Water Challenges for a Changing World

Joint Programming Initiative

Under an average economic growth and an actual efficiency improvement of 1% a year, the world wide water demand and supply gap will be approximately 40% by 2030.

Charting Our Water Future (2009)
The 2030 Water Resource Group

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1. Knowledge without boundaries

In 2008, the European Commission presented a new policy: 'Towards joint programming in research' with the meaningful subtitle 'Working together to tackle common challenges more effectively'. They challenged countries to develop initiatives on joint programming with the purpose of increasing the efficiency and impact of national public funding in strategic areas. Joint programming targets public research programmes first and foremost, which means public-public cooperation. This proposal is a first step to progress in the direction of the definition and implementation of common research agendas with jointly agreed-upon multi–annual activities and funding mechanisms. This document deals primarily with research in the field of water and hydrological sciences. The availability of water in sufficient quantities and adequate quality is indeed a public issue of high priority and addresses a pan-European and global environmental challenge.

The need for the development of an efficient and effective common public research programme dealing with water issues is obvious. The demand for water grows faster than the world population. In the coming bio-based economy, anticipated to emerge in the 21st century, agriculture will become as an even more intensive water user. This means that, in situations of relative scarcity, competition between the different user groups (agriculture, municipalities and industry) will be strong. This will also have a great impact on European ecosystems. Satisfying water users under increasing scarcity will require not only effective use and accelerated development of science and technology, but also paying more attention to integrated water management. To be successful in overcoming problems like water resources depletion and water scarcity, Europe needs to cooperate intensively on water research.

In addition, climate change is expected to have a strong impact on Europe, affecting the intensity and the spatial and temporal distribution of temperature and precipitation events. The variability in precipitation is also expected to increase, leading to a higher probability of extreme events such as droughts and floods. For instance, according to the European Commission, between 1998 and 2004 Europe suffered over 100 major damaging floods, which resulted in some 700 deaths and at least € 25 billion in insured economic losses. By the end of the century, the costs of flooding in Europe could increase to over 100 billion each year (CRUE ERA-NET). Between 2000 and 2006, 15% of the EU area and 17% of the EU population were affected by droughts. To illustrate the economic impact of drought, suffice to say that the 2003 drought produced economic losses in excess of € 8.7 billion.

2. Themes for the Joint Programming Initiative

2.1 Introduction

In order to achieve successful European cooperation, common strategic themes need to be defined. This will lead to breakthroughs in water science and technology. Joint research themes must go beyond the demand of individual countries, aiming for research efficiency and effectiveness. JPI will facilitate synergies and complementarities of current EU, national and regional initiatives.

2.2 Quantity and quality

Overexploitation of resources originates from unbalances in water demand and availability. This leads to a decrease in quantity and even low-quality water resources. Multiple causes have been identified, including population growth, urbanisation and increased agricultural intensity. In European cities there is a high demand for drinking water and water treatment, concentrated in a relatively small area. Additionally, due to soil paving and urbanisation, rainwater often does not infiltrate into the soil and groundwater. In coastal areas, groundwater depletion can lead to undesired effects such as salinization of groundwater by sea intrusion. The intensification of agriculture results in increased demand for irrigation water. Part of the exhaustion problems can also be caused by existing infrastructure which is aging and deteriorating (e. g., leaking water works). Finally, the price of water can contribute to water exhaustion. Since water prices are relatively low, wasting water has little impact on the economic results of many activities. Additionally, low water prices hamper the introduction of new water technologies.

Water pollution can be traced to a number of economic activities, such as industries, agriculture and urban use. The use of fertilizers in agriculture and the mobilization of soil and water salts result in raising nutrient levels in surface and groundwater. Particular attention needs to be paid to Nitrogen, a very soluble fertilizer, which is responsible for the pollution of water bodies all over the world. Pesticides are not only polluting many water resources, but also soils which accounts for future pollutions to water. Storage and use of chemicals, gas and oil can also lead to soil and groundwater point source pollution. Finally, emerging contaminants (e. g., hormones and pharmaceuticals in general but also cosmetics and nanoparticles) come up as a growing problem.

The geochemical background quality of groundwater bodies, including trace elements and natural salinity, may prohibit a variety of human uses and further decrease the availability of freshwater resources thus adding on water stress in water scarce regions. Release of geogenic elements like fluor, arsenic and heavy metals may be triggered by human activities (e. g., fertilisation, overexploitation of coastal aquifers leading to saline intrusion) and represent an important threat to human health (fluorosis) as well as for agriculture.

2.3. Extreme events

Drought and floods are to a great extent natural traits of European climates, but are accentuated by human activities and by climate change. Human activities affecting drought and floods are for example the canalisation of rivers, changes of natural landscape through deforestation and an increase in soil paving. Climate change will render extreme river floods more frequent, particularly in the central, eastern and northern parts of Europe, and will increase flash-floods in mountainous and coastal areas. An additional effect of flooding is the pollution of rivers and groundwater resulting from the overflow of toxic waste sites. In deltaic and lowland areas floods from the sea (storm-surge) will periodically induce mixing of seawater with fresh groundwater leading to brackish conditions in coastal aquifers. Droughts and floods have a clear impact on the quality of European ecosystems and result in a variety of societal losses which are not always evident or easy to evaluate.

Technological and ecological solutions are an imperative condition, but do not represent a sufficient condition. Research is also needed in societal aspects such as governance and behavioural sciences.

3. Challenges

3.1 The grand challenge

The grand challenge is to achieve a sustainable water balance for a sustainable economy in Europe and abroad.

The main challenge of this JPI is certainly ambitious, as it addresses a number of issues of significant importance as the above mentioned bottlenecks (i. e., water quantity and quality and extreme events) facing European water. Firstly, there is a growing gap between global water demand and water supply. The fast approaching bio-based economy will exert pressure to enlarge this gap. Secondly, with growing water demand and the discharge of waste water to the environment, our ecosystems will be threatened by overexploitation of water sources and increased pollution. Thirdly, due to climate change, drought in some areas and flooding in others will also damage the ecosystems and society as a whole.

An active policy on common research in Europe can create a strong and coordinated, scientific and economic position in the global water sector on the protection and value of water, which would be of mutual benefit and interest and transferable to the rest of the world. Additionally, this can also contribute to meet the needs of developing countries via technology transfer for example.

3.2 Economic challenges

In 2020 Europe is the most competitive water sector in the world.

Since water is a scarce resource, water issues should be dealt with in a more environmentally sustainable manner from both a technological and socio-economical perspective. The size of the world market is estimated at $ 463 billion (Goldman Sachs). This figure includes pumping stations, filters, conveyance structures and related purification and sanitation equipment. The European water sector is of prime economic importance, and it offers jobs for thousands of citizens across Europe. Investments in water technology around the world increase every year, in a market which has become very competitive. The European water industry can benefit from this market, developing customized solutions for site-specific problems. To be competitive, investments in generating knowledge and its valorisation are essential. In fact, the analysis of water technology deployment in the last decades permits to conclude that the risk of ineffective investments is high if the water system is not properly understood. Since water is a scarce resource, water issues should be dealt with in a more environmentally sustainable manner from both a technological and socio-economical perspective. Particular attention will be paid to water pricing, so that the cost recovery principle of the Water Framework Directive (WFD) is fully implemented. Water costs should take also into account ecosystem services. This Joint Programming Initiative will cooperate with the Water Supply and Sanitation Technology Platform (WSSTP) and related stakeholder networks to increase the efficiency and uptake of the research and development capacity of the European water sector.

3.3 Ecological challenges

Enhancing the absorbing and self-purification capacity of the landscape and water ecosystems to reduce the emission of pollutants.

The anthropogenic pressures and the degradation of biological integrity of ecosystems contribute to a large extent to the decrease of water resources. Overexploitation and degradation of the biotic structure alters ecosystem processes, decreasing ecosystem ability to provide resources to society. The ecological challenges include among others the preservation and protection of waters as a crucial asset for sustainable development. These challenges may be illustrated by the fact that the landscape of the Baltic Sea countries generates almost 60% of the total load of nutrients to the Baltic Sea. This represents two times more nutrient loads to the sea than the combined point sources (industry and cities). Increase of nutrient loads to lakes and streams can trigger the formation of toxic cyanobacterial blooms. The presence of these bacteria reduces water quality, increases the costs of water treatment, generates serious threats for human health and reduces the regional economic potential (i. e., ecosystem services such as biodiversity, tourism, recreation and landscape and aesthetical cultural values). Dioxins and permanent organic pollutants constitute the second threat for the landscape. These compounds tend to accumulate in the food chains and may affect fisheries and human health. Extreme events such as droughts and floods also have a clear impact on the health of European ecosystems (e. g., increased pollution, brackish groundwater, etc.).

3.4 Societal challenges

Every citizen must be provided with clean drinking water and proper sanitation.

European citizens need protection from new and emerging water pollutants.

Access to water is a basic need. Its quantity and quality affect the health and well-being of European citizens, and this is of course strongly related to economic strength. Raising awareness amongst water users is an important issue. European citizens need protection from new and emerging water pollutants. Sanitation needs to be extended and intensified, improving connections to centralized systems and focusing on cities established near threatened water bodies. Water re-use and nutrient recovery from municipal, industrial and agricultural waste water offer economic advantages and societal gains. Meeting these challenges will additionally help to achieve the goals of the Water Framework Directive (WFD) related to integrated water resources management. Advocacy and mediation will be required to make new technologies socially acceptable. For instance, the use of non-conventional water resources - such as sea water or brackish water desalination by reverse osmosis - has potential to solve specific problems of European citizens. However, this technology is very energy consuming and has a negative effect on carbon gas emissions, and it will lead to a high water price, thus affecting its acceptance. Moreover, large amounts of brine (concentrated salt effluents, potentially affecting aquatic life in the sea) are produced.. Technological adjustments and case-by-case analyses will be required to ensure that European citizens are willing to enjoy the benefits of this and similar technologies. User interaction has also been recognized as a key element to develop widely accepted water policies. The JPI must strive to integrate the experience and perspectives of the persons involved in the different aspects of the water cycle.

3.5 Technological challenges

Joint research on health risks must lead to major breakthroughs in drinking water technology and sanitation.

Joint research must lead to reducing energy input in desalination and water treatment processes and co-generating energy in processes such as sewage treatment.

The current development of water technology is insufficient to meet the main goal of this JPI. Consequently, major scientific and technological breakthroughs are needed in all areas of water use. Crossovers are required with related scientific fields, such as energy, sensors, nanothechnology and health. Examples of the required multidisciplinary approach are the growing concern about immuno-resistant microorganisms in European water bodies, the need to recover phosphate and nitrate fertilizers from wastewater and the increasing energy prices. These challenges will force science to explore integrated processes to develop new water sources reducing energy input in desalination processes and co-generating energy in processes such as sewage treatment. The members of the water JPI have expressed a strong interest in trans-national co-operation has been found in the members of this JPI. This interest will need to be extended to related scientific fields to build the multidisciplinary resources required for the development of new water technologies.

4. Proposing GPC members

At this stage, the water JPI is proposed by Spain and The Netherlands and supported by the following Member States and Associated Countries:

- (AT) The Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW).
- (CY) The Cyprus Institute (CyI), The Energy, Environment and Water Research Centre (EEWRC).
- (DE) The German Federal Ministry of Education and Research.
- (ES) The Spanish Ministry of Science and Innovation.
- (FI) The Finnish Funding Agency for Technology and Innovation (TEKES) and the Academy of Finland (AKA).
- (FR) Minister of Ecology, Energy, Sustainable Development and Sea.
- (HU) The National Office for Research and Technology.
- (IE) Environmental Protection Agency (EPA).
- (IT) The Italian Higher Institute for Environmental Protection and Research (ISPRA).
- (NL) The Dutch Ministry of Economic Affairs.
- (PL) European regional Centre for Ecohydrology u/a UNESCO / PAS.
- (RO) The Romanian National Authority for Scientific Research (ANCS).
- (SE) The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS).
- (TR) The Scientific and Technological Research Council of Turkey (TUBITAK).

5. Objectives

5.1 General objective

Member States and Associated Countries will move into the direction of defining and implementing a common research agenda with multi-annual commonly decided activities and funding mechanisms.

Research efforts on water must be increased with the objective to serve the needs of the people involved in management and decision-making as well as providing information and results to wider audiences.

To achieve a number of goals at local, national and European levels, for example defining and achieving good ecological status, adapting to climate change, halting the loss of biodiversity, ensuring sustainable and equitable management of water resources, providing good governance frameworks for water and sanitation services, etc., we must be able to understand processes, use diagnostic tools and scenarios to predict and anticipate the future, measure discrepancies between current status and objectives, and finally prioritize and set guidelines for corrective action and measures. Moreover, in order to achieve water policies' milestones, increased efforts are required for reaching efficient articulations of policies, scientific and technical inputs. The JPI will seek to improve and efficiently promote efficient

Science Policy Interfacing (SPI) and Technology Transfer, in setting research agendas and programming research based on better definitions of research needs from decision-makers and managers, and inversely, in ensuring that R&D groups produce usable results, which can then be taken up by managers.

In the field of integrated water resource management, this JPI aims at boosting Europe's ability to address major economic and societal challenges, the resolution of which depends critically on research in a various number of disciplines. Therefore, the JPI targets the development of a common strategic agenda and its best possible implementation with clear and SMART milestones and deliverables. Member States and Associated Countries associated to this JPI will move in a coordinated way towards the definition and implementation of common research agendas with multi-annual and commonly decided activities and funding mechanisms.

Under the aims of the current Water Framework Directive there is a strong collective need to build a comprehensive and shared vision of the water system such as to bridge its technological, environmental, political and institutional organisation, while taking into account geographical, historical, social and economical perspectives. The Framework Directive has introduced policies, decisions and actions aiming at achieving the principles of integrated management in the field of water resources and systems. Achievements of its goals remain uncertain mainly due to the difficulty to apprehend the intricacy and intertwining of geographical boundaries, spatial scales, differences in governance modes, institutional and cultural settings, stakeholders, activities, state of aquatic environment, evolution of water bodies and their pressures.

As detailed in previous sections, the water JPI proposes to address the themes of water quantity and quality and extreme events, for which four main challenges have been identified namely: economic, ecological, technological and societal challenges.

All the objectives of the proposed water JPI, detailed below, are in compliance with the EC document 'Towards Joint programming in research'(COM 2008, 468 final).

5.2 The bio-based economy

Prevention of the negative effects of the bio-based economy on the water system.

The renewed EU Sustainable Development Strategy (2006) reaffirms the strong political willingness from the EU to move into the sustainable path where environmental protection goes hand in hand with economic prosperity and social cohesion. The strategy defines Sustainable Consumption and Production, Climate Change and Clean Energy as being among the key challenges for Sustainable Development in Europe. In European terms, eco-innovation is a key development strategy and is regarded as a major opportunity for the EU economy.

There is a strong transition towards what is currently called the bio-based economy. In the coming years to come biomass will become a key raw material for energy generation and for the synthesis of bio-polymers. Biomass production will have a major effect on the water system. This for example is the case in the Amazons where rain forest is being replaced by fast growing species like eucalyptus. Changes in land cover trigger a number of changes,

including increased water consumption and desertification. Implementing a bio-based economy in Europe will have an impact on water availability for industrial purposes and municipalities.

Joint research is therefore needed to prevent and decrease the negative effects of the bio-based economy and find a new balance in the water system.

5.3 Sustainable ecosystems

Searching sustainable balance in the ecosystem.

As mentioned above (section 3.3), pollutants like Phosphorous and Nitrogen are causing damage to the natural balance of the European ecosystems. The development of new technologies (e.g., membrane technology) will permit to retain certain pollutants and re-use them as raw material for fertilizers and industrial by-products.

Some water-related effects of climate change (e. g., increase of floods and droughts) are threatening ecosystems. The aims here are to develop methodological tools, indicators and complex models for monitoring of threats, risk assessment and early warning. It is also envisaged to develop cause-effect and feedback analyses and to enhance and strengthen ecosystem resilience to stress with regards to human pressures. Additional objectives will aim at integrating ecosystem regulation in the management process and at identifying systemic restoration solutions taking into account the good ecological status concept. The target is not to eliminate the threats to ecosystems, but to amplify the control and regulation capacity of nutrients and water cycling at the river basin scale.

Joint research is therefore needed to achieve a sustainable balance in the ecosystem.

5.4 Healthier water systems for a healthier society

New contaminants like new viruses and hormones are threatening water quality and thus societal wellbeing.

What are the (new) contaminants such as polar compounds, pharmaceuticals or new viruses? How can we predict their environmental behaviour and treatment (e. g., based on quantitative relationships between the chemical structure of substances and their activity, QSAR's) and what impact do they have on human health? To what extent are these (new) contaminants removed by natural processes in water and soil, or by physical techniques in drinking water treatment, (e. g., ion exchange, membrane filtration, activated carbon filtration, zeolites, nanotechnology, UV technology and oxidative processes)? Have water chemistry and the biological stability of drinking water an effect on microorganism growth (e. g., *Legionella*)? How can the quality of the produced water be maintained in the distribution system? Which health risks could result from new water (chain) concepts such as supply of hot water, cooling towers, water reuse and water in the city?

Joint research is therefore needed to improve our knowledge of new contaminants, like viruses and hormones, and their impacts on water quality and societal well-being.

5.5 Closing the water cycle

A growing scarcity of fresh water will emphasize the need of closing the water cycle.

Factors such as the increase of agricultural activities for the production of biomass or the growing world population will soon result in fresh water becoming even scarcer. Closing the water cycle seems to be an efficient method to meet the problem of scarcity. But, is it that easy? Closing the water cycle requires an integration of methods and measures to reach a unique goal: sustainable use of fresh water. In a number of areas including industrial agriculture the economic incentive for closing the cycle does not exist, due to the low price of water. The demand for closed water systems is obvious in arid areas, where research institutes are currently working on new concepts and technologies.

In this field it is necessary to deepen in the concept of water footprint, establishing practical methods and certifiable systems. Besides the development of new reliable technologies (such as membrane technology) it is also necessary to investigate the use of new materials and concepts such as Management of Aquifer Recharge (MAR) or Soil-Aquifer Treatment (SAT) and to promote the recovery of raw materials from waste water. Research leading to the achievement of this objective will bring economic, societal and ecological advantages.

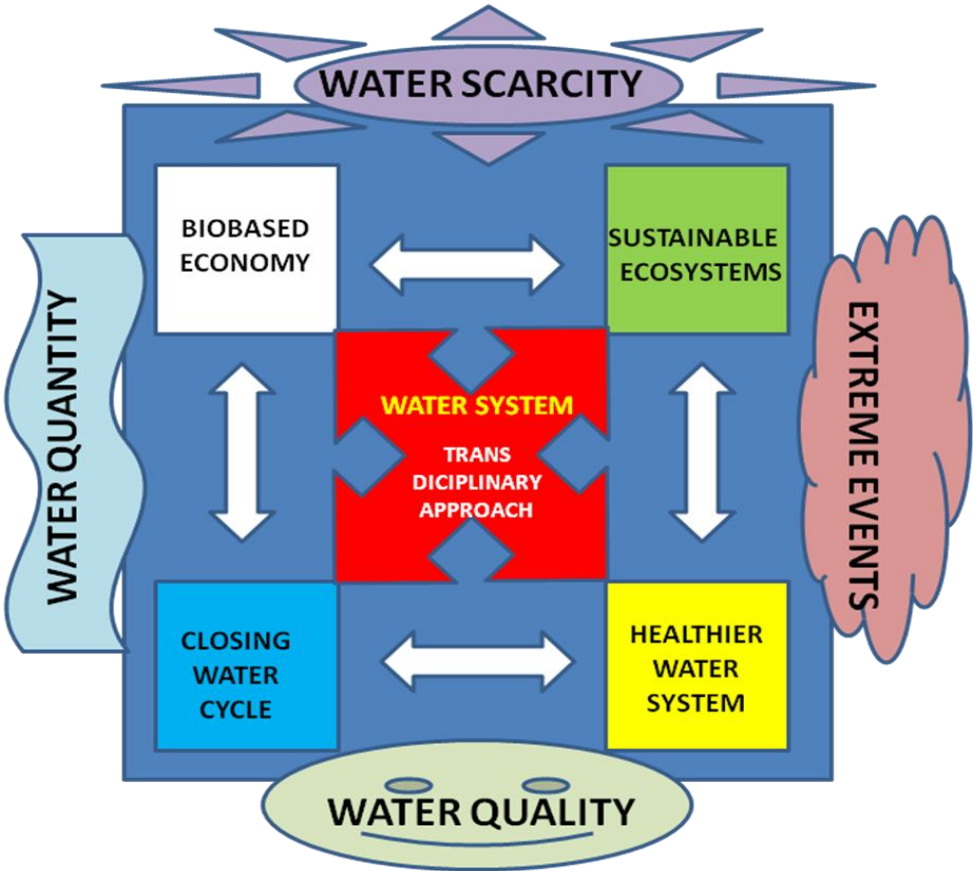
Finally, it is worth to mention that we will take care of the dissemination of knowledge to all water stakeholders including the public.

6. Research questions being addressed

6.1 Main research questions

In line with the JPI objectives, research questions can be subdivided in the four categories:

- The bio-based economy;
- Sustainable ecosystems;
- Healthier water system for a healthier society; and
- Closing the water cycle.

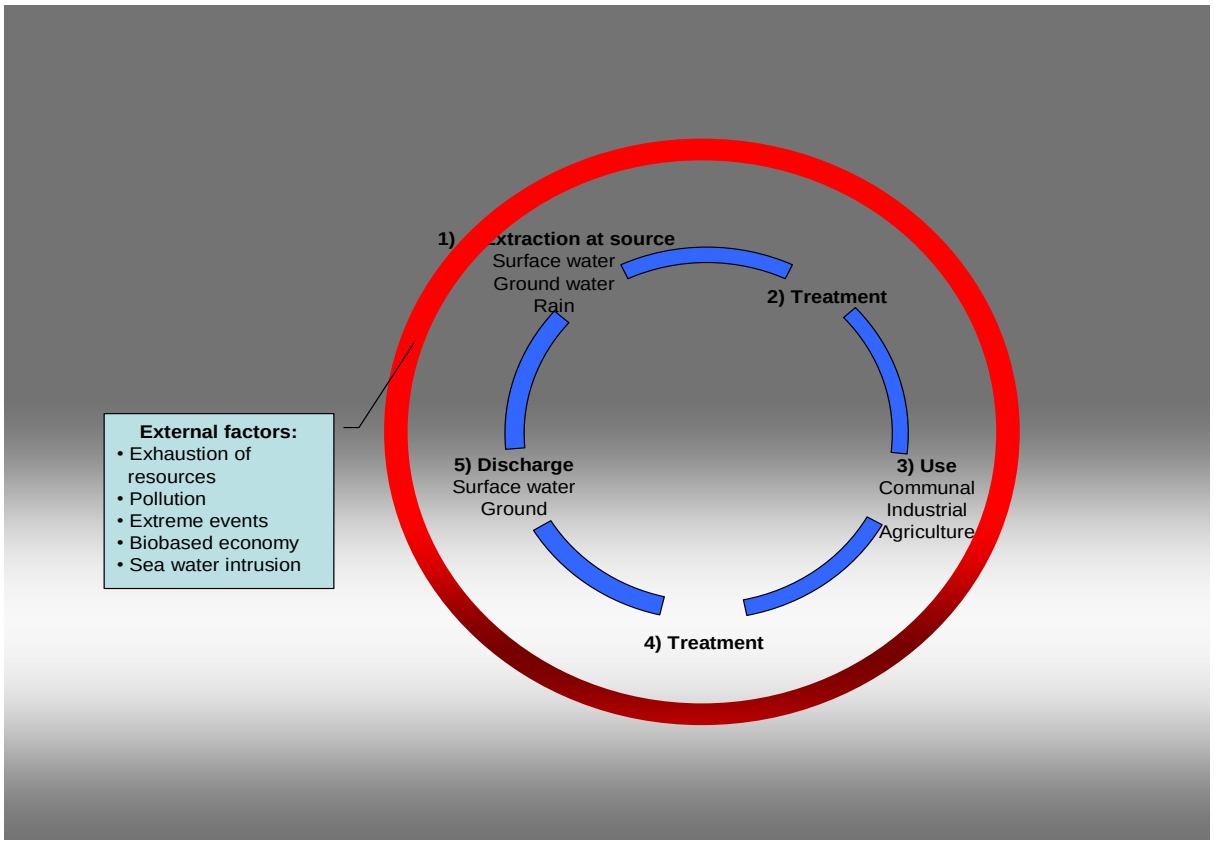


6.2 The bio-based economy

The most obvious effect of the bio-based economy is the intensification of agriculture. This also means intensification in water use, herbicides and fertilizers. However, the bio-based economy has not been fully deployed yet. As a consequence, joint research on this question will be timely to prevent and decrease its effects and to find a new balance in the water system. Concepts such as water footprint or the complete understanding water abstraction effects on European ecosystems need to be developed through joint research.

6.3 Sustainable ecosystems

In order to achieve a sustainable water balance we first need to establish the influence of external factors on the water cycle. When water is used or consumed, water is transported, treated and discharged to water bodies that can again serve as a source for water diversions. A simplified picture of the water cycle is depicted below.



The external factors that have relevant influence on the cycle are:

- Exhaustion/overexploitation/depletion of resources by citizens and industry,
- Pollution,
- Climate changes, inducing short to long-term variations of the water availability (including extreme events)
- The developing bio-based economy and
- Sea water intrusion.

Meeting present and future demands concerning quality and quantity of water for different purposes (citizens, agriculture and industry) requires deeper knowledge in two major areas. One is on the links between water and society, and the other is on appropriate technological, organizational and management solutions to the variety of ecological, societal and economical alterations currently in process and in which water plays a major role.

In order to achieve optimal water distribution and use without causing quantitative or qualitative overexploitation, an integrated and trans-disciplinary research approach is required.

6.4 Healthier water system for a healthier society

Clean water is probably the world's best medicine. Water quality is currently threatened by emerging pollutants. Pollution by municipal and industrial sources, and diffuse pollution from urban and agricultural areas continue to build up pollution levels in the environment. Joint research is necessary to elucidate pollutant effects on human health and ecosystems, and to prevent the entrance of these contaminants in the water cycle. Achieving these goals (which directly derive from the WFD) requires a two-step strategy:

1. Reduction of pollutants emission (water recirculation, clean technologies, new waste water treatment technologies); and
2. Enhancement of the absorbing capacity and self-purification of the landscape and freshwater ecosystems.

The enhancement of resilience should be based on three elements:

1. Synthesis and progress of the research on modification of the water cycle in agricultural and urban areas;

2. Developing research on the implementation of ecohydrology (using ecosystem processes as management tools, complementing technologies); and

3. Developing trans-disciplinary science (ecology, hydrology, socio-economy) for systems approach in IWRM with particular emphasis on ecohydrological biotechnology.

6.5 Closing the water cycle

Society has an ambivalent relation with water resources. On the one hand, water is a natural resource necessary for societal well-being. If adequately managed, water fulfils a multitude of services and functions for a sustainable livelihood. This is the case of domestic and economic services (drinking water, hygiene, food, production, recreation, industry, agriculture, etc.) and collective services and functions (energy, ecology, etc.). On the other hand, considering the current pressure, water can no longer be considered an unlimited public resource.

Water scarcity requires new integrated concepts related to water re-use, energy, recovery of valuable substances, monitoring and control, as well as to the interaction with natural resources. The current water systems are far from being effective and efficient. Water systems consume extraordinary amounts of energy and, in some countries, leakages represent up to 50% of the water supply (European Environmental Agency Indicators, 2003). Research will have to explore more decentralised concepts which achieve a sustainable balance in the ecosystem and contribute to the reduction of carbon gasses emissions.

Water footprint has been defined as the total volume of freshwater used to produce the goods and services consumed by an individual or community or produced by a business (Water Footprint Network). Relevant research questions arise from this concept: what is the link between water footprint and the ecosystem? To what extent will the water footprint of the bio-based economy compete with the water requirements of freshwater ecosystems?

Water scarcity requires new integrated concepts related to water re-use, energy, recovery of valuable substances, monitoring and control, as well as to the interaction with natural resources. The current water systems are far from being effective and efficient. Water systems consume extraordinary amounts of energy and, in some countries, leakages represent up to 50% of the water supply (European Environmental Agency Indicators, 2003). Research will have to explore more decentralised concepts which achieve a sustainable balance in the ecosystem and contribute to the reduction of carbon gasses emissions.

Research questions related to closing the water cycles at local or regional scale include impact studies on existing and new pilot areas, modelling of the behaviour of pollutants introduced by the reuse of waste waters, conception and modelling of closed-loop concepts in industry, coupled water and energy saving strategies. This technological and environmental

research has to be systematically combined with a socio-economic approach that will investigate the social acceptance of such new concepts and evaluate costs and benefits of the different solutions (including environmental costs and benefits).

The knowledge generated in these research questions will contribute to achieve the Millennium Development Goals.

7. Added value, benefits and impact

The challenges identified in this JPI cannot be fully addressed by any individual Member State alone. Although the National and Framework Programmes have provided relevant funding to European water research, the wide variety of issues to be tackled and their complex dimension have limited the deployment of successful technologies and policies. The Water JPI provides an opportunity for economies of scale, larger critical mass of resources and for more cross-border programme collaboration. This JPI will permit to widen up the scope of European proposals, and increase the impact of research by exploiting the multiplying effect of trans-national and multi-disciplinary cooperation in Europe and beyond.

The following list presents a summary of the benefits of the proposed JPI to European citizens and European competitiveness:

- Development of scientific, technological, economic and societal tools fostering efficiency in water management, internalization of externalities and sustainable water management practices.
- Raising the technological profile of the water industry that will employ a growing number of European citizens. A knowledge-based European water industry will increase its leadership in the word market.
- Improving the current information on water resources availability, demand, and vulnerability to present risks and uncertainties.
- Improving adaptation to drought, desertification and flooding risks. Developing mitigation measures. Increasing the sustainability of water related activities.
- Protecting the health of European citizens (water-related issues); protecting aquatic life.
- Raising awareness on the effects of different societal activities on water demand, use, quality and availability.
- Extending water availability through the optimization of water uses (both consumptive and no consumptive), reduction of treatment costs, and improvement of water quality.
- Establishing opportunities for increased cross-border Scientific and Technological co-operation in Europe and beyond.
- Sharing knowledge and pooling resources among European researchers and policy makers.
- Training and development (increased research capacity and capability).

The following paragraphs detail the added value, benefits and impact of the water JPI under a variety of perspectives.

7.1 Policy support

The water JPI will produce science-based knowledge leading to support and advice European policies, supporting the identification of problems, their quantification, and the development of technical and managerial solutions. All these aspects will lead to European policies promoting better life standards for European citizens. The water JPI will also have the capacity to focus on local and regional scale problems, where the transfer from research to policy is more effective. The research questions identified in this document will permit to support the implementation and revision of key EU Directives, as well as to prepare new water-related EU directives. Contributions will be performed to the following legislative documents and their respective policy areas:

- The Water Framework Directive (WFD), regulating river basin management. The Science/Policy Working Group of the WFD will be targeted for close interaction with this JPI;
- The Groundwater Directive, complementing the WFD;
- The Flood Risk Management Directive, aiming at reducing the likelihood and/or the impact of floods;
- The Drinking Water Directive, whose standards are currently under revision;
- Water Scarcity and Drought in the European Union, which has been the subject of an EC Communication and related stakeholder reports;
- The Urban Waste Water Directive;
- The Integrated Pollution Prevention and Control (IPPC) Directive, regulating industrial emissions to water (among other media); and
- The Nitrates Directive, regulating water pollution resulting from agricultural activities.

In addition to contributing to defining and updating EC policies, this JPI will provide support to the Member States in their efforts to implement EC Directives and to the associated countries to implement their national Laws.

7.2 Synergies with ongoing RTD activities funded by the EC

This JPI will serve the purpose of structuring Member and Associated State investments in Water research. The survey on national water research funding performed to design this JPI has evidenced that water research is often dispersed at the National level in different Ministries, Universities, Agencies, Regional Governments and Programmes. The JPI will permit to make these investments more visible and coordinated, establishing dynamic, thematic, transnational, and trans-disciplinary research actions. The JPI will bring national water research funding into a European dimension, and will permit complementary activities respect to other EC funded water RTD actions, therefore improving greatly the availability and value of research funding. The JPI has been designed to be sensitive to local water problems, thus responding to the large variability in European water issues. While the Framework program has traditionally focused on a problem-solving approach, all aspects of water science and technology (from basic to pre-competitive; from industrial to sociological) will be targeted in the water JPI.

The Framework Programme

Hundreds of RTD initiatives have been funded by the Framework Programme dealing with the multiple aspects of water. Integrated Water Management problems and Water Policy have been the subject of projects focusing on Europe or on International Cooperation

activities. A JPI on water research will result in more opportunities for European scientists, technologists and engineers to participate in European research endeavours.

The nature of the JPI is similar to that of the ERA-NETs in a number of aspects. The past and present water ERA-NETs have established research networks in which European researchers and funding agencies have harmonized procedures and jointly managed coordinated research projects, thus preparing ground for this JPI. The ERA-NETs have overcome a number of legal and practical barriers, succeeding in setting up common proposal submission and evaluation procedures. The experience gathered through the ERA-NETs will be useful to set the basis for efficient water JPI governance, but also to foresee frontier research activities in the water field. The IWRM ERA-NET focussing in IWRM to sustain the WFD needs has been considered in many instances as a model for the design of the water JPI. Both research actions are primarily interested in Europe and share the ambition of projecting research results to the world. The CRUE ERA-NET introduced structure within the area of European Flood Research by improving co-ordination between national programmes and establishing a future research agenda**.** The SNOWMAN ERA-NET dealt with sustainable soil and groundwater management under the stress of pollution. These issues have been included in this proposal, with the intention of updating the challenges and the research responses focussing in a long-term vision. The CIRCLE ERA-NET performed activities focusing on the adaptation to climate change, giving particular consideration to water scarcity. These examples illustrate the synergies and complementarities between both approaches.

The Water Supply and Sanitation Technology Platform (WSSTP)

The WSSTP was created by the EC to improve efficiency and financial opportunities in the water sector. This Technology Platform is led by industries in collaboration with academics, research organisations and water users. The European industry is very well represented in this Technology Platform, which is equally committed to meet global challenges and regional demands ensuring water and sanitation services, and to make significant and measurable contributions to the Millennium Development Goals. The different nature of the JPI and the WSSTP will result in complementarities which will be exploited in both directions: This JPI will effectively complement WSSTP activities, particularly in what refers to the definition of the WSSTP Strategic Research Agenda and the Implementation Plan (containing six pilot programmes/themes based on IWRM principles). On the other hand, the water JPI will benefit from the Industry perspective of the WSSTP. As a consequence, the JPI will address updated, realistic, challenging and problem-solving objectives and research topics.

7.3 Establishing partnerships beyond Europe

Water is a global issue of the highest importance to any citizen of the world. The large variability in climate, water availability, hydroecological pressures, water demands and water governance traditions in Europe makes solutions obtained at the European scale potentially useful for other areas of the world, as stated in the Euro-Mediterranean conference (Barcelona, Spain, 2010). Strategic partnerships will be sought to enhance competitiveness and to address global challenges or specific problems on the basis of mutual benefit and mutual interest.

Water resources management is a key issue for many countries in the world. According to The United Nations World Water Development Report, urgent action is required to avoid a

global water crisis. The European Union Water Initiative (EUWI) was launched to create the conditions for mobilising all available human and financial EU resources, aiming to achieving the water-related Millennium Development Goals (MDGs). The EUWI reinforces the political commitment and influences Poverty Reduction Strategies and allocation of resources. Efforts to achieve the MDGs embrace planning and action in both water resources development and management. Water JPI actions devoted to training and mobility, together with dissemination, will play a fundamental role to support the EUWI, since they are being designed with an International Scientific Cooperation perspective. Obstacles in technology transfer will be partially overcome in non-industrialised countries, since these countries will directly benefit from the innovations resulting from this JPI. The Water JPI will provide a critical mass of researchers to favour the visibility of Europe in this field and thus, we will be able not only to contribute but also to lead the development of related international water research programs.

7.4 An initiative for the citizens

This JPI will target citizen well-being and personal development in Europe and beyond. Research actions to be adopted in the JPI will be required to demonstrate their contribution to improve the life of the citizens in urban and rural communities, in more and less developed regions, from the young to the senior citizens, and with respect for gender issues. Water is known for being at the centre of social conflicts which have historically hurt citizens in Europe and beyond. Water JPI actions will be also encouraged to focus on social agreement and on conflict resolution. Mediation and advocacy in water issues will be promoted at all levels to ensure that RTD activities are clearly perceived as contributing to improve the life of the citizens in all its dimensions.

7.5 Cooperation with ongoing and future JPIs

Water research is related to a number of relevant European research actions. JPIs are not an exception, and four of the recently adopted JPI proposals contain clear links with this Water JPI:

Agriculture, Food Security and Climate Change

Water is a key input to both irrigated and rainfed agriculture, as well as to livestock production. Food security is largely based on water, particularly under the stress of climate change. Balanced water supply and demand in the agricultural sector is a key to sustainable agriculture. While this JPI considers water as an input to agricultural production, in the water JPI water is considered as a natural resource which may be exhausted and polluted if misused in agriculture.

Health, Food and Prevention of Diet Related Diseases

Water has been quoted to be the most important and basic food, as well as a basic ingredient to the food processing industry. A number of diseases are related to drinking water, making safe drinking water supply a basic ingredient of a healthy life. Confronting basic drinking water requirements for European and non European citizens with the hydrologic cycle is a major challenge in Europe and beyond. Furthermore, irrigation water quality will impact food quality so that any alternative solution for irrigation water

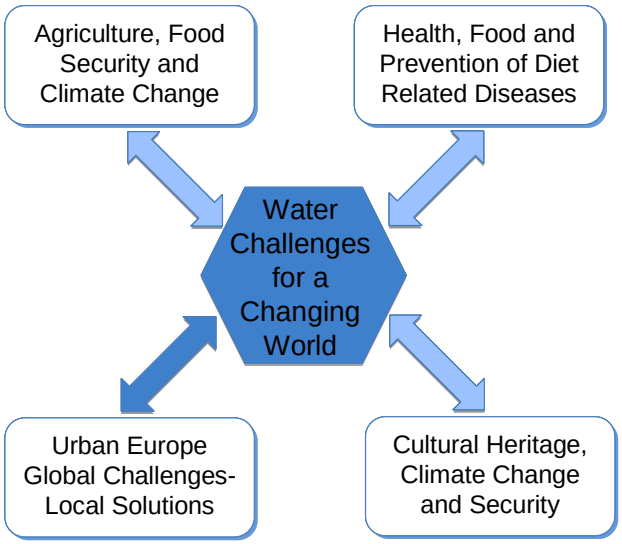
management has to be scrutinised with respect to consumer risks via the chain irrigation-soil-plant-crop. Both JPIs will produce complementary perspectives and research products whose applicability will depend of the establishment of a sustained dialogue between the involved scientific disciplines.

Cultural Heritage, Climate Change and Security

The preservation and appreciation of the abundant European cultural heritage requires scientific knowledge on a number of disciplines. Water science and technology is important in a number of cases. Water is a main vector of pollutant transfer and also a direct degrading agent, in particular for immovable cultural heritage. For instance, acid rain rapidly degrades valuable heritage. In a very different example, water science is used in Venice to preserve its cultural treasures. Finally, water is the subject of intangible cultural heritage in the form of water bodies strongly tied to local cultural values. Both JPIs will complement to attain specific common objectives.

Urban Europe Global Challenges – Local Solutions

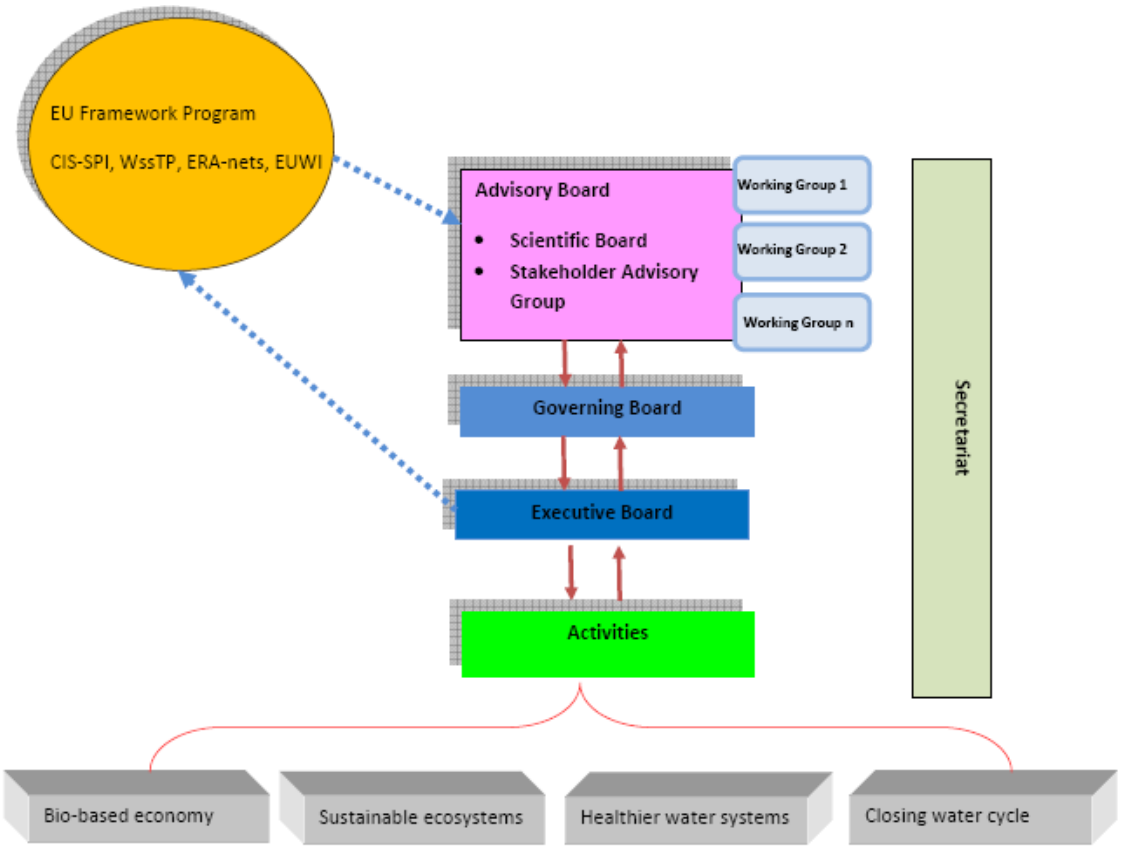
Cities are growing, and their water infrastructure needs to supply water to more citizens. Safe and sustainable water supply and sanitation systems must be reengineered to meet ever-growing demands. The urban perspective to citizen services and the water perspective (integrating cities in the water cycle) must interact to ensure sustainability of European cities.



8. Preliminary suggestions concerning the governance and implementation of JPI

Accession to this JPI is based on the unanimous voting of all partners, in full compliance with regulation that will be set up and approved by the Governing Board.

The proposed Governing Structure is presented as follows:



Governing Board (GB)

- Purpose:
  - It deals exclusively with water related policy issues; its strategic decisions are based on advice provided by the *Stakeholders Advisory Group* and the *Scientific Board*.
- Roles and functions:
  - To draft the short and long term strategy.
  - To approve contributions from Member Countries.
  - To approve accession of new countries to the JPI.
  - To adopt the Terms of Reference.
  - To adopt the composition of the other boards.
  - To adopt and resolve calls for proposals.
  - To implement the guidelines for Framework Conditions.
- Membership**:**
  - One representative of each country participating to the JPI, acting as National Delegate. It comprises a President, a Vice-president and members.

Executive Board (EB)

- Purpose:
  - To implement the strategy defined and issued by the GB, to which the Executive Board is subordinated.
- Roles and functions:
  - To draft the implementation plan for the strategy elaborated by the Governing Board.

- To set the dates for calls for proposals and draft the Guides for proposers for each call.
- To draft specific regulations for project evaluation and monitoring.
- To run the financial management of the program.
- To coordinate the foresight activities, the programme research activities (calls for proposals), the assessment of JPI impact, the training activities, the dissemination of results, etc

- Membership:
  - A limited number of members elected by the GB. It comprises a President, a Vice-president and members.

Advisory Board

The Advisory Board will give advice to the GB on respective priorities. It will be composed of:

Scientific Board (SB)

- Purpose:
  - To provide input to the GB from a scientific perspective.
  - To define scientific topics in synergy to those mentioned by the European Commission within each Working Program of the theme Environment (including Climate Change) of the Cooperation Specific Program within the Framework Programme and by the partner States.
  - To propose these topics to the GB for approval, in close relation with the Strategic Research Agendas (SRA) defined both at partners States level and at EU level.
  - To organize the evaluation procedures.
- Roles and functions:
  - To inform on the scientific issues expressed by stakeholders from scientific perspective
  - To propose the JPI long term strategy
- Membership:
  - It is comprised of academia/industry experts conducting research in the JPI field. It comprises a President, a Vice-president and members.

Stakeholders Advisory Group

- Purpose:
  - To provide input to the Governing Board from the user perspective. Stakeholders represent water industry, local/national authorities, users, NGOs, etc.
  - To define urgent research and development needs in synergy with those mentioned by the European Commission within each Working Program of the Framework Programme and by the Member States and the Associated Countries.
- Roles and functions:
  - To provide and assess scientific issues expressed by Scientific Board from users' perspective.
  - To propose the JPI short term strategy.
- Membership:
  - One representative per institution.

Both the *Scientific Board* and the *Stakeholders Advisory Group* will be organised in *Working Groups* according to the specific needs of the moment. Each Member State or Associated Country will be represented in the *Working Groups* most interesting for its own needs. The Advisory Board will be the link between the JPI activities and ongoing international and EC-funded activities, the WssTP and the CIS-SPI working group of the WFD.

Secretariat

- Purpose:
  - Subordinated to Executive Board, the secretariat ensures technical support for the Governing Board, the Stakeholders Advisory Group and the Scientific Board, taking care of the administrative implementation of JPI internal instruments.
- Membership:
  - Technical staff.

This document presents the concept of the proposed water JPI, to be presented for adoption at GPC-level. The details of its implementation, work plans and responsibilities will be discussed, agreed and finalised by the JPI members as the next step.

Implementation might include (but is not restricted to) the following aspects:

- **Developing a European-wide network** of research funders and policy makers that are involved in national, multi-national and EU programmes on "Water" as basis for cooperation;
- Establishing a good basis for support of the diverse group of **stakeholders**;
- Elaboration of a **Strategic Research Agenda** for "Water". A **foresight process** will be implemented for looking into the future even further, *i. e.*, 15 years and more ahead from the actual point in time.
- Developing a toolkit for **improved international coordination** of public and public-private funding of research based on existing and new EU and national research programmes;
- Developing a **knowledge-transfer strategy** across stakeholders groups;
- **Programme research activities** (calls for proposals, evaluation, project management and monitoring ,etc). A continuous monitoring process will provide actual input on the status of implementation. Monitoring will also include the observation of research in similar areas and beyond European borders.
- Regular **evaluations** of the JPI programme.