



THE VALUE OF WATER



**Multiple Waters,
for multiple purposes and users**

Towards a Future proof model for a European water-smart society



Introduction

This Vision document has been developed by WssTP, with the input of its members and key stakeholders.

It has been developed in the first half of 2016, to set the directions for tackling the key societal challenges related to water which is one of the key resources underpinning our lives and economies.

The document outlines what the future water-smart society may look like, based on emerging technology and societal trends which are expected to lead to a paradigm shift on how we deal with the finite resources on our planet. By 2030 the transition to the water-smart society should be in full swing.

It outlines the higher level innovations that will be required to realise that vision, and as such sets the base for a renewed Strategic Innovation and Research Agenda (SIRA), and serves as an inspiration for both policy makers, researchers, technology developers, water service providers, and water management authorities, to join forces in building a sustainable, robust, resilient and dynamic water-smart society for Europe while strengthening Europe's contribution to the global societal challenges and water market.

Terms and definitions

The Value of Water • Expression of the importance of water for our society at large, including the enabling function for all our economic activities, societal functions related to health and well-being as well as the (potential) economic value of resources (nutrients, chemicals, metals, minerals) and energy, embedded in our water streams.

The Value in Water • Indicating the economic and societal value that can be realised by extracting and valorising substances such as nutrients, minerals, chemicals and metals as well as energy, that embedded in used water streams.

Water-smart society • A society in which the true value of water is recognised and realised, and all available water sources are managed in such a way that water scarcity and pollution of groundwater is avoided, and water and resource loops are closed to a large extent to realise a circular economy and optimal resource efficiency, while the water-system is resilient against the impact of climate change events.

Water-system • The combination of water infrastructure (grey and green), processes, governance mechanisms, rules, organisations related to the extraction, treatment, distribution, use and re-use of water, as well as the resilience of the water infrastructure.

Hybrid grey and green infrastructure • A combination of grey engineered infrastructure, green engineered infrastructure and natural systems, part of the water-system that will be used for water extraction, treatment, distribution, re-use and resilience.

Multiple waters • Important underpinning concept of the WssTP water vision, picturing a future in which different alternative water sources and qualities (fresh ground and surface water, rain water, brackish water, saline water, brines, grey water, black water, recycled water) will be available in our society, and applied for different functions by multiple users.

Digital Water • Important underpinning concept of the WssTP vision, based on the predicted development of a world where all people, “things” and processes are connected through the “Internet of everything” leading to capillary networks and sensors, meters and monitoring of the water-system up to the individual user, as such generating large amounts of valuable data (big data) for innovative Decision Support and Governance systems.

WssTP future-proof model for a water-smart society • A model and framework that structures the required research, development and innovations with respect to the current water-system, in order to realise the vision of a “water-smart society”.

Executive Summary

“Access to ..[water] .. is a basic human right and water is crucial for human health and well-being, as well as economic performance and business growth. It is also a finite and shared resource, therefore action by an individual, a business or a community can have a substantial impact on access to it by others.

Deloitte Water Tight 2015

The WssTP vision for a water-smart society

This WssTP vision document aims to show the routes towards better use, valorisation, and stewardship of our water sources by society and businesses while developing resilient and sustainable solutions for our key global water challenges. It describes how these challenges can be turned into opportunities for Europe, to develop new technologies, solutions, business and governance models for the **water-smart society of the future**. The vision imagines a future, where water scarcity and pollution of ground- and surface water in Europe are avoided, water, energy and resource loops are closed to a large extent to realise a circular economy, the water system is resilient against climate change events and European water-dependent business thrives as a result of forward-looking research and innovation.

As such it frames the context for developing a renewed Strategic Innovation and Research Agenda (SIRA) that defines the most important research, development and innovation actions to be promoted by WssTP and its collaboration partners for the upcoming decades.

Contributing to solve societal challenges and European competitiveness

The WssTP Vision is focusing on European water challenges, trends and required developments, but it also indicates how this is connected to Europe's role in solving global water challenges, including the United Nations Sustainable Development Goals, while confirming and strengthening Europe's position in the global water-related economy valued at 62.9 Trillion Euro.

In order to make the water-smart society emerge, WssTP proposes to focus research, development and innovation investments in Europe on four key impact parameters:

1. **Reducing the impact** of Europe's society on our natural water resources by 50%;
2. **Realizing the true value of water** for our society, the economy, and the environment;
3. **Boosting the European water market** as well as global competitiveness of the European water industries;
4. **Securing long term resilience, stability, sustainability, and security** of the society with regard to water.

To realise these objectives, Europe will need to develop innovative water-technologies, digital solutions, and economic, business and governance models that contribute to solving water challenges in Europe and for the world at large.

A paradigm shift towards a sustainable and circular water-smart society

WssTP promotes **a future proof European model for the water-smart society** that entails a **paradigm shift** in the way our future society will be organised and managed with regard to water. It requires bold and courageous decisions, investments, changes and new types of collaborations for stakeholders at all levels of society, involving citizens, public authorities at all levels, industries, farmers as well as representatives of our natural environment.

It will leverage on both dramatically higher levels of manageability enabled by the emerging cyber-physical society, **“digital water”** technologies and boosting the availability of **“multiple waters”** to complement fresh water sources, as well as much deeper levels of awareness, integration and collaboration between organisations and citizens.

These important changes will offer a boost for Europe's industry as it requires significant investments in redesigned and adapted infrastructures as well as innovative technologies. It also provides complex challenges that require a longer term programme to foster a stable migration towards the new water-smart society.

A future proof model for a water-smart society

The **WssTP future-proof model for a water-smart society** entails four key components to carry out research and development, but more importantly, to bring RTD results to market and realise systemic innovation in our water-system by:

1. The Value of Water: developing a water-smart economy using advanced solutions and a systems approach to eco-innovation, a state-of-the-future water infrastructure, a circular water-economy, as well as new economic models based on **the true value of water**, in order to increase rational use and re-use. It also entails valorising the value in water, meaning extracting and exploiting relevant resources such as nutrients, minerals, metals but also energy that is embedded in used water streams. Innovations shall enable cost effective solutions that open-up new multi-Billion Euro markets for European industries towards the valorisation of secondary raw materials and energy;

2. New digital and water technologies: deploying advanced digital solutions for water in a capillary network of sensors in water distribution systems, capturing and using this new information to manage them in real time. Developing advanced water-treatment solutions to achieve good status of European water bodies, enable synergies between centralised and decentralised treatments, as well as economically viable extraction and valorisation of valuable substances and energy in water. Use advanced materials in the water infrastructure and improve solutions to reduce water use in agriculture. Our emerging enabling technologies will enable Europe to reach previously unimaginable levels of control, manageability, and valorisation of water for our society;

3. A hybrid grey and green water infrastructure: rethink and redesign the water distribution and water service systems into a high-tech human-built water infrastructure integrated with a nature based ecosystem. It combines centralised and decentralised water treatments, leading to reduced water-loss, increased water reuse, optimising the exploitation of alternative water sources in a circular economy, and strengthening resilience against climate change events, especially droughts and floods;

4. Enabling inclusive multi-stakeholder governance: new governance models that manage availability of water for all users and sectors (industry, agriculture, cities, waterborne transport) and multiple purposes, based on the understanding of true value of water, and using fit-for-purpose, adaptive and evolving economic and governance mechanisms, supported by advanced near-real time decision support systems and information exchange at all levels (rural, industrial, urban, regional, national, European and even global).

The transition to the water-smart society

WssTP envisions a European water sector that will be significantly transformed with respect to the current state of play. New concepts such as **"Multiple Waters"**, **"Digital Water"** and **"Hybrid grey and green infrastructures"**, will be driving the transition, decision makers and new water-smart economics. All will be enabled by new technologies fostered within an open innovation environment and a completely **redesigned water infrastructure**. The impact of climate change events will be under control. **New governance structures, economic mechanisms** and novel more profound water stewardship programmes, will manage the water market towards smart allocation of water.

In the future water-smart society, more than 30% of the total water demand (e.g. hundreds of km³/yr) will be delivered by alternative water sources such as rain-water, brackish, saline and re-used water streams. New water- and crop-growing technologies, the redesigned water infrastructure and advanced (self) management tools will increase water savings throughout our society: from agriculture to (bio) industries, homes as well as for energy production, reaching savings of up to 300 km³/yr. Overall the WssTP water vision aims for a set of innovations leading to a 50% reduction of the pressure on our fresh ground and surface waters, making avoidance of water scarcity in Europe a reality and contributing significantly to solving the important water scarcity at world level.

By 2030 the transition to the water-smart society will be in full swing, driven by visionary front-running (agro) industries, urban, and rural areas. They will have taken the lead in showing the migration paths towards the future water-smart society by implementing ambitious long term investment and innovation programmes, as well as **real life Living Lab** experimental areas. They will have created a fertile innovation eco-system for solution developers, researchers, forward looking water users, and water-governing bodies to develop the leading solutions of the future. These will boost Europe's global competitiveness in the 2.5 Trillion Euro water-handling market, creating numerous new green jobs in Europe while providing important contributions to achieving the water related Sustainable Development Goals.

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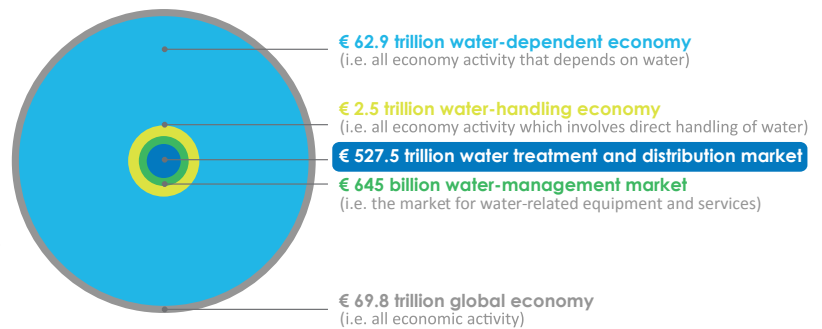
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1 • Background to the Vision

Water challenges

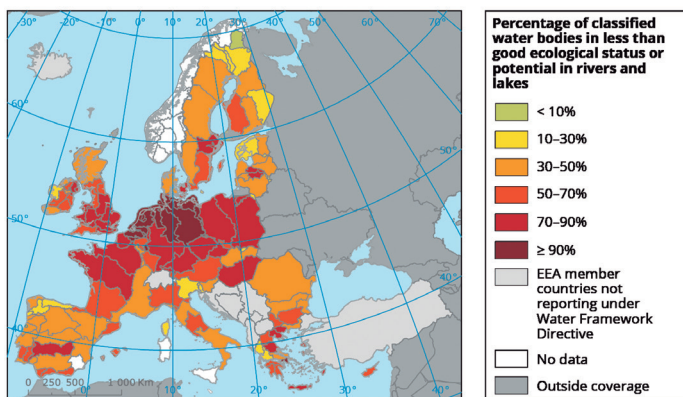
“Unless the balance between demand and finite supplies is restored, the world will face an increasingly severe global water deficit.” **UNESCO Water report 2015**

The global water supply, treatment, and distribution sector is a critical enabler of our society: it guarantees our food, sanitation, health, and well-being. Without it everything else in the 69.8 Trillion Euro global economy would fail. Global trends however, project world-wide growth in water use¹ with 55% by 2050, due to growing demands from manufacturing, thermal electricity generation, agriculture and domestic use, all increasing the pressure of human activities on our fresh-water sources. Furthermore, water quality is declining due to urban, industrial, and agricultural pollution, impacting water availability of sufficient quality for users. Diffuse pollution significantly affects 90% of river basin districts, 50% of surface water bodies and 33% of groundwater bodies across the EU².



Source: adapted from GWI

In the OECD countries water demand is expected to stabilise towards 2050 at around 1000 km³ per annum (350 km³/yr in the EU⁴), but quality of water and increasingly intense weather events, induced by climate change pose challenges. They need to be solved for a sustainable society that guarantees adequate water availability for all uses and users.



Source: EEA

Currently we lack comprehensive insights into the way we use our available water sources as well as the status of our water bodies and we face challenges for restoration of the quality of EU waters to acceptable levels⁵.

Water recycling is minimal⁶ and we are struggling to deal with the increasing effects of climate change such as floods and droughts, with significant geographical differences throughout the European continent.

In the future most OECD countries, including Europe, will have to deal with the challenge of potentially increased water scarcity, especially in Southern Europe and coastal areas but also increasingly in Central, Eastern and North-Western Europe. **Water scarcity is already a serious problem** in 11% of the EU territory and it is expected that the territory facing water scarcity problems will grow to 30% in 2030⁷. Apart from the availability of water, our **water quality will also be affected**⁸ as a result of seawater intrusion in coastal aquifers, faster dissolved oxygen depletion because of higher water temperatures, and higher content of pollutants that flow into water bodies following extreme rain events⁹. Systems to increase insights in the water-system, solutions to deal with disruptive climate change events, as well as novel technologies and strategies will be needed to optimise management of our water sources and make sure that sufficient water of an adequate quality will be available for our society.

The need for a new WssTP water vision

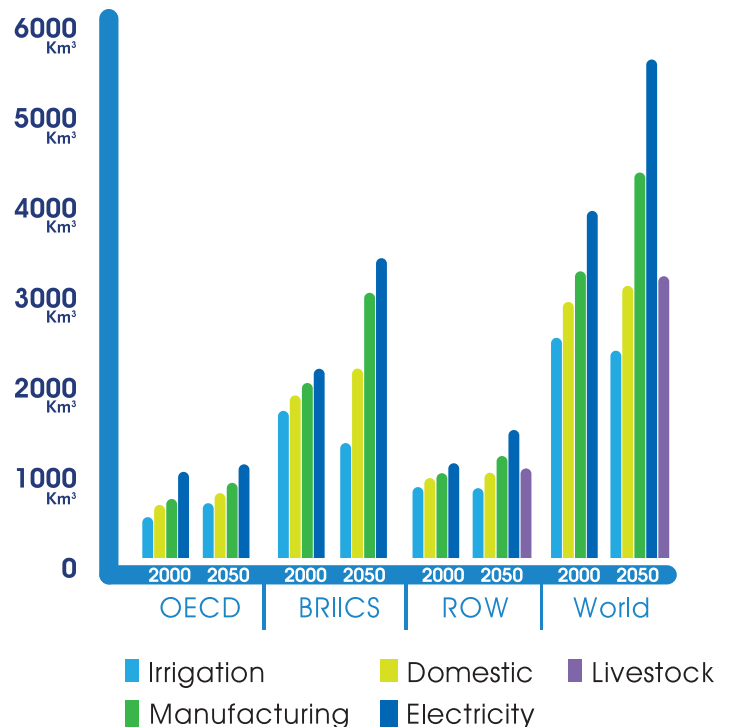
In a future world in which the population will grow to almost 10 Billion people, the amount of water users dramatically increases, and our daily life, health, well-being and economies essentially depend on water availability, scarcity is not an option.

A European vision for a water-smart society hence needs to identify novel solutions and routes towards important reduction of fresh-water extraction from our natural eco-system, while making available sufficient water sources.

Moreover, a vision for a water-smart society needs to take account of emerging new opportunities to solve societal problems, resulting from an increasingly connected cyber-physical world, as well as an emerging suite of innovative, powerful and enabling technologies. This opens new avenues to harness innovations to build, organise and manage our water-system in a much better way.

The innovations needed to build our future sustainable and water-smart society, pose challenges that cannot only be solved at regional or national level. European and global solutions are needed to respond to some of the key cross-border challenges:

Global water demand in 2000 and 2050



Source: adapted from OECD Environmental Outlook to 2050

Lack of insight in water quality and use

We lack detailed management information on how water is being used by citizens, industries and farmers. This information will be needed to enable better decision making to favour more rational use and re-use policies and programmes. Gaps in monitoring the chemical status of surface waters were so significant that in 2012 the status of over 40 % of water bodies in the EU was unknown¹⁰. This hampers our insight on how to improve the water quality.

Emerging global challenges and market opportunities lead to a pressing need in Europe to increase the level of monitoring on the quality and quantity of water availability and use. This needs to be addressed at European level, due to the cross-border nature of European water bodies. Detailed measurement, monitoring and data-analyses and more precise assessment of the status, will be needed for more effective forecasting of trends to support dynamic decision making at all levels (water treatment plants, wastewater treatment plants, water distribution system, river basin, industries, homes etc.), linked to manageability, resilience and value.

Increasing impact of climate change events

Climate change affects many aspects of society and the European water-system (flood defences, irrigation systems, drinking and waste water networks) is no exception. They have significant impacts on the natural water balance across the EU, impacting the replenishment of water resources and reducing water availability. Our future water-system will have to endure and be resilient to more and more extreme weather events including heavier precipitation, floods and droughts. Flood events already pose multiple health risks and cause widespread damage across Europe, and with more frequent and intense flood events expected, the damage costs of floods will likely increase even more.

In addition, climate change, population growth and migration will disturb the balance between water supply and water demand resulting in water scarcity and threat to the natural water eco-systems. Apart from significant scarcity of water, our water quality will also be affected¹¹ as a result of seawater intrusion in coastal aquifers, faster dissolved oxygen depletion because of higher water temperatures, and a higher content of pollutants that flow from urban and industrial sites into water bodies following extreme rain events¹².

To cope with these challenges a robust, flexible and resilient water infrastructure is needed that takes account of the cross-border impacts of climate change events. Unfortunately, our current water infrastructure is often outdated and hence not able to cope with such problems. Add to that, the impact that water losses caused by the deteriorating infrastructure have on our environment, and it is clear that change is needed through a manageable migration path. Furthermore, multi-stakeholder policies and strategies have to be strengthened for disaster preparedness, and interventions to anticipate and mitigate their impacts on the European water-system and society.



Increasing interdependence of stakeholders and policy areas

Global demographic trends will lead to ever closer and more integrated urban-agro-industrial and natural environments in which scarce water needs to be managed. This will necessarily lead to the realisation of new multi-sectorial governance models where – depending on geographical specificities – different combinations of stakeholders and tailored decision models will be applied to secure appropriate water governance.

The nexus of natural resources, materials and energy, the way they are used, re-used and recycled, preservation and redevelopment of the natural environment, and more general quality of life, health and sustainability are issues that need to be addressed at EU and global level. At European level, we increasingly need to adequately manage scarce resources across borders. We need to collaborate at the relevant policy layers when it concerns the trade-off between food, water, energy, health, transport, environment and economic policies, when working towards a sustainable European society and competitive economy.

Moreover, new financing, business models and mechanisms will be needed that involve economies of scale, smartening gas, electricity and water grids across different sectors, as well as across borders. We need to ensure the availability of capital in European markets to redesign and gear our water infrastructure for our water-smart society.

“Europe has the chance to turn water challenges into new technological, societal and business opportunities”

Altogether, this leads to a need to reset Europe’s research, development and innovation agenda based on a future vision that takes into account newly emerging societal and technological trends and opportunities.

2 • Opportunities for Europe

Europe is uniquely positioned to turn these challenges into innovative solutions that reconfirm its global leadership in water management, and boost competitiveness and/or performance of the water service providers, water users and technology providers.

European society is increasingly aware that we need to change the way we manage the limited natural resources on our planet. European industries are global leaders in water technologies and the continent features an advanced, highly populated society that is well-suited to develop and show-case the innovations needed for our future water-smart society, recognising the true value of water. New combinations of innovative digital solutions, water treatment technologies, economic, governance and business models as well as a redesigned hybrid grey and green water infrastructure can be developed to reduce the impact of our society on fresh water sources, and create a resilient water-system for the future.

Real-life urban, industrial and rural areas can be transformed into fertile real-life open-innovation environments for novel synergetic water-concepts and solutions, to be exported all over the world.

Leveraging on this, Europe can take the lead in a societal paradigm shift and develop a **future-proof model for a water-smart society**, in which **the value of water** is optimally exploited as most precious resource for human health and well-being, but also as absolute lever for economic performance and business growth. In this WssTP vision, the key solutions will be found in **closing our water loops** to a much higher extent, making **new water sources** such as brackish, saline water and brine, rain water and used water available through decentralised systems, as an integrated part of our water-system. It should valorise re-use of water as well as valuable substances and energy in water for different purposes.

At the same time, it should ensure good status of European water bodies, as well as resilience against climate change events. Both multiple waters, good quality status of our water bodies, and resilience need to be supported by advanced multi-stakeholder governance by various interlinked economic sectors based on an ever more connected digital society underpinning the core of the WssTP vision concept:

Towards multiple waters, for multiple purposes and multiple users: A paradigm shift towards a sustainable and circular water-smart society



Source: WssTP

To realise this vision WssTP proposes a **4-tier future-proof model for a water-smart society** to carry out research and development, but more importantly, to bring RTD results to market and realise systemic innovation in our water-system by:

1. Developing a water-smart economy: using advanced solutions and a systems approach to eco-innovation, a state-of-the-future water infrastructure, a circular water-economy, as well as new economic models based on the true value of water for different sectors and purposes, in order to increase rational use and re-use;

2. New digital and water technologies: deploying advanced digital solutions for water in a capillary network of sensors in water distribution systems at various levels (industrial, urban, rural, regional, river basin), capturing and using this new information to manage them in real time. Developing advanced water-treatment solutions to achieve good status of European water bodies. Enable synergies between centralised and decentralised treatments, as well as economically viable extraction and valorisation of valuable substances and energy in water. Use advanced materials in the water infrastructure and improve solutions to reduce water use in agriculture. Our emerging enabling technologies will empower Europe to reach previously unimaginable levels of control, manageability and exploitability of our water society with regard to water;

3. Rethink and redesign the water distribution and water service systems: a high-tech human-built hybrid grey and green water infrastructure integrated with a nature-based ecosystem, that combines centralised and decentralised water treatments, leading to reduced water-loss, pollution prevention, increased water reuse, optimising the exploitation of alternative water sources in a circular economy, and strengthening resilience (adaptation and mitigation) against climate change events, especially droughts and floods;

4. Enabling inclusive multi-stakeholder governance: new governance models that manage availability of water for all users, sectors (industry, agriculture, drinking water, waterborne transport) and multiple purposes, based on the understanding of true value of water. Using fit-for-purpose, adaptive and evolving economic and governance mechanisms, supported by advanced near-real time decision support systems, information exchange at all levels (European, national, multi-national, regional, urban, industrial and rural) to overcome key barriers towards innovating the water-system.

WssTP will identify and articulate the catalysing research, technological developments, and innovation actions that are needed to bring about the transition towards this water-smart vision in a timely and large scale manner. Integrated and systemic solutions will be combined with communication, investment, regulatory, fiscal and innovation support programmes.

The WssTP **future-proof model for a water-smart society** is an integrated part of the WssTP Vision and further elaborated in Chapter 3. It will contribute to realising four key impact parameters which the WssTP Vision is aimed at:

- 1. Reducing the impact** of Europe's society on our natural water resources by 50%;
- 2. Realizing the true value of water** for society, the economy, and the environment;
- 3. Boosting the European water market** as well as global competitiveness of the European water industries;
- 4. Securing long term resilience, stability, sustainability, and security** of the society with regard to water.

The targeted impact of the WssTP Vision is further detailed in Chapter 4, describing Key Impact Parameters, impact on the water market and natural eco-system.

"... nearly 80% of the jobs constituting the global workforce are dependent upon having access to an adequate supply of water and water-related services, including sanitation."

Irina Bokova, Director-General of Unesco, UN Water report 2016: Water and Jobs.

3 • The WssTP Vision for Europe and the world

WssTP envisions an European water sector that will be significantly transformed with respect to the current situation. New concepts such as “**Multiple Waters**” and “**Digital Water**” will be driving decision makers and new water-smart economics. All will be enabled by new technologies fostered within an open Innovation environment and a **redesigned water infrastructure**. New **governance structures**, partnerships to capture the true value, **pricing mechanisms** and novel more profound **water stewardship** programmes, will manage the water market towards 50% reduced pressure on our natural water system.

Overall **the value of water** for all sectors in our society will be better recognised, making more water and alternative water sources available for different uses and users within a circular society. Here ICT solutions and technologies by using digitally enabled innovations will prove to be an important driver. New markets will emerge if the true value of water is better recognized, and if we manage water accordingly. Such an approach can only boost the “traditional water market” and make new ones emerge that valorise important amounts of raw materials as well as embedded energy in used water streams, and make those available for our society.

Key innovation concepts for the water-smart society

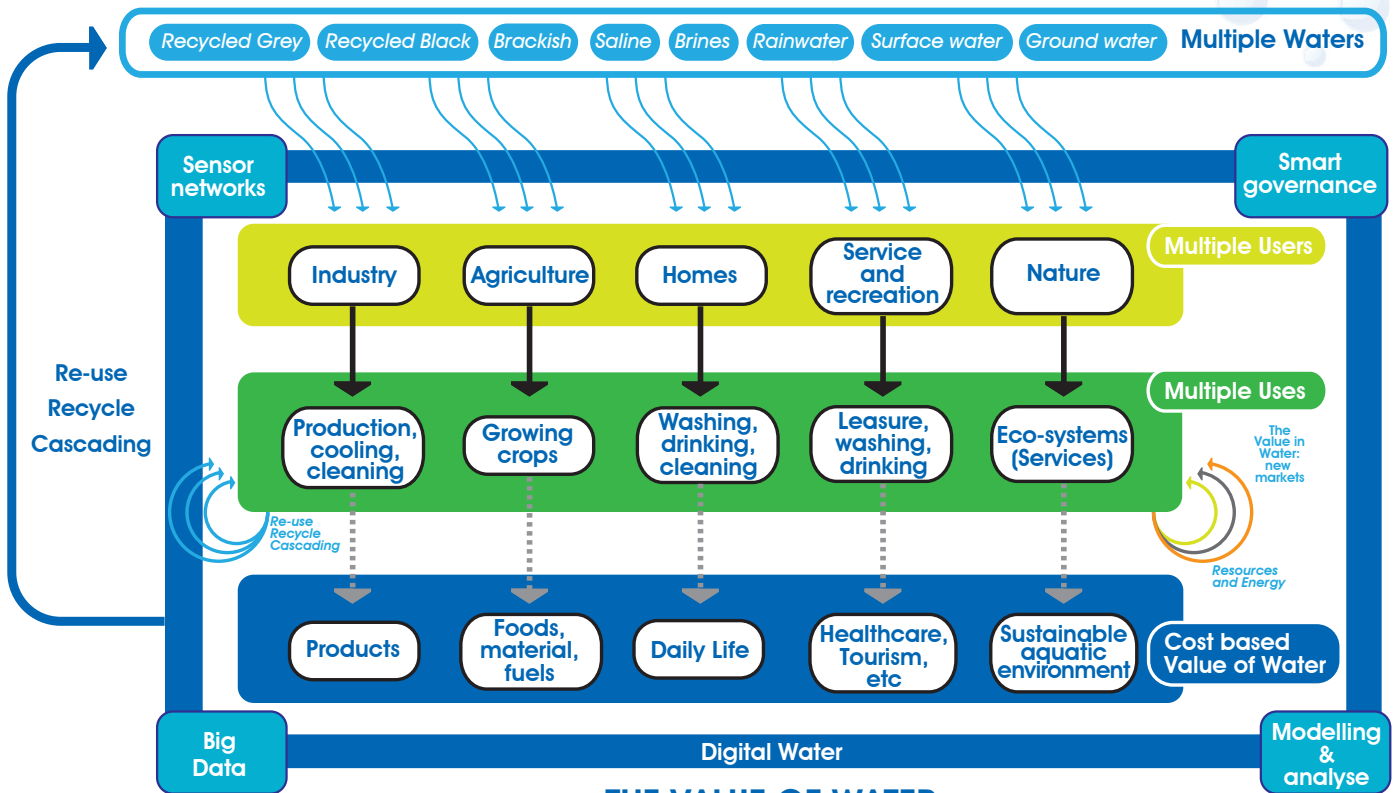
The multiple-waters concept

The WssTP vision pictures a future European society that manages our precious **multiple water sources** from clean rivers, surface and ground water, but also alternative sources such as rain-water, brackish and saline water, brines, and used water, as a **holistically integrated system**. In the future we will optimise water management and allocation by storing, treating, and distributing the **right water for the right purpose to the right users** in a synergetic combination of centralised and decentralised water treatment. Water use will be optimised based on the circularity principle for water such as cascading, reuse, recycling, while enacting new economic mechanisms and models based on the **true value of water**.

In the future more than 30% of the total water demand (e.g. hundreds of km³/yr) will be delivered by alternative water sources, complementing and reducing the pressure on our fresh ground and surface waters. A few examples: rain water will be captured by green-infrastructures (e.g. green roofs on homes) in cities and made available for citizens. New local loops and decentralised water treatment systems will make sure that used water from apartment blocks or living quarters can be recycled and re-used, even considering options for extracting, valorising and using nutrients in the used water streams for fertilizers in the integrated urban natural environments. Innovative cost efficient desalination systems combined with green infrastructures will treat saline water and brine as well as brackish water in coastal area, and make them available for various urban and industrial (e.g. cooling) applications, while local loops will ensure recycling and re-use of industrial waters. Hybrid centralised and decentralised systems will enable a “fit-for-use” concept to be applied to multiple waters, using different water qualities for multiple uses, depending on the local availability and user needs.

New digital technologies (see “Digital Water” hereafter) will have introduced detailed measurement and near-real time monitoring of water extraction, treatment, distribution, use and re-use, with the possibility to distinguish between different water qualities, sources, quantities and users. New governance and decision support systems will support the rational use of multiple waters, based on the true value of water and new economic models with minimised impact to natural water bodies.

“The right water for the right purpose to the right users”



THE VALUE OF WATER

Source: WssTP

Crucial for our economy, industry, society, nature and citizens

The Value of Water: multiple waters in a digitally connected water-smart society

The "Digital Water" concept

New **digital technologies** in an all connected world (smart sensors, drones/robots, satellite technologies for earth observation and environmental monitoring) will provide detailed and capillary insights into water availability, use and quality, up to the level of each individual user, similar to data ("Digital Water"). An ubiquitous network of smart sensors throughout the water-system from river basin up to the smaller "water grid" cycles, will swell the gigabytes of data being generated today by utility infrastructure to thousands of terabytes in the future, with other estimates suggesting smart meters could generate around 1,000 petabytes of data a year globally once full rollouts are complete. A holistic approach to digital systems applications at various scales (industrial, urban, rural, regional, international river basin) will be exploited by the joint stakeholders to manage our water-system.

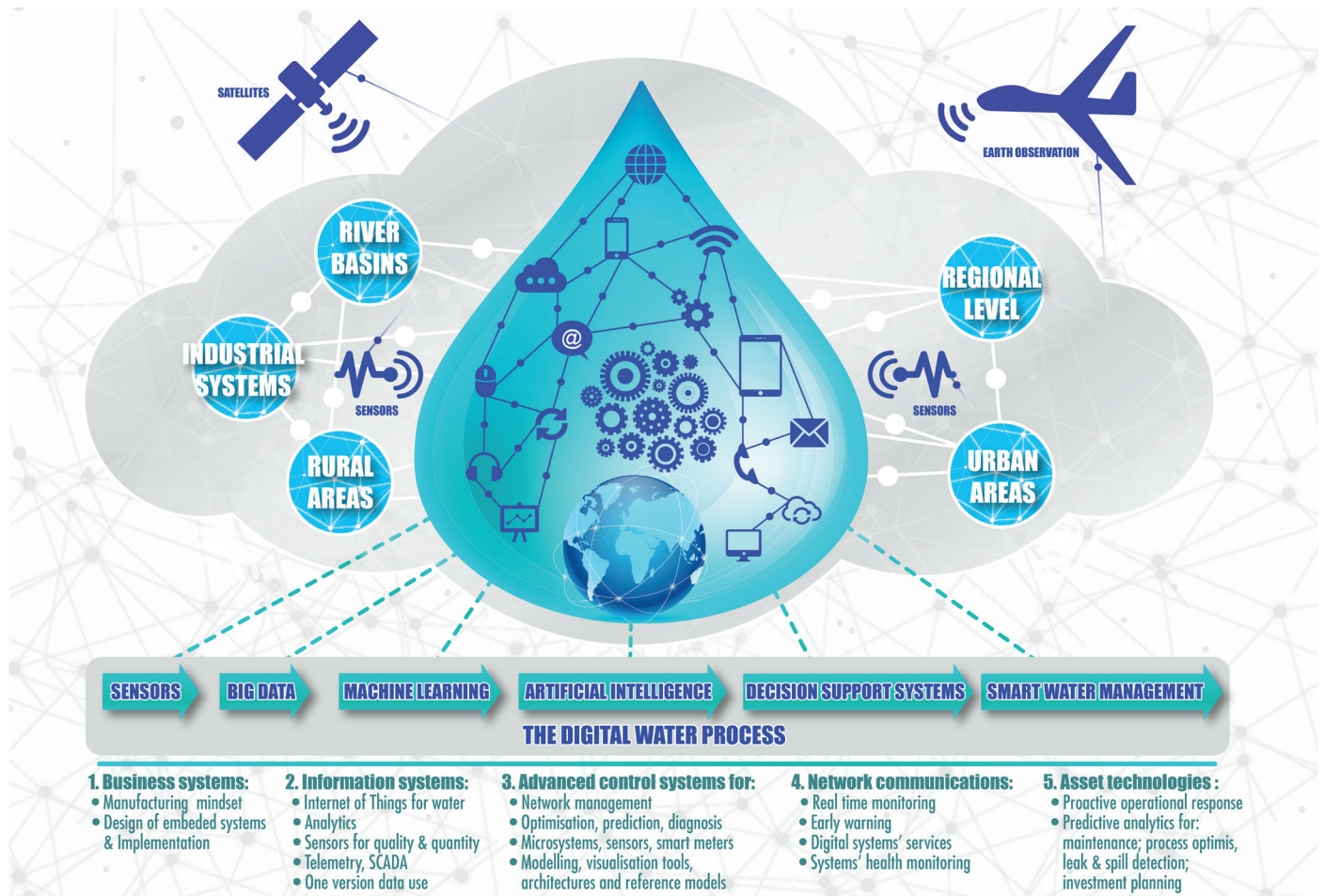


"Global utility company expenditure on data analytics will grow from \$700m in 2012 to \$3.8bn in 2020, with gas, electricity, and water suppliers in all regions of the world increasing their investment."

GTM Research, 2014

Utilities will be reinvented to become big-data related service providers leveraging on the Open Data paradigm. They will have high-quality forecasting capabilities, using new mathematical modelling systems and visualisation applications, and **unforeseen levels of real-time knowledge and decision support**. The widely diffused network of sensors, metering and advanced modelling and software systems will monitor quality and quantify water flows in the economy and the environment. This will allow a much smarter, more dynamic and adaptable near real-time water allocation management and governance system that is robust, more resilient and less vulnerable against external events.

New software solutions and associated services for digital water management developed in Europe, will find an important and growing market, strengthening Europe's position in the global market.

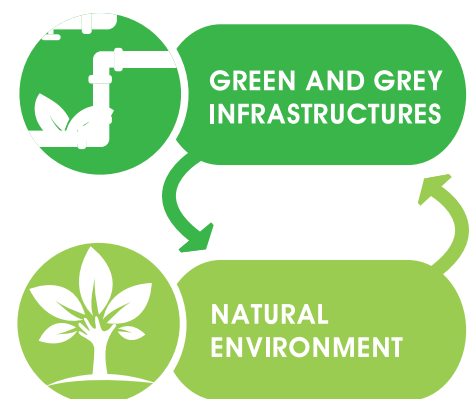


Source: WssTP

A redesigned integrated grey and green smart infrastructure

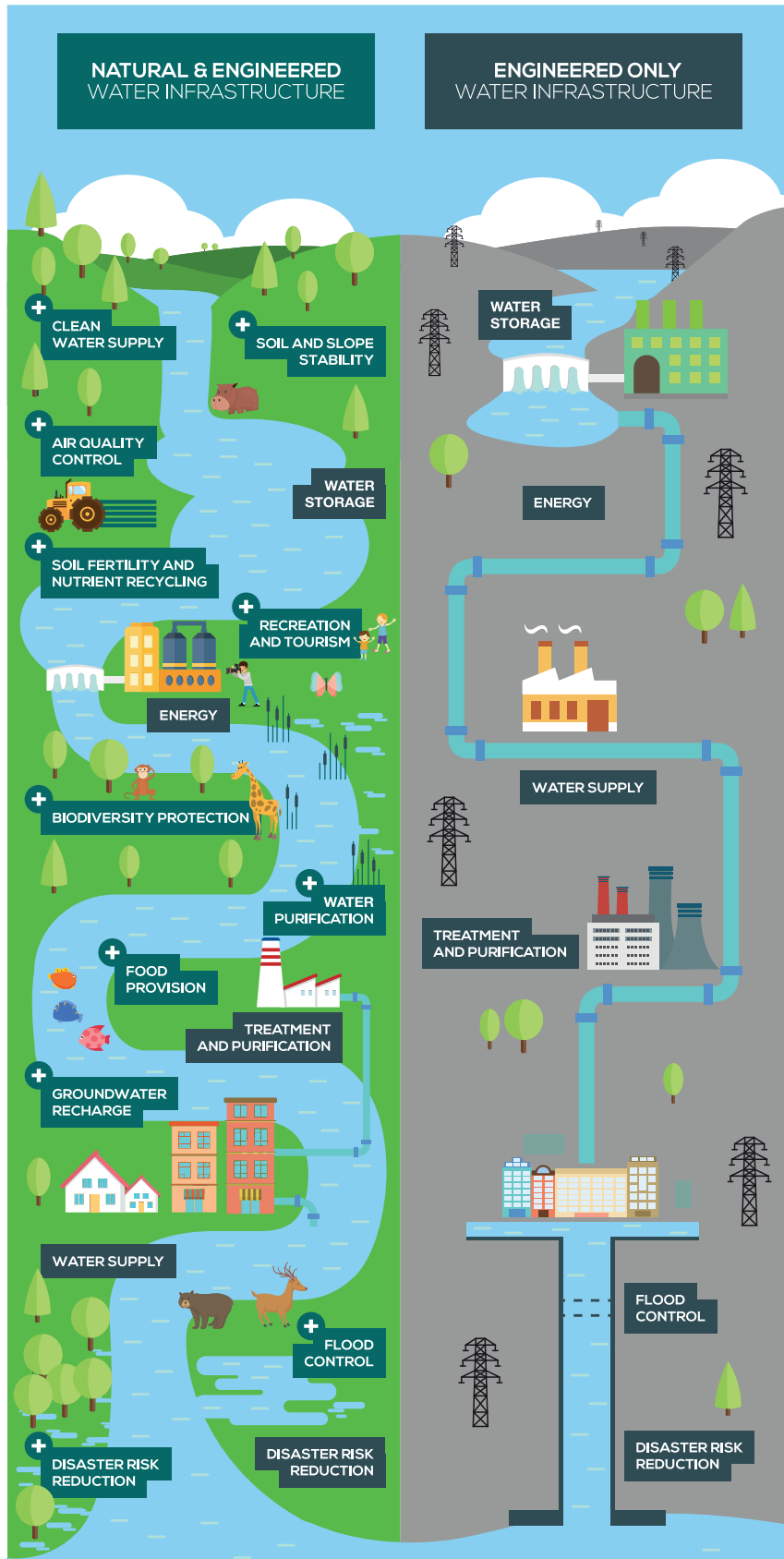
The future water infrastructure will be an integrated infrastructure that consists of the human-built (engineered) grey and green infrastructure as well as natural 'green' assets, such as rivers, aquifers green belts, infiltration areas and natural storage capacity to ensure sustainability of multiple ecosystem services. It also includes constructed/designed 'green' assets, such as constructed wetlands, green roofs and walls, water parks, habitats for wave reduction or shore protection. By creating a more integrated water infrastructure, individual water-related assets (resources, pre-treatment, waste water) are shared across sector boundaries. This will result in a more energy and environmentally efficient water infrastructure, better ensuring water quality and optimising the balance between supply and demand but also protect from the extreme water-related events or natural hazards (such as floods, droughts, heat waves, mud flows).

This holistic view on water assets should bring forward a more sustainable water system that ensures over time and mutually leverages the benefits of both the **engineered and natural assets**. In the future system, nature has a key role in contributing to overall system resilience and adaptability based on more effective use of natural cycles, as well as efficient and cost-effective nature-based solutions.



Source: WssTP

“Re-designing the water infrastructure for multiple waters, the right purpose and multiple users”



Source: adapted from IUCN

“Ecosystem services remain under-valued, under-recognized and under-utilized within most current economic and resource management approaches. A more holistic focus on ecosystems for water and development that maintains a beneficial mix between built and natural infrastructure can ensure that benefits are maximized.”

UNESCO Water Report 2015

Flexibility is achieved by redesigning the water infrastructure for the dynamic allocation of multiple water resources for the right purpose to multiple users. At the present day a single quality of water is supplied from centralised water sources to decentralised water users without differentiation in required water quality. By including new concepts into the water infrastructure design where needed – such as decentralised supply, treatment and storage systems, and localised micro water grids (water loops) connected to the existing infrastructure – the right quality of water can be increasingly supplied to the right user, reducing treatment costs.

The future integrated water infrastructure will have benefitted from the development of innovative technologies and materials. **Active sensing, measuring and monitoring technologies will enable adequate management and cross-sector decision-making on a regional and supra-regional level.** This **smartening of the water system** will enable the dynamic allocation and distribution of different qualities of water from multiple sources using multiple local loops in the distribution system. In addition to monitoring, this system could assist in designing reactive and pro-active policies and strategies, to safeguard the sustainability of regional and /river basin water resources. Also near-real time monitoring of the water-infrastructure and the quality of water therein, will play an important enabling role in developing advanced warning systems, making safe water distribution to citizens and industries more secure and less vulnerable against external events and threats. And last but not least, as the water infrastructure will be redesigned, renewed and rehabilitated, leakages will be reduced to the maximum.

To handle climate effects such as floods and droughts and to ensure multiple ecosystem services the waterbodies are providing, **water planning will be integrated in comprehensive (supra) regional development plans that involve traditional water assets, green assets and ecosystems.** In addition, the water system is managed through climate and water forecast maps in order to support economic activities, growth and jobs. Big data, model based simulation and virtual reality tools will enhance these management systems to plan maintenance and longer term asset investments towards durable resilience of the adaptive water management eco-system. The majority of cities will have adopted plans for adapting to climate change by 2030 and more cities are adopting integrated urban planning and risk assessment strategies and have emergency plans in place.

As the water system includes all assets – built and natural – in 2030 **the value of natural assets and ecosystems is incorporated in the total cost of infrastructure and pricing of water.** Water-related development plans are based on regional cost-benefit analyses and economic tools and include the cost of water resilience plans as well as the benefits of prevented damages caused by water disasters. Furthermore, new business models will have emerged that enable and support the costly redevelopment of the water infrastructure.

Water accountability and stewardship

Recognising its crucial value for our society, water will be an integrated and recognised element in policy making for agriculture and food security, transport, energy, industry, financing, environmental protection, public health and public security. This will be based on much deeper insights and forecasting capabilities on availability, built on (big) data and widely accepted Water Impact Indicators. This will garner a better understanding of the value of water in different parts of our society, underpinning new economic models for water throughout the continent with diversifications based on availability and the true value of water. Water impacts of human activities will be accounted for by industries, cities and farmers, in a similar way as for environmental impacts in general, and including possible certification schemes for **Water Footprint Assessment (WFA)** of the impacts by products, processes and services. Industry, cities and farmers will have adopted longer term water stewardship programmes and practices, for a responsible use of water and our natural environment via corporate and urban social responsibility approaches. Together they will collaborate actively with nature preservation organisations to restore and redevelop nature as an integrated part of our water-ecosystem.

Individual users will be empowered to play their role, using a redesigned water-distribution and use infrastructure with multiple loops, and advanced digital water solutions to manage what water they will use for what purpose.

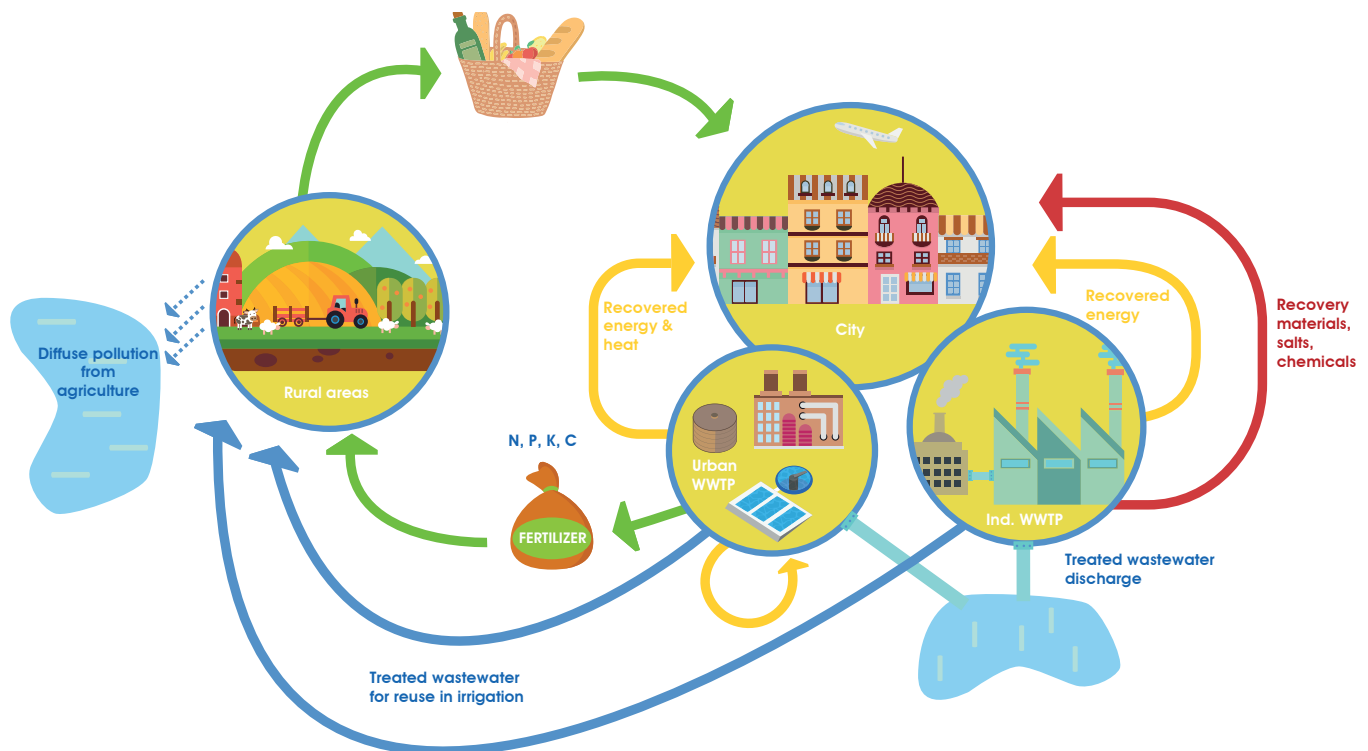
Open Water science, Innovation and Business

Ambitious living-labs in cities, rural and industrial areas will involve different multi-stakeholder governance collaborations, as well as researchers and solution developers, to realise and test new technological and non-tech solutions in the European model for a water-smart society, and to foster accelerated market introduction.

Appropriate Open Innovation, Open-Science and Open Data will have harnessed Europe's global leadership in water technologies. Europe will lead in **new cost-effective water treatment technologies**. It will lead in advanced irrigation and crop-growing technologies that drastically reduce water use in agriculture all over the world. It will also lead to water information systems, for near-real time decision support, and Europe will be exporting its model for a water-smart society, which combines these new technological solutions with modern inclusive governance practices.

Innovations in water treatment, redesign of the water infrastructure, increased awareness and better user-oriented management tools, will have led to strong reduction of water pollution and will have enabled water in Europe to be recycled to more than 30%. In some areas in Europe **the water loop will even be closed to almost 100% for important industrial water users**. This will benefit our industries both in Europe, through increased water and cost efficiency, but also outside of Europe. European water solutions will be deployed in emerging regions, enabling European industries to operate and be competitive even where water scarcity and risks for floods is more critical.

Research and development results from Europe's Open Innovation system and set-up will have led waste-(water) management companies and new entrepreneurs to have discovered potential **new multi-Billion Euro markets** in resources for instance by valorising valuable nutrients, critical materials, chemicals and energy in our used water streams. They are harvesting, extracting, treating and re-using the value in these waters, growing emerging markets, through new businesses and eco-services. These businesses generate new profits and grow jobs in the water market in Europe and globally.



Source: WssTP

Water-smart economics, resilience and governance

In the future water economics in Europe will be transparent, probably based on a combination of cost based principles, the true value of water, and “the polluter pays principle”¹³ as outlined and under implementation through the European Water Framework Directive. Sound and healthy economic mechanisms will be applied to stimulate water-efficiency by users, taking into consideration cost recovery. New financial models together with multiple and new combinations and financial sources, will secure sufficient capital for longer term investments in a much smarter infrastructure that includes nature as an asset.

New business opportunities related to the value in water, will help develop new business models to finance a part of the water infrastructure. Smart integration of nature based solutions will cover for important functions in the water-ecosystem such as storage, buffering and treatment. This will contribute to optimising costs of the future water infrastructure. Also water accountability and footprint assessments will help new multi-stakeholder economic models to have emerged. These will account for all relevant elements, including the impact on nature, to construct economically robust plans to finance a sustainable and climate proof long term water infrastructure.

“New opportunities for water management by integrating, restoring and redeveloping the natural environment”

The majority of European cities, regions, and countries, across sectors (industry, energy, agriculture, transport) will have adopted policies and implementation plans for climate change adaptation and mitigation. They will have adopted an integrated multi-sectorial (urban/rural) planning and risk assessment strategies, based on new knowledge and insights based on the “Digital Water concept” and will use nature as one of the resources to create resilience against droughts and floods.

They will have emergency plans in place to ensure resilience on the long run. Multi-level governance of river basis across countries will have realised advanced digital monitoring systems and cross-border water stewardship practices. This will have helped to reach responsible use and discharge of water securing good quality water sources for downstream users

“Novel inclusive governance models to involve water users, public authorities and nature”

As hydrological boundaries cut across administrative perimeters, cross-border dependencies on water quality (e.g. downstream impacts of discharges) will require these “multi-stakeholder governance set-ups” to manage and exploit their adaptive water eco-systems through a network of internationally connected regional governance collaborations. They will jointly govern water management systems on a regional, national and cross-national level. Local characteristics will be addressed while ensuring no water limitations for end-users and no disruption in supply to critical societal functions due to water scarcity.

New multi-stakeholder governance collaborations will have implemented new ways to combine smart water management and preservation of nature, even integrating natural systems as an opportunity to redevelop natural areas and restore bio-diversity within an integrated grey and green (natural and engineered) water infrastructure.



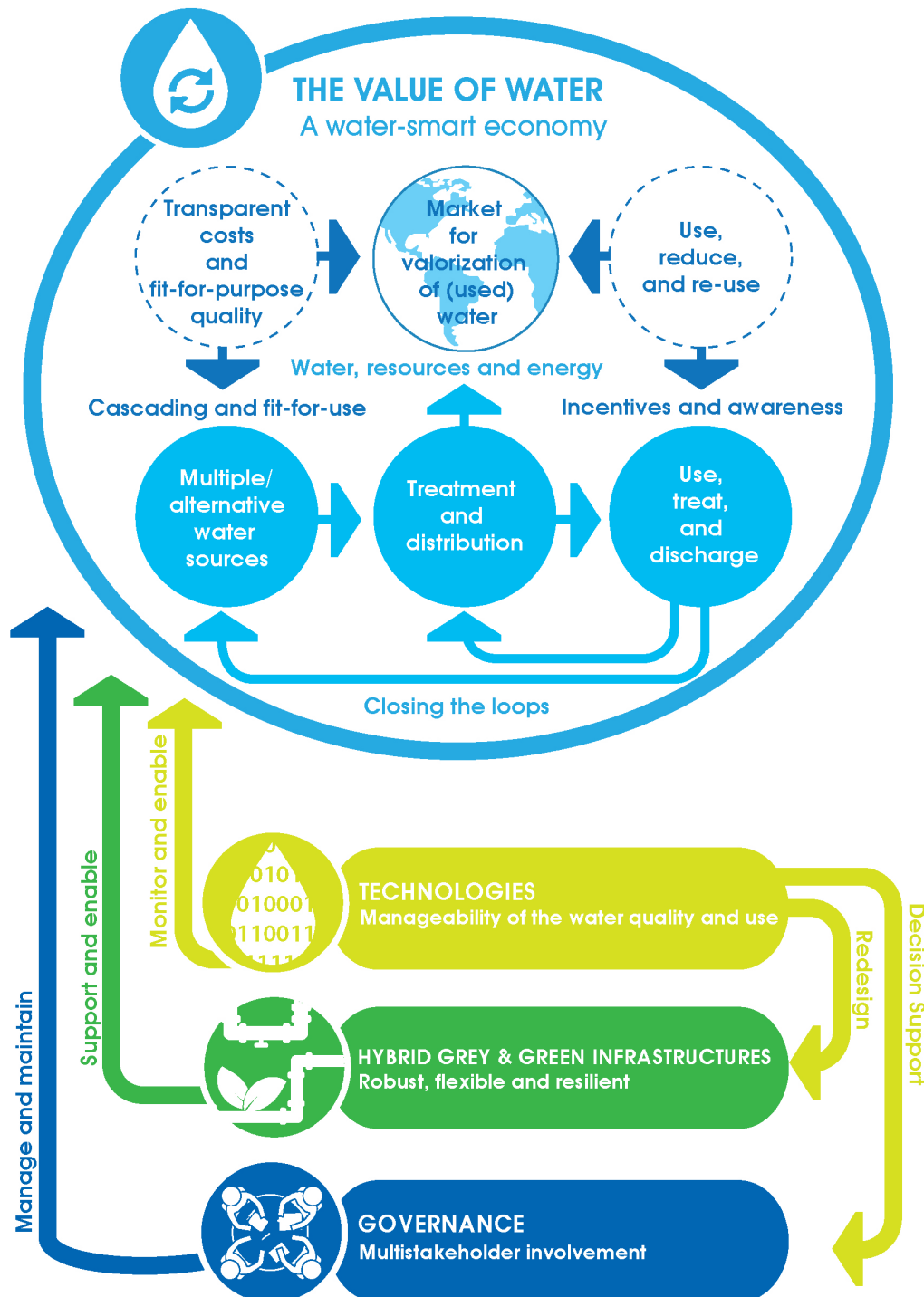
Source: WssTP

Governance will be supported by real-time and continuously updated climate and water forecast models and maps, provided by high end information technologies such as global GIS based knowledge management systems. Advanced decision support systems will provide regional governance systems with capabilities to make informed decisions, recognising the value of water for their citizens and industries, including potential risks and uncertainties, by combining these advanced forecasting models with data from regional metering of water production, use and re-use activities. To manage and regulate the distribution, sanitation, use and re-use of water, governance will also incorporate and use financial mechanisms and legal arrangement for these water related activities at (inter)regional level.

In the future governance model, enhanced stakeholder engagement plays a key role in water-related decision-making process, stimulating active collaboration, public-private partnerships and increased involvement with water issues. Collaborative decision-making and including stakeholder views will lead to improved services and transparency. Awareness creating measures will have led to well-informed and smart water users, who are aware of the value of water and water usage and empowerment of stakeholders through open access to information.

A future proof WssTP Model for a Water-Smart Society

The WssTP Vision is built on its **key innovation concepts** (see above) and a **future-proof model for a water-smart society**. This model encompasses four main components which focus the WssTP Strategic Innovation and Research Agenda (SIRA) on the main developments needed to realize the vision.



WssTP Model for a future proof water-smart society

Source: WssTP

The four components and the elements that characterise them can be summarised as follows.

1. **A water-smarter society and economy (market)** that combines 5 elements to optimise water management:

- efficient water use (use, reduce, re-use);
- matching water quality/allocation for use (fit-for-purpose and cascading);
- new business and economic models, based on the true value of water for our society;
- entrepreneurial exploitation of the value that is in water (energy, nutrients, chemicals, metals etc.);
- source-control measures minimising diffuse emissions and residual contamination contributing to a good ecological status of the fresh water sources.

2. Significantly improved **insights in water availability, qualities and use**, as well as improved technical and organisational **capabilities to better manage the water cycle**:

- advanced technologies that make new and various alternative water sources available for multiple uses;
- innovative digital technologies (e.g. sensors, data-analysis and support tools) to enable measurements, near-real time monitoring and insights of water extraction, treatment, distribution, quality and use;
- new digital technologies for better planning of water infrastructures and allocation towards resilience under changing circumstances;
- new solutions for source control measures for prevention of water cycles' pollution (or avoiding pollution to enter water cycles) and avoiding pollution through water discharge
- advanced irrigation and crop-growing technologies that drastically reduce water use in agriculture;
- more advanced and cost-effective solutions to extract and exploit the value that is in water: from energy up to, nutrients, micro-pollutants, chemicals, minerals and metals.

3. An improved, **robust and resilient hybrid grey and green-infrastructure**, that underpins the future water-smart society by:

- providing a system multiple (local) water loops, integrating central and decentralised water treatment into the existing infrastructures, enabling dynamic allocation and distribution of different water qualities from multiple sources with minimal loss;
- novel solutions, including nature based assets, to absorb manage and adapt to the impact of climate change related events such as increased prolonged droughts and floods as well as deliver a host of further ecosystem services.

4. Improved **inclusive multi-stakeholder governance models**, that foster smart decision making and governance of water allocation and distribution within a resilient, long term and stable policy environment, aligning river basis management with water services and uses, by:

- regionally tuned multi-stakeholder governance models set-ups that involve both the public-sector, industry, agriculture and representatives of nature and appropriate public/user participation mechanisms in decision making processes;
- coordinating fresh water and alternative water availability and allocation for various water users (waterborne transport, ecosystem services, industry, drinking water, etc.);
- strengthening stakeholder capacity (incl. ICT-enabled) to participate in multi-level, multi-stakeholder governance models for water allocation and distribution and improved resilience and water stewardship;
- jointly developing, maintaining and financing a long term resilient water infrastructure based on advanced forecasting models, and integrating nature as part of the asset management.

4 • The impact of the WssTP Vision

The WssTP vision stimulates the development of a myriad of state-of-the-future technological and non-technical solutions for building the water-smart society in Europe and spreading the model globally. It will contribute to tackling important global societal challenges, as well as creating new markets and boosting Europe's industries.

Key Impact Parameters

WssTP aims to contribute to realising real impact in Europe through **three Key Impact Parameters**¹⁴:

1. Reducing the impact of Europe's society on our natural water resources by:

- a. Increasing re-use from the current 5% to up to 30%, making up to an additional 100 km³ /yr of water available for multiple uses and users;
- b. Reduce water "loss" in the overall human-built water system from the current estimated average 20% across Europe to lower levels, taking into account regional differences of sustainable water availability (which could make another estimated 50 km³/yr of water available for multiple uses);
- c. Valorising much higher levels of alternative water sources (brackish, saline water and brine and rain water), potentially making available an additional 15 -30 km³/yr of water for different purposes;
- d. Reducing water consumption in agriculture, industries, and cities by more effective irrigation and agriculture as well as more conscious users, reducing overall impact on water consumption with 50 km³/yr;
- e. Reducing the amount of water used for energy production with 10 - 20% (currently 25% of the overall water use) by promoting alternative energy sources and as such breaking the Energy-Water nexus;
- f. Source protection, minimising residual contamination in order to improve the quality of the fresh-water sources and ensuring appropriate recharging of natural water reserves

2. Recognise the true value of water and boost the European water market as well as global competitiveness of the European water industries by:

- a. developing new advanced water treatment technologies (reducing water pollution and by promoting reuse for various purposes), management models, infrastructures and systems to exploit the value of multiple alternative water sources for multiple users and purposes, to be commercialised in Europe as well as in the 650 Billion Euro global water-management market (i.e. market for water-related equipment and services);
- b. 5-10 times increase in the valorisation of water by extracting and exploiting heat, energy, nutrients, minerals, metals, chemicals etc. in used water, opening-up various new multi-Billion markets in Europe for recovered resources. This will create new businesses and jobs while realising a true circular economy for both biological and technical nutrients¹⁵ in used water streams.

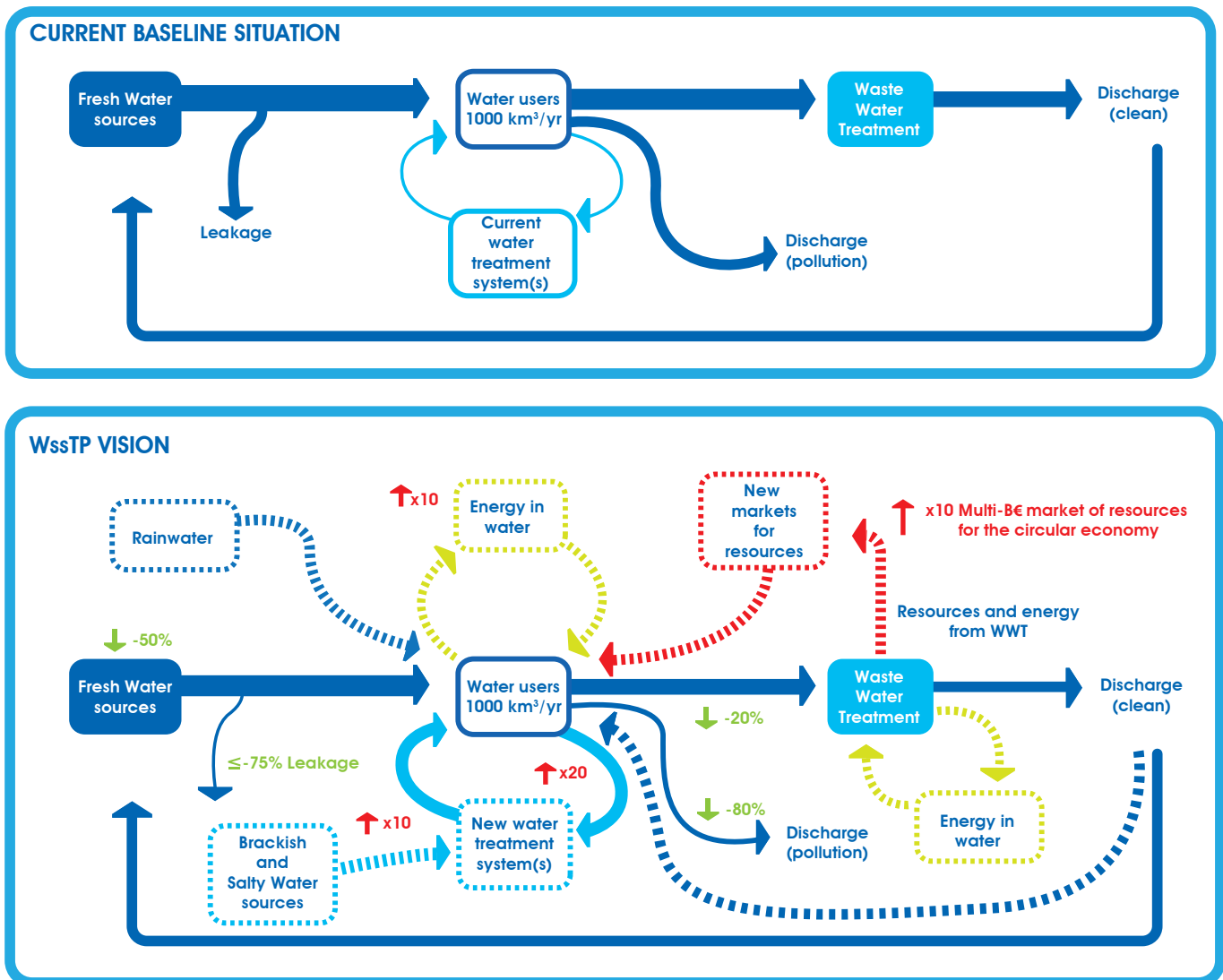
"Non-exploited phosphate in only 10% of Europe's waste water has a potential value of > 13 Billion Euro"

3. Securing long term resilience, stability, and sustainability of our society with regard to water, by:

- a. making the water-system robust, flexible and adaptable against external influences such as droughts and floods combining engineered man-made and natural green infrastructure with advanced digital solutions such as sensing, ICT and DSS systems leading to; 50% less damage to floods, 50% less occasions where droughts result in lower agricultural production, 50% less occasions where droughts affect shipping abilities, 50% less occasions where heat waves endanger electricity production due to lack of cooling water;
- b. drastically reducing pollution and eutrophication and restoring bio-diversity while integrating nature as one more integrated asset of the durable future water-system
- c. capitalising on the value of water through increased resource efficiency of our industrial system, and by 5 – 10 times increase in harvesting the value in water, as new sources for economic sustainability
- d. designing and implementing new economic, investment and governance models and plans to secure long term financial viability and manageability of our water-system

“A future proof European model for a water-smart society”

The key impact on resource efficiency and circularity in the water sector is visually represented in the following picture.



An opportunity for Europe: Increasing water resource efficiency and circularity

Source: WssTP

Economic and market impacts

Up to now, nothing near the true potential value of water has been fully explored. The WssTP Vision intends to open new pathways to recognise the true value of water, leveraging its economic relevance and creating important economic impacts for Europe. This reaches from exploiting the economic value of using **multiple waters** as a crucial resource for important economic sectors in Europe, to opening-up **new markets based on the value in water** and safeguarding Europe from negative economic impacts on our cities, industries, agriculture and waterborne transport due to **climate change events**.

- First of all, various opportunities to **use multiple water sources** remain underexploited. "At present, only about 2.4% of the treated urban wastewater effluents and less than 0.5% of annual EU freshwater withdrawals is reused annually, which accounts for approximately 1 billion m³ of treated urban wastewater"¹⁶. At the same time, brackish, sea water and rain water offer large amounts of underexploited water sources that could be used to complement fresh-water use. Innovative water treatment technologies are emerging, that enable increasingly economic solutions for adapting different water qualities for their use while avoiding pollution. A large number of industries in Europe depend from the water sector. A recent UN report even calculates that "more than 40% of the world's total active workforce, are heavily water-dependent"¹⁷. This includes agriculture, forestry, inland fisheries, mining and resource extraction, power generation and water supply and sanitation, as well as in several manufacturing and transformation industries including food, pharmaceuticals and textiles. Mitigating water scarcity through the multiple waters concept helps reconfirming the crucial value of water, while driving competitiveness of the water industry based on innovation, including for new investments in the capital intensive water infrastructure.

- Secondly, new more costs efficient water treatment technologies will support extracting valuable resources in used-water, and open-up **new markets, businesses and employment based on the value in water**. Large metropolitan waste water facilities process 41.6 trillion litres/yr of treated waste water effluents at EU level, which is loaded with nitrogen and other nutrients which often remain unexploited. The estimated value of some of these nutrients that are available in common waste waters is between \$300-400/mT (N products) and \$500-600/mT (P products) considering the huge demand for these products in agriculture (especially in emerging and developing countries)¹⁸. For phosphate only¹⁹ this means a potential value of **13.7 Billion Euro of non-exploited phosphate** considering only 10% of the total volume of waste water effluents in Europe. Western Europe depends on imports for more than 80% of its phosphate requirements²⁰, which poses a risk given the limits to economically accessible phosphate rock reserves—one of the most important sources of mineral fertilisers—and the high concentration of those reserves in only a few countries.

Other valuable resources in used water streams such as other nutrients, chemicals as well as critical raw materials (e.g. from mining waste water streams), are difficult to estimate, but merit further research to assess additional new market opportunities for European industry. Hence making resources from used water streams available to our society represents a crucial contribution to the circular economy. It also contributes to a long term sustainable society by making ever more scarce finite raw materials available for our industries, including for example raw earths from mining which are critical for our high-tech industries such as for electronics, wind energy and photovoltaics.

- Last but not least, significant economic impact can be reached by **avoiding costs of climate change events for cities, industries and farmers**. Over the last 15 years, floods have led to at least 25 Billion Euro worth of insured damage²¹ in addition to uninsured costs, with an estimated annual damage of 4.9 Billion Euro in 2014 and potentially predicted to grow fivefold by 2050²². It is evident that developments and investments in a future hybrid grey and green water infrastructure that is resilient against climate change effects will have considerable economic impacts for Europe, in terms of cost savings for our society, beyond the positive economic effects of engineering and building new infrastructures.

The WssTP Vision builds on these opportunities, as such generating an important boost for Europe's water service providers, water users and technology providers in a global market with an estimated value of circa 62.9 Trillion Euro.

Realizing the WssTP vision will make an important contribution to establishing a sustainable European water market, but also to economic development, growth and jobs. The EU's "traditional" water sector includes a large amount of players, including 9000 active SMEs²³ and provides almost 500 000 full-time equivalent jobs²⁴. By stimulating various industries in the water value chain to develop novel solutions, business models and even new value chains all stakeholders will benefit i.e. by:

- Boosting the market for **solution** providers of water technologies (water treatment, software systems for decision support systems, etc.);
- Boosting the market for **solution providers** of digital technologies directly applicable to, and/or specific for the water market
- Reinventing **utilities**, including basin management authorities, into big data and "digital water" service providers, offering completely new levels of decision support at all levels of water management;
- Helping water-demanding and energy intensive **industries** to dramatically increase resource efficiency due to re-use of water, energy and other valuable substances in water and decouple nexus interdependencies;
- Opening new markets for **entrepreneurial utilities and industries** that can transform the value in water into energy, valuable materials and transform their business from waste treatment to becoming resource suppliers;
- Generating new public (procurement) and private assignments for **engineering companies** that need to develop new advanced water distribution systems, including irrigation systems, that close the water loop(s) and enable dynamic allocation of the right quality of water for the right purpose and the right user;
- New business related to **flood infrastructure, shipping and harbour infrastructure**, that need to be adapted for the effects of ever more frequent and intense climate change induced events;
- Creating new **engineering and consulting services** for industry, water bodies and governments all over the world based on the future-proof model for a water-smart society
- Strengthening **nature preservation** and integrating the human and nature's green infra-structure, while restoring and redeveloping our natural environment for dual use.

Impact on natural water eco-systems

The vision based on a paradigm shift to new socio-economic technologies, governance and new business-oriented solutions is also recognising the need that such solutions will be developed 'working with nature' and will go hand-in-hand with better water body status, functioning ecosystem services and pollution-source oriented solutions (such as changing production pattern).

Advanced smart technological developments will address diffuse pollution and the increasing trends of emerging pollutants and their mixtures in various water cycles.

5 • Transition to the Water-smart society

Water services' assets have a long lifetime and cannot be rethought and transformed in short periods of time. There is a real need for a transition period in which the water industry can implement innovative solutions into long lasting infrastructures, services and practices. To facilitate the migration to its vision, WssTP promotes a Strategic Innovation and Research Agenda (SIRA) outlining the key challenges, research and innovation priorities for each challenge, but also proposing implementation modes. A novel but in our view important implementation mode, to foster the migration path towards the WssTP vision, are the ambitious **European living labs** which will be set-up to demonstrate how the current water eco-system, infrastructures and governance can migrate to future water-smart societies, as an example for others to follow.

The new WssTP SIRA will provide a roadmap for a Europe wide collaborative transition towards these new infrastructures and technologies. To materialise this ambitious vision and roadmap we will need leadership, mandates, plans, and resources supported by multiple players in the European and global society with regard to water. This will require:

1. Support from key policy makers and politicians at municipal, regional, national, European, and global level;
2. Alignment with other Technology Platforms and European Water Umbrella organisations such as EurEau, European Water Association, European Water Partnership, EurAqua, Aqua Europa, Netwerc H2O, the European Manufacturers of Water and Thermal energy meters etc.;
3. Coalition building for policy shaping with relevant NGO's and Governmental Organisations such as UNESCO and WHO;
4. Financial support from regional, national, European and global political decision makers, based on synergetic approach between national funding, public European funding (European Structural and Investment Fund (ESIF), the Common Agricultural Policy (CAP), European Research Innovation Funding and finance (European Investment Bank, European Investment Fund, the World Bank, as well as large private investors);
5. Coalition building for Research and Innovation, by discussing WssTP 's Vision and SIRA with funding organisations and/or mechanisms: H2O20 (various sections), Joint Programming Initiatives (Water, Climate, FACCE), COST, EUREKA, EIT-KICs (Climate, Raw materials, Energy);
6. Removal of non-technological barriers towards the realisation of the Vision e.g. discussions with European Innovation Partnerships such as EIP Water, EIP Agri, EIP Smart Cities and others, strengthening the EIP's focus on barriers related to the vision;
7. Foster a vibrant, fair and open knowledge development and sharing environment in which business needs are adequately protected through clear agreements between innovation partners and adequate IPR protection policies: matching open science/open innovation with the need to do business.

The WssTP leadership – including selected ambassadors and opinion leaders - will invest its own energies and relationship capital in building momentum, recruiting influential supporters and assuring the WssTP itself evolves as an entrepreneurially minded results oriented and visionary platform.

The WssTP Vision envisages co-investment from key stakeholders, such as cities, industries, river basins authorities and regions as well as leveraging of European Union funds including Structural and Agricultural Funds and the European Investment Bank's (EIB) InnovFin and EFSI programmes.

Europe's 250 River Basin Districts (RBDs)- as recognised under the Water Framework Directive - shall be leveraged and incentivised to participate as representatives of the complete EU map of local water stewardship organisations, bringing with them intelligence, market power and "access to channel". Europe's RBDs will be categorised as 'advanced', 'gazelle' and 'catch-up' districts, and diverse strategies shall be devised to support them.

WssTP will evaluate and contribute to propose regulatory measures which will provide a stable and attractive investment framework for private sector investment.

6 • Conclusions

The WssTP vision of a future proof European model for the water-smart society, proposes a paradigm shift in the way our future society will be organised and managed with regard to water. It requires bold and courageous decisions, investments, changes and new types of collaborations for stakeholders at all levels of society, involving citizens, public authorities at all levels, industries, farmers and representatives of our natural environment.

It will leverage on both dramatically higher levels of manageability enabled by the emerging cyber-physical society and “digital water” technologies, as well as much deeper levels of awareness, integration and collaboration between organisations and citizens. The vision can only be realised by:

1. Important **redesigns of and investments in our water system**, leading to more diversified “multi-loop” water distribution networks that enable the dynamic allocation of multiple waters for the right purpose and to multiple users while ensuring an adequate water quality and safety level required for different water uses;
2. Developing **state of the future technologies and solutions**, that enable more efficient and economic treatment of multiple waters, to make them suitable in a “fit-for-purpose” water allocation, to combat source-point pollution and empower important reduction of water consumption e.g. for agriculture and energy production, and to extract valuable substances as well as energy from used water streams and turn these into resources for our society;
3. Profound **integration of nature based systems and functions** into our water-infrastructure, in combination with long term resilience forecasting and planning, to gear our system for the impact of ever more intense climate change events;
4. **Rolling-out a vast network of sensors and metering systems** up to the level of individual users be they at homes, industries or farmers, and the development of advanced data-analytics and real-time management information systems at different governance levels to enable advanced water management;
5. The design and deployment of **new economic, business and governance models** at regional, national and European level, to secure appropriate inclusion of cost-recovery, costs of externalities and the “polluter-pays” principle, within level playing field market environment, inclusive governance and transparent regulations that secure access to appropriate quantities and qualities of water.

“A paradigm shift towards a sustainable and circular water-smart society”

These important changes will offer a boost for Europe’s industry as it requires significant investments in redesigned infrastructure and innovative technologies. It also poses complex challenges that require a longer term programme to foster a stable migration towards the new water-smart society.

End Notes

- 1) According to The Organization for Economic Co-operation and Development (OECD), by the middle of the century water demand will increase by 55% compared with 2015 levels, mainly due to growing demands from manufacturing, thermal electricity generation and domestic use.
- 2) COM(2015) 120 final "The Water Framework Directive and the Floods Directive: Actions towards the 'good status' of EU water and to reduce flood risks".
- 3) UNESCO water report 2015.
- 4) <http://www.eea.europa.eu/themes/water/water-resources/water-abstraction>.
- 5) "...we still have a long way to go before the quality of all EU waters is good enough, due to decades of previous degradation and persisting ineffective management. ... in 2012 the status of over 40 % of water bodies was unknown and it was impossible to establish a baseline". 2012 Commission 'Blueprint to safeguard Europe's Water Resources'.
- 6) 2.4% of the treated urban wastewater effluents and less than 0.5% of annual EU freshwater withdrawals, according to <http://ec.europa.eu/environment/water/reuse.htm>
- 7) Gap Analysis of the Water Scarcity and Droughts Policy in the EU, final report 2012.
- 8) Hipsey and Arheimer, 2013.
- 9) IPCC, 2014.
- 10) Gap Analysis of the Water Scarcity and Droughts Policy in the EU, final report 2012.
- 11) Hipsey and Arheimer, 2013.
- 12) IPCC, 2014.
- 13) The EU Environmental Liability Directive.
- 14) The Key Impact Parameters result from expert estimations within the WssTP stakeholder group, regarding the potential benefits that may be expected when the WssTP Vision 2030 will be implemented.
- 15) Based on the Cradle to Cradle concept by McDonough and Braungart.
- 16) <http://ec.europa.eu/environment/water/reuse.htm>
- 17) The United Nations World Water Development Report 2016.
- 18) Khunjar, W.O., Fisher J. "Nutrient Recovery in the Global Water Industry", presented at WERF – Water Environment Research Foundation, 2014.
- 19) Based on an Italian study by Paolo Battistoni* e Franco Cecchi** from the Universities of Verona and Ancona, finding an average of 7.5 mg/l of Phosphate and 42 mg/l of Nitrate, in urban waste waters in Italy.
- 20) Current World Fertilizer Trends and Outlook, Food and Agriculture Organization, 2008, p.12
- 21) Water Information System for Europe, European Commission.
- 22) European Environmental Agency, 26 January 2016.
- 23) COM(2012) 216 final.
- 24) 'Potential for stimulating sustainable growth in the water industry sector in the EU and the marine sector — input to the European Semester', Water Industry Final REPORT, Acteon — to be published.

About WssTP

WssTP is the European Technology Platform for Water. Initiated by the European Commission in 2004 as an industry-lead stakeholder forum. 12 years after and over 160 members, WssTP has become the recognized voice and promotor of water-related RTD and innovation in Europe. We strive to increase coordination and collaboration, to enhance the performance of the water service providers, water users, and technology providers, in a sustainable and inclusive way.

WssTP has developed different Programs which are key to the functioning, objectives, and implementation of the WssTP strategy:

- **Collaboration and Working Groups Program** to foster collaborative initiatives between members that create value for members and society.
- **The Membership Program** to diversify and enrich the membership base to empower the exchange and collaboration amongst actors of the whole water value chain.
- **The Communications Program** to disseminate and raise the visibility of European research results and solutions, and the water sector in general.
- **The Advocacy Program** to create an enabling and business environment for water related RTD and innovation.
- **The Innovations Program**, to bring solutions and knowledge to the market.
- **The Investor Program** to facilitate the growth of investments in the sector.

Colophon

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