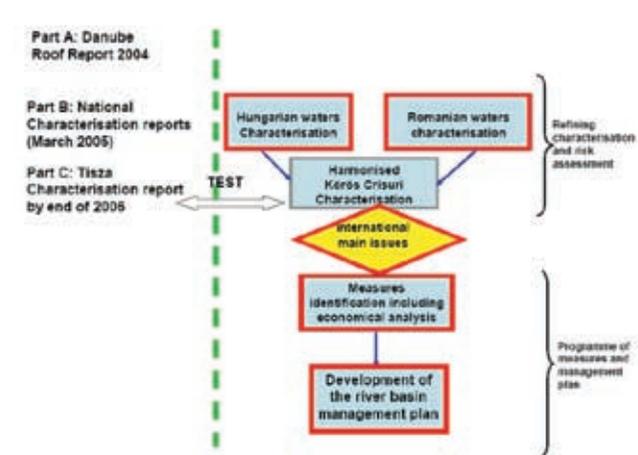
The experience provided by the UNECE Water Convention shows the potential added-value of the 1997 UN Watercourses Convention, which is not yet ratified by a sufficient number of countries around the world and has not yet entered into force.

## The WFD: A practical tool for transboundary management

The WFD provides fundamental added value for transboundary cooperation: beyond bilateral, multilateral and international agreements, **it provides a common reference frame at the level of the whole transboundary basin**, leading to the harmonisation of practices between riparian countries, including with the EU neighbours in the Balkans and Eastern Europe. For example, the management of the Danube involves 19 States, only nine of which currently belong to the EU. After 43 bilateral treaties, the WFD allowed integration at a multilateral level and for the whole transboundary basin.

## Management plan of the Körös – Crisuri pilot basin

The accidental pollution in 2000 of the Tisza, a major tributary of the Danube, led to strengthened co-operation between Hungary and Romania. The Körös/Crisuri, the main sub-basin of the Tisza, was chosen for a project financed by the French Fund for the Environment to test WFD implementation with a sub-basin approach. Co-ordination was led by the ICPDR, with a bottom-up approach leading to an overall management plan for the international district of the Tisza. The results are transferable to the other rivers shared by Romania and Hungary and to all the riparian States of the Tisza and the Danube. (<http://www.icpdr.org> – <http://oieau.fr/spip.php?article1196>)



## Sharing experiences and capacity building

### The development of European research networks on IWRM

The WFD highlights the need for research in the field of IWRM. It is important to organize exchanges for better sharing of experiences, identification of research needs, and coordination of the future research programmes. Research coordination is facilitated by the concept of the ERA-Net projects through the European Research Area (ERA) launched by the European Commission in 2000.

IWRM-Net, an ERA-Net project, is helping to set up transnational research programmes and transfer the results of research to end-users (decision makers, managers, elected officials, local authorities and the public). IWRM-Net brings together 20 programme managers from 14 EU and neighbouring countries. The first transnational research programme was launched in November 2007 and a second one is planned at the end 2009. (For more information, see [www.iwrm-net.eu](http://www.iwrm-net.eu).)

There are several other ERA-Net projects that deal with water issues: CIRCLE (climate change), SPLASH (water scarcity in developing countries), SNOWMAN (soil contamination), and SKEP (environmental issues). The creation of an "ERA-Net cluster" is planned after 2010. (See Research chapter for more information and examples).

## The MELIA Project – Mediterranean Dialogue for Integrated Water Management

This project, supported by the EU, aims at assessing the water management policies in the Mediterranean countries from the angle of IWRM principles and the WFD requirements, in order to contribute to the harmonization of water policies. ([www.meliaproject.eu](http://www.meliaproject.eu)).

## The development of monitoring and information systems

Integrated water management at basin level implies knowing the resources and uses. Data gathering is necessary to plan actions and evaluate their effects. However, water data are often dispersed between several producers and are packaged to meet different needs. It is thus necessary to improve data exchange and to develop integrated information systems.

**The Water Information System for Europe (WISE)** compiles data, gathered at the European level by Member States and various organizations, that until now were fragmented or not available. Developed by the European Commission and the European Environment Agency, WISE was initially dedicated to the WFD but is gradually integrating other directives. (<http://water.europa.eu>)

**The Euro-Mediterranean Water Information system (EMWIS)** is the main tool for regional water information and knowledge exchange in the Mediterranean region. It is managed by a technical unit set up by three national operators (in Spain, France and Italy). Its success was recognised by the Euro-Med Water Directors and has inspired similar initiatives in South America, Central America, and sub-Saharan Africa). EMWIS may be extended in a “Mediterranean Water Knowledge Hub” according to the last Ministerial Conference on Water (December 2008). ([www.emwis.net](http://www.emwis.net))

**A data catalogue for the Eastern Europe/Caucasus/Central Asia region of the UNECE** will be developed for the monitoring group of the UNECE Convention.

## Global Monitoring for Environment and Security (GMES):

GMES is a joint initiative from the European Commission and the European Space Agency (ESA), which has been integrated into the Kopernikus Program. Águas de Portugal (AdP) and Instituto da Água (INAG) have been working with Instituto Superior Técnico (IST) on specific applications of satellite imagery for water management, which have provided important monitoring, forecast and pollution event analysis. At present, IST and other partners are implementing a demonstration project funded by ESA. ([www.aquapath.info/en](http://www.aquapath.info/en))

## Cooperation – transfer of knowledge and capacities

The European Union and EU countries provide support to facilitate the implementation of IWRM and transboundary cooperation in the non-EU countries.

**The European Water Initiative (EUWI)** was set up to support the European Union’s contribution to the Millennium Development Goals in the water sector, with three priorities: access to quality drinking water and adapted sanitation for the poorest populations; sustainable and equitable management of transboundary waters; governance principles to ensure an equitable distribution between the various water users. It comprises four regional components (Africa, Central and Eastern Europe, the Mediterranean region, Latin America). For example, EUWI provided support for the countries of the Niger basin to develop a shared vision (2006-2008 project), which will provide the foundation for future cooperation and the joint production of a “Sustainable Development Action Plan”. (<http://www.abn.ne>)

**The European Water Facility in the ACP countries (Africa, Caribbean, Pacific)** has supported the EUWI implementation with 500 million Euros. Extension of the Facility is imminent. It is the most important allocation for ACP water projects ever launched by the EU ([www.europa.eu.int/comm/europeaid/projects/water/index\\_en.htm](http://www.europa.eu.int/comm/europeaid/projects/water/index_en.htm)).

The European Water Facility has provided financing for several major projects, including: the building of the **African Water Information System** (2007 – 2010), led by the African Network of Basin Organizations (ANBO) and the Organization for the Development of the Senegal River (OMVS) ([www.sadieau.org](http://www.sadieau.org)), and the setting of **performance indicators for transboundary basin management in Africa** (2007-2010), jointly funded by the French Ministry of Foreign Affairs and led by the INBO and ANBO. This project is field-testing performance indicators adapted to IWRM implementation in African transboundary basins and sharing results with other basin organisations through training programmes (<http://www.aquacoope.org/PITB>).

The **Neighbourhood policy of the European Union** dedicates funds to the improvement of water policy. Initially intended for Eastern Europe, it was extended to the Southern Mediterranean countries. A new unique financial instrument – the European Instrument for Neighbourhood and Partnership (with 12 billion Euros for 2007-2013) – was set up on 1st January 2007, to replace the MEDA and TACIS programmes.

## WFD: Can its principles be shared with the rest of the world?

EU countries consider the WFD a good tool for the concrete implementation of a basin management approach. Neighbouring countries have also shown interest in the WFD guidelines, and successful examples of cooperation have been reported.

Outside the EU, the WFD can not be used exactly as it is, because the entire scheme would be very demanding, but its approach and principles are transferable, and it could provide methods for IWRM implementation: designation of proper authorities,



the process of planning and programming actions, public participation, assessment of the ecological status, economic analyses, transboundary cooperation, etc. This is a reference frame that can be transposed and considered as an example of good practices to reinforce transboundary management: in the EECCA countries, in Mediterranean countries (through Med EUWI/WFD Joint Process), in Latin America (through the Twinlatin project), in Africa (through EUWI and European Water Facility).

Experience can be gained from the progress in implementing the WFD made in the 12 States that have joined the EU since 2004 and from cooperation with non-EU countries to provide a single management plan for international districts partly extending outside EU boundaries. Experience can also be gained from the adaptations that are being made for islands and ultra-peripheral regions of the EU. Small island basins are tremendous laboratories for developing integrated water management tools that should be exported elsewhere at a larger scale.

### The Irtysh Basin (Russia/Kazakhstan)

An agreement was signed in 1993 for the protection of the Irtysh Basin. The 2004/2005 partnership protocols integrated the WFD principles and laid out the process for development of a single management plan. A project "Transboundary management of the Irtysh River" financed by FFEM (French Fund for Global Environment), defined the institutional setup for the Irtysh International Commission and developed a data collection and monitoring system and water quantity models. <http://oieau.fr/spip.php?article1200>;

<http://www.ecomsk.ru/english/water.htm>

## Financial Challenges

River basin management implies mobilizing significant financial and human resources. A good strategy is to define financing mechanisms at the scale of river basins, with the establishment of financial water agencies in charge of collecting specific taxes based on the "polluter-pays" principle (see Financing chapter).

## Key messages / recommendations

### Key messages

- River basin management and transboundary cooperation are essential to find solutions to our common water

challenges.

- River basins are the most relevant unit for organizing water management.
- Basin management and transboundary cooperation are a necessary frame to implement IWRM, better manage flood/droughts and adapt to climate change.
- International commissions play an important role as platforms for coordination.
- The WFD has enabled the dissemination of basin management all over Europe, according to common approach and objectives. It represents an operational frame for multilateral coordination at the river basin scale.

## Policy recommendations

- Basin management and transboundary cooperation need full political support and have to pass from theoretical approaches into practical implementation.
- Objectives, deadlines, actions, and financial resources should be defined through management plans for practical implementation of river basin management.
- Specific funding mechanisms should be set up, based on the polluter-pays principle, through the establishment of basin water taxes and basin organizations.
- User participation should be organized within specific bodies (e.g., River Basin Committees) for dialogue and involving all users in decision-making.
- Raising public awareness is necessary, with good communication and consultation on the challenges and the measures to be taken.
- Support should be given for creation of international agreements and commissions.
- Agreements for transboundary aquifer management should be developed and agreements on surface water should systematically be extended to groundwater.
- Integrated information systems should be developed at basin, national and transboundary levels.
- The knowledge of the specific water environments of islands and overseas territories should be improved and suitable reference frames should be defined.
- The lessons and principles for good governance from the WFD principles have relevance for countries outside the EU and should be shared.
- It would be advisable that those countries which have not yet done so ratify the UNECE Water Convention and its Protocol on Water and Health. The knowledge gathered in Europe on basin management and transboundary cooperation through the EU Water Framework Directive and the UNECE Water Convention shows also the added-value the UN Watercourses Convention could have, if it would be ratified and entered into force.

- The means devoted to capacity building on basin management should be increased through a significant support from international and bilateral donors and the reinforcement of cooperation programmes.



# 9

## Cooperative water research: Addressing the challenges of the sector



Europe has a well-developed water research capacity, which is enriched through collaboration with scientists from many parts of the world. This collaborative approach is accelerating progress within Europe and outside in fields such as climate change, integrated water resources management, water treatment, and emerging pollutants. Public-private cooperation and the involvement of stakeholders ensure that research meets pressing needs and that results are rapidly taken up and applied.

European and international water research offers excellent opportunities to establish robust, global networks. It should thus be expanded – building upon the main competencies of the respective institutions and technology providers. Cooperation at the research level can also be a driver for further cooperation on other levels.

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*Main contributions rely on work from the Water Supply and Sanitation Technology Platform and numerous research projects funded within the Framework Programmes of the European Commission.*

### Introduction

Research in Europe develops innovative and proactive measures for sustainable water management in Europe and the world. It works to address global challenges – the ones we are facing today and those we will face in the decades to come. Many of these challenges are detailed in other chapters of this document. Briefly they include:

- Climate change – how to adapt water management and the design and operation of water systems.
- Water and energy – developing new more resource-efficient technologies.
- Population growth and increasing urbanization – more efficient water and sanitation infrastructure and technologies.
- Ageing infrastructure for water supply, sewerage and urban drainage – how to invest in modernizing existing systems as well as designs for new more adapted ones.
- Emerging pollutants – the effects of trace concentrations of most of the ubiquitous compounds, such as pharmaceuticals, personal care products and industrial chemicals, especially from the human toxicity perspective.

The regional document for the 4<sup>th</sup> WWF in Mexico 2006 emphasized the organizational structure of European water research – focusing on the Water Supply and Sanitation Technology Platform and one of its major outputs: the Strategic Research Agenda supporting innovative tools and solutions.

This chapter will briefly describe the European water research community with its main players and funding agencies. This includes partners from the EU Member States and non-EU countries along with partners from the global research community to support networking and international exchange of knowledge between countries – industrialized and developing. In cooperative research, non-EU member states such as Switzerland, Norway and Israel have traditionally played an important role. With the extension of the European Union towards the East, new partners from this region have been increasingly involved and their specific research interests often enrich EU study objectives. Highlighted projects exemplify this collaborative approach and reflect the broad range of currently executed research efforts.

## The European water research community

European water research activities are as complex as Europe itself; they involve many players, stakeholders, researchers and funding agencies on different levels. The European Union and the different institutions of Member Countries play a key role in project funding.

The European Commission has its own science department, the Joint Research Centre. Its mission is to provide scientific and technical support for the conception, development, implementation and monitoring of European policies. Within the European Commission, the Directorate Generals (DG) of Research and Environment have developed a set of instruments, tools and platforms to give direction to European research efforts. In addition to European academic and private-sector research, technology development and water research is also executed on a national, bilateral and also on a company level.

This research contributes not only to promoting good water management from the technological and institutional points of view but also to developing a sound water knowledge base and an awareness of water's political dimensions and of the necessity to actively protect the viability of our aquatic ecosystems. With a better understanding of the context and impact of global change, the aim is to identify ambitious objectives in order to develop new concepts and tools. While research on climate change impacts has already been conducted for many years, the focus is increasingly on mitigation and adaptation measures.

Europe hosts some of the large global players in water services. These companies work on European and global solutions to address today's challenges for safe and innovative water services. Besides the large companies, a broad range of small and medium sized enterprises also contribute innovative technologies and solutions. Research funding also aims at strengthening the European water technology sector, thus many research projects involve academic and private research institutes as well as private-sector companies. This type of public-private collaboration allows projects to address the pressing questions of the society, the water sector and service providers and ensures the rapid application and exploitation of scientific results.

## Ongoing activities of the Water Supply and Sanitation Technology Platform

The Water Supply and Sanitation Technology Platform (WSSTP) aims to enhance the potential for technological innovation and the competitiveness of the European water sector. It has brought together European water experts, researchers, private-sector companies and associations, civil society organisations, and public institutions to discuss and debate current challenges and find joint solutions. The working groups within the WSSTP define common technological and scientific research programmes and propose realistic implementation plans.

In 2005 the first WSSTP Strategic Research Agenda identified four major challenges requiring targeted research activities and real applications via pilot programmes:

- The increase in tensions between supply and demand as well as water costs.
- The urbanization and management of the water cycle and its infrastructure in cities.
- Extreme phenomena such as floods or droughts.
- The supply and treatment of water in rural and development areas.

Currently the WSSTP working groups are updating the Strategic Research Agenda, which is expected to be published this year.

## European research activities to address global challenges

The thematic areas of the WSSTP form the background for new initiatives. The WSSTP Strategic Research Agenda has identified six pilot themes to tackle the four major challenges for sustainable water management for Europe. They are all articulated around the concept of IWRM as given in the Water Framework Directive. The six pilot programmes are as follows:

- Mitigation of water stress in coastal zones.
- Sustainable water management inside and around large urban areas.
- Sustainable water management for agriculture.
- Sustainable water management for industry.
- Reclamation of degraded water zones (surface and ground).
- Proactive and reactive management of extreme hydro-climatic events.

These pilot themes are reflected in continuous research activities. Because the outputs of these activities are useful not only for Europe, but also for many other regions, including the developing world, they are contributing to the global achievement of the Millennium Development Goals.

Since the launch of the Framework Programmes (FP) in 1984, water has been a key priority in European environmental research with a major emphasis in the FP5 (1998-2002) within the so-called Key Action of Water. The Sixth Framework Programme (2002-2006) has given priority to the development of new knowledge, strategies and instruments to reduce the impact of global change, including climate change, on water resources in Europe and the other parts of the world. By launching its European Water Initiative in 2002 as part of the Millennium Development Objectives, the European Union has ensured the inclusion of a research component to improve scientific cooperation on integrated water resource management and sustainable access to safe water and sanitation.

The aim of the Seventh Framework Programme (2007-2013) is to emphasize the role of research in a knowledge-based society, and a knowledge-based economy, by promoting the innovation and competitiveness of European industry. Environmental research has received a budget of 1.9 billion Euros for the whole seven-year period.

### **Main topic areas**

European water research ranges from basic research, e.g. regarding the impact of climate change on our water resources, to development and application of new analytical tools or technologies, such as combining nanomaterials with membranes to create more effective water treatment technologies.

### **Integrated water resources management**

Implementation of integrated water resources management still requires a substantial amount of research to develop the appropriate measures and solutions for the tasks set forth in the Water Framework Directive (WFD). This also involves European partners from outside of the EU since some of the transboundary basins reach beyond the current EU borders (see Basin Management chapter). The SPI-Water project, "Science-Policy Interfacing in support of the Water Framework Directive implementation", aims at analyzing and evaluating projects in the field of river basin management that are of potential use for WFD implementation. Lessons from these projects are disseminated using the WISE-RTD Web Portal, which is connected to the Water Information System for Europe (WISE). They support the development of WFD river basin management plans and of EU Water Initiative/WFD joint process activities for facilitating the implementation of integrated water resources management principles in non-EU countries.

### **New integrated concepts and water technologies for urban water infrastructure**

Urban areas are in particular affected by the major trends in demography, climate change and consumption. While today the world population is estimated at 6.7 billion people, it will increase to about 10 billion by 2050. Today 50% of the world population lives in cities, by 2030 it is predicted to climb to 80%. An expected wealth increase will affect consumption habits favouring products and services with a higher water footprint. In conjunction with

pressures from global change, escalating costs and other risks inherent in conventional urban water management mean that we will be facing ever increasing difficulties in efficiently managing scarcer and less reliable water resources.

Several FP6 research projects aim to introduce new concepts in urban water management to increase sustainability, reduce risks and develop new technologies. The FP6 project SWITCH ([www.switchurbanwater.eu](http://www.switchurbanwater.eu)), which was launched during the last World Water Forum, includes partners and case studies from both Europe and developing countries to bring about a paradigm shift in urban water management – a shift away from existing ad hoc solutions in urban water management towards a more coherent and integrated approach. The vision of the project is sustainable urban water management in the 'City of the Future'. The consortium, which includes academics, urban planners, water utilities and consultants, works directly with civil society through learning alliances in ten 'global cities'. These are platforms that bring city stakeholders (utilities, planners, NGOs, finance departments, etc.) together with researchers.

Another large-scale project called TECHNEAU ([www.techneau.eu](http://www.techneau.eu)) aims at developing innovative solutions for safe water supply as it was recently defined by the amendment of the European drinking water directive: from source to tap. New technologies, such as membrane treatment and hybrid processes; monitoring tools for detecting emerging contaminants and pathogens; modelling tools; and new concepts in risk management allow significant progress and further develop the multi-barrier concept. TECHNEAU has a close link to stakeholders and end-users in Europe and abroad, e.g., India and South Africa.

### **Priority and emerging pollutants**

Every substance that we produce shows up in the environment in trace concentrations. The results from the FP5 project POSEIDON (<http://poseidon.bafg.de>) have been published in 2007 by IWA under the title "Human Pharmaceuticals, Hormones and Fragrances - The Challenge of Micropollutants in Urban Water Management". The book gives a good overview of this unregulated topic and summarizes analytical methods, risk assessment, legal background from different regions of the world, removal options for these compounds in the water supply, and wastewater treatment and source control solutions.

While the impact of compounds such as endocrine disruptors has been proven, science can not yet determine the effect of trace concentrations of most of the ubiquitous compounds. The projects MODELKEY ([www.modelkey.org](http://www.modelkey.org)) and KEYBIOEFFECTS aim at closing that gap by trying to link certain effects in ecosystems to specific compounds present in the aquatic environment, identifying the respective stressors and establishing reliable cause-effect relationships.

### **Advanced treatment for industries**

Since industry is responsible for over 20% of total global water use and more than 80% in some EU member states, e.g., Belgium, sustainable solutions for industrial water use and recycling are indispensable. Different approaches to treatment,

including removal of specific recalcitrant pollutants and more generic technologies, are currently addressed in two research projects, which move from fundamental to applied research. INNOWATECH ([www.innowatech.org](http://www.innowatech.org)) deals with "Innovative and integrated technologies for the treatment of industrial wastewater". It develops new technologies and solutions for the industrial sector and is complimentary to the Neptune Project, which deals with municipal wastewater treatment (see box).

AquaFit4use ("Water in Industry, Fit-for-Use Sustainable Water Use in Chemical, Paper, Textile and Food Industry") aims at specified environmental objectives in industrial water use and reuse. It is focused on the development of new, reliable, cost-effective technologies, tools and methods for sustainable water supply, use and discharge in the main European water consuming industries. The objectives are to reduce fresh water needs by more than 30%, mitigate the environmental impact (5% less CO<sub>2</sub> emissions and 20-40% less sludge disposal), produce and apply water qualities in accordance with the industries' own specifications (fit-for-use) from all possible sources (5% increased productivity) and contribute to 'closing' the water cycle in an economical, sustainable and safe way (over 10% energy saving).

### Examples of international cooperative research projects

Many of the problems that affect Europe, affect other parts of the world, such as the densely populated deltaic regions, even more strongly, and future scenarios predict the impacts will intensify. European research addresses these problems on different levels. Projects bring together experts from different scientific fields and from different countries in Europe and outside. Networking, involving all stakeholders, and disseminating the results to experts and practitioners form key elements in the execution of the research activities. The idea is to bring the knowledge from the lab to its practical application and in the process to contribute to establishing a cooperative European and global research community.

### Advanced municipal wastewater treatment technologies

Municipal wastewater treatment is widely and successfully applied in Europe. Nevertheless new technologies and concepts are required for an improved removal performance, better sustainability, and ability to address the challenges of the future (see Sanitation Chapter).

## MBR-Network: A cluster of EU projects dedicated to the Membrane Bioreactor technology

The European Commission promotes intensively the development of the Membrane Bioreactor (MBR) technology, a promising wastewater treatment process. It funds four projects entirely dedicated to MBR research, development, capacity building and technological transfer. The four projects are supported by three different financial instruments set up by the European Commission within the Sixth Framework Programme and are implemented in parallel from October 2005 up to December 2009.

The projects are:

- AMEDEUS - "Accelerate Membrane Development for Urban Sewage Purification".
- EUROMBRA - "Membrane bioreactor technology (MBR) with an EU perspective for advanced municipal wastewater treatment strategies for the 21st century".
- MBR-TRAIN - "Process optimization and fouling control in membrane bioreactors for wastewater and drinking water treatment".
- PURATREAT - "New Energy Efficient approach to the operation of Membrane Bioreactors for Decentralized Wastewater Treatment".

Around 50 European and international companies and institutions are actively involved in these projects and are joining their efforts and coordinating their actions within the cluster "MBR-Network". The four projects have a total budget of around 15 million Euros, of which approximately 9 million Euros is being financed by the European Commission. They represent the largest coordinated research initiative worldwide dedicated to MBR technology since this treatment process was first developed in the early 1990s.

The projects' outputs – important technological breakthroughs, process improvement, knowledge and capacity transfer and building – will lead to better acceptance, competitiveness and broader implementation of the technology in both municipal and industrial fields.

The "MBR-Network" is accessible through its website [www.mbr-network.eu](http://www.mbr-network.eu), which has 1000 international members registered.

For more information, contact Boris Lesjean, Berlin Centre of Competence for Water, Germany ([Boris.Lesjean@kompetenz-wasser.de](mailto:Boris.Lesjean@kompetenz-wasser.de)).

## New sustainable concepts and processes for optimization and upgrading municipal wastewater and sludge treatment – the NEPTUNE project

The scope of sewage treatment is changing. Up-to-date municipal wastewater treatment plants (WWTP) were seen as an end-of-pipe treatment just before discharge with the aim of avoiding eutrophication and hygienic health hazards in surface water. Due to the global demographic trends as well as new legislation (e.g., the Water Framework Directive) increased focus is put on quantity and quality of effluents.

WWTP, which are more and more seen as an interface between sanitation and the environment, are delivering resources to the environment and for human activities (recharge of drinking water reservoirs, recycling of nutrients, efficient energy use). This focus shift has implications on the quality goals set for WWTP products:

- From water treatment to water reuse.
- From nutrient removal to nutrient recycling.
- From removal of pathogens only to removal of micropollutants and ecotoxicity.
- From energy optimization to energy production.
- From sludge disposal to reuse of sludge and its resources.

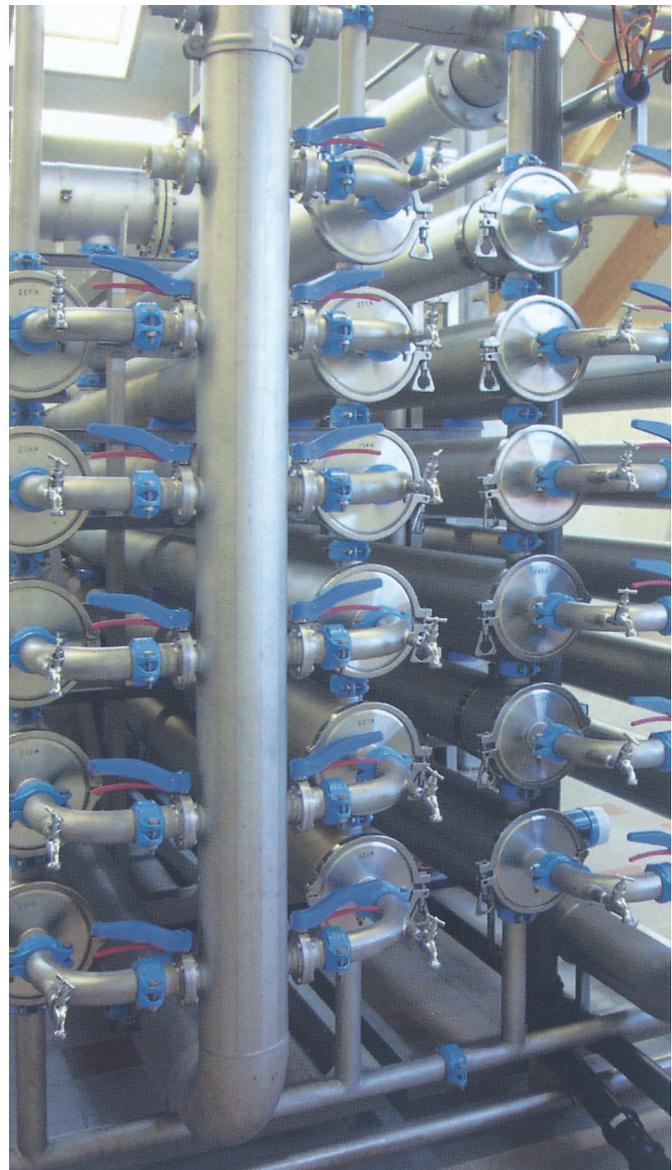
The NEPTUNE project ([www.eu-neptune.org](http://www.eu-neptune.org)), comprising 16 European and 2 non-European partners, approaches these tasks by focusing on technology solutions that will allow WWTPs to meet present and future standards via upgrading existing municipal infrastructure (new control strategies with online sensors effluent upgrading with oxidation, activated carbon or wetland treatment; safe sludge processing and reuse) as well as via new techniques (fuel cell applications; new oxidation processes; production of polymer and phosphate from sludge). Life cycle assessment studies are employed to assess various technical options and propose a suitability ranking.

WWTP are the major pollutant point source for surface water, and consequently their performance will to a large extent determine whether the targets legislated by the WFD are achieved. The emerging interest in organic (eco-)toxic compounds requires characterizing treated effluent and treatment technologies concerning ecotoxicologic aspects and micropollutants. The project is contributing to this discussion through ecotoxicity assessment and micropollutant fate studies.

For more information, contact Dr. Natalija Miladinovic, EAWAG Swiss Federal Institute of Aquatic Science and Technology ([natalija.miladinovic@eawag.ch](mailto:natalija.miladinovic@eawag.ch)).

## Technologies for safe and sustainable use of alternative water sources

Water scarcity and droughts (see chapter 6), because they involve multiple risks ranging from public health and food safety to severe economic losses and conflicts, are high on the European agenda. Tapping into alternative water sources is often the only option to safeguard the urban, industrial and agricultural water supply. Since more than a decade, research in Europe has been focusing on water reuse, novel desalination technologies, and methods to enable the safe use of wastewater in different areas and for different applications. During FP6, water research addressed managed aquifer recharge using treated wastewater (see box) and seawater desalination. Wastewater treatment plant effluents and seawater represent reliable alternative water sources but entail significant challenges for the provision of cost-effective water supply tailored to specific requirements.



## Artificial aquifer recharge with reclaimed water

Managed aquifer recharge (MAR) counteracts not only the stress on often overabstracted aquifers but also can reduce the impact from saltwater intrusion in coastal zones. With less evaporative losses and a smaller environmental footprint, MAR schemes are a viable storage alternative to conventional dams. However, since groundwater is regarded as a pristine water body, MAR with reclaimed water demands sound risk assessment and management and a design tailored to the specific local subsurface conditions.

The FP6 projects RECLAIM WATER "Water reclamation technologies for safe artificial groundwater recharge" ([www.reclaim-water.org](http://www.reclaim-water.org)) and GABARDINE "Groundwater artificial recharge based on alternative sources of water, advanced integrated technologies and management" ([www.gabardine-fp6.org](http://www.gabardine-fp6.org)) comprise case studies from several global target regions in developing and developed countries. They aim at the provision of effective technologies to monitor and mitigate emerging risks posed by chemical contaminants and pathogens in reclaimed wastewater streams used for aquifer recharge. Technological water reclamation solutions are used in an integrated way with natural attenuation processes occurring in the subsurface to achieve upgraded water quality, as assessed on the basis of key contaminants. Decision support systems are used along with risk studies and integrated modelling tools. The projects thus form the basis of future European legislation and definition of best management practices.

For more information on RECLAIM WATER, contact Prof. Thomas Melin, RWTH Aachen University ([thomas.melin@avt.rwth-aachen.de](mailto:thomas.melin@avt.rwth-aachen.de)), and, on GABARDINE, Prof. Martin Sauter, University of Göttingen ([martin.sauter@geo.uni-goettingen.de](mailto:martin.sauter@geo.uni-goettingen.de)).



## Advanced membrane-based desalination

Membrane-based desalination has experienced a significant boom during the last few years as a quick solution to pressing water scarcity in several regions of the world, such as the Mediterranean countries, Australia and the Middle East. Two FP6 projects covered this topic. MEDESOL, "Seawater desalination by innovative solar-powered membrane-distillation system" ([www.psa.es/webeng/projects/medesol/](http://www.psa.es/webeng/projects/medesol/)), evaluates the technical feasibility of producing potable water from seawater by integrating several membrane distillation (MD) modules into a Multi-Step Membrane Distillation System. The goal is to provide an environmentally friendly, cost-improved desalination technology for use in arid and semi-arid regions in the EU and outside based on solar MD with a capacity ranging from 0.5 to 50 m<sup>3</sup>/day.

The MEDESOL-1 prototype has been set up at Plataforma Solar de Almería (PSA), Spain. The PSA, a branch of the Centre for Energy, Environment and Technological Research (CIEMAT) of Spanish Ministry of Science and Innovation, is the largest centre for research, development and testing of concentrating solar technologies in Europe.

The MEDINA project "Membrane-based desalination: an integrated approach" (<http://medina.unical.it/>) investigates different membrane operations in pre-treatment and post-treatment stages for process intensification the aim of improving the overall performance. This includes analytical methods for feed water characterization, identification of optimal seawater pretreatment strategies, optimization of RO membrane module configuration, and zero liquid discharge strategies.

## Decrease of energy consumption in desalination plants

A Spanish technological company, Acciona Agua, jointly with a consortium of companies and research centres, is currently leading the CENIT- EOLIA project (within the national government programme), to research desalination technologies in marine wind farms. The project is directly linked to the development of alternative energy sources to meet the electrical energy demand of reverse osmosis operations. The project's main objectives are to reduce management and exploitation costs and to reduce energy consumption between 15 and 30%, in addition to reducing environmental impacts due to CO<sub>2</sub> emissions and brine effluent.

For more information on MEDESOL, contact Dr. Julian Blanco, CIEMAT-PSA - Ministry of Science and Innovation, Spain ([julian.blanco@psa.es](mailto:julian.blanco@psa.es)) and, on MEDINA, Prof. Enrico Drioli, University of Calabria ([e.drioli@unical.it](mailto:e.drioli@unical.it)).

## Ecohydrology

The scope of ecohydrology includes understanding, modelling and application of aquatic ecosystems' intrinsic characteristics and properties to optimize their capacities to resist and recover from adverse anthropogenic and climatic effects in order to keep a good ecological status. Ecohydrology offers a valuable alternative to new infrastructure projects when optimizing the programs of measures required by the Water Framework Directive without jeopardizing the environmental goals.

### Ecosystem services for the water community: UNESCO's Demonstration Site in Guadiana (Portugal)

"Ecohydrology for Sustainability" is one of the five pillars of the UNESCO-International Hydrological Programme (IHP) medium-term strategy, which addresses also the Millennium Development Goals and the EU Water Initiative. The ICCE - International Centre for Coastal Ecohydrology of the University of Algarve, Portugal ([www.icce.com.pt](http://www.icce.com.pt)) is dedicated to research, education and public awareness in the field of Ecohydrology in coastal areas in the Mediterranean region and Africa. At present their research work is focused on the development of models for ecosystem services' optimization. At the Guadiana Demonstration site (supported by UNESCO – IHP) results have been used to bring forward both ecological and socio-economic added value to the water community.

For more information, contact Carlos Póvoa, Águas de Portugal ([c.povoa@ADRPT](mailto:c.povoa@ADRPT)).

## Key messages

In European water research, academia and the water industry closely cooperate with all respective stakeholders to boost innovation and application of project results in practice – bridging divides between countries in Europe and abroad at different levels. Some key lessons on the role, organisation and value of water research:

- Water research has to develop proactive and innovative solutions to address the increasingly pressing challenges of the water sector, in particular those stemming from climate change and demography.
- Novel water technologies can contribute to these solutions and allow the implementation of the European legislative framework.
- Cooperative research between academic and private-sector partners supports rapid application of project results and dissemination of knowledge.
- International scientific cooperation establishes networks of excellence and avoids duplication of research.
- Research, in addressing key challenges in the water sector, enables the reduction of risks for the global society and the environment.

## Policy recommendations to address the remaining challenges

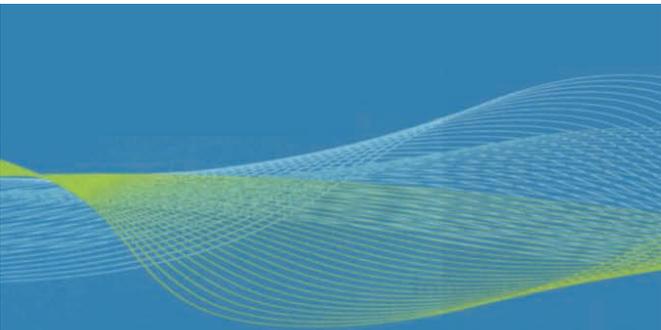
European and international water research offers excellent opportunities to establish robust and global networks of cooperation. It should thus be expanded – building upon the key competences of the respective institutions and technology



providers. The pool of knowledge has to be utilized also outside of Europe to accomplish the Millennium Development Goals.

- Challenges of the water sector have to be addressed in an integrated way, for example including both adaptation and mitigation measures in responses to climate change.
- New energy efficient water technologies have to be developed to reduce the energy consumption of seawater desalination, which is becoming increasingly popular.
- Risks from trace concentrations of emerging pollutants in water have to be evaluated against risks arising from other paths of intake of these pollutants such as food, detergents, bottled drinks, air and consumer goods.
- International cooperation has to be intensified by developing models for cooperation that go beyond the borders of the EU or the US to address the challenges globally.
- A central database of all European national and international water research will help to disseminate and utilize the knowledge generated in research projects.





# 10

## Financeability and Water Efficiency



It is more important than ever to adopt a pro-active and sector-wide approach to the financeability of the water sector, in particular to either promote or maintain the perception of the water sector as low-risk and to facilitate access by utilities to low-cost long-term debt.

Water efficiency is a critical element of addressing water scarcity and potential climate risks as well as the long-term viability of water utilities. However, there is a need to pay proper attention to the cost structure of water utilities in order to make the objectives of cost recovery and water efficiency work together.

In the EU-12 and beyond, sector consolidation is a logistical necessity for the implementation of the required investments and absorption of grants over relatively short transition periods. When used to create win-win scenarios to overcome political barriers to necessary sector restructuring, grants can promote operational consolidation, cost-effective regional solutions and long-term efficiency gains.

This chapter has been written by the European Investment Bank (EIB). A number of other organisations (as listed in Annex 1) had the opportunity to review and comment on the initial draft and provide an input into a number of case studies. This chapter takes into account these comments and suggestions where possible.

### *Overview of key issues in financing of the EU water sector*

EU water legislation has been and remains a significant driver for a continued high level of new investment in the European water sector. An important element of the new generation of directives and policy proposals is recognition of the importance of water efficiency in all its forms and the need to adapt systems in their widest sense to the effects and uncertainties caused by climate change. This calls for an even greater emphasis on creating a long-term economic and financial framework for the water sector, within which low regret solutions can be formulated and the objectives of resource efficiency can be made compatible with the development of viable utilities.

There is a de facto trade-off between financing new environmental infrastructure and addressing the inefficiency of existing infrastructure due to capital maintenance backlogs. Decision-makers with limited public funds are faced with a dilemma: do they focus on finding the money for new environmental infrastructure or on ensuring funds for maintaining and replacing existing infrastructure. Generally, money for new infrastructure can be raised where there is a visible outcome, effective enforcement and/or political will. However, for asset maintenance or replacement, deferral has often seemed the most expedient option, particularly since raising taxes or tariffs to cover such costs is politically difficult.

In many countries of the EU, average replacement rates of underground water supply and sanitation assets run into the



hundreds of years. In some places, underinvestment for extended periods has left the sector with a substantial maintenance and replacement backlog (see Sanitation chapter). Positive action is needed to avoid a spiral of increasing operational costs and inefficiencies. Turning around inefficient systems in need of remedial investments is a long and even more capital-intensive process than maintaining an adequate, planned pace of renewal.

The capital maintenance backlog is indicative of a general cost-recovery and tariff backlog. Cost recovery remains fiction without accounting and planning methods that provide reasonable projections of the necessary level of funding for maintenance and replacement or without tariff setting that reflects that level of funding. The reality in several countries in Europe is that tariffs, even when supplemented with national or local government transfers, are not high enough to ensure maintenance and replacement of existing assets at a long-term sustainable pace and to a modern standard, leaving the sector underfinanced.

To cover the high level of compliance-driven investment in new infrastructure and the maintenance and replacement of an ageing existing infrastructure, tariffs will most likely have to be increased. However, this is difficult since increases are subject to a high-degree of public scrutiny, significant inertia in the planning and political system and the need to take into account affordability issues, particularly in the less wealthy regions of Europe. In some regions, many households are already spending a relatively high proportion of their disposable income on water services.

The European water sector has traditionally relied on the use of public funds to extend coverage, particularly in the case of sanitation, and there have been significant cross-subsidies between densely and sparsely populated areas, between groups with different affordability constraints and between utility services. Rapid reversal of traditional cross-subsidy mechanisms, such as through the de-averaging of tariffs within service areas or cost-recovery at an unviable scale would compound affordability issues in vulnerable localities. Ultimately, issues of regional development could be at stake.

The water sector is capital intensive and dependent on long-term borrowing against future tariffs and taxes, with the overall amount of debt per consumer to be serviced set to rise. The value of invested capital per consumer is very high as compared to other sectors; revenues, on the other hand, as a function of distributed volumes, are comparatively low. Revenues are unable to cover the immediate financing needs for either major enhancement works (“lumpy” investments) or significant replacement efforts. There is therefore a continuous need for debt financing and re-financing for a wide range of needs. Moreover, the overall amount of debt will rise as coverage and environmental obligations are extended, particularly where there is a major backlog in asset replacement. This debt will have to be serviced out of user fees or taxes, which constitute the ultimate sources of money.

Access to capital markets and debt financing is governed by the risk profile of the water sector and individual utilities. The ability of the water sector to obtain the right financing is a function both of utilities’ performance and the legal, institutional and financial environment that is created around them. The ability of individual utilities to borrow at a sustainable cost of capital is largely governed by their ability and willingness to repay the debt in a timely manner as well as mechanisms or regulation to reduce the financial risk to lenders or subsidise the cost of capital directly.

The fundamentals of a mature water sector are generally good, with a low-risk/low-return profile, given its monopolistic and essential nature. However, sustained or significantly increasing investment needs, political volatility in tariff setting, increasing affordability concerns, decreasing visibility of returns on investments and suboptimal institutional or legal arrangements have the potential to negatively affect the low-risk perception of the water sector. In addition, without adequate adaptation and system resilience, the water sector and utilities may become more exposed to operational and financial risk under extreme climatic events.

As tariffs are the main revenue source of utilities, actual and future tariff collection is a significant factor in a utility’s ability to repay loans. Political pressure to keep tariff levels low and/or poor tariff collection rates often lead to poor cost recovery levels and little or no real surplus for debt repayment. A particular challenge for service providers is the potential impact on revenues



## Regulator's obligation to ensure the financeability of the UK water sector

Water and sewerage services are delivered to customers in England and Wales by appointed water and sewerage companies. The economic regulator OFWAT has a duty to ensure that all UK water companies are able to finance the proper carrying out of their functions by securing a reasonable return on capital, both equity and debt. This is an integral part of the review of tariffs that takes place at five year intervals. For the period 2005-2010, OFWAT determined an adequate return on capital for the sector to be 5.1%.

The application of tariffs that are negotiated with OFWAT ensures the financial viability of 5-year investment delivery programmes. The tariff setting takes into account the financial needs for capital maintenance and new investments, which are subsequently inflation adjusted, and a realistic return on capital. The system of regulation also gives water companies incentives to meet efficiency targets as well as to pursue the cheapest financing.

of the drive for end-use water efficiency or a general downward trend in consumption without adequate review of cost recovery mechanisms.

The current financial crisis may result in capital rationing, so access to debt financing may become an even more severe problem for weaker service providers or local governments in the foreseeable future. This further intensifies the need for a proactive approach to financeability of the sector.

**The water sector in the new EU Member States (the EU-12) and Pre-accession/Potential Candidate Countries faces similar issues as in the EU-15, but to a much higher degree and with fewer means.** Whereas the water systems of the EU-15 can largely be considered as mature, if in some cases inefficient, the new and future member states have to catch up, not only in terms of environmental compliance, but also in terms of dealing with dilapidated systems, severe pollution legacies and low coverage of services, particularly outside the main urban agglomerations. In many of these countries, tariffs are set at levels that do not adequately recover costs, as a result of political capture or real affordability issues.

Although the new EU Member States have access to a significant amount of grant based funding, they have used this funding to finance new compliance-related environmental infrastructure rather than target the inefficiencies of existing systems. Moreover, co-financing requirements for accessing these EU grants may have used up resources that could otherwise have been used for activities necessary to maintain the existing systems. Almost all countries of the EU-12 have had difficulties in making full use of the available grants. The reasons for this include: unrealistic implementation schedules given the insufficient implementation capacity (both professional and administrative), a steep learning curve to adapt to the necessary procedures, and long programming cycles for accessing grants.

In many new member states and countries outside the EU, political developments and the decentralisation process of the last 15 years has fragmented the water sector into too many small

and medium-size municipalities or utilities that lack the capacity to adequately provide public services or the scale to access financing at suitable terms. As a whole, a regulatory, economic and financial environment still needs to be established that will enable the perception of the water sector as a stable, low-risk/low-reward sector that can access suitable long-term financing in sufficient quantities.

## Strategies to address the key issues facing the EU water sector

There needs to be a greater focus on the cost side of the cost-recovery equation. Poor investment decisions and inappropriate infrastructure design can potentially do more harm to financial sustainability than can be remedied through financial optimisation, good operational management or through sustainable tariff increases. It is therefore essential for financial sustainability, as well as for justifying and recovering costs from users and taxpayers, that utilities are run efficiently and that compliance with EU directives and other relevant legislation is achieved cost-effectively and at a reasonable pace. Technological innovation needs to be pursued that will reduce the cost of maintenance,

## Regulation in a monopolistic market:

### Achieving efficiencies and cost effectiveness

In Portugal, except for Lisbon, responsibility for water sector management belonged, until the 1990s, exclusively to the municipalities. With the introduction of private sector participation in regional water companies (maximum 49% share), the Government set-up the Institute for the Regulation of Water and Waste (IRAR) to ensure the quality of service provision and to supervise the financial sustainability of the sector.

Although the IRAR is not an independent regulatory authority, does not fix tariffs and has limited enforcement power (as opposed to the "strong" regulator OFWAT), it has introduced competitiveness among operators and led to a gradual performance increase of the whole sector. IRAR developed a set of Key Performance Indicators for the regulated activities of water, wastewater and solid waste. These are published annually and the operators who do not perform well relative to the benchmark are "exposed", thus providing an incentive to improve their performance. An important role of IRAR is to act as an independent and professional facilitator in disputes between consumers and the service provider over investments and tariffs.

While regulators have traditionally been introduced as a measure to counterbalance the introduction of private sector participation, there is increasing recognition of the value of regulation among purely public utilities. One of the best examples is the Netherlands, where a similar process of amalgamation of smaller systems into purely publicly owned regional water companies was accompanied by a voluntary benchmarking scheme. While there is no tariff regulation as such, there have been significant economies and efficiencies and the benchmarking system has been considered so successful that the scheme will be made mandatory.

operation as well as exploit potential resource and energy recovery as sources of revenue (see Water and Energy chapter). Fundamentally, cost recovery can only become reality if it takes place within a planning framework that allows fairly accurate forecasting of asset replacement costs.

The WFD has brought in a number of innovations with the aim of promoting economically sound policies, including planning and economic analysis at river basin level, extensive stakeholder involvement and a move towards water pricing that reflects the true cost of water provision (see Basin Management chapter). The WFD, if implemented fully, will put focus on water efficiency and pollution avoidance and potentially reduce the investment cost of water infrastructure, with greater emphasis on economic instruments such as tariffs and metering. Public participation and river basin authorities, acting as facilitators, are key factors in synthesising different national and local interests and knowledge to bring about cost-effective compliance with new environmental objectives. However, there needs to be better integration of economic planning and water resources management to ensure the right choices are made.

### Prioritising investments and mobilising finance through the River Basin Agency concept in France

Since the 1960s, France has pioneered the concept of planning and mobilising financial means around a river basin concept. Six river basin areas and six Agences de l'Eau (AdEs) have been created. These agencies represent a wide range of stakeholders and raise and manage funds by means of water extraction charges and pollution/treatment charges set by river basin committee.

The funds are used to cover the agency's operational costs and finance capital investments in the sector by providing operators with loans or subsidies. Water bills in France show the "levy" earmarked for capital investment as a separate item from the tariff to cover operating and maintenance costs. Projects approved for financing by the water funds receive a subsidy of up to 40% and a soft loan of up to 20% of the cost of the project, as well as technical support. In addition, a series of incentives are offered to operators that meet targets in terms of quality standards.

The AdEs encourage prioritisation of investments and planning at a basin-wide level and provide a way of passing a series of costs and risks associated with the financing of water projects on to consumers/taxpayers as a form of development fee that is not under direct control of the local government level. Because this is done not via general taxation but by means of earmarked taxes and "proportional levies", it is transparent and sustainable.

The Water Framework Directive provides the potential for marrying a basin level approach with cost-benefit analysis for Structural Funds, by making the river basin a common reference framework for water resource management and regional economic development planning.



Cost-recovery and prices need to "work" for water efficiency and vice versa. Awareness is increasing that incentive based instruments like water pricing and metering are effective tools to promote efficient use of water. Water efficiency will also bring down costs in the long run and make cost recovery easier to achieve by reducing or deferring investments for new water resources. Such demand-side measures are generally low-regret from a financial and environmental perspective. However, making cost recovery and water efficiency work together can be a significant challenge for a utility, particularly when starting from a point of inefficiency.

With metering, system and operational inefficiencies become separated from end-use inefficiencies, without significantly altering the basic cost structure and revenue needs of the utility or the fact that, ultimately, user and tax payers will pay all costs of addressing potential inefficiencies of the system. Introduction of demand-side measures, metering in particular, generally results in a fairly rapid decrease in per capita demand but the effect on fixed costs takes much longer to materialise since the utility is tied into existing infrastructure. There will be an inevitable upward pressure on tariffs that will often further accelerate demand reduction up to a certain point. The combination of a rapid drop in demand, meter-based billing and inertia in the necessary tariff adjustment is particularly dangerous for a utility.

The pace and method of metering and other demand side measures must be balanced with a tariff evolution or other cost recovery mechanisms that will ensure the ability of utilities to finance a sustainable level of infrastructure renewal plus any significant backlog; otherwise system inefficiency will become further entrenched along with loss of credibility with the public.

A proactive approach to financeability of the water sector needs to be taken and risks better managed. The public health and environmental obligations of the various stakeholders of the water sector only have meaning in so far as they are enforced



and are financeable, meaning that there is access to money when it is needed, and at a reasonable cost. With a need for low-cost long-term debt that can sustain continued investment and that is affordable in the long-term, there is a need to create and/or maintain a low-risk profile of the sector and utilities or to create mechanisms to subsidise or share these risks, in addition to whatever direct transfers may be applied.

The key strengths of a well-functioning and mature water sector are typically transparency of the business model (not too much diversification), monopoly (no competition risk), transparency of the rule setting process (low regulatory and political risk), and stable operating performance and low cash flow volatility. The key weakness of the sector is its continuous high need for external financing for large capital expenditure requirements.

The issue of solvency of water utilities is not a useful concept, since the assets are mostly not saleable and discontinuation of operations is a de facto non-option, with the public as the operator of last resort. Risk and pricing therefore come down to liquidity and the ability to service debt in a timely fashion. The core issue is the stability of adequate cash flow to sustain high levels of debt.

Examples of ways to ensure cost effectiveness, lower sector risks, ensure stable cash flows or directly lower the cost of finance include:

- **Sound planning and cost-effective design, including strategies for cost-effective compliance**, particularly under climate change and other uncertainties.
- **Technical and operational economies of scale** (interconnectivity, regionalisation of services, cooperation among municipalities).
- **Financial, managerial and operational improvement** of utilities
- A **reliable and transparent system of regulation** to ensure realistic objectives and to pass on well-justified costs to tariffs and taxes, with a sustainable long-term perspective. Facilitating the right level of tariffs, not low tariffs.
- **Systematic and targeted approaches to affordability.**
- **Direct guarantees from state or local government.**

- **Transparent, targeted grants or subsidies**, to blend with debt.
- **Financial economies of scale** through pooling of revenues, taxes or risk-sharing (e.g., multiutilities or corporate structures such as holding companies, etc.), including **financial intermediation** to address asymmetries in perceived risk and information and/or allow the pooling of borrowers and the application of whole or partial guarantees against stable revenues (e.g., water banks, dedicated funds, regional vehicles, etc.)
- **Clear concession regulations** to facilitate access to cheaper private finance for certain types of investment.

### Institutional reform to create a financial framework in Portugal

In the early 1990s, the Portuguese water sector was fragmented, consisting of more than 3300 municipal water supply systems, causing poor quality of services, poor absorption of EU funds, low effectiveness of investment and slow progress on public health and environment indicators. With the need to comply with EU environmental regulations and the availability of Cohesion Funds acting as strong drivers for change, Aguas de Portugal (AdP) was established in 1993 as a wholly public sector company with national responsibility for planning, coordinating and financing water projects.

The national authorities implemented a series of measures that included the territorial integration of water systems and merging of small existing local water systems into new regional infrastructural systems, managed by new regional water companies (multi-municipal systems). The role of AdP was to promote and finance systems for the bulk supply of water and the treatment of wastewater for consortia of municipalities, holding a majority share in the regional water companies.

The regional companies hold concessions of 25-43 years for the design, construction, operation and maintenance of bulk water supply and treatment schemes. They are financed by means of supply contracts for guaranteed volumes at set tariffs. Their financial health is based on the terms negotiated with the multi-municipal consortia that determine investments, quality standards, tariffs, the mechanism for distributing risks and the terms for early termination of the concession and the possible substitution of other operators. The water companies' risks are reduced by the commitment of the concession-granting bodies to safeguard the operators' economic and financial equilibrium. This is ensured by setting tariff levels that cover operating and financing costs, including a return on the capital invested.

The success of this new institutional solution was heavily dependent on municipalities' perception of a win-win situation. These new public-public partnerships (regional water companies), with a strong focus on cost-effective solutions and operating under a concession contract that assures their economical sustainability, could easily finance themselves through equity, commercial financing and EU funding. The reforms made it possible to speed up investment rates in the water sector, thereby ensuring the effective absorption of EU funds, allowing the compliance with regulations, the guarantee of good levels of service and increase of attendance levels and, at the same time, sustainable and cost-effective solutions.

Grants in the new EU Member States could be used to create long-term efficiencies. The EU-12 and candidate countries have varying timelines for the application and implementation of EU legislation. Significant structural funds are made available to fund regional economic development, with environmental infrastructure being eligible. While EU funds are a relatively minor source of funding in relation to the total investment needs of the water sector, they have the leverage to promote institutional change, create long term efficiency gains, promote more sustainable tariffs and address affordability issues.

In order to facilitate the absorption of grants and to ensure the financing of investments, governments also need to facilitate or create the right national financial and programming mechanisms – mechanisms that are flexible enough to operate in parallel with and complementary to a number of different sources of money, including structural funds. With, in some cases, limited fiscal space, state support can be used to lower the cost of capital made available to utilities through targeted subsidies or dedicated financial intermediary structures.

Absorption of grants in the new EU Member States could be improved. Consolidation of the sector – a process whereby smaller water service providers cooperate or are replaced by or associated with larger and stronger providers over a geographical area – is a logistical necessity for the implementation of the required investments and absorption of grants over the relatively short transition periods.

The term “regionalisation” can cover a number of consolidation models for a fragmented water sector. Many countries in Europe have undergone this process, including old EU Member States such as the UK, the Netherlands and Italy. The method of implementation can range from central appointment of operators to promoting association of local authorities using financial incentives or the implied threat of consequences from not fulfilling regulatory targets. Generally, the move towards regionalisation is accompanied by an effort to introduce a commercialised type of management and accountability. Regionalisation also necessarily implies a degree of cross-subsidisation and solidarity among the population. If adequate financial incentives are provided or substantial economies of scale in terms of costs can be achieved, win-win scenarios can be created.



In some cases regionalisation has involved the reconstitution of viable operators after a process of decentralisation of local government and water services, resulting in sector fragmentation. While decentralisation has the potential to bring political responsibility and accountability close to the consumer, it must be within an institutional setting that does not allow undue political interference in operational decisions or unrealistic objectives without financial means. Moreover, for it to work there also needs to be a credible enforcement of public health and environmental obligations.

The absorption of EU grants can also be improved through strong institutional structures that can adequately prepare and implement projects. In the EU, the JASPER (Joint Assistance to Support Projects in European Region) initiative helps new Member States prepare major infrastructure projects using EU Structural and Cohesion Funding.



## Regionalisation strategies in Europe to overcome fragmentation

The cases in Romania, Albania and Italy are illustrative of some of the legal and political issues of the regionalisation process. In the case of Romania, existing regional operators were broken up in the 1990s decentralisation process, leaving smaller towns with an overwhelming responsibility to provide sustainable water services under the prevailing financial and economic situation. Prior to EU accession in 2007, pilot projects to group small and medium towns around simple investments proved a testing ground for legal and institutional issues. Implementation of projects was fraught with systemic difficulties and threatened to undermine cooperation among the local authorities taking part. Nevertheless, there was a clear Romanian vision to strengthen the ability of the sector to absorb future EC funds.

The Romanian government then took the full step to make access to substantial EC funds after 2007 contingent upon the creation of publicly-owned corporatized Regional Operating Companies (ROCs) under long-term Delegated Management Contracts (DMCs) with Inter-community Development Associations (IDAs). The model had to comply with prevailing EC law on the direct award of contracts, generating a two-tier management model, with the IDA providing smaller towns with significant vote in investment decisions and supervision of the DMCs. In terms of access to finance, only few of the ROCs are strong enough to independently take on sub-sovereign debt. Borrowing is still largely dependent on explicit or implicit national or local government backing.

In Albania, following years of donor supported decentralisation and commercialisation of water utilities at local level, the national government is pursuing a similar regionalisation strategy. The country's 56 water utilities and approximately 600 rural systems independently run by communes have a significant potential for economies of scale. An essential part of the strategy has concerned the establishment and improvement of sector regulation, which is now under the responsibility of an independent institution, and of sector monitoring, which is now performed by of the general directorate for water and sanitation.

Experience from Italy has shown that regionalisation can be a long-term process that is fraught with many legal and political challenges. Fifteen years after the Galli Law of 1994 started a process to reduce the number of operators from over 8000 to 100, the amalgamation of operators in many *Ambiti Territoriali Ottimali* (ATOs) or optimum territorial areas is still ongoing. Many water companies are still owned or controlled by municipalities and suffer from an insufficiently skilled management and limited incentives for higher performance. So far, few operators have managed to access long-term private financing. The situation is particularly acute for small ATOs with low population densities, not served by multi-utility corporations. Many mono-water utilities are non-bankable due to the existing regulatory uncertainties. The result is that only multi-utilities, which diversify the risks among sectors and cross-subsidise the water sector, manage to invest in the sector at present.

There are several lessons to be drawn from the already significant body of examples of regionalisation. Regionalisation will only be successful if there is a sustained government-level commitment to the process and the result is a well-defined set of responsibilities for each actor. Benefits in terms of better access to finance will only accrue from regionalisation if the resulting legal situation is clear enough to provide low regulatory risk, and if the process improves performance and achieves sufficient scale in financial terms. For the most part, the need will remain for a proactive approach to financial support for weaker regions or during large investment challenges.

In the short term, vested interests or the general prevailing political and cultural environment may prevent voluntary associations among local authorities. However, in the medium term the pressure arising from the costs of effective enforcement of public health and environmental compliance, particularly as service areas extend outside the main urban agglomerations, will make some form of consolidation inevitable, unless a high level of financial and technical assistance is to be maintained indefinitely.

## Key messages

### Financeability of the Water Sector

A proactive approach to the financeability of the obligations of different water sector actors is required. The perception of the water sector as low-risk is critical for access to cheap long-term debt. Specific recommendations include:

- Minimising compliance costs and closer coordination of water resource management with economic development planning to ensure sound, cost-effective choices.
- Ensuring the continued ability for the water sector, in particular water utilities, to access cheap long-term debt, through a variety of institutional and regulatory measures as well as transparent subsidy mechanisms.
- Isolating some of the most contentious issues in the general debate over tariffs and taxes by creating targeted policies for the poor and minimum levels of service.
- Facilitating transparent debate on the allocation of costs for new major climatic related investments.

### Water efficiency, metering and cost recovery

Water efficiency, in terms of both quantity and quality, is a critical element of addressing water scarcity and potential climate risks as well as the long-term viability of water utilities. However, there is a need to pay proper attention to the cost structure of water utilities in order to make cost recovery work. Cost recovery can only become a reality within a planning framework that allows fairly accurate forecasting of asset replacement costs to a modern standard.

- At utility level, cost recovery pricing and metering will promote both system and end-use efficiency only if accounting practises, incentives and tariff setting are properly aligned with a sustainable level of infrastructure renewal.
- The pace and method of metering must be balanced with the ability of utilities to recover costs through a suitable tariff evolution or transfers.

## Particular challenges in new and future EU Member States

In new and future EU Member States, investments and tariffs need to be supported by effective enforcement, increased public awareness and creation of appropriate financial and institutional mechanisms: Leadership and direction is required to implement sector objectives. In order to achieve this, there needs to be a competent national agency with the necessary powers and skills.

- Grants, when used to create win-win scenarios, can overcome political barriers to necessary sector restructuring. They can thus be used to promote operational consolidation, cost-effective regional solutions and long-term efficiency gains. However, due care needs to be taken to create clear and effective decision-making structures.
- In the EU-12 and beyond, sector consolidation is a logistical necessity for the implementation of the required investments and absorption of grants over relatively short transition periods.
- Regulators can play a key role in bridging the confidence gap between the public, utilities and political decision-makers where large tariff increases are necessary to ensure sustainability.



# ANNEX 1

## Parties involved in the European Regional Process

This annex lists the parties involved in the European Regional Process. First, the authors and coordinators of the regional document are listed per chapter. Secondly, all the individuals and organisations contributing to the European Regional Process are mentioned.

Apart from the individuals listed here, we would also like to express our thanks to all the participants in the many conferences and workshops related to the European Regional Process. A full list of all the individuals taking part in these events was too extensive to add to this document, but is made available at the website of the European Water Partnership ([www.ewp.eu](http://www.ewp.eu)).

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# ANNEX 2

## References

This annex contains an overview of the sources used in writing the thematic chapters of the European Regional Document. Furthermore, a number of websites are given where more information can be found on the topics. For the sake of the length of the document, the websites mentioned in the chapters are not repeated here.

### Regional Overview

#### Websites

Council of Europe, [www.coe.int](http://www.coe.int)

European Environmental Agency, [www.eea.europa.eu](http://www.eea.europa.eu)

Eurostat, [ec.europa.eu/eurostat](http://ec.europa.eu/eurostat)

Global Health Facts, [www.globalhealthfacts.org](http://www.globalhealthfacts.org)

Global Water Intelligence, [www.globalwaterintel.com](http://www.globalwaterintel.com)

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University of Bonn, [www.uni-bonn.de](http://www.uni-bonn.de)

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Chartered Institute of Water and Environment Management, [www.ciwem.org](http://www.ciwem.org)

Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall, [www.dwa.de](http://www.dwa.de)

French National Water Training Center, [www.oieau.org/cnfme](http://www.oieau.org/cnfme)  
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### Further information on the case studies in the chapter can be found at:

Climate change adaptation R+D: <http://peseta.jrc.ec.europa.eu/>, [www.adamproject.eu/](http://www.adamproject.eu/), [www.environment.fi/default.asp?contentid=300867&lan=EN](http://www.environment.fi/default.asp?contentid=300867&lan=EN)

Flood safety along the River Tisza, Hungary: [www.tizariver.com](http://www.tizariver.com)

Germany: [www.anpassung.net](http://www.anpassung.net)

Guidance on flash flood management: [www.apfm.info/pdf/pilot\\_projects/APFM-CEE-Synthesis\\_web.pdf](http://www.apfm.info/pdf/pilot_projects/APFM-CEE-Synthesis_web.pdf)

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Transboundary mapping of groundwater resources: [www.whymap.org/](http://www.whymap.org/)

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[www.defra.gov.uk/environment/climatechange/uk/legislation/](http://www.defra.gov.uk/environment/climatechange/uk/legislation/), [www.ofwat.gov.uk/pricereview/pr09phase1/](http://www.ofwat.gov.uk/pricereview/pr09phase1/), [www.environment-agency.gov.uk/subjects/waterquality/2004943/?lang=\\_e](http://www.environment-agency.gov.uk/subjects/waterquality/2004943/?lang=_e)

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EU Floods Directive, [ec.europa.eu/environment/water/flood\\_risk](http://ec.europa.eu/environment/water/flood_risk)

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EU Water Framework Directive, [ec.europa.eu/environment/water/water-framework](http://ec.europa.eu/environment/water/water-framework)

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ENERGYSTAR, [www.energystar.gov](http://www.energystar.gov)

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Svan label, [www.svanen.nu](http://www.svanen.nu)  
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Water Footprint Network, [www.waterfootprint.org](http://www.waterfootprint.org)

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AWIS - African Water Information System, [www.african-wis.org](http://www.african-wis.org)

EMWIS - Euro-Mediterranean Information System on know-how in the water sector, [www.emwis.org](http://www.emwis.org)

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GWP-Med, [www.gwpmed.org](http://www.gwpmed.org)

INBO - International Network of Basin Organizations and its regional networks (CEENBO, MENBO, etc), [www.inbo-news.org](http://www.inbo-news.org)

INWTC - International Network of Water Training Centers, [www.inwtc.org](http://www.inwtc.org)

IOWater - International Office for Water, [www.iowater.org](http://www.iowater.org)  
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RWTH Aachen University, [www.rwth-aachen.de](http://www.rwth-aachen.de)

Water Information System for Europe, [water.europa.eu](http://water.europa.eu)

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### websites

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# ANNEX 3

## Communiqué from Sub-Regional Meeting on “Education, Knowledge and Capacity Building in Water Issues”, Ukraine 10-11 October 2008

We, the 42 participants from Ukraine, Byelorussia, Moldova and Turkey of the Sub-Regional Meeting “Education, Knowledge and Capacity Building for Achieving the Millennium Development Goals within Sub-Region”

Having met in Kremenchug, Ukraine 10-11 October, 2008;

Concerned about the proper implementation of MDGs in terms of right for water, access to clean water and role of education, knowledge and capacity building in the process within the Sub-region;

Having noted with grave concern that during the current ongoing transition period of Sub-regional countries it has still not been possible to address the urgent and complex problem of water issues, in particular regarding the ensuring human rights for clean water;

Reaffirming Principle 16 of the Rio Declaration on Environment and Development which states that national authorities should endeavor to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without adversely affecting international trade and investment;

Reiterating the commitment to the goals of the Johannesburg Declaration on Sustainable

Development and the Plan of Implementation adopted at the World Summit on Sustainable

Development in Johannesburg, South Africa, September 2002;

Committed to the principles of EU Conception on Education for Sustainable development, international movement regarding Human rights for Water and European Regional Process to the Fifth World Water Forum

Taking note of necessity for ensuring participation of Sub-regional countries in the process where strong concern about the water problems and rights for water state-of-the art exist along with not sufficient state of Water Technology and Science;

### Define the following main problems within the Sub-Region:

- Lack of understanding of human rights for water in particular at the local level which is illustrated by number of cases of their violation;
- Weak involvement of Ukrainian youth in the process who are responsible for future water;
- Low level of water monitoring and weak public access to data base;
- Lack of effective stimulation of precautionary principles, currently all efforts are concentrated on elimination the consequences of water contamination
- Weak using of biotechnology for water purification

### Suggestions for problem solving:

- encouraging youth involvement in the process including the creation of international network between Eastern European and Western and Central European Youth;
- stimulating participation of Ukrainian youth in the preparation process toward 5th WWF;
- attracting attention to rights for water among broad stakeholders including local governmental officials and university faculty, journalists by providing a number of training programs and broad media campaign;
- stimulating of the broad information campaign and advisory service regarding interconnection between rights for water violation and state of human health;
- strengthening research concerning biochemistry and biotechnology for water purification;
- supporting efforts for improving state of water monitoring

## **Created the following Messages to the 5<sup>th</sup> WWF:**

### **“Youth is the best investment for Future Water”**

### **“Full recovering of used water properties”**

Call on all stakeholders, public or private, international and European institutions to actively support efforts, applying the principle of common but differentiated responsibilities, to implement solutions of the Sub-regional meeting of Eastern European countries and to deliver threats and challenges of the countries to the 5th WWF participants;

Recommend that, consistent with the already expressed European and international concern regarding the region, donors, including the EU Commission and the GEF, World Bank should be encouraged in their funding priorities and budgets, enabling support for the start up and later implementation of selected aims within Sub-Region;

Recommend that a Working Group be established to develop a Programme of Action within Sub-Region, to enable concerted actions in collaboration with governments, appropriate national and international organizations, and other stakeholders, including professional and public interest organizations and industry, youth. Recommend further that this working group should start its multilateral activities without delay;

The participants express their appreciation for the excellent organization, facilities and hospitality, provided by the Sustainable Development and Ecological Education Center, Ukraine and Kremenchug Tech University, Ukraine and US Embassy in Ukraine for financial support of the event.

## ANNEX 4

# Water for a sustainable Europe – our vision for 2030



We have achieved sustainable water resource management and universal access to modern and safe water supply and sanitation because we value water in all its dimensions – in its economic, social, environmental and cultural importance.

*The Water Vision for Europe aspires to be a Vision for all people in Europe and around the globe. The Vision is formulated from a people's perspective in a positive and proactive manner that seeks to encourage ownership by all. Putting people and values at its core, the Vision departs from the premise that only if we mobilise people and stakeholders around common values we will be able to achieve sustainability with regards to water in Europe. It desires to unite and stimulate people and stakeholders to act in partnership in order to solve Europe's water problems and to contribute to solutions that will address the global water crisis.*

*The Vision serves as guidance to reach joint actions in the different partnerships on advanced water management and to solve the water problems in Europe and globally. It is underpinning both programmes of Aquawareness - the European Water Awareness and the Water Stewardship Programme. The postulates of the Vision will serve as a basis for the concrete project settings of both programmes: as a source for awareness activities and as a basis to define principles of sustainable water management for best governance tools of the stewardship programme.*

*The Vision, which was initiated by the European Water Partnership (EWP) in 2008, was elaborated in an open multi-stakeholder process, including representatives from the EU Commission, the EU Presidency, the EU Parliament as well as leading multinationals and NGO's. It was handed over to the European Union Institutions on 30th June 2008 during the launch of Aquawareness.*

*After this expert view on the basic vision text, a broad discussion, dissemination and commitment of a maximum of stakeholder groups throughout Europe was crucial. Therefore, a regional consultation process across Europe was launched by the EWP providing the opportunity to add region-specific points. Four regional workshops took place in Castellon (Spain), Copenhagen, Vienna and Brussels. Within these workshops the following outcomes were pursued:*

- o to generate joint commitments towards sustainable water management, set up by the stakeholders of each region,*
- o to include region-specific points*
- o to set up a map of actual projects/ activities implementing the vision aims*
- o to identify the main obstacles to the implementation of the vision aims*

*The Water Vision for Europe, enriched by the region-specific points, will be presented on a global level during the 5th World Water Forum in Istanbul. In the meantime, and as a follow up after the Forum a status quo on where Europe stands on water and a gap analysis on obstacles hindering the realisation of the Vision-aims will be started within a Vision mapping process. On the basis of this Vision mapping a guidance document with recommendations for actions for the incoming European Commission and European Parliament will be prepared and handed over in autumn 2009.*

*The Vision serves as the valuebase for the European Water Partnership in all its projects and initiatives as well as in its relations with its partners.*

*The basic text of the Vision, as was presented on the 30th of June in Brussels, can be found below.*

## Water Vision for Europe

1. We treat water as our common heritage with an economic, social, environmental and cultural value for our societies. Water is not a commodity like any other one – it's a fragile resource which can not be replaced and we protect and preserve it for future generations to sustain our societies, our economies and the environment. Water sustainability is crucial for us.
2. Water is an essential human need and we recognize the access to basic water supply and sanitation as a human right. The people in Europe have universal access to safe, modern and affordable water and sanitation services. At the same time we are able to satisfy the other human water needs – for businesses, industry, agriculture and recreation and have achieved a balance with needs of the environment also with regard to sustain biodiversity. We can rely on essential ecosystem services from our healthy rivers, lakes, coastal waters and wetlands and our people can also enjoy high quality rivers, lakes and coastal waters for ecologic and recreational purposes.
3. We manage our water resources sustainable within river basins across political boundaries including transboundary waters and we apply an integrated adaptive water management approach. All the stakeholders including all inhabitants in the basin participate actively in the management decision process. We apply a preventive approach which integrates quality and quantity as well as surface water, groundwater and coastal waters. We have adopted and implemented ambitious legislation such as the Water Framework Directive and other related legislation and made other policy areas such as agriculture, regional, industrial, trade, transport and energy policy 'water sensitive'.
4. We have achieved a true 'water democracy' where we apply the principles of transparency, integrity, solidarity and equity and where all people and stakeholders are aware of their rights and responsibilities. Our well informed people use their freedom of choice wisely - what they drink and how they use water - and use their opportunity to participate actively in the governance of water management and services. The people have a say in the quality and organization of their services and our services are efficient and sensitive to environmental and social needs.
5. We have jointly achieved a culture where water resources are not wasted, spoiled or overused. We have actively pushed a paradigm shift from supply driven water management to an integrated supply and demand driven approach as well as from an end of pipe to a preventive approach. We are able to satisfy most of our needs with water resources within the same river basin.
6. We have achieved a change of mindset, attitude and practices through raising water awareness and the application of appropriate instruments and incentives. Proven sustainable water practices, pricing and charging policies, transparency about water footprints of individual, industrial, agricultural and local authorities' practices and of products have been useful instruments in achieving a modern water efficient society.
7. Water services have a price. We pay for services and for the uses and our pricing policies are guided by transparency, sustainability, efficiency as well as a social and environmental

approach. We use water pricing and other economic instruments to achieve sustainable water use.

8. We are coping with the challenges of climate change as well as with the natural phenomena such as floods and droughts as we are continuously improving our adaptive, integrated management approach and we adapted our infrastructure and practices. Our infrastructure is planned, constructed, operated and maintained in an efficient and environmental and social acceptable manner based on a long term perspective.

9. We apply appropriate technologies and have thereby continuously improved our water efficiency and minimized pollution to a level which is negligible with regard to human and environmental health. Communities, agriculture and industry enjoy the economic and social benefits of a high level of water productivity by applying recycling technologies, closed production cycles and efficient irrigation techniques and other technologies. We promote and conduct research and development to continuously improve our know how on adaptive integrated management and innovative technological solutions and have achieved a fast track to bring those technologies to the markets.

10. Europe is a responsible partner in the world that actively promotes and supports the achievement of sustainable water management and universal access to water supply and sanitation in all countries. We have understood that sustainable water management is key to peace and security and to eradicate poverty and have made water a priority of our foreign and development policy. Our trade and economic policies have integrated water issues and we have significantly reduced our global water footprint to a level that is sustainable.

## 5<sup>th</sup> World Water Forum Secretariat

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