Water JPI

Strategic Research & Innovation Agenda

Adopted 30 June 2014

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Disclaimer

This publication reflects the consensus reached by the Water Joint Programming Initiative (JPI) Governing Board members in June 2014 and represents the Strategic Research and Innovation Agenda (SRIA), Version 1.0. Its drafting and publication was made possible under the framework of Tackling European Water Challenges (WatEUr) Coordination and Support Action. This is an update of Version 0.5 of May 2013 with contributions from a Workshop held in Lyon in April 2014 and from a public consultation. The release of an updated SRIA 2.0 is scheduled for the end of 2015.

List of Abbreviations

Acqueau	Eureka cluster for Water
CAP	Common Agricultural Policy
CIS-SPI	Common Implementation Strategy – Science-Policy Interface
COD	Chemical oxygen demand
COST	European Cooperation in Science and Technology
DBP	Disinfection by-product
DSS	Decision support system
EB	Executive Board of the Water JPI
EEA	European Environment Agency
EIP on Water	European Innovation Partnership on Water
ERA	European Research Area
ERA-NET	Framework Programme instrument to step up the cooperation and coordination of research activities carried out at national or regional level in the member states and Associated States
ESS	Ecosystem services
EWS	Early warning systems
Eureka	Inter-governmental initiative supporting cooperative RDI to encourage the competitiveness of European companies
FACCE	Food Agriculture and Climate Change Joint Programming Initiative
GB	Governing Board of the Water JPI
GPC	High Level Group
Horizon 2020	The European Union Framework Programme for Research and Innovation (2014–2020)
JPI	Joint Programming Initiative
JPIAMR	Joint Programming Initiative on Antimicrobial Resistance
LMI	Lead Market Initiative
MAR	Managed Aquifer Recharge
PPP	Public-Private Partnership
RDI	Research, development and innovation
SAG	Stakeholders Advisory Group of the Water JPI
SAT	Soil-Aquifer Treatment
SRIA	Strategic Research and Innovation Agenda
STB	Scientific and Technological Board of the Water JPI
WFD	Water Framework Directive
WatEUr	Tackling European Water Challenges, an FP7 Coordination and Support Action energizing the Water JPI
WFD	Water Framework Directive
WssTP	Water Supply and Sanitation Technology Platform

Executive Summary

Over the last few decades a number of policies and research, innovation and development (RDI) activities have been put in place in order to protect water resources. Despite these efforts, many regions in Europe still face water scarcity and/or water-quality problems. Climate change, groundwater over-abstraction and diffuse pollution are, among others, the main factors influencing water availability. If no action is taken, their impact will be even greater in the years to come. Guaranteeing a sustainable supply of good-quality water should be a priority for European society; both policy and RDI activities should, therefore, contribute to this aim. Water supply for the development of different activities (agriculture, energy production, public services, etc.) also needs to be ensured to benefit the economic prosperity of Europe.

It is in this context that the Joint Programming Initiative 'Water Challenges for a Changing World' (the Water JPI) has defined its grand challenge as '**achieving sustainable water systems for a sustainable economy in Europe and abroad**'.

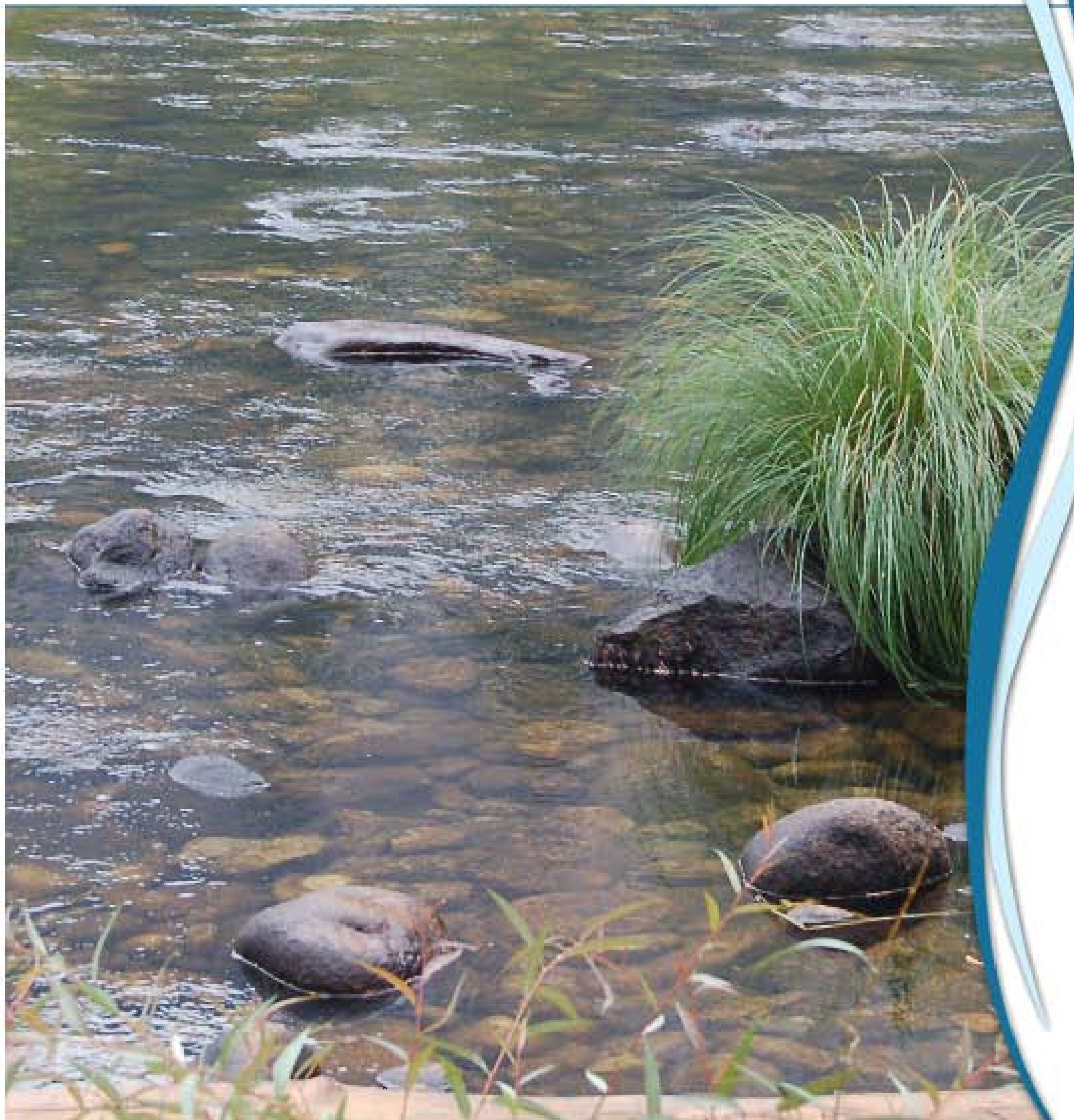
JPIs are intergovernmental initiatives aimed at tackling societal challenges that cannot be addressed by European countries in isolation. To this end, JPIs foster cross-border collaboration and coordination. The JPI process results in the definition of a Strategic Research and Innovation Agenda (SRIA), a document that lays out specific actions in the short, medium and long term, tackling a specific challenge. The Water JPI was launched in 2010. This initiative brings together 19 partner countries, the European Commission and 5 observer countries. **The present document contains Version 1.0 of the SRIA of the Water JPI.**

The development of SRIA 1.0 has been a long process, which started with the publication of the Water JPI Vision Document in 2011 and with consultations to the Water JPI Advisory Boards. Various information sources – including national RDI agendas, the strategic agendas of neighbouring initiatives, foresight studies and European policy documents – were reviewed in order to identify RDI needs and related actions in the water domain. Stakeholders and the general public were consulted on the contents of the SRIA 1.0 through, respectively, the first consultative workshop and a public consultation. Research needs and related actions are structured around five core themes:

Maintaining ecosystem sustainability;
Developing safe water systems for the citizens;
Promoting competitiveness in the water industry;
Implementing a water-wise bio-based economy; and
Closing the water cycle gap.

The adoption of SRIA 1.0 results from the collaboration and consensus of Water JPI partners. This collaboration will be extended during the development of the next version of the SRIA (SRIA 2.0), as well as by the implementation of joint activities (such as collaborative projects, mobility schemes or infrastructure sharing). The Water JPI will therefore play an important role in the construction of the European Research Area (ERA) in the field of water.

1. Introduction



1. Introduction

1.1 The Water Challenge

Water is a precious natural resource, essential for the survival of living organisms and the maintenance of ecosystems. It has a wide range of applications in our daily life and it is a driver for economic prosperity. Water can be used for energy production and it is necessary for the development of industrial and agricultural activities. Aquatic ecosystems provide important ecosystem services such as the storage of freshwater, the housing and safeguarding of biodiversity, and the buffering of micro-climatic changes. The protection of water resources is therefore essential for society. To this end, EU member states have put specific national policies and measures in place. Policies have also been adopted at the European level, such as the Water Framework Directive (WFD), which establishes a legal framework to protect and restore clean water across Europe and ensure its long-term and sustainable use. There are also other related directives, such as the Urban Wastewater Directive, the Bathing Water Directive, the Nitrates Directive, the Drinking Water Directive and the Floods Directive. The 2012 Blueprint to Safeguard Europe's Water Resources could probably be deemed the flagship water policy framework. Many research and innovation projects have also been carried out in order to identify sound and viable measures and solutions for the protection of water resources.

Despite policy - and research-driven efforts at national and European levels, water resources are still under pressure in numerous regions. According to the European Environment Agency (EEA),[1] this pressure will worsen in the years to come. Immediate action is, therefore, necessary to address existing and emerging challenges in the field of water resources.

Competition for different water uses (agriculture, public services, energy, industry and environmental protection) has made this resource a limiting factor. Thus, across the EU, agriculture alone accounts for approximately a quarter of water use. This figure is as high as 80% in southern European countries.[2]

The 2007 Communication of the European Commission on Water Scarcity and Droughts[3] stated that water stress already affects 30% of European population. Water scarcity hits mainly southern European countries, but northern European countries are affected as well. Climate change (through the uneven distribution of seasonal rainfall and the higher incidence of extreme events) and increasing urban sprawl phenomena will likely increase the water supply–water demand gap, thereby exacerbating water scarcity in increasing areas of Europe.

Additionally, almost half of Europe's water bodies will not achieve the WFD targets[4] due primarily to diffuse pollution and the insufficient treatment of wastewater. The use of fertilisers for agriculture and the prevalence of emerging pollutants and pathogens all have a clear effect on water quality – putting both human health and ecosystem conservation in jeopardy. Furthermore, the presence of pollutants in water increases the costs of water treatment and reduces the regional economic potential. Floods contribute to impaired water quality as soil particles are washed away from soils or as water-treatment plants stop functioning.

The availability of water resources is subject to groundwater over-abstraction and the construction of infrastructures for water regulation and supply. An excessive use of groundwater for agricultural purposes not only limits water access for other uses but also may lead to societal conflicts and to the unfair distribution of natural resources across sectors. Groundwater over-abstraction is also a cause of salt intrusion in coastal areas. Infrastructures such as dams, reservoirs and dykes have often resulted in improved control and monitoring of water resources. Nevertheless, these infrastructures are also responsible for a range of hydromorphological changes with potentially adverse ecological consequences.

At the technology level, major scientific and technological breakthroughs are still needed to cope with emergent challenges such as the growing concern about multi-resistant microorganisms, the need to recover and reutilise phosphorus and nitrogen fertilisers from wastewater, the deployment of capital-intensive water infrastructures, and the need to reduce energy input in all water processes.

The 2012 and 2013 European Innovation Scoreboards confirm that the innovation rate in Europe is lower than that in Japan, South Korea and the United States of America. The EU28 continues to have a better performance lead over Australia, Brazil, Canada, China, India, Russia and South Africa. This lead is, however, declining. Policies and programmes need to favour appropriate conditions for relevant RDI breakthroughs and innovation. RDI breakthroughs within the water sector could report significant benefits to the EU (the worldwide turnover amounts to US$246 billion[5]).

This brief overview of the main factors affecting water resources shows that there is a need to tackle existing and emerging challenges in the water domain in order to quickly single out solutions that guarantee water supply for various uses whilst ensuring the sustainable development of ecosystems and the economic prosperity of Europe. This need opens up at the same time new opportunities in RDI, such as construction and maintenance of water-related infrastructure, technologies for the safe reuse of wastewater more efficient irrigation techniques, to name a few.

1.2 Joint Programming Initiatives (JPIs): a new framework to address societal challenges

Launched in 2008, the Joint Programming process aims at tackling societal challenges in strategic areas by fostering cross-border collaboration and coordination of member states and by integrating member states' publicly funded RDI programmes.[6] The JPI process results in the development and implementation of a Strategic Research and Innovation Agenda (SRIA), which defines a number of specific actions in a particular domain. Based upon a variable geometry approach, the participation of member states is voluntary. The launching of each of the ten currently ongoing JPIs has responded to the definition of a societal challenge which cannot be solved by any European country in isolation.

JPIs contribute to developing common solutions, to optimising the efficiency and impact of public research funding, to supporting the implementation of joint actions (such as cross-border collaboration projects or infrastructure sharing), and to improving coordination with other national and European RDI programmes. JPIs are therefore meant to play a key role in the construction of the European Research Area (ERA).

1.3 The Water JPI: Its mission

The Water JPI ('Water Challenges for a Changing World') aims at tackling the grand challenge of '**achieving sustainable water systems for a sustainable economy in Europe and abroad**'. The physical domain of the Water JPI is coincident with that of the Water Framework Directive (WFD): 'inland surface waters, transitional waters, coastal waters and groundwater'. This JPI was endorsed by the High Level Group (GPC) in May 2010, and currently includes 19 partner countries, in addition to the European Commission, and 5 observer countries.

According to the mapping exercise concluded in April 2011, the European member states and the associated countries run Water RDI programmes adding up to an annual investment of about €370m. Current Water JPI partners represent 88% of this funding (€328m).

In order to address the overall challenge indicated above, the Water JPI has set out six specific objectives:

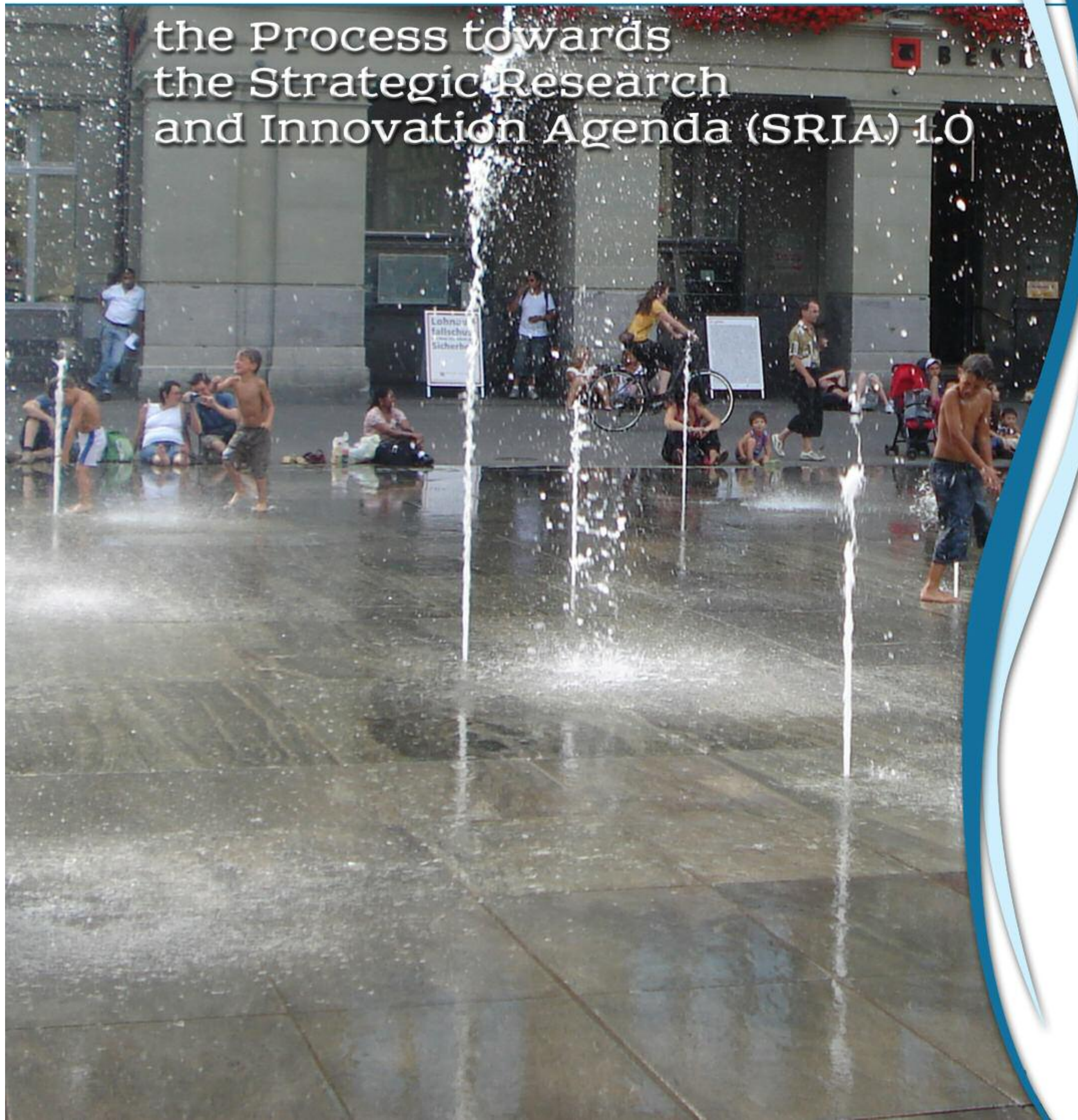
1. Involving water end-users in effective uptake of RDI results;
2. Attaining critical mass of research programmes.
   The goal is to involve at least two-thirds of the public water RDI investment in Europe;
3. Reaching effective, sustainable coordination of European water RDI;
4. Harmonising national water RDI agendas in partner countries;
5. Harmonising national water RDI activities in partner countries. Joint programming activities will amount to at least 20% of the total budget of partners' national water RDI programmes;
6. Supporting European leadership in water science and technology.

The five RDI themes of the Water JPI, constituting the core of the SRIA, are:

1. Maintaining ecosystem sustainability;
2. Developing safe water systems for the citizens;
3. Promoting competitiveness in the water industry;
4. Implementing a water-wise bio-based economy; and
5. Closing the water-cycle gap.

2. Methodology:

the Process towards the Strategic Research and Innovation Agenda (SRIA) 1.0



2. Methodology: the Process towards the Strategic Research and Innovation Agenda (SRIA) 1.0

The Water JPI's SRIA results from a collective, shared and forward-looking exercise that identifies and prioritises RDI directions. The development of the SRIA is a long process that started with the preparation of a Vision Document. This Vision Document, which defines the research scope of the Water JPI in the form of objectives and research questions, was endorsed by the Governing Board in 2011. Research questions were derived from partners' contributions and from a preliminary analysis of national RDI agendas.

Following the first consultation with the members of the Water JPI Scientific and Technological Board (STB) and the Stakeholders Advisory Group (SAG), a number of specific proposals on RDI topics and the most appropriate instruments for their implementation were outlined.

Both the Vision Document and the proposals made by the Advisory Boards were taken into account in the preparation of SRIA 0.5. The Water JPI's SRIA 0.5, adopted in May 2013 (and available on the Water JPI's website) lists a number of RDI needs for each of the five core themes of the Water JPI, as well as specific objectives linked to those needs and potential implementation instruments.

The Water JPI's SRIA 1.0 builds on SRIA 0.5, and follows the same structure. However, in Version 1.0, specific instruments are not proposed for the identified needs, as this information will be included in the Water JPI Implementation Plan, which is currently under development. Following the release of SRIA 0.5 in May 2013, further needs and objectives were identified through the review of numerous information sources (e.g. national agendas, strategic agendas of other European initiatives). Additional feedback was provided by: (i) the Advisory Boards of the Water JPI and national experts, in an ad hoc consultative workshop; and (ii) the wider public via an online public consultation. This feedback has proven very useful for refining the contents of the Agenda. Figure 1 depicts the activities leading to SRIA 1.0.

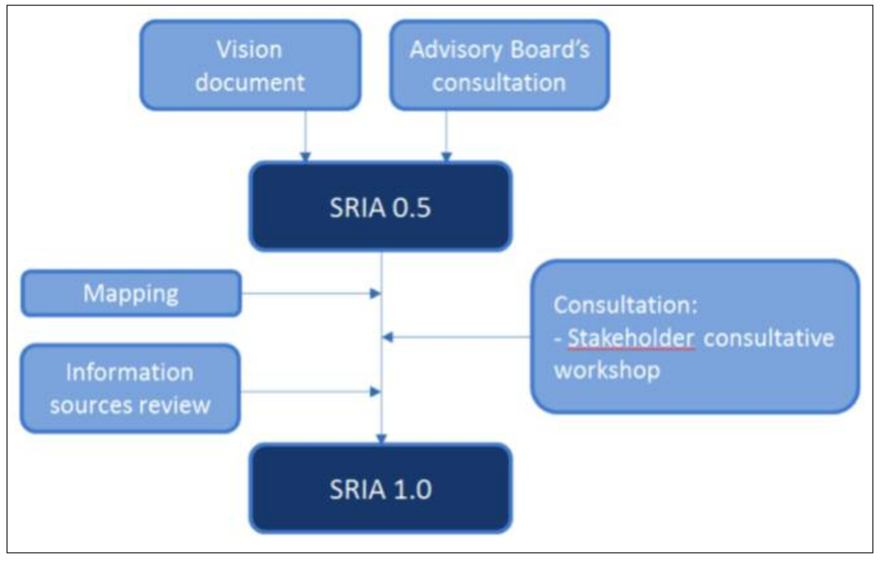


Figure I. Methodological approach for elaboration of SRIA 1.0

2.1 Information Sources Review: collecting and processing of information

The purpose of this activity, carried out between June 2013 and February 2014, was to better understand the water landscape by looking at water policies, RDI programmes, and existing societal, scientific and technological challenges in order to identify: (i) potential new core themes and subthemes for the Water JPI; and (ii) current and emerging RDI needs/objectives.[7] The following information sources have been reviewed (Annex III gives the full list of references):

- National RDI programmes;[8]
- Deliverable 2.1 of the WatEUr project, aimed at mapping European water RDI (policies and strategies, funding schemes and performance);
- Strategic agenda of the EIP and related action groups;
- Strategic agenda of the WssTP;
- Policy documents, including the Water Blueprint and European roadmaps;
- Horizon 2020 Societal Challenges 2 and 5 – 2014–2015 Work Programme;
- Foresight studies.

All the identified RDI needs/objectives were compiled in a single list and classified in themes and subthemes.

A thorough search for relevant foresight studies was made between June 2013 and September 2013 in bibliographic databases, foresight consultancy websites, national/ European/international institutional sites, funding councils and search engines. The search was restricted to studies covering Europe and associated countries, and written in one of the working languages of the European Union (English, French and German). The following keywords were used for the identification of foresight studies: Foresight, Scenarios, Horizon Scanning, Forward Looking Activities, Futurology, Future Studies, Future Research, Delphi Method, Backcasting, Roadmap, Future Workshop.

Thirty-six foresight studies were singled out and reviewed by experts. Figure 2 gives the distribution of studies by theme.

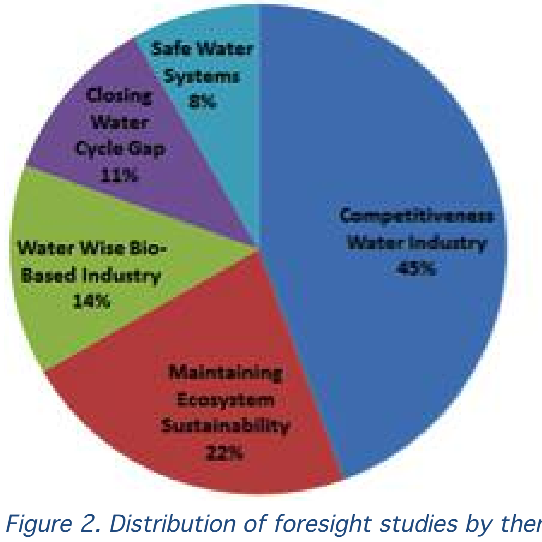


Figure 2. Distribution of foresight studies by theme of the Water JPI.

2.2 Critical Review: framework and context analysis

The remit of this activity was to assess both the importance and urgency of all the previously identified RDI needs in order to determine water RDI priorities. To this end, the views of the Advisory Boards of the Water JPI and national experts in water RDI were taken into account through the organisation of a consultative workshop.

Importance is an indication of the extent to which RDI a particular domain will contribute to responding to societal needs at the socio-economic/environmental or policy levels (societal importance) and to answering scientifically relevant questions (scientific importance).

Urgency refers to the time scale at which an action should be taken – short, medium or long term – on the basis of its societal and scientific importance (i.e. '**when**' RDI activities should be funded).

- Short-term priorities refer to RDI needs for which, according to the views of stakeholders and society at large, funding is recommended between 2014 and 2016;
- Medium-term priorities refer to RDI needs for which funding should be provided between 2016 and 2020;
- Long-term priorities are those for which funding should be provided beyond 2020

Since the development of this SRIA was based on a participatory approach, the organisation of a consultative workshop represents one of the milestones of the Water JPI. The workshop was held in Lyon on 3 and 4 April 2014. The specific aims were to:

1. Gather information on scientific/technological outputs, trends, ruptures, gaps and priorities;
2. Obtain participants' feedback on the content of the SRIA 1.0 draft document available at that time (themes and subthemes, needs, objectives, most appropriate instruments for the implementation); and
3. Prioritise RDI needs according to their importance and urgency.

This two-day workshop was structured around a number of plenary and working group parallel sessions (five working groups; one for each of the Water JPI themes). A total of 54 stakeholders attended the workshop. This figure included members of the Water JPI Governance Board (19), national experts (18), members of the Water JPI Advisory Boards (16), and a representative of the European Commission.

Workshop results are available in its Proceedings document (Deliverable 3.2, 30 April 2014). The members of the Water JPI Advisory Boards were further consulted on the proceedings.

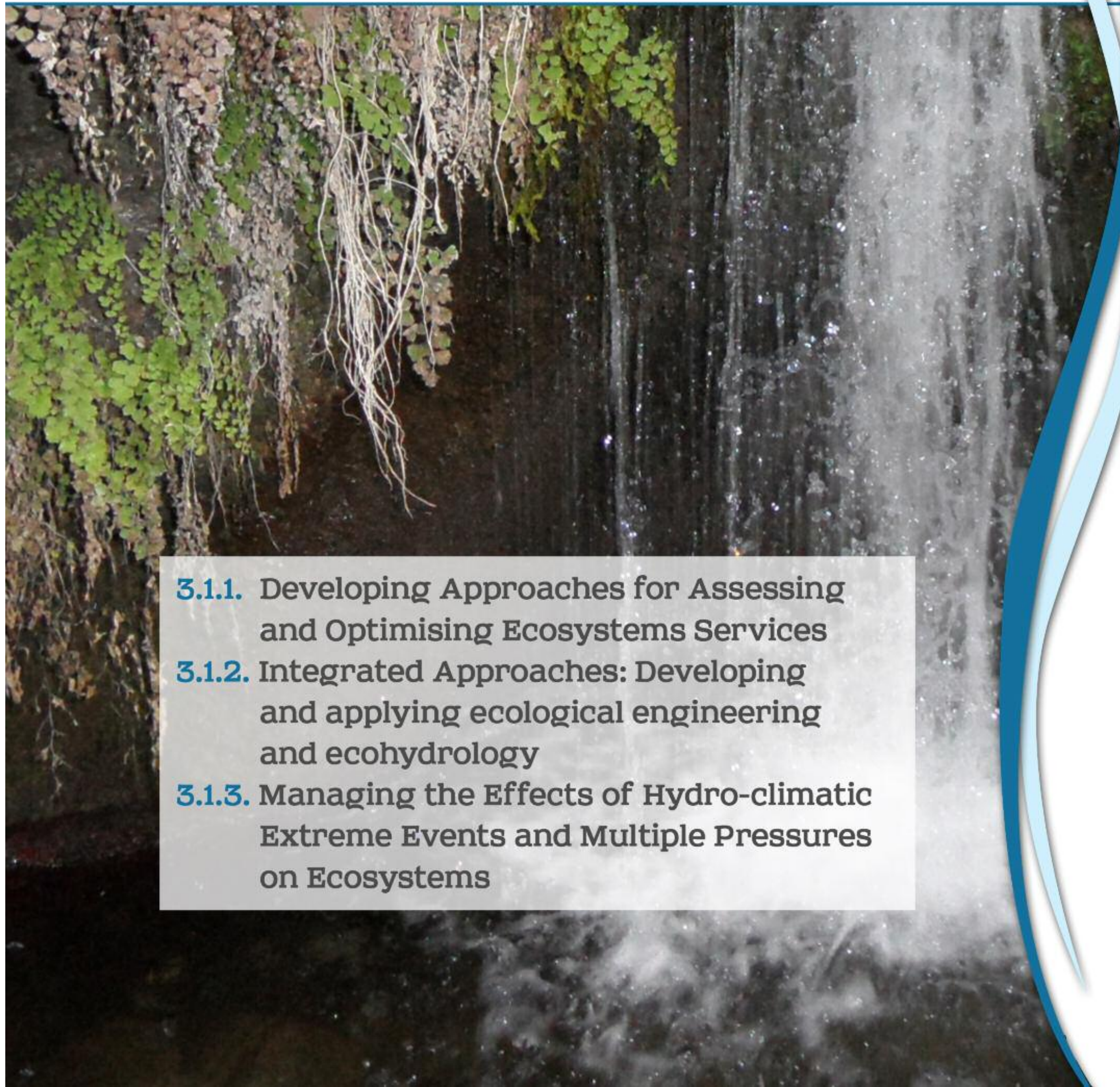
3. Research and Innovation Challenges

Five RDI themes are described below, following the definition presented in the vision document of the Water JPI:

1. Maintaining ecosystem sustainability;
2. Developing safe water systems for the citizens;
3. Promoting competitiveness in the water industry;
4. Implementing a water-wise bio-based economy; and
5. Closing the water cycle gap.

Each theme represents a specific aspect of the grand challenge for which multi- and interdisciplinary research and innovation are required. Themes are therefore challenge driven. The expected social, economic, technological, environmental and policy impacts are outlined. Descriptions present the transition from a challenge-driven theme to specific RDI disciplines, methodologies and tools. Themes are divided into sub-themes. For each of them, specific, non-prioritised RDI needs and objectives have been identified, and are presented in a Table format. Some of the RDI objectives proposed here are linked to other RDI needs and objectives as RDI activities and outputs from the latter may be of interest for the former. Those linkages are shown between brackets when relevant.

3.1. Maintaining Ecosystem Sustainability



3.1.1. Developing Approaches for Assessing and Optimising Ecosystems Services
3.1.2. Integrated Approaches: Developing and applying ecological engineering and ecohydrology
3.1.3. Managing the Effects of Hydro-climatic Extreme Events and Multiple Pressures on Ecosystems

3.1 Maintaining Ecosystem Sustainability

Water demand, mis-management and climate change inducing short- to long-term variations in water availability (including extreme events) have increased the stress on water bodies and associated ecosystems. Europe faces a water landscape often characterised by water scarcity in certain regions and flooding in others, over-exploitation of water for agriculture, forestry, aquaculture, cities, pollution, sea-water intrusion, severe hydromorphological changes, and intense structural works on rivers and lakes. In this context, integrated and interdisciplinary research and development aimed at understanding and maintaining the essential functions and processes of ecosystems (i.e. 'ecosystem sustainability') is needed.

Expected Theme Impacts

Impact	Description
Social	Contribute to safeguarding natural resources for future generations. Aquatic and riparian ecosystem sustainability research will contribute to identifying, proposing and prioritising measures to help societies adapt and react to current and future pressures. Better protection of public health and the environment from effects of extreme weather events.
Economic	Address market failures (integration of externalities in policy-making), considering that preservation costs are lower than restoration costs. Monetary and non-monetary valuation methods will contribute to better decision - and policy-making process as well as economic impacts.
Technological	Increased availability and usefulness of data- and decision-making products for extreme weather events. Development of new tools in ecological engineering and early warning systems (EWS), including sensors, web services, numerical codes and ecological restoration technology.
Environmental	Better assessment and evaluation of ecosystem service approaches. Better understanding of hydromorphological processes. Achieving sustainable resource use. Improved water management and availability of good water quality in case of extreme weather events.
Policy	Research on ecosystem sustainability will support a relatively wide range of national, European and international policy initiatives including the EU Biodiversity Strategy *([COM(2011) 244])*, particularly Target 2: 'By 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15% of degraded ecosystems'. Set up to monitor and predict adverse effects, an EWS gives reasonable time to allow policy-makers to take appropriate measures.

3.1.1 Developing Approaches for Assessing and Optimising Ecosystems Services

Ecosystem services (ESS) are defined as the benefits people obtain from nature (MEA, 2005[9]). ESS fall into the following categories: (i) provisioning services, i.e., material outputs from ecosystems such as food, fresh water, raw materials and medicinal resources; (ii) regulating services, i.e. the services that ecosystems provide by acting as regulators of climate, pollution, pollination, soil stability, etc.; (iii) cultural services, the non-material benefits obtained from ecosystems such as recreation and mental and physical health, tourism, aesthetic appreciation and inspiration for culture, art and design, spiritual experience and sense of peace; and (iv) supporting services, which underpin almost all other services and include habitat for species and maintenance of genetic diversity (CIS-SPI report, 2011[10]). At the policy level, ESS are in essence economic and decision-based valuation tools to protect biodiversity. Thus, for instance, the cutting of a forest for urban sprawl leads to substantial gains for construction companies but the costs of this land conversion are subsequently paid by society at large as a result of biodiversity loss and dwindling levels of carbon storage. Another example is the restoration of floodplains and wetlands. Restoring former floodplains and wetlands may entail considerable costs. However, increasing retention measures helps reduce flood risk, reduce pollution, improve the ecological and quantitative status of freshwater, and decrease the risk of water scarcity. Monetary valuation methodologies permit integration of the value of these non-marketable issues into the decision-making process. For a sound water management plan to be set up, this monetary valuation should be complemented by a social valuation of ecosystems as some social values are enhanced by perception, history and traditional practice in the use of water and by the environmental, political and institutional context in which water regulation takes place. Research and development are required to refine the methodology through case study analyses, and to establish firm links with general water policies. Overall, a better understanding and assessment of ecosystem services relies on research on the ecological functioning of aquatic and riparian ecosystems.

In the last few years ESS has appeared as a promising concept to support the implementation of the WFD. Thus, and as concluded during the 2nd 'Water Science Meets Policy' event organised in Brussels by the initiative CIS-SPI, the ESS approach is expected to provide responses on the economic requirements of the WFD, in particular those concerning derogations based on disproportionate costs, cost recovery and incentive pricing. In the same vein, the ESS approach could support the implementation of the 'Water Scarcity and Droughts' Communication of the European Commission based, among other principles, upon water-pricing and water-efficient technologies and practices.

RDI needs and related objectives	Time frame
1.1.1 Developing approaches for assessing and optimising ecosystem services and the ecological functioning of ecosystems - Understanding and quantifying the ecological functioning of ecosystems. - Developing an ESS approach based on this better understanding and quantification of the ecological functioning of ecosystems. - Developing indicators and other monitoring schemes regarding the good functioning of aquatic ecosystems in support of the WFD. Developing the next generation of monitoring schemes and indicators of the good functioning of aquatic and riparian ecosystems. - Developing new bio-assessment tools and validation methodologies. - Understanding the role of biodiversity as a driver of ecosystem resilience. - Assessing the role of aquatic ecosystems in the global bio-geochemical cycle.	Short
1.1.2 Testing methodologies for the valuation of ecosystems services - Developing and applying harmonised databases and new methodologies for assessing and mapping the social, economic and environmental value of water ESS.	Short
1.1.3 Integrating ecosystem services into water resources management - Developing meta-ESS by overcoming the existing fragmentation of responsibilities and the dispersion of knowledge between disciplines. - Aligning the monitoring and reporting frameworks through ecosystem approaches. - Developing innovative water-management schemes. - Adopting an ESS approach to the role of agriculture, forestry and aquaculture to allow for careful planning in the use of water resources while addressing the needs of local users. A comprehensive monetary and social evaluation of all secondary services provided by all agents is required.	Short

3.1.2 Integrated Approaches: Developing and applying ecological engineering and ecohydrology

'Ecological engineering' has been defined as the application of engineering and life-science principles to the design of sustainable ecosystems integrating human society with its natural environment for the benefit of both (Mitsch and Jørgensen, 2004[11]). The goals of ecological engineering are to: design and create new sustainable ecosystems with human and ecological value and to restore ecosystems that have been substantially disturbed by human activities (e.g. urban development, agriculture, forestry, or aquaculture).

Ecological engineering is based on the following principles (Mitsch and Jørgensen, 2004):

1. The self-designing capacity of ecosystems;

2. Reliance on system approaches, aimed at the study of the entire system rather than components of the system in isolation from each other (Cairns, 1998 in Mitsch and Jørgensen, 2004);

3. Conservation of non-renewable energy sources; and

4. Conservation of biological resources.

By way of example, ecological engineering approaches are used to retain, or even to degrade, certain pollutants and to reuse them as raw materials for fertilisers and industrial by-products. Potential applications of ecological engineering in rural landscapes may include wetland treatment, as well as hydromorphological restoration or sediment management. At the urban level, potential applications of ecological engineering could be found by combining the expertise of landscape architecture, urban planning and urban storm water management. Ecological engineering deals with both fundamental ecological processes and engineering applications on scales ranging from microscopic to watersheds and beyond. In turn, ecohydrology is an integrative science, application-driven discipline aimed at providing a better understanding of the effects of hydrological processes on biotic processes, and vice versa, in freshwater and coastal-zone ecosystems from the molecular to the river basin scale (Zalewski, 2002;[12] Hannah et al., 2004[13]). The ultimate goal of ecohydrology research is to enhance the carrying capacity of ecosystems while ensuring water quality, biodiversity, ecosystem services and ecosystem resilience. Ecohydrology practice focuses on the use of the ecosystem's properties and processes to regulate the hydrological cycle as well as matter and energy fluxes. Potential applications of ecohydrology in rural areas include the construction of biogeochemically reactive barriers in land-water ecotones and in pollution hot-spots (Bednarek et al., 2010;[14] Izydorczyk et al., 2013[15]) in order to intensify the degradation of nutrients and, therefore, protect water ecosystems. In urban areas, blue-green networks of surface waters and ecosystems could be used to deliver clear benefits to society such as reduction of pluvial flooding, reduction of urban heat–island effects, and improved levels of air quality (Zalewski, 2012).

RDI needs and related objectives	Time frame
1.2.1. Establishing pressure-impact-response relationships in aquatic and riparian ecosystems - Developing a better understanding of the effects of hydromorphological pressures (damming, embankment, channelisation, non-natural water-level fluctuations) on the structure and functioning of aquatic and riparian ecosystems. Link with 1.2.3. - Quantifying the effects of pollution on biological communities. - Developing systems-based approaches – including socio-economic aspects – for the identification of existing or innovative cost-effective measures to restore or design sustainable ecosystems. - Assessing the vulnerability of ecosystems to pressure factors.	Medium
1.2.2. Understanding the impacts of pressures on the terrestrial and aquatic interface - Studying the linkage between the terrestrial parts of a catchment and the aquatic ecosystem, including wetlands and peatlands. - Analysing the linkage between upstream and downstream areas, the role and functional importance of floodplain/lateral connectivity and channel dynamics, and the interaction between groundwater and the hyporheic zone. Link with 1.2.7. - Quantifying the ecological flow in order to enable the good functioning of ecosystems while ensuring water availability for different uses. Link with 1.2.6. - Assessing the role of ecosystems, notably the terrestrial and aquatic interface, in the attenuation/mitigation of impacts from pressures, including extreme events. - Developing integrated catchment, and transitional waters, management plans that integrate the terrestrial and aquatic interface.	Medium
1.2.3. Developing hydromorphology for studying options to restore continuity, sediment transport and fish migration within river systems Understanding the processes and dynamics of sediment transport, hydraulic connectivity, flow regimes and fish migration within river systems. Link with 1.2.1.	Short
1.2.4. Achieving WFD objectives in Heavily Modified Water Bodies - Understanding the techniques and approaches, including modelling tools, that can be efficiently used to maintain and improve the ecological potential of Heavily Modified Water Bodies, i.e. defined as water bodies subjected to several concurrent pressure factors.	Short

RDI needs and related objectives	Time frame
1.2.5. Managing the risks caused by alien species - Understanding the impacts of alien species on river balance, notably on water quality (dilution capacity, nutrient cycles, and chemistry of the biomass). - Developing techniques for the long term removal of alien species and to restore infested river bed material (gravel, pebbles...) with a minimum impact on river ecology.	Short
1.2.6. Understanding the implications of ecological flows Quantifying the ecological flow in order to enable the good functioning of ecosystems while ensuring water availability for different uses. Estimating ecological (or environmental) flow for different fauna and flora habitats. Link with 1.2.2. Improving the theoretical background to quantify the effects of different flow regimes on ecosystems using hydraulic, hydrological and ecological data and models.	Short
1.2.7. Characterising hydraulic connectivity among water bodies Analysing hydrochemical and microbial dynamics along flow lines (surface water and groundwater). Link with 1.2.2.	Medium

3.1.3 Managing the Effects of Hydro-climatic Extreme Events and Multiple Pressures on Ecosystems

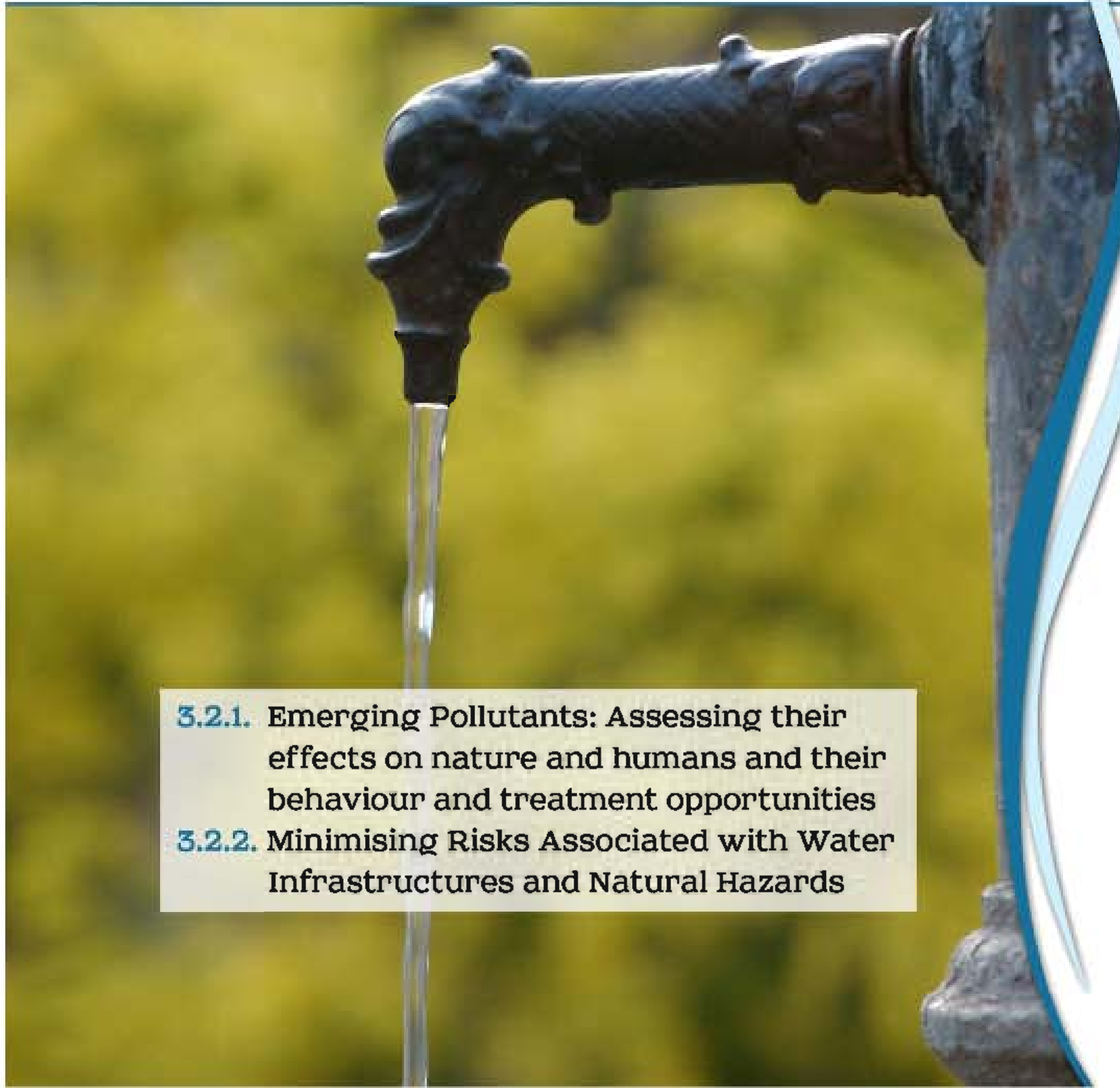
Integrated systems for collecting, analysing, interpreting, and communicating data can be used to make decisions early enough to protect public health and the environment from the effects of extreme weather events, and to minimise unnecessary concerns and inconveniences to the population. The primary objectives of forecasting tools (including EWS) are to improve prediction of catastrophic events (floods, droughts) and to minimise the impacts on human lives, natural ecosystems, cultural heritage and food cycles.

Currently Identified Needs

RDI needs and related objectives	Time frame
1.3.1. Setting the causes of drought/scarcity; predicting drought events and water scarcity - Diagnosing the causes of water scarcity in Europe, and forecasting the incidence of drought events under climate change scenarios. Studies at the regional scale will be favoured. - Developing management strategies focusing on cost–benefit analyses of agricultural evapotranspiration *vs.* water conservation for alternative hydrological uses.	Short
1.3.2. Developing innovative (or improved) tools for the protection and prevention of hydro-climatic extreme events - Developing innovative tools (such as EWS) for prevention and protection of extreme events, including sensor technology and monitoring networks. - Improving EWS for the forecasting of flooding and the assessment of associated risks.	Short

RDI needs and related objectives	Time frame
1.3.3. Improving water management to mitigate the harmful impacts of extreme events (extreme weather events, impaired water quality) - Diagnosing droughts, floods and impaired water quality as a result of climate change. Developing people-centered monitoring and EWS, including both expert and local knowledge. Relevant questions include: Is local knowledge concerning hazards and impacts reliable enough? What are the main limitations of local knowledge regarding natural phenomena? How to overcome these limitations? How to better integrate local and scientific knowledge? How to deal with the different time and spatial scales? - Setting up risk-management strategies taking into account socio-economic needs, environmental dynamics/risks and land use in areas vulnerable to droughts and floods. Key stakeholders should be involved in setting up such strategies. - Maximising the reliability of projections of precipitation at various spatial and time scales. - Improving the short-to-medium term forecasting of related extreme events. - Preparing strategies for better tackling extreme weather events through the collection and analysis of post-disaster data (including practices/measures). - Developing integrated modelling across surface water and groundwater, coastal and fluvial systems, hydrological and meteorology, water and sediment transport. - Improving existing hydrodynamic models coupled with the development of a monitoring scheme adapted for aquifers in order to improve the quantitative management of the resource. - Assessing the role of aquatic systems in nutrient and carbon fluxes and other global biochemical cycles in response to climate change and extreme events.	Short
1.3.4. Managing multiple pressure-impact liaisons on ecosystems - Supporting experimental research (e.g. microcosms) to quantify multiple impacts on ecosystems. - Understanding the resilience of ecosystems to multiple pressures. - Assessing risks related to multiple pressures on ecosystems and developing innovative risk-management approaches..	Medium to Long

3.2. Developing Safe Water Systems for the Citizens



3.2.1. Emerging Pollutants: Assessing their effects on nature and humans and their behaviour and treatment opportunities
3.2.2. Minimising Risks Associated with Water Infrastructures and Natural Hazards

3.2 Developing Safe Water Systems for the Citizens

Water quality and societal well-being are currently threatened by emerging pollutants and pathogens (including antibiotic-resistant bacteria and viruses). Key knowledge gaps remain around their environmental behaviour (in surface water and groundwater). Assessing the impact of emerging pollutants on human health and citizens' quality of life through the reuse of urban effluents in irrigation, water supply and water storage in rural and urban environments needs substantial research efforts. Moreover, scientific and technological attention needs to be paid to innovative practices for minimising risks associated with water distribution and storage facilities and with natural hazards. Water distribution and storage facilities are, for the most part, old and their performance is often far from optimum. Associated risks fluctuate between life-threatening accidents to low reliability of the conveyance networks. Low conveyance performance is commonly associated with energy inefficiency, an issue which severely affects the sustainability of water services to citizens.

In addition to promoting societal health, this JPI aims to protect citizens from the effects of natural hazards. For instance, urban floods have often had devastating effects on human life and property in Europe and beyond. Climate change may increase the frequency and intensity of floods and droughts locally. Protecting citizens will require increased RDI efforts in disciplines such as water resources, hydrodynamics, ICT, social sciences and geography. Participatory research approaches will be required to manage these risks.

Expected Theme Impacts

Impact	Description
Social	This theme faces the social water challenges directly, as it addresses the protection of human life, health and assets. The international profile of the topic contributes to alleviating water challenges inside and outside Europe, where most of the global population increasingly lives in urban areas.
Economic	As an indicator of the relevance of managing urban water systems, the World Business Council for Sustainable Development estimated that OECD nations need to invest at least US$200 billion per year to replace ageing water infrastructure to guarantee supply, reduce leakage rates and protect water quality.
Technological	This theme needs technological innovation in terms of chemical/physical and biological tools and EWS to detect and prevent natural, chemical and biological risks and to enhance the resilience of urban water systems.
Environmental	Emerging pollutants and accidents related to urban water infrastructure status or management result in relevant environmental concerns. Urban floods have similar effects, as in storm water-retention ponds or water-treatment plants. Reduce the impact of emerging pollutants on water bodies.
Policy	Understanding the fate and behaviour of emerging pollutants in water bodies, and improving urban network performance and resilience to floods will support the implementation and refinement of specific policies. While a number of European policies gravitate around this theme, it is important to recall the numerous national and local policies both in Europe and in other countries targeted for the deployment of these technologies (WFD, Blueprint, Directive 2007/60/EC on the assessment and management of flood risks and national policies).

3.2.1 Emerging Pollutants: Assessing their effects on nature and humans and their behaviour and treatment opportunities

In recent years, concern has been raised with respect to the presence of some emerging pollutants in treated municipal drinking water. Since removal rates with conventional wastewater treatment processes are low for several emerging contaminants, discharge of wastewater effluents into receiving waters is a major environmental and health concern. Even though emerging pollutants have been detected, mainly in surface waters and wastewater, concern about their presence in groundwater bodies has also been reported.

Future research on emerging pollutants in water from urban or agricultural sources should deepen our understanding of the following issues: What are the new contaminants, such as polar compounds, pharmaceuticals, personal care products, perfluorinated and organosilicon compounds, endocrine disruptors, disinfection by-products (DBPs0, or emerging pathogens (including antibiotic-resistant bacteria and viruses), cyanotoxins and nanomaterials? How can we predict their environmental behaviour in surface water, sediments, soil and groundwater? Which innovative rapid analysis and detection systems could be developed? What impact do emerging pollutants have on human health (toxicology) and on ecosystems (ecotoxicology)? How can we prevent the emergence of these pollutants and the risks thereof? To what extent are these contaminants removed, or modified, by natural processes in water and soil, or by the techniques used in water treatment or reuse? What types of technologies (including post-treatments) should be applied for a more efficient removal of these compounds? Should these compounds be removed in decentralised units before entering in sewers? Which health risks could result from new water management practices, such as water reuse in urban areas? How do we identify and manage the 'next generation' of emerging pollutants?

Currently Identified Needs

RDI needs and related objectives	Time frame
2.1.1. Developing analytical techniques for groups of substances Improving methodologies for the detection, quantification and monitoring of emerging substances, DBPs, their metabolites and degradation products in different compartments of the environment. The development of real-time, warning systems and online technologies is of special interest. Developing new approaches to analyse the combined effects of chemicals (i.e., chemical mixtures), integrative bio-assessment tools and new biomarkers and bioassays.	Short
2.1.2. Controlling disinfection by-products, emerging pollutants and pathogens, including their environmental effects Understanding and predicting the environmental behaviour of emerging pollutants in surface water, sediments, soil and groundwater. Assessing the transfer time of different pollutants as well as understanding the processes during transfer. Expanding the knowledge base on antibiotic resistance in aquatic environments: developing comparable and validated data sets on the prevalence and spread of major bacteria in the aquatic environment with clinically and epidemiologically relevant antimicrobial resistance in Europe. Developing integrated risk-assessment procedures, including the effect of long-term exposure, for antibiotics and other emerging pollutants acting at sub-lethal levels. Modelling transport, growth and degradation of emerging pollutants and pathogens. Assessing and implementing management measures and technologies to reduce the impact of emerging pollutants and pathogens on water quality. Specific focus on wastewater reuse is required. Developing a better understanding of the extent to which emerging pollutants are removed or modified by water treatment plants/natural processes in soil and water. Understanding the factors that control the bioavailability and fate of emerging pollutants in organisms. Characterising the effects of emerging pollutants and their metabolites, on human health and on ecosystems. Assessing both the occurrence and toxicity of regulated and emerging disinfection by-products. Developing strategies to reduce emerging pollutants at source (e.g. airports, golf courses, rail tracks, highways, hotels, pharmaceutical sources). Improving technologies for the specific removal of natural organic matter from surface water so as to avoid the formation of DBPs during the chemical disinfection process (with chlorine, chloramine, and ozone). Link with 3.1.2.	Short

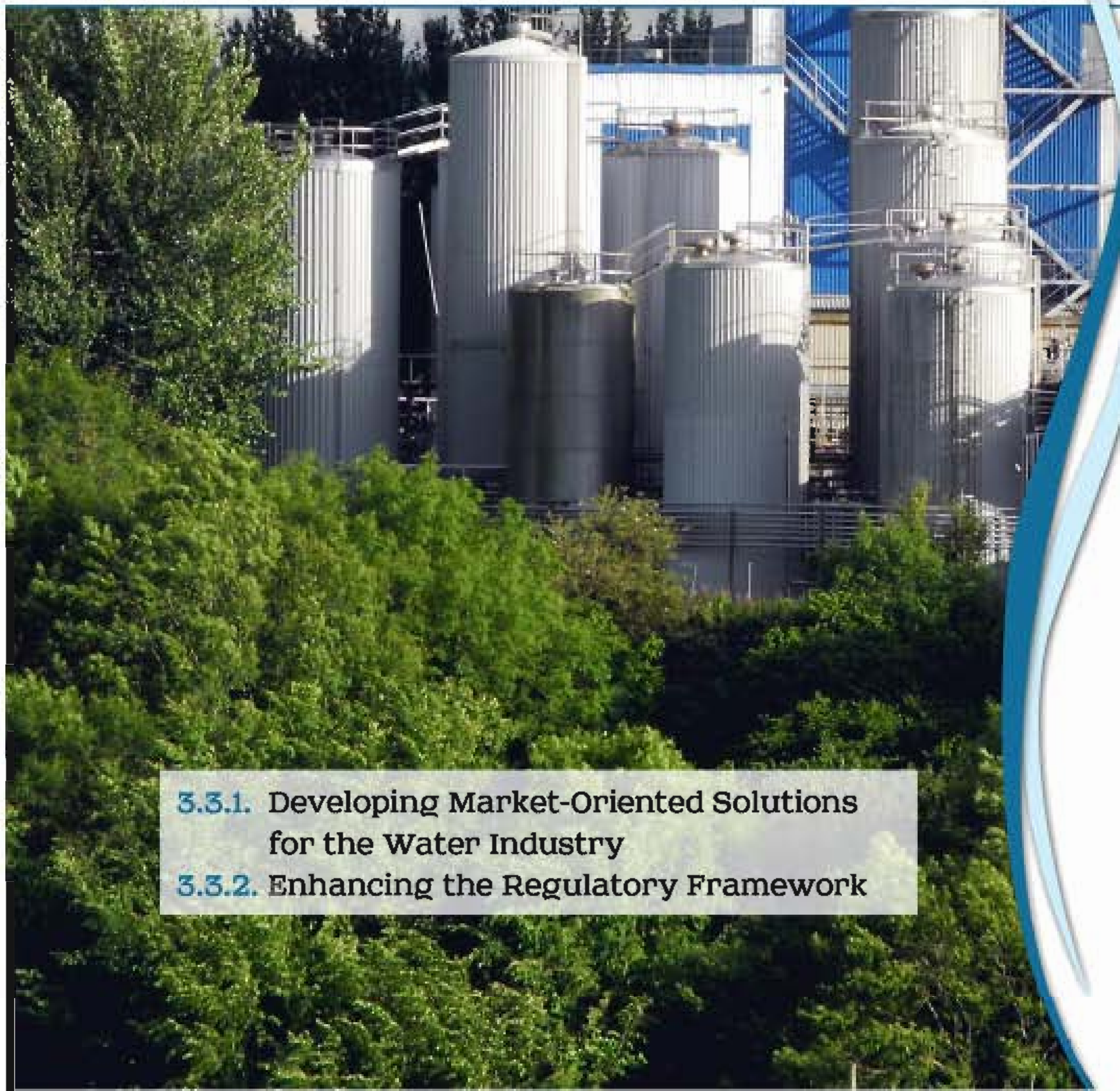
3.2.2 Minimising Risks Associated with Water Infrastructures and Natural Hazards

Current global changes (such as climate change and urban sprawl) demand innovative practices to minimise the risks associated with: (i) water distribution and storage facilities in urban areas; and (ii) natural hazards (floods and water scarcity as well as associated risks for citizens' life and assets). Protecting the capacity of urban water networks to deliver water to citizens with target quality standards is a major goal for both European and non-European countries. Urban water networks concentrate large public investments, guarantee the right to water access and represent a very important niche for multinational European companies of all sizes. Research can protect citizens, investments and businesses by supporting innovative management and decision-making. Urban water natural hazards can be exemplified by urban floods and water scarcity. Their devastating power will be limited through multidisciplinary research exploring the areas of risk prevention and management. A variety of scientific and technological areas will be explored to put research results at the service of citizens' life and assets. The two aspects of this subtheme (infrastructure and natural hazards) may be combined in specific topics. For instance, the performance of storm water retention ponds could be improved, including the management of contaminants, and overflows in advanced wastewater treatment facilities could be managed when affected by floods.

Currently Identified Needs

RDI needs and related objectives	Time frame
2.2.1. Exploiting ageing urban water systems for dependable and cost-effective service Developing methodologies and technologies for the effective monitoring and control of urban water networks and storm water systems. Enhancing the resilience of urban water systems (i.e. pipeline networks, drinking-water reservoirs, pumping stations and large water treatment plants). Improving the efficient use of state-of-the-art monitoring and control systems. Developing decision-support systems (DSS) for long-term rehabilitation decisions based on the time evolution of system conditions. Improving data-management routines. Link with 3.1.1.	Long
2.2.2. Progressing towards urban flood-proof cities. Link with 1.3.2 and 1.3.3. Developing and setting up technological and managerial solutions to urban floods. Producing integrated systems for the prediction and risk management of urban floods (overflows in advanced wastewater treatment facilities, urban hydrology, surrounding river flow, hydrodynamics, internet of things, drainage design, social sciences and climate change analysis). Developing a smart city approach to integrate sensors and public information services designed for all event phases. Link with 3.1.1.	Short
2.2.3. Improving water systems performance Developing technologies for the monitoring of water losses and water consumption, including the localisation and repair of leaks in live systems. Developing solutions for decentralised treatment and water management (wastewater and storm water). Promoting the sustainable use of storm waters and groundwater, and drainage in cities. Promoting innovative separation and extraction technology pilot projects in industrial zones to harvest resources from wastewater and reused water.	Medium
2.2.4. Assessing the impact of water scarcity on safe drinking water Developing and setting up technological and managerial solutions to urban droughts. Producing integrated systems for the prediction and risk management of urban water scarcity. Developing smart innovations to tackle water scarcity in the city.	Medium

3.3. Promoting Competitiveness in the Water Industry



3.3 Promoting Competitiveness in the Water Industry

Innovative technologies are required by the water industry to develop products and services fuelling the European economy. The world water market has an estimated size of €234,000m, and Europe is currently leading it with a combination of large multinational companies and technology-rich SMEs[16]. According to the Strategic Research Agenda of the Water Supply and Sanitation Technology Platform (WssTP),[17] the European water sector has an annual turnover of €72,000m, sustains 600,000 jobs, manages a network of 5.7m km, and operates 70,000 wastewater plants.

The Water JPI is committed to prioritising and funding problem-solving research leading to the development of market-oriented solutions. Cooperation with stakeholders will be sought at all levels to ensure that research results are swiftly transformed into business opportunities. Innovation will be particularly promoted in this theme, taking advantage of the capacities and know-how of specialised innovation agencies partnering in the Water JPI. Activities will focus on aspects such as new materials and processes, management tools, ICT and energy efficiency.

Expected Theme Impacts

Impact	Description
Social	Smart water technologies will contribute to societal well-being through better human health as a result of better water quality. More water resources will be available for societal uses, particularly in low-water quality, water-scarce and drought-vulnerable areas. Social acceptance of reused waste will improve significantly.
Economic	Bring major business opportunities inside and outside Europe, setting the ground for sustained economic growth and industrial leadership. RDI activities will contribute to sustaining the competitive advantage of Europe, reducing innovation time to market. Water-energy nexus will be entirely understood and energy costs saved.
Technological	More reused wastewater will be available for agricultural and industrial uses; groundwater storage will increase. The current European leadership in water treatment for urban and industrial purposes will be supported.
Environmental	Water technology will contribute to improving the status of water bodies in quantitative and qualitative terms. Natural resources will be used in a more efficient way.
Policy	A number of European and national policies will be streamlined to support market uptake of water Innovations. Water policies (WFD) will be indirectly supported by RDI activities on this theme.

3.3.1 Developing Market-Oriented Solutions for the Water Industry

This subtheme focuses on the development of robust, smart and cost-effective technological solutions in each of the areas described below:

- Water distribution and measurement. The analysis of water conveyance networks around the world provides evidence of large differences in leakage rates. As a consequence, there is room for improvement in network performance in Europe and worldwide. Technological solutions include the monitoring of water losses and flow meters adapted to different accuracy requirements and water quality standards. Telemetry and remote control are commonly used in these type of applications, but standardisation and interoperability remain an issue.
- Overall solutions for water treatment and reuse. Wastewater treatment and reuse is a key research topic in response to the challenge of an increasing demand resulting from population growth, agricultural and forest production and climate change. Water scarcity and the need to protect natural resources are the main drivers for the development of innovative water treatment and reuse technologies in water-scarce areas. Potential applications of reclaimed water include agricultural and landscape irrigation, groundwater recharge, industry and, in specific cases, potable use.

- ~~Technological developments in water reuse face a number of constraints: financial, human health, environmental safety standards and regulations, monitoring and evaluation, energy consumption, and public acceptance and awareness.~~ Case studies from different European areas and involving different types of reused water producers and receivers are needed to complete the understanding of the processes involved. Solutions identified in these case studies should be tested for transferability to other sectors and areas of Europe and the world.
- Water desalination. In areas with high water demand for residential use, tourism or agriculture, desalination can contribute to the solution of water scarcity. Desalination is challenged by installation and energy costs, and by environmental issues such as brine management. Local water stakeholders often experience both the problem-solving capacity of this technology and the relevance of the related challenges. The thermodynamic energy requirement to separate water and salt implies that – despite technological progress – desalination will always be an energy-intensive technology. The Water JPI will address desalination challenges by combining renewable energies with desalination plants and reducing the environmental impact of brines.
- Valorisation of wastewater sewage/sludge and desalination brine. Shifting from the conventional view of waste to a resource that can be processed for the recovery of energy (converting organic matter into biogas using sludge digestion) and raw materials brings many opportunities to the water sector. A number of technical, economic and management approaches are available for recovering nutrients from wastewater streams. One example of such an approach is the recovery of phosphorus to produce fertilisers. Additionally, the production and recovery of chemicals such as cellulose, phosphate, polyhydroxyalkanoate (bioplastic) and alginates has become technologically and economically feasible. The recovery of all these chemicals enables substitution of mining or industrial products. Exploring these options will increase market opportunities.

Currently Identified Needs

RDI needs and related objectives	Time frame
3.1.1. Developing smart water technologies (sensor networks and real-time information systems in water distribution and wastewater networks) Developing innovative, affordable (micro- and nano-) sensors and detection systems, remote control systems, data networks, intelligent methods and DSS to manage (monitor and control) water distribution and wastewater networks. Standardisation and interoperability will support competitiveness and defend consumers' interests. Link with 2.21 and 2.2.2. Developing algorithms and software tools for modelling and simulating water acquisition and control systems.	Short

RDI needs and related objectives	Time frame
3.1.2. Delivering technological solutions for water and wastewater treatment (including biological processes) - Developing innovative membrane systems, including their support materials, for water treatment and wastewater treatment. - Developing innovative, safe, efficient and low-cost advanced processes for water treatment and assessment. Research should respond to the demand for decentralised water and wastewater in European regions, especially in rural areas. Advanced processes for water treatment and assessment should be able to treat micro-pollutants in wastewater. - Assessing the robustness of biological water treatment processes and boosting the shift from conventional water treatment plants to biological water treatment plants. - Understanding how natural organic matter behaves during advanced treatment processes. Link with 2.1.2. - Performing life-cycle assessments of treatment technologies to identify strategies aimed at increasing the efficiency of the water treatment process (e.g. reduction in the amount of inputs, low energy consumption, smaller footprints). - Optimising water and wastewater treatment systems through holistic modelling and simulation approaches. - Developing opportunities for the analysis of hybrid systems (i.e. systems combining conventional treatment processes and membranes filtration) combining several degradation/removal mechanisms in different compartments. - Enhancing the efficiency of wastewater treatment plants (in terms of energy efficiency, zero emission) through the conception and validation of new processes. Link with 3.1.4. - Developing water treatment processes by taking into account the principles of biomimetics (nature-based solutions) and ecosystem services. - Plant-wide modelling, optimisation and control of new water-treatment systems.	Medium
3.1.3. Promoting innovative approaches to asset management - Managing water assets in the context of sustainability, taking into consideration the social, economic and governance dimensions. Setting objectives, criteria, and metrics to analyse the current situations and development needs. - Developing methodologies for assessing current and expected impacts of climate and global changes on infrastructures and on customers' expectations; considering both technological and social sciences approaches. - Developing innovative procedures and fair economic systems to analyse and disseminate costs and benefits related to the improvement of water efficiency. - Developing diagnostic tools to better assess the need and/or possibility to renovate an infrastructure. Asset management innovation concepts should be taken into account at the development stage of diagnostic tools. Diagnostic tools should be based on an iterative approach (e.g. serious games) to test possible alternatives.	Medium

RDI needs and related objectives	Time frame
3.1.4. Supporting the energy water nexus (namely on efficiency and sustainability). Link with 3.1.2. - Progressing in the understanding of the water-energy nexus. - Assessing energy use in the whole water cycle in different environments. - Joint planning of water and energy. - Reducing energy consumption and recovering energy from water with a watershed perspective. - Maximising renewable energy use and production from wastewater processes through innovative technologies, including the management of thermal energy and heat recovery from sewage. - Developing low-energy and high-efficiency technologies and processes. A focus should be made on the use of renewable energy. - Developing innovative, efficient and cost-effective technologies to recover energy from wastewater. - Developing wastewater anaerobic processes for temperate and cooler climates and/ or low Chemical Oxygen Demand (COD) wastewater. - Implementing new applications such as solar thermal energy for disinfection, water treatment, water desalination, etc.	Short
3.1.5. Obtaining water and energy from the ground - Predicting and preventing environmental impacts linked to fracking and shale gas, sand oil (and oil recovery) exploitation. - Developing treatment processes for the water used for shale gas extraction. - Improving the allocation of groundwater for different uses according to its quality and quantity (e.g. energy extraction, agriculture). Groundwater quality and quantity assessment methodologies are needed.	Short
3.1.6. Developing water reuse and recycling technologies and concepts - Developing technologies, setting up demonstrators for the reuse of wastewater for agricultural and aquaculture purposes, and for water management purposes (i.e. artificial aquifer recharge). Developing separation and extraction technologies in water-using industries. - Reusing wastewater for different purposes according to its quality level. - Developing and evaluating innovative and sustainable decentralised treatment systems allowing the reuse of storm water and grey water as well as energy recovery from black water. - Supporting innovative separation and extraction technology pilot projects in industrial zones to harvest resources from waste and reused water. - Developing innovative processes for the production of drinking water from wastewater. - Developing mobile water-cleaning systems for the production of drinking water. - Development of harmonised and established standards for water reuse in irrigation throughout Europe.	Short

RDI needs and related objectives	Time frame
3.1.7. Recovering products from treatment plants Concept of treatment plants as producers of valuable resources (like nutrients [phosphate], sludge, bioplastics, heating metals [from brines]) through sustainable processes. Developing holistic control approaches aimed at optimising water quality, energy and resources recovery. Link with 3.1.2 and 3.14. Generating technologies aimed at reducing gas emissions in treatment plants (and their associated odours and toxicity). Developing new, eco-friendly materials; supporting sustainable management of urban waste and recycling of raw materials to produce energy from waste and biomass.	Medium

3.3.2 Enhancing the Regulatory Framework

Economic instruments can play an important role in assessing the economic value of water resources, in evaluating the efficiency of protection measures, in quantifying their impact on users, in developing new concepts on water management (cap and trade, quotas), and in enhancing the use of new technological solutions. However, limited access to appropriate forms of finance can be a restraint to water-related innovations. New frameworks aimed at protecting the economic value of European industries as well as to better anticipate regulation and adaptation needs are requested in order to minimise existing risks when developing or adapting new technologies in the water sector. There is also a need to explore various factors in the fields of education, regulation and governance regarding innovations (risk versus reward) in order to remove such bottlenecks.

RDI needs and related objectives	Time frame
3.2.1. Removing barriers to innovation - Exploring regulatory, governance, education and management conditions that contribute to removing barriers to innovation, considering i.e. the impact or effect of the price of water. - Reducing the time to market of building demonstrators in order to close the gap between research-related demonstration and market-opening demonstration. - Removing bottlenecks such as limited institutional capacity to formulate and institutionalise recycling and reuse measures, to tackle inadequate policies or to overcome the lack of financial incentives. - Developing indicators measuring the social value of innovations in the water sector. - Implementing effective policy and management frameworks that pave the way to the market uptake of innovative technologies. - Developing management models for new technological solutions to support sustainable operations, maintenance and market uptake. Link with 3.2.1. - Favouring knowledge transfer from other scientific fields regarding key lessons in the commercialisation of marketing products. Supporting the transfer of relevant results from other scientific fields for their application in the water RDI domain. - Understanding the requirements driving the social adoption of innovations by integrating technical and social sciences and humanities research and innovation, by involving stakeholders at the adequate levels and scales of participation and by enabling large-scale socio-technical experimentation.	Short

3.4. Implementing a Water-Wise Bio-Based Economy

3.4 Implementing a Water-Wise Bio-Based Economy

Máire Geoghegan-Quinn, the European Commissioner for Research, Innovation and Science, has defined bioeconomy[18] as 'the use of renewable resources from land and sea, and the use of waste to make value added products, such as food, feed, bio-based products and bioenergy'. One of the most likely effects of a bio-based economy is the intensification of agriculture, forestry and aquaculture, resulting from the development of non-food products (biomass, bio-fuel, timber, etc.). Further intensification will pose a number of challenges for Europe, such as increased pressure on natural and artificial resources (water, land, and agrochemicals), and the need for more efficient agroforestry systems. On the other hand, non-food activities can play a relevant role in water reuse and recycling. Since the bio-based economy has not yet been fully deployed, joint RDI activities will arrive on time to streamline its water profile in quantitative and qualitative terms. Understanding the effects of the bio-based economy on European ecosystems and on water-delivery systems will require intense cooperative research. This theme is characterised by strong interactions between hydrology, agronomy, forestry science and plant-breeding. Experimental, modelling and social sciences approaches need to be combined to ensure that the right combination of technologies and policies is deployed in the agricultural sector to reach the target of sustainable intensification. In the Water JPI, agricultural water use is analysed from the point of view of natural resources, not as a production factor.

Expected Theme Impacts

Impact	Description
Social	Society will benefit from more environmentally friendly farming operations, which will ensure compatibility between current land-use activities and the envisaged deployment of the bio-based economy. Water abstractions and consumptive use will not limit other societal water uses.
Economic	Agricultural and forest productivity will increase if appropriate measures (aimed at reducing soil and water pollution and at enhancing resource efficiency) are taken. Today, the European bio-economy (standard and innovative applications) is already worth more than €2 trillion annually and employs over 22 million people. The implementation of a water-wise bio-based economy will create more employment opportunities and wealth.
Technological	Development of new agricultural and forest practices, and blue biotechnology.
Environmental	Better use and protection of European natural resources, substantiated in the protection of water levels in aquifers and lakes, and discharge in streams. Additionally, environmental water quality will improve due to actions targeting farming and forest pollution.
Policy	This theme supports: (i) the European Bio-economy Strategy, released by the European Commission in 2012; (ii) the priority recommendations from the Lead Market Initiative (LMI) for bio-based products; (iii) the Common Agricultural Policy (CAP); (iv) a wide variety of national policies targeting water quality, and the agriculture and forestry sectors.

3.4.1 Improving Water Use Efficiency for a Sustainable Bio-economy Sector

Resource efficiency represents one of the main challenges of our society. A resource-efficient economy aims at the sustainable use of natural resources with a view to meeting the needs of a growing population within the ecological limits of a finite planet, while minimising impacts on the environment. The purpose of resource efficiency is to create more with less and to deliver greater value with less input. Resource-efficiency approaches applied to water are particularly needed within the European agricultural and forestry sectors, currently challenged by the development of the bio-based economy. These sectors account for the majority of global freshwater withdrawals, and are responsible for the vast majority of societal consumptive water use in Europe. This is particularly important since the most relevant competitor in terms of consumptive water use is the environment. Even small improvements in water productivity can result in substantial water savings. Resource efficiency is required in both rain-fed and irrigated systems, since evapotranspiration is the largest consumptive water loss throughout Europe. At the policy level, resource efficiency constitutes one of the flagship initiatives of the Europe 2020 Strategy, the EU's growth strategy for a 'smart, inclusive and sustainable economy'.[19] Research is needed in a variety of disciplines. Crop agronomy and forestry science will support the assessment and minimisation of water use. Plant-breeding will produce varieties more adapted to local water conditions and result in higher water-use efficiency. Irrigation science and technology needs to be developed to optimise water-application practices with state-of-the art conveyance and on-farm equipment.

Currently Identified Needs

RDI needs and related objectives	Time frame
4.1.1. Implementing efficient water-use systems and practices for the European and overseas markets - Developing, testing and evaluating innovative and efficient irrigation systems and practices combining crop water requirements, crop physiology, ground-based sensors, imagery satellite, ICT, and expert systems. Resource efficiency will be extended to the use of energy and agrochemicals (i.e., fertigation). Systems will be developed for different development environments to ease access to a variety of markets.	Short
4.1.2. Developing water-conserving farming and forestry practices and varieties - Developing techniques, based on biological materials, to improve the management of soiled water on farms and outside the farm gate. Designing water-efficient, cost-effective farming/forestry techniques and technologies supporting water conservation and efficiency. Link with 4.1.4. - Assessing more water-efficient and/or salinity-tolerant crops and forestry species and varieties. - Evaluating the application of organic materials and other amendments to improve soil properties related to water.	Medium
4.1.3. Setting up water-valuing schemes for agriculture and forestry - Establishing new criteria for valuing water in agriculture and forestry. - Developing appropriate tools and guidelines for estimating the associated environmental resource costs.	Long
4.1.4. Progressing towards future-proof agricultural water use - Analysing the effect of future climatic conditions and water availability on agriculture and forestry through the use of experimentation and integrated models. - Designing future agriculture and forestry systems under climate change conditions and water resources availability. Link with 4.1.4.	Medium

3.4.2 Reducing Soil and Water Pollution

Efforts to reduce farming-induced soil and water pollution have not yet removed farming as the major cause for poor soil and water quality in certain parts of Europe. Along with farming activities, sewage treatment plants and industrial discharges represent the most important sources of pollution in Europe (EEA, 2008[20]). Regarding agricultural, forestry and aquacultural water pollution, nutrients from fertilisers (mainly nitrogen and phosphorus), pesticides and their metabolites, pathogenic microorganisms excreted by livestock and organic pollution from manure, are regularly detected in water bodies at levels sufficiently high to affect aquatic and riparian ecosystems. Research is needed to develop a range of cost-effective in-situ measures to use inorganic and organic fertilisers and pesticides more efficiently. Substantial reductions in pesticide use can be achieved through modifying crop rotations and sowing dates, selecting more pest-resistant crop varieties, and designating buffer strips along water courses. New formulations, advanced application techniques, assessment of environmentally safe crop requirements and leaching prevention constitute additional relevant research lines. Sustainable agrochemical consumption patterns may also be effectively achieved through a mix of policy responses, involving regulation, economic incentives and information-based instruments, including awareness-raising campaigns. This subtheme will feed crop technology, and bio-economy policies with site-specific research oriented towards the sustainable intensification of farming and land-use activities.

RDI needs and related objectives	Time frame
4.2.1. Developing sustainable production systems Developing monitoring schemes and indicators, assessment methods and management tools to identify, quantify and minimise agricultural and forest pollution sources as well as to assess impacts caused by pollution. Reducing diffuse and point source pollution caused by agrochemicals, mineral fertilisers and manure. This will require the development of cost-effective, easy-to-access and adaptive technologies, including (among others) manure separation, and treatment and energy recovery technology, irrigation, precision farming, regulated drainage and an adapted management of buffer strips. Preventing water-related soil degradation, including salinity, erosion, structural degradation, compaction, oxidation of organic soils, among others. Developing new, integrative simulation models for soil, water and crop management providing agrochemicals dynamics in soil and water to build effective tools for decision-making on natural resources and policy support. Link with 4.1.2.	Short
4.2.2. Designing measures underpinning water and land-use policies. Link with 4.1.3 and 4.1.4. Developing methodologies to define appropriate monitoring scales and locations for policy development/assessment. Comparing combinations of context-specific, cost-effective, acceptable measures to reduce water pollution from agriculture and forestry in various climatic and pedological conditions. Delineating specific policy target areas and designing measures, as well as their effectiveness.	Medium
4.2.3. Overcoming barriers preventing water reuse in irrigated agriculture and forestry Understanding, managing and communicating the potential reuse of water in agriculture and forestry. Harmonising and establishing standards on water reuse in irrigated agriculture and forestry throughout Europe. Link with 3.1.6. Assessing social perceptions, costs, water quality, technical and safety bottlenecks.	Medium

3.5. Closing the Water Cycle Gap

3.5 Closing the Water Cycle Gap

Recurring water resource crises call for a better understanding of hydrological processes and improved technical and socio-economic management. In many areas of Europe, growing freshwater scarcity currently emphasises the need to close the water cycle gap by reconciling water supply and demand in both quantitative and qualitative terms. The demand for closed water systems is obvious in semi-arid areas, where research institutes are currently developing new concepts and technologies. Water scarcity requires new integrated concepts related to water re-use, energy, recovery of valuable substances, monitoring, control, decentralised systems, and the interaction with natural resources. Water quality may induce water scarcity in many societal water uses, thus calling for multi-target analyses of water availability. Research needs to be deployed in a number of scientific fields to improve the knowledge base on the availability and use of water resources. Water resources observation and modelling will be required to better understand hydrological processes and to analyse and forecast the effect of management options. This technological and environmental research must be systematically combined with a socio-economic approach investigating the questions of participation, behaviour and commitment of stakeholders. The costs and benefits of the different management solutions (including environmental costs and benefits) must be assessed systematically. The concept of water footprinting needs to be deepened, establishing practical methods and certifiable systems. Innovative concepts for water resources management need to be developed, with the aim of providing scientific solutions to societal water challenges. RDI activities will be required at different hydrological scales.

Expected Theme Impacts

Impact	Description
Social	The diversity of pressures and impacts on water bodies suggests that water policy can only be effective if it is implemented in a close 'horizontal' dialogue with the stakeholders interested in clean water and healthy water ecosystems. The impacts of water crises are not equally distributed in society, and can be a source of conflict between different water users. Improved water management will alleviate societal tensions.
Economic	Economic instruments such as taxes and subsidies can act as incentives for prudent water management. They constitute a vital complement to water regulation, and can assist water allocation between competing user demands. Mitigation measures and short-term solutions to overcome water scarcity (e.g. water transfers) will be included in the assessment of costs related to scarcity or drought, and the assessment of economic vulnerability of users and assets.
Technological	Improvement of management techniques of water resources (aquifer recharge, DSS, *inter alia*) with interoperability of databases, sensors, combined socio-economic and physical water models.
Environmental	Both water quantity and water quality are key factors in aquatic and riparian ecosystems. A decrease in available water resources jeopardises environmental flows as a minimum requirement for a healthy ecosystem. Other impacts include the loss of biodiversity and the degradation of landscape quality.
Policy	Regulatory measures are essential tools to ensure compliance with environmental standards of water quality and quantity. Economic policy instruments contribute to supporting these regulations, as expressed in the 2012 EU Water Blueprint. Understanding the mechanisms leading to improved water management will lead to better policy design and adaptation.

3.5.1 Enabling Sustainable Management of Water Resources

Improving our understanding of water resources rests upon integrated water and catchment management analyses involving surface water and soil management, erosion and pollution control, as well as environmental management and wastewater. The pressure for water reuse resulting from increased water demand (quantitative and qualitative), climate change and climate variability add relevance to this sub-theme. Links between pressures and water resources will be established through research activities aimed at elucidating specific connections between water resources, pressures and uses. The combination of observations and hydrological modelling (water bodies, overland flow, vadose zone, groundwater and land cover) will be targeted to ensure appropriate conceptualisation of the processes involved. Effective combinations of water quantity and quality will be sought, in the search for the integrated understanding which can lead to operational management tools for complex, changing environments. Innovative concepts such as Managed Aquifer Recharge (MAR) or Soil-Aquifer Treatment (SAT) are increasingly being used to manage and store water in water-scarce areas. A number of similar solutions have been locally developed over the centuries depending on the source and availability of water, demand, geology and socio-economic structure. These methods are being widely re-applied and developed using current technologies. However, examples of quantified assessments of their effectiveness are limited. Improved understanding of how recharge structures actually function and the impact they have on water availability, water quality, sustainability and the local and downstream environment, need to be gained and disseminated to promote cost-effective implementation.

Currently Identified Needs

RDI needs and related objectives	Time frame
5.1.1. Promoting water RDI infrastructures Establishing a European research infrastructure supporting up-scaling of water flow (runoff and groundwater), reactive transport and ecosystems to the relevant scale in order to facilitate policy implementation and assist scientists worldwide. Research infrastructure can be physical infrastructure (e.g. experimental catchments or field labs) or virtual databases/exchange platforms (to guarantee long-term records). Databases should be comprehensive, easy to access and interoperable. Advances in the up-scaling of theories and tools are needed.	Short
5.1.2. Promoting adaptive water management for global change Assessing the impacts of extreme weather events and global change on the water cycle and uses. Developing and testing improved plans and methodologies for adaptive water management in relation to global change. Methodologies will be tested on relevant cases using scenario development, uncertainty assessments and pilot experiments.	Short
5.1.3. Implementing Managed Aquifer Recharge (MAR) Development of MAR projects: Planning, operation, risk assessment and management. RDI activities will lead to mitigation of groundwater over-abstraction and degradation of groundwater resources by providing guidelines, supporting a harmonised legislation and by providing tools for risk assessment.	Short (regional) to Medium (global)

RDI needs and related objectives	Time frame
5.1.4. Securing freshwater in the Mediterranean and Baltic basins Developing a systemic approach to study, manage and protect Mediterranean and Baltic catchments. There is a need to improve current knowledge on hydrological and hydrogeological processes (water flow and contaminants transfer). Balance between fresh and brackish water in coastal areas will also be targeted.	Short (regional)
5.1.5. Securing freshwater in the Danube (Danube Knowledge cluster, Article 185[21]) Developing a systemic approach to protect water resources through an integrated water resources management approach.	Short (regional)
5.1.6. Mitigating water stress in coastal zones Developing a systematic approach to comprehensive coastal zone management based on monitoring and modelling. Integrate the different uses on coastal zones to prevent water quality and quantity degradation. Demonstrating the feasibility of Aquifer Storage and Recovery by using various sources of water. Evaluating inter-seasonal freshwater storage possibilities in existing aquifers. Developing novel geophysical and hydro-geophysical models for characterisation of water bodies at a finer scale. Models will include water supply and demand-scenario builders and DSS. Monitoring and dynamic modelling of artificial recharge and natural infiltration.	Short
5.1.7. Innovating on practical, low-cost technologies treating wastewater to produce resources safe for reuse. Link with 3.1.6 and 3.5.2. Removing emerging contaminants at an industrial scale. Developing integrated approaches combining technological solutions with social acceptability.	Short

3.5.2 Strengthening Socio-economic Approaches to Water Management

Social, economic and governance systems need to address innovative solutions to improve the balance between water demand and availability. Participatory approaches bring together different stakeholders, users and water authorities and provide platforms for fruitful discussions. These platforms have been conceived to identify problems, to facilitate dialogue, and to identify alternatives suitable for decision-making. This process of horizontal and vertical stakeholders' integration will only be effective if they have access to high-quality scientific and technical information on which to base their discussions. Effort should then be made to best inform society at large about state-of-the-art scientific knowledge on water resources, as well as on social processes for information and decision-making. Research is required to improve DSS as critical tools to integrate scientific knowledge on decision-making. Multidisciplinary DSS, covering from social human sciences to physical sciences will be required for this purpose, as well as to effectively guide policy development and water management decisions. The knowledge base on water users' behaviour and water economics needs to be expanded. Practical applications include the willingness of consumers to use alternative water sources (such as recycled water for agricultural or forest purposes or for artificial recharge), and water governance – particularly regarding frameworks, instruments, pricing policies and integrated models.

Currently Identified Needs

RDI needs and related objectives	Time frame
5.2.1. Integrating economic and social analyses into decision-making processes Improving baseline economic information and communication tools and methodologies for local decision-makers. Adapting to hydro-climatic extremes (droughts and floods): Risk-based decision-making and planning tools including socio-economic sciences, effective communication and conflict resolution. Link with 2.2.2 and 2.2.4. Understanding the conditions for efficiency of current economy-based instruments such as pricing policies (financial and fiscal instruments) and related policy instruments (e.g. subsidies for agriculture). Providing insight on the transaction costs resulting from the implementation of the WFD measures (cost-effective analysis of measures, assessing disproportionality of costs to justify exemptions, water pricing and assessing cost-recovery level of water services).	Medium
5.2.2. Reconnecting socio-economic and ecological issues Widening the current knowledge base on the existing relationships between good ecological status, biodiversity and ecosystem services. Developing methodologies for valuation of and payment for ecosystem services, including tangible and intangible services. Link with 3.1.1 and 5.1.7. Examining the water footprints of major European imported commodities to determine where there are supply-chain vulnerabilities, which might usefully be addressed through innovation in respect of water. Engage with the agenda on the life cycle water footprint labelling of products.	Long

RDI needs and related objectives	Time frame
5.2.3. Promoting new governance and knowledge management approaches for water management Developing new approaches for water management aimed at setting up innovative alternatives suitable for decision-making. These approaches should be ideally based on: (i) the broad participation of stakeholders; (ii) multidisciplinary research; and, (iii) the development of scenarios to support decision-making in the short and long term. Implementing robust legislation in support of sustainable development. Envisaging education and communication initiatives to raise social awareness concerning consumption habits and water scarcity (technical and behavioural approaches, including knowledge on the water cycle) with an influence on water availability and water quality. Increase the level of social acceptance and use of grey water. Link with 3.2.1. Improving the level of dissemination and adoption of available knowledge and best-practice options. Awareness campaigns in those areas affected by water cycle variations (extreme precipitation events, drought, inflow variability etc.). Awareness campaigns for real-estate owners on hydrological risks and mitigation measures. Disseminating information on good practices in the agricultural and industrial fields.	Short

4. The Water Joint Programming Initiative (JPI) within the European Context

Water is at the core of the activities of a wide range of initiatives and research-funding networks and organisations, such as ERA-Nets,[22] EUREKA (with the ACQUEAU[23] cluster in particular), technology platforms[24] (amongst other, the Water Supply and Sanitation Technology Platform, WssTP), Euraqua,[25] the WFD Common Implementation Strategy Groups, or the European Innovation Partnership (EIP).[26] Water has been, and still is, a historical priority for European RDI-related programmes (Framework Programmes,[27] LIFE,[28] COST[29] or Structural Funds[30]).

This diversity of actors and programmes confirms that water is at the top of the agenda of European RDI actors. Nevertheless, fragmentation represents a potential obstacle in the development of an RDI strategy for the sustainable use of water resources and for a sustainable, competitive industrial water sector. **The Water JPI will promote coordination and cooperation with these RDI actors.**

In addition, **the Water JPI will seek to enhance synergies with other JPIs in order to establish common activities.** In this sense, the Water JPI has at this point reviewed the strategic agendas of other JPIs and it has identified specific research areas of the Water JPI's SRIA that could contribute to tackling the societal challenges addressed by other JPIs. The results of this analysis are shown below.

Name of the JPI	Relevant Water JPI's subtheme and research needs
JPIAMR[31]	**2.1 Emerging pollutants: assessing their effects on nature and humans, their behaviour and treatment opportunities** **Research, Development and Innovation needs:** 2.1.2. Disinfection by-products, emerging pollutants and pathogens, including their environmental effects
Climate	**1.3. Managing the effects of hydro-climatic extreme events and multiple pressures on ecosystems** **Research, Development and Innovation needs:** 1.3.1. Understanding the causes of drought/scarcity; predicting drought events and water scarcity 1.3.2. Developing innovative (or improved) tools for the protection and prevention of hydro-climatic extreme events 1.3.2. Improved water management to mitigate the harmful impacts of extreme events **2.2. Minimising risks associated with water infrastructures and natural hazards** **Research, Development and Innovation needs:** Towards urban flood proof cities 2.2.4. Assessing the impact of water scarcity on safe drinking water **3.1. Developing market-oriented solutions for water industry** **Research, Development and Innovation needs:** 3.1.3. Promoting innovative approaches to asset management **5.2. Strengthening socio-economic approaches to water management** **Research, Development and Innovation needs:** 5.2.1. Integrating economic and social analyses into decision-making processes **4.1. Improving water use efficiency for a sustainable bio-economy sector** **Research, Development and Innovation needs:** 4.1.4. Progressing towards future-proof agricultural water use **5.1. Enabling sustainable management of water resources** **Research, Development and Innovation needs:** 5.1.2. Promoting adaptive water management for global change

Name of the JPI	Relevant Water JPI's subtheme and research needs
FACCE[32]	**1.1. Developing approaches for assessing and optimising ecosystem approaches** **Research, Development and Innovation needs:** 1.1.1. Developing approaches for assessing and optimising ecosystem services and the ecological functioning of ecosystems 1.1.2. Testing methodologies for the valuation of ecosystem services 1.1.3. Integrating ecosystem services into water resources management **1.2. Integrated approaches: developing and applying ecological engineering and ecohydrology** **Research, Development and Innovation needs:** 1.2.1. Establishing pressure-impact relationships in aquatic and riparian ecosystems 1.2.2. Understanding the impacts of pressures on the terrestrial and aquatic interface **1.3. Managing the effects of hydro-climatic extreme events and multiple pressures on ecosystems** **Research, Development and Innovation needs:** 1.3.4. Managing multiple pressure-impact liaisons on ecosystems **3.1. Developing market-oriented solutions for the water industry** **Research, Development and Innovation needs:** 3.1.6. Developing water reuse and recycling technologies and concepts **4.1. Improving water use efficiency for a sustainable bio-economy sector** **Research, Development and Innovation needs:** 4.1.1. Implementing efficient water-use systems and practices for the European and overseas market 4.1.2. Developing water-conserving farming and forestry practices and varieties 4.1.3. Setting up water-valuing schemes for agriculture and forestry 4.1.4. Progressing towards future-proof agricultural water use **4.2. Reducing soil and water pollution** **Research, Development and Innovation needs:** 4.2.1. Developing sustainable production systems **5.1. Enabling sustainable management of water resources** **Research, Development and Innovation needs:** 5.1.2. Promoting adaptive water management for global change
Oceans	**1.3. Managing the effects of hydro-climatic extreme events and multiple pressures on ecosystems** **Research, Development and Innovation needs:** 1.3.3. Improving water management to mitigate the harmful impacts of extreme events

5. Progress towards Strategic Research and Innovation Agenda (SRIA) 2.0

The SRIA is a living document, under continuous review and update in order to cover current and actual RDI needs in a fast-changing world. Upon release of SRIA 1.0, efforts will shift to the development of SRIA 2.0. This third version of the Agenda will be published in December 2015, in coincidence with the end of the WatEUr Coordination Support Action.

The European water RDI is currently characterised by its rapid evolution as new working groups and structures are continuously created (this is the case for, for example, the EIP Action groups, the working groups of the WssTP and the Common Implementation Strategy [CIS]). The Water JPI will review the work carried out by these new groups and structures, so that new RDI needs are taken into account in the preparation of SRIA 2.0.

In addition to the information sources used in SRIA 1.0, the new version will be fuelled by the second Water JPI Mapping Report, to be released by the end of 2014. The new version will also deepen the relationship between needs and Water JPI instruments. Additionally, a broader perspective will be gained by integrating information coming from outside Europe. New information sources – such as those listed below – will be analysed, thereby completing the analysis of relevant information sources initiated in February 2013:

- River Commissions (e.g. Rhine, Danube);
- Strategic agendas of European Technology Platforms (e.g. WssTP, SusChem, Forestry, Sustainable Mineral Resources);
- Strategic agendas/roadmaps of European networks (Euraqua, EuroGeoSurvey, Norman);
- Recent developments of the European Stewardship Standard;
- Outputs from international conferences (such as the European Water Research Conference organised by the Water Science Alliance);
- CIS working groups;
- Roadmap of the European Water Association;
- Roadmap of Eureau;
- Agendas of relevant ERA-Nets in the field of water resources;
- Activities of the EIP action groups;
- Activities of active Water Partnerships in Europe; and
- Roadmaps/agendas of the organisations to which members of the SAG belong.

The second stakeholder workshop of the Water JPI will be organised during the first semester of 2015. This second workshop will be more targeted than the first one, emphasising specific areas requiring further analysis.

A public consultation was launched from 28 March to 30 April 2014. The consultation, in the form of an online questionnaire, allowed the wider public to express their views on the importance and urgency of each of the RDI needs identified during the 'collection and processing of information about water RDI context and trends' activity. A total of 637 responses was received. The results of the first public consultation will be used for structuring working groups so that more balanced groups (in terms of gender, affiliation and country of origin) are created.

The Water JPI Advisory Boards and a selection of European experts and governmental representatives will discuss the agenda content and propose priorities. A second public consultation will be launched in the first semester of 2015. In this case, the target will be to reach out to more categories of stakeholders, with a better coverage of Europe. The questionnaire will be designed for a faster and more complete uptake of the information in SRIA 2.0.

Annex I: Members of the Water Joint Programming Initiative (JPI) Advisory Boards

Members of the Scientific and Technological Board (STB)

Member	Institution
Dr. Luc Abbadie	Laboratory BIOEMCO (Biogeochemistry and Ecology of Continental Environments), University Pierre & Marie Curie, France
Prof. Eilon Adar	Institute for Water Research, Israel
Dr. Damiá Barceló, *President*	Catalan Institute for Water Research and CSIC Spain
Dr. Marc F.P. Bierkens	University of Utrecht and Deltares, The Netherlands
Dr. Cees Buisman, *Vice President*	Wetsus, The Netherlands
Dr. Despo Fatta-Kassinos	Nireas-International Water Research Centre, Cyprus
Prof. Robert Ferrier	The James Hutton Institute, United Kingdom
Prof. Maria Kennedy	UNESCO-IHE Institute for Water Education, The Netherlands
Prof. Claudia Pahl-Wostl	University of Osnabrück, Germany
Dr. Jens Christian Refsgaard	Geological Survey of Denmark and Greenland, Denmark
Dr. Susan D. Richardson	Athens, Georgia, United States
Prof. Karl-Ulrich Rudolph	University of Witten/ Herdecke, Germany
Dr. Sveinung Saegrov	Norwegian University of Science and Technology, Norway
Prof. João Santos Pereira	Technical University of Lisbon, Portugal
Dr. Eric Servat	Institut de recherche pour le développement (IRD), France
Dr. Merete Johannessen	Norwegian Institute for Water Research, Norway
Dr. Michele Vurro	Italian National Research Council, Italy

Members of the Stakeholders Advisory Group (SAG)

Acronym	Institution
Acqueau	The EUREKA Cluster for water
ARC	Aqua Research Collaboration
CIS-SPI	Science-Policy interface
EMWIS	Euro-Mediterranean Information System on know-how in the water sector
Euraqua	European Network of Freshwater Research Organisations
Eureau	European Federation of National Associations of Water and Wastewater Services
EWA	European Water Association
FAO Land and Water	Food and Agriculture Organization of the United Nations, Land and Water Department
SYKE, *Vice President*	Finnish Environmental Institute
CHJ	Júcar River Basin Organization
WssTP, *President*	Water Supply and Sanitation Technology Platform

Annex II: List of Water Joint Programming Initiative (JPI) Partners and Observers

JPI Partners

Country	Leading Representing Institution(s)
AT, Austria	Environment Agency, Vienna University of Technology
CY, Cyprus	Research Promotion Foundation
DE, Germany	Federal Ministry of Education and Research (BMBF), Jülich Forschungszentrum
DK, Denmark	The Danish Council for Strategic Research, Danish Hydraulic Institute (DHI)
EE, Estonia	Ministry for Environment, Tallinn University – Institute of Ecology
ES, Spain, *Coordinating Country*	Ministry of Economy and Competitiveness
FI, Finland	Academy of Finland Research Council for Biosciences and Environment
FR, France	AllEnvi BRGM, AllEnvi IRSTEA
IE, Ireland	Environmental Protection Agency (EPA)
IL, Israel	Ministry of Energy and Water
IT, Italy	Institute for Environmental Protection and Research (ISPRA), Ministry of the Environment, Ministry of Education, University and Research
MD, Moldova	Academy of Sciences of Moldova
NL, The Netherlands, *Co-Coordinating Country*	Ministry of Economic Affairs
NO, Norway	Ministry of Climate and Environment
PL, Poland	Ministry of Science and Higher Education, Centre for Ecohydrology under the auspices of UNESCO (ERCE)
PT, Portugal	Science and Technology Foundation (FCT)
RO, Romania	Romanian Office for Science and Technology, National Authority for Scientific Research (ANCS)
TR, Turkey	The Scientific and Technological Research Council of Turkey (TUBITAK), Turkish Water Institute (SUEN)
UK, United Kingdom	Natural Environment Research Council (NERC), Department of Environment, Food and Rural Affairs (DEFRA)
EC, European Commission	(Non-voting partner)

JPI Observers

Country	Leading Representing Institution(s)
BE, Belgium	Flemish Environment Agency
EL, Greece	National Technical University of Athens
HU, Hungary	Representation of Hungary to the EU
LV, Latvia	University of Latvia
SE, Sweden	The Swedish Research Council Formas

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[22] ERA-Net: European instrument aimed at fostering cooperation and coordination of research activities within a specific research domain. The Water JPI will search for fruitful collaboration with relevant ERA-Nets (e.g. IWRM, CRUE, SPLASH, SNOWMAN, CIRCLE).

[23] Acqueau is the Eureka Cluster for Water. Its aim is to label innovation projects in Public-Private Partnerships (PPP).

[24] Led by industries, the role of technology platforms is to develop RDI agendas.

[25] Euraqua is the European Network of Freshwater Research Organisations.

[26] The EIP on water aims at stimulating creative and innovative solutions to tackle water challenges by bringing together actors from RDI, water users and water utilities.

[27] The Framework Programmes for Research and Technological Development are the EU's main instruments for supporting collaborative research.

[28] LIFE is the EU's financial instrument supporting environmental and nature-conservation projects throughout the EU.

[29] COST is an intergovernmental organisation that supports networking and mobility actions through the COST actions.

[30] The Structural Funds aim at removing economic, social and territorial disparities across the EU while making the EU more competitive. RDI activities have a considerable support from the Structural Funds.

[31] Joint Programming Initiative on Antimicrobial Resistance.

[32] Joint Research Programming Initiative on Agriculture, Food Security and Climate Change.