Water Europe

Technology & Innovation

THE VALUE OF WATER

Multiple Waters
for Multiple Purposes and Users

Towards a Future-Proof Model for a European Water-Smart Society

Water
Europe

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Introduction

This Vision document has been drawn up by Water Europe, with the input of its members and key stakeholders.

It was developed in the first half of 2016 to establish the course of action 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 water-smart society of the future may look like, based on emerging technology and societal trends which are expected to lead to a paradigm shift in terms of how we deal with the finite resources on our planet. By 2030, the transition to this water-smart society should be in full swing.

The document also outlines the higher-level innovations that will be required to realise this vision, and as such lays the foundation for a renewed Strategic Innovation and Research Agenda (SIRA), inspiring 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 global societal challenges and the global water market.

Terms and Definitions

The Value of Water • expresses the importance of water for our society at large, including enabling 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 • indicates the economic and societal value that can be accomplished by extracting and valorising substances such as nutrients, minerals, chemicals and metals, as well as energy, 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 are avoided. Water and resource loops are largely closed to foster 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 and organisations related to the extraction, treatment, distribution, use and reuse 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, reuse and resilience.

Multiple Waters • important concept underpinning the Water Europe water vision, picturing a future in which different alternative water sources and qualities (fresh ground and surface water, rainwater, brackish water, saline water, brines, grey water, black water, recycled water) will be available in our society, and employed for various purposes by multiple users.

Digital Water • important concept underpinning the Water Europe 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 all the way along to the individual user, as such generating large amounts of valuable data (big data) for innovative Decision Support and Governance systems.

Water Europe Future-Proof Model for a Water-Smart Society • a model and framework that gives structure to the required research, development and innovations with respect to the current water system, in order to fulfil 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 Water Europe Vision for a Water-Smart Society

This Water Europe vision document aims to set out the pathways 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**. This vision is of a future where water scarcity and pollution of ground- and surface water in Europe are avoided; water, energy and resource loops are largely closed to foster a circular economy; the water system is resilient against climate change events; and European business dependent on water 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 Water Europe and its collaboration partners for the upcoming decades.

Helping to Solve Societal Challenges and Boost European Competitiveness

The Water Europe Vision focuses on European water challenges, trends and required developments, but it also indicates how these are 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.

In order to help the water-smart society to materialise, Water Europe that research, development and innovation investments in Europe focus on four key impact parameters:

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

To achieve 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, Circular, Water-Smart Society

Water Europe promotes **a future-proof European model for a 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 collaboration for stakeholders at all levels of society, involving citizens, public authorities at all levels, industries and farmers, as well as representatives of our natural environment.

Its advantage comes from dramatically higher levels of manageability enabled by the emerging cyber-physical society, **"digital water"** technologies and increased availability of **"multiple waters"** to complement freshwater sources, as well as much deeper levels of awareness, integration and collaboration between organisations and citizens.

These important changes will offer a boost for European industry, which requires significant investment in redesigned and adapted infrastructure as well as innovative technologies. It also provides complex challenges that require a longer-term programme to foster stable migration towards the new water-smart society.

A Future-Proof Model for a Water-Smart Society

The **Water Europe future-proof model for a water-smart society** involves four key components to carry out research and development, but more importantly to bring RTD results to market and achieve systemic innovation to our water system:

1. The value of water: developing a water-smart economy using advanced solutions and a systems approach to eco-innovation, a state-of-the-art 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 reuse. It also entails valorising the value in water, meaning extracting and exploiting relevant resources such as nutrients, minerals, metals and also energy that are embedded in used water streams. Innovation will 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, enabling synergies between centralised and decentralised treatments, as well as economically viable extraction and valorisation of valuable substances and energy in water. Using advanced materials in water infrastructure and improving solutions to reduce water use in agriculture. Our emerging and enabling technologies will empower Europe to reach previously unimaginable levels of control, manageability, and valorisation of water in our society;

3. A hybrid grey and green water infrastructure: rethinking and redesigning water distribution and water service systems into a high-tech, human-built water infrastructure integrated into a nature-based ecosystem. This 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 the availability of water for all users and sectors (industry, agriculture, cities, waterborne transport) and multiple purposes, based on understanding the 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).

Transitioning to a Water-Smart Society

Water Europe 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 Infrastructure**", will drive the transition, decision makers and new water-smart economics. All will be enabled by new technologies developed 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 , more profound water stewardship programmes will direct the water market towards smart allocation of water.

In this future water-smart society, more than 30% of the total water demand (i.e. hundreds of km^3/yr) will be delivered by alternative water sources such as rainwater, brackish, saline and reused 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, saving up to 300 km3/yr. Overall, the Water Europe water vision aims for a set of innovations leading to a 50% reduction in the pressure on our fresh ground and surface waters, making preventing water scarcity in Europe a reality and contributing significantly to solving the significant global levels of water scarcity.

By 2030 the transition to a water-smart society will be in full swing, driven by visionary front-running (agro) industries, rural and urban areas. These will have taken the lead in developing the migration paths towards the water-smart society of the future 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 ecosystem 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 water handling market, creating numerous new green jobs in Europe while making significant contributions towards reaching the sustainable development goals for water.
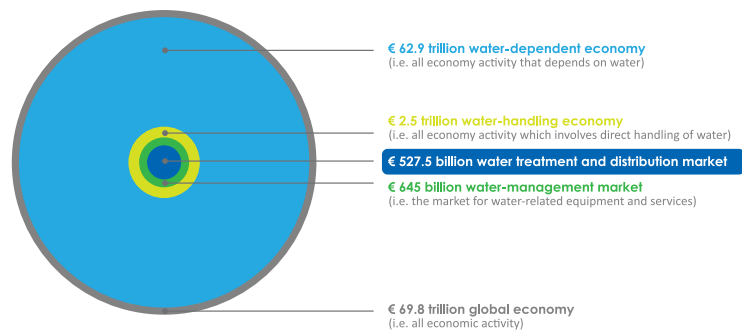
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1• Background to the Water Europe Water Vision

Water Challenges

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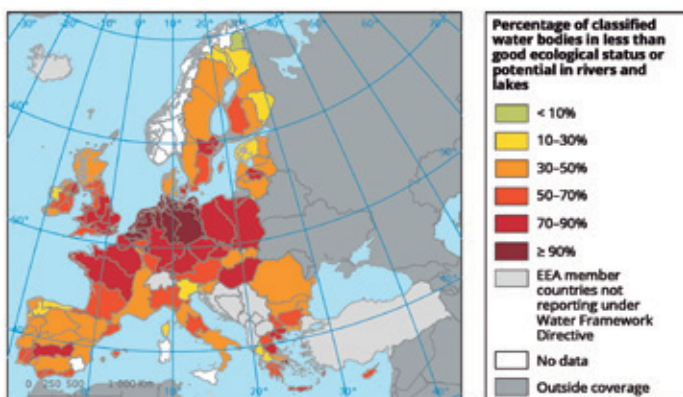> **UNESCO Water report 2015**

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 global economy would fail. Global trends, however, forecast 55% worldwide growth in water use[1] by 2050, due to growing demands from manufacturing, thermal electricity generation, agriculture and domestic use, all increasing the pressure of human activities on our freshwater sources. Furthermore, water quality is declining due to urban, industrial, and agricultural pollution, impacting on the availability of water 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 EU[2].

€ 62.9 trillion water-dependent economy
(i.e. all economy activity that depends on water)

€ 2.5 trillion water-handling economy
(i.e. all economy activity which involves direct handling of water)

€ 527.5 billion water treatment and distribution market

€ 645 billion water-management market
(i.e. the market for water-related equipment and services)

€ 69.8 trillion global economy
(i.e. all economic activity)

Source: adapted from GWI

In the OECD countries, water demand is expected to stabilise towards 2050 at around 1,000 km[3] per annum (350 km[3]/yr in the EU[4]), but quality of water and increasingly intense weather events induced by climate change pose challenges. These need to be solved to create a sustainable society that guarantees adequate water availability for all uses and users.

Percentage of classified water bodies in less than good ecological status or potential in rivers and lakes

< 10%
10–30%
30–50%
50–70%
70–90%
≥ 90%
EEA member countries not reporting under Water Framework Directive
No data
Outside coverage

Source: EEA

Currently we lack comprehensive insight into the way we use our available water sources as well as the status of our water bodies and we face challenges to restore the quality of EU waters to acceptable levels[5].

Water recycling is minimal[6] and we are struggling to deal with the increasing effects of climate change such as floods and droughts, with significant geographical diffe-rences across the European continent.

In the future most OECD countries, including those in Europe, will have to deal with the potential challenge of increased water scarcity, especially in Southern Europe and coastal areas but also increasingly in Central, Eastern and North-Wes-tern Europe. **Water scarcity is already a serious problem** in 11% of EU territory and it is expected that the territory facing water scarcity problems will grow to 30% in 2030. Apart from the availability of water, our **water quality will also be affected**[8] as a result of seawater intrusion into coastal aquifers, faster depletion of dissolved oxygen because of higher water temperatures, and higher content of pollutants that flow into water bodies following extreme rain events[9]. Systems to gain further insight into 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 Water Europe Water Vision

In a future world in which the population will grow to almost 10 billion people, the number 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 pathways towards significantly reducing freshwater extraction from our natural ecosystem, while making sufficient water sources available.

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 be solved merely 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
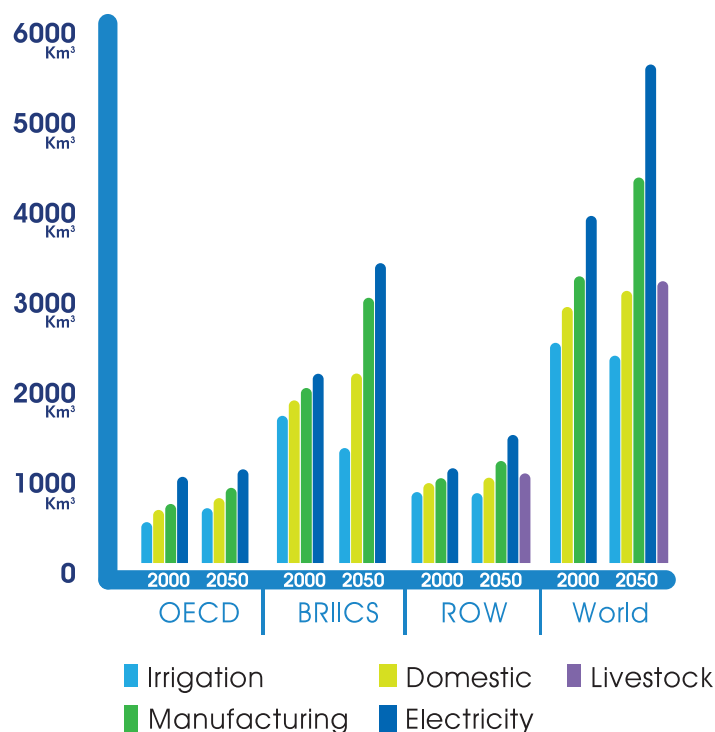
Source: adapted from OECD Environmental Outlook to 2050

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 reuse policies and programmes. Gaps in monitoring the chemical status of surface waters were so numerous that in 2012 the status of over 40% of water bodies in the EU was unknown[10]. This hampers our insight into how to improve water quality.

Emerging global challenges and market opportunities lead to a pressing need in Europe to increase the level of monitoring of the quality and quantity of water availability and use. This needs to be addressed at the European level, due to the cross-border nature of European water bodies. Detailed measurement, monitoring and data analyses and more precise status assessment 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 systems, 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 wastewater networks) is no exception. They have significant impacts on the natural water balance across the EU, impacting on 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 threatening natural water ecosystems. Apart from considerable water scarcity, our water quality will also be affected[11] as a result of seawater intrusion into coastal aquifers, faster depletion of dissolved oxygen because of higher water temperatures, and a higher content of pollutants that flow from urban and industrial sites into water bodies following extreme rain events[12].

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 made to anticipate and mitigate their impact 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 development 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, reused 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 the EU and global levels. At the European level, we increasingly need to adequately manage scarce resources across borders. We need to collaborate at the relevant policy layers regarding 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 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-placed to develop and showcase 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 freshwater 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.

Source: Water Europe

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 a precious resource for human health and well-being, but also as a crucial lever for economic performance and business growth. In this Water Europe 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, rainwater and used water available through decentralised systems, as an integrated part of our water system.

The future water-smart society should valorise reuse 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. Multiple waters, good quality status of our water bodies and resilience all 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 Water Europe vision concept:

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

To realise this vision Water Europe 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 achieve systemic innovation in our water system by:

1. Developing a water-smart economy: using advanced solutions and a systems approach to eco-innovation, state-of-the-art 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 reuse;

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. Enabling synergies between centralised and decentralised treatments, as well as economically viable extraction and valorisation of valuable substances and energy in water. Using advanced materials in the water infrastructure and improving solutions to reduce water use in agriculture. Our emerging and enabling technologies will empower Europe to reach previously unimaginable levels of control, manageability and exploitability of water in our water society;

3. Rethink and redesign the water distribution and water service systems: high-tech, human-built, hybrid grey and green water infrastructure integrated into a nature-based ecosystem that combines centralised and decentralised water treatments, leading to reduced water loss, preventing pollution, 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 the availability of water for all users, sectors (industry, agriculture, drinking water, waterborne transport) and multiple purposes, based on understanding the 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 to innovating the water system.

Water Europe 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 Water Europe **future-proof model for a water-smart society** is an integral part of the Water Europe Vision and is further explored in Chapter 3. It will contribute to achieving the four key impact parameters of the Water Europe Vision:

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

The targeted impact of the Water Europe Vision is further detailed in Chapter 4, describing the Key Impact Parameters, the impact on the water market and the natural ecosystem.

"[...] 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 Water Europe Water Vision for Europe and the World

The Water Europe Water Vision for Europe and the World

Water Europe envisions a European water sector that will be significantly transformed with respect to the current situation. New concepts such as "**Multiple Waters**" and "**Digital Water**" will drive decision makers and new water-smart economics. All will be enabled by new technologies developed 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 manoeuvre the water market towards a 50% reduction in 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 using digitally enabled innovations will prove to be an important driver. New markets will emerge if the true value of water is better recognised and if we manage water accordingly. Such an approach can only boost the "traditional water market" and make new ones emerge that valorise considerable amounts of raw materials as well as energy embedded in used water streams, and make these available for our society.

## Key Innovation Concepts for the Water-Smart Society

The Multiple Waters Concept

The Water Europe vision paints a picture of a future European society that manages our precious **multiple water sources** from clean rivers, surface and ground water, but also alternative sources such as rainwater, 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 total water demand (i.e. hundreds of km^3/yr) will be delivered by alternative water sources, supplementing and reducing the pressure on our fresh ground and surface waters. A few examples: rainwater will be captured by green infrastructure (e.g. green roofs on homes) in cities and made available for citizens. New local loops and decentralised water treatment systems will ensure that used water from apartment blocks or living quarters can be recycled and reused, and options for extracting, valorising and using nutrients in the used water streams for fertilizers in integrated urban natural environments will be considered. Innovative, cost-efficient desalination systems, combined with green infrastructure, will treat saline water and brine as well as brackish water in coastal areas, and make it available for various urban and industrial (e.g. cooling) applications, while local loops will ensure recycling and reuse 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 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 reuse, with the potential 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"
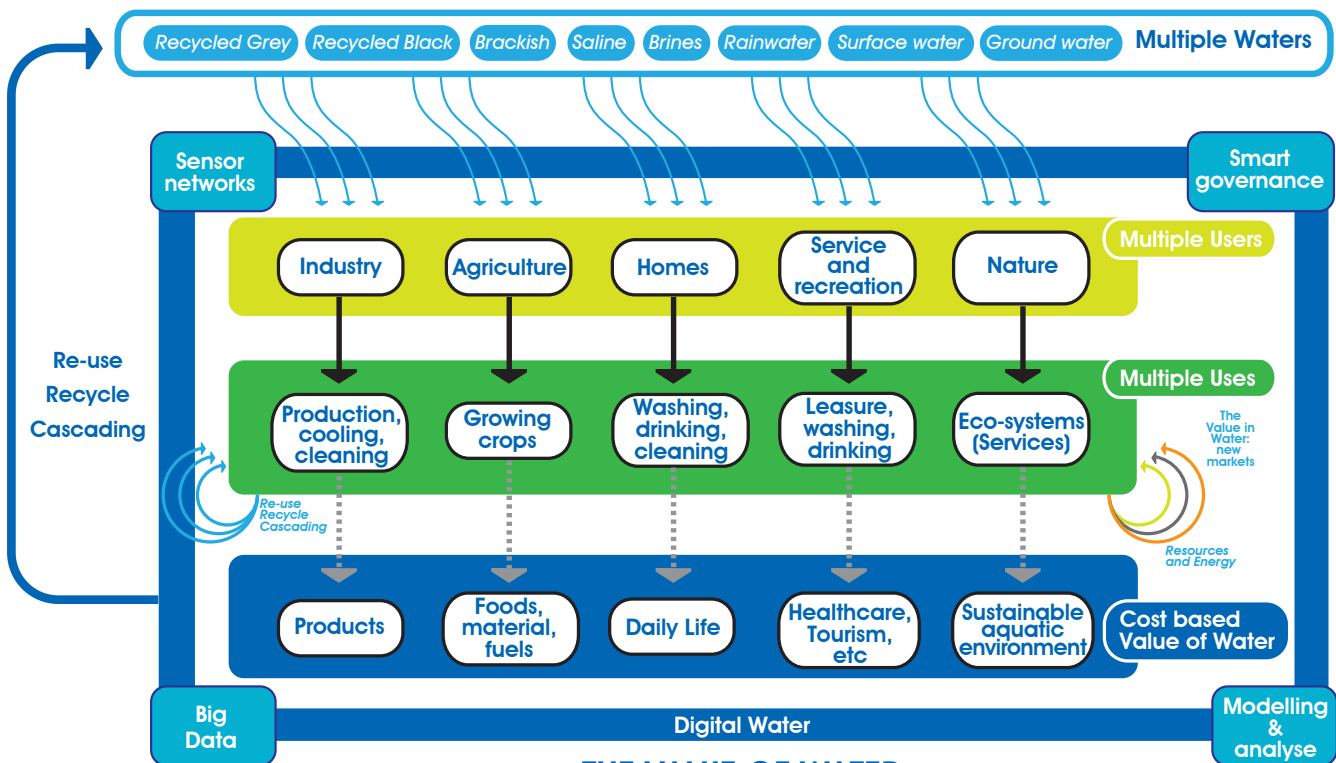
THE VALUE OF WATER

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

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

Source: Water Europe

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("Digital Water"). A ubiquitous network of smart sensors throughout the water system from the river basin up to the smaller "water grid" cycles will swell the number of 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.
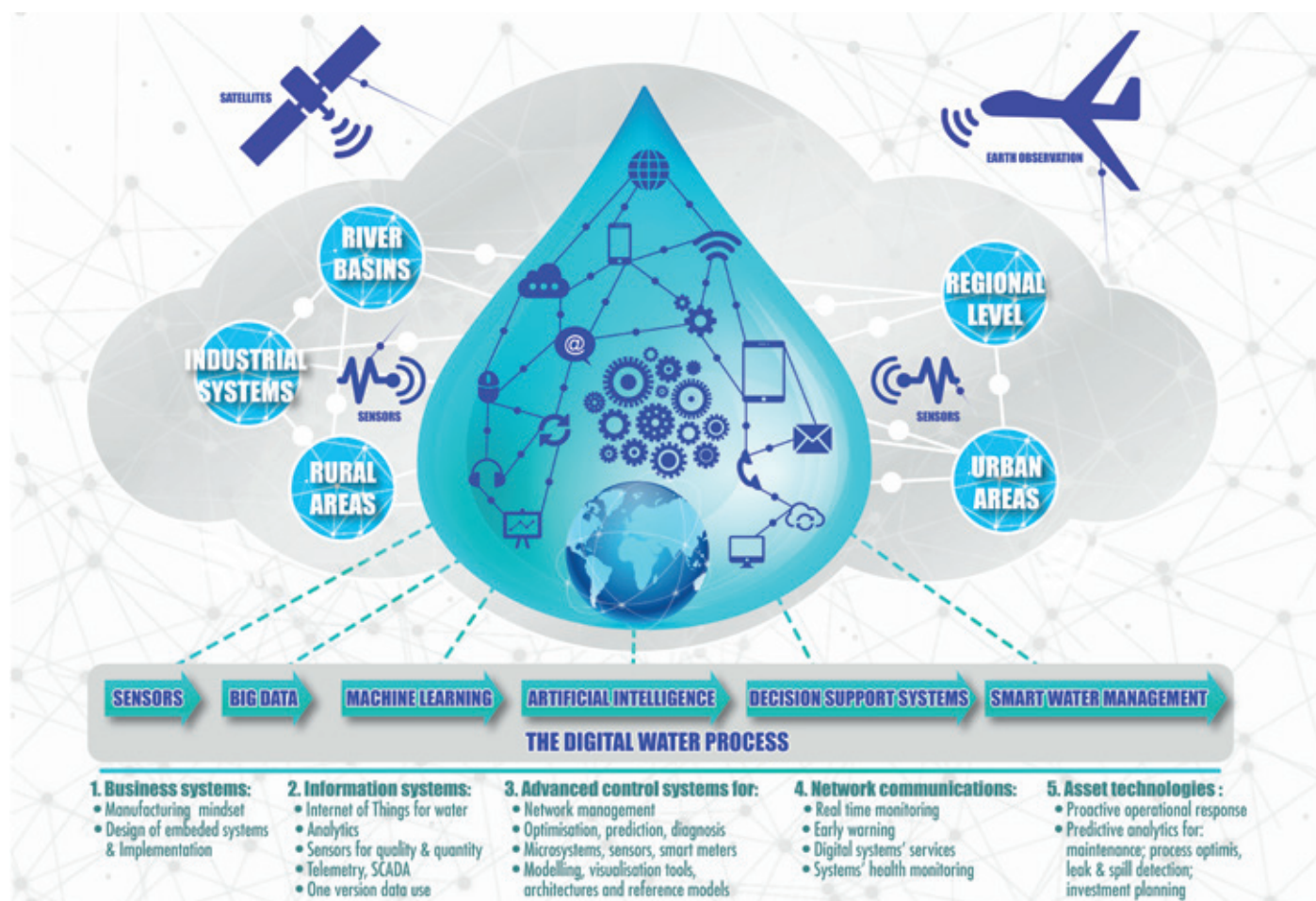
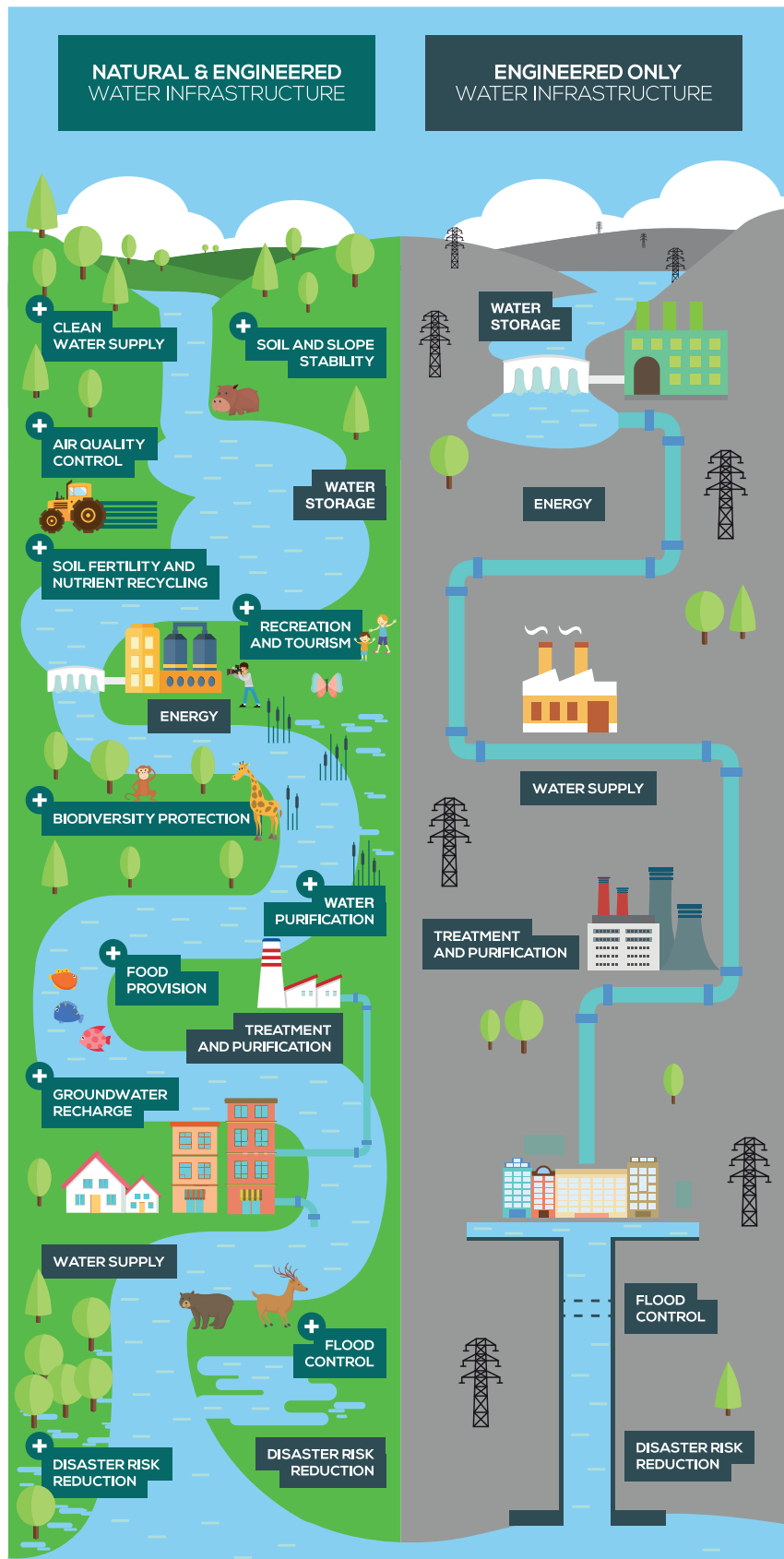## A Redesigned Integrated Grey and Green Smart Infrastructure

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 and habitats for wave reduction or shore protection. By creating a more integrated water infrastructure, individual water-related assets (resources, pre-treatment, wastewater) 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 extreme water-related events or natural hazards (such as floods, droughts, heat waves or mud flows).

This holistic view of water assets should bring about a more sustainable water system that over time ensures 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, cost-effective, nature-based solutions.
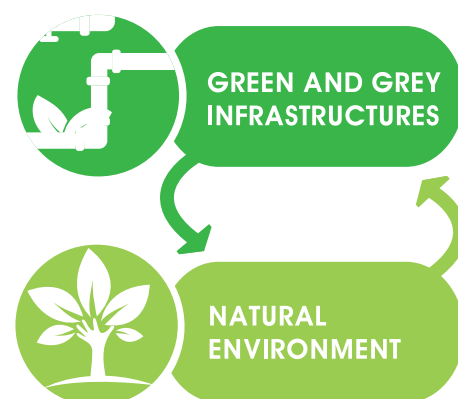
"Redesigning the water infrastructure for multiple waters, the right purpose and multiple users"

NATURAL & ENGINEERED
WATER INFRASTRUCTURE

ENGINEERED ONLY
WATER INFRASTRUCTURE

- CLEAN WATER SUPPLY
- SOIL AND SLOPE STABILITY
- AIR QUALITY CONTROL
- WATER STORAGE
- SOIL FERTILITY AND NUTRIENT RECYCLING
- RECREATION AND TOURISM
- ENERGY
- BIODIVERSITY PROTECTION
- WATER PURIFICATION
- FOOD PROVISION
- TREATMENT AND PURIFICATION
- GROUNDWATER RECHARGE
- WATER SUPPLY
- FLOOD CONTROL
- DISASTER RISK REDUCTION
- DISASTER RISK REDUCTION

WATER STORAGE
ENERGY
WATER SUPPLY
TREATMENT AND PURIFICATION
FLOOD CONTROL
DISASTER RISK REDUCTION

Source: adapted from IUCN

Flexibility is achieved by redesigning the water infrastructure for the dynamic allocation of multiple water resources for the right purpose to multiple users. At present, a single quality of water is supplied from centralised water sources to decentralised water users without differentiation in terms of the water quality required. 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 increasingly be 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 proactive policies and strategies to safeguard the sustainability of regional and river basin water resources. Near real-time monitoring of the water-infrastructure and the quality of water therein will also 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 is redesigned, renewed and rehabilitated, leakages will be reduced as much as possible.

To handle climate effects such as floods and droughts and to ensure the multiple ecosystem services the water bodies are providing, **water planning will be included 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 ecosystem. 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 will be included 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 preventing 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 integral, 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 insight and forecasting capabilities regarding 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. Impacts of human activities on water 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 impacts by products, processes and services. Industry, cities and farmers will have adopted longer-term water stewardship programmes and practices for 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 integral part of our water ecosystem.

Individual users will be empowered to play their role using redesigned water distribution, use infrastructure with multiple loops and find 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 make and test new technological and non-tech solutions in the European model for a water-smart society, and to bring about 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. This 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 large reduction in water pollution and will have enabled more than 30% of water in Europe to be recycled. In some areas in Europe **the water loop will even be closed at 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 flood risk are 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 discover 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 will be harvesting, extracting, treating and reusing the value in these waters, leading to growth in emerging markets through new businesses and eco-services. These businesses will generate new profits and create jobs in the water market in Europe and globally.
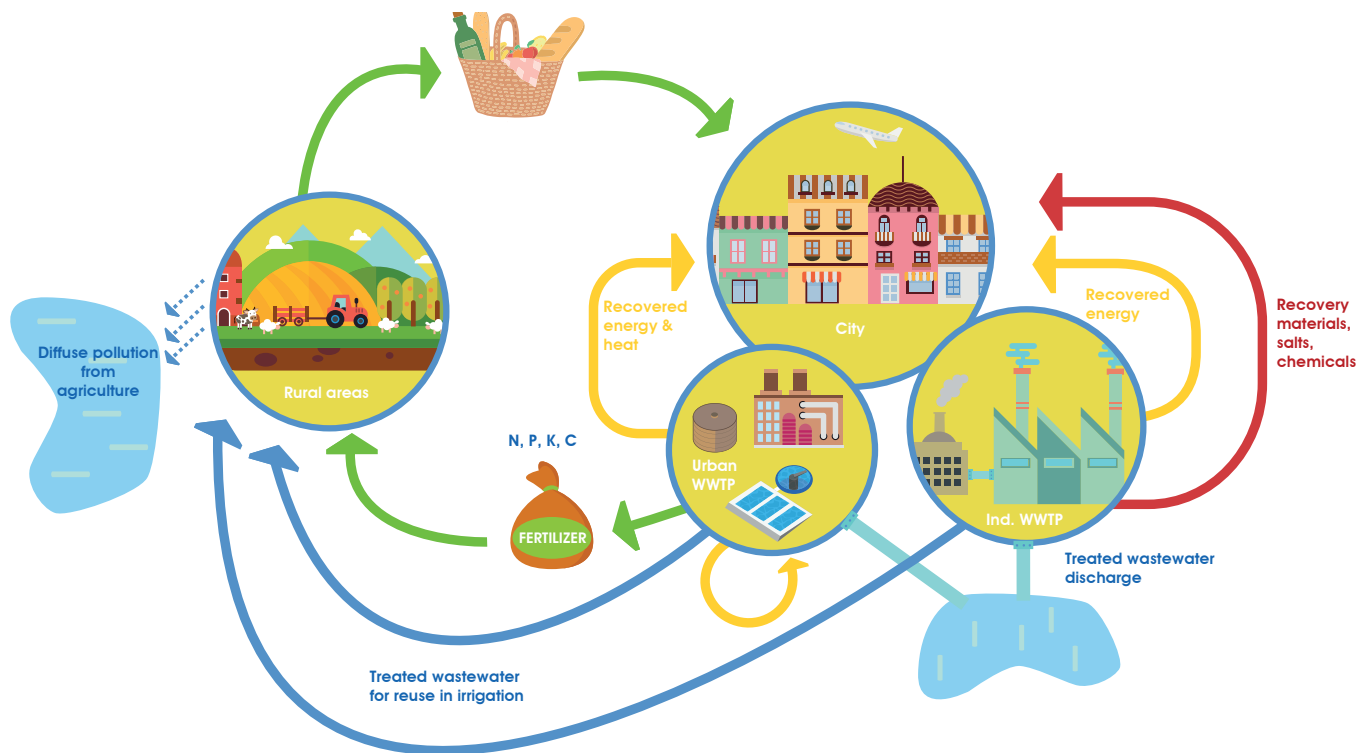
Source: Water Europe

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 implemented 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 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 part of the water infrastructure. Smart integration of nature-based solutions will cover important functions in the water ecosystem such as storage, buffering and treatment. This will contribute to optimising the costs of the future water infrastructure. Water accountability and footprint assessments will also have helped new multi-stakeholder economic models to emerge. 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 will have adopted policies and implementation plans for climate change adaptation and mitigation across various sectors (industry, energy, agriculture, transport). They will have adopted integrated multi-sector (urban/rural) planning and risk assessment strategies, inspired by new knowledge and insight based on the "Digital Water concept", and will use nature as one of the resources to develop resilience against droughts and floods.

They will have emergency plans in place to ensure resilience in the long term. Multi-level governance of river basins across countries will have created 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.

"New, 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 ecosystems 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 biodiversity within an integrated grey and green (natural and engineered) water infrastructure.

Governance will be supported by real-time, 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 reuse activities. To manage and regulate the distribution, sanitation, use and reuse of water, governance will also incorporate and use financial mechanisms and legal arrangements for these water-related activities at (inter-)regional level.

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

A Future-Proof Water Europe Model for a Water-Smart Society

The Water Europe 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 Water Europe Strategic Innovation and Research Agenda (SIRA) on the main developments needed to realize the vision.
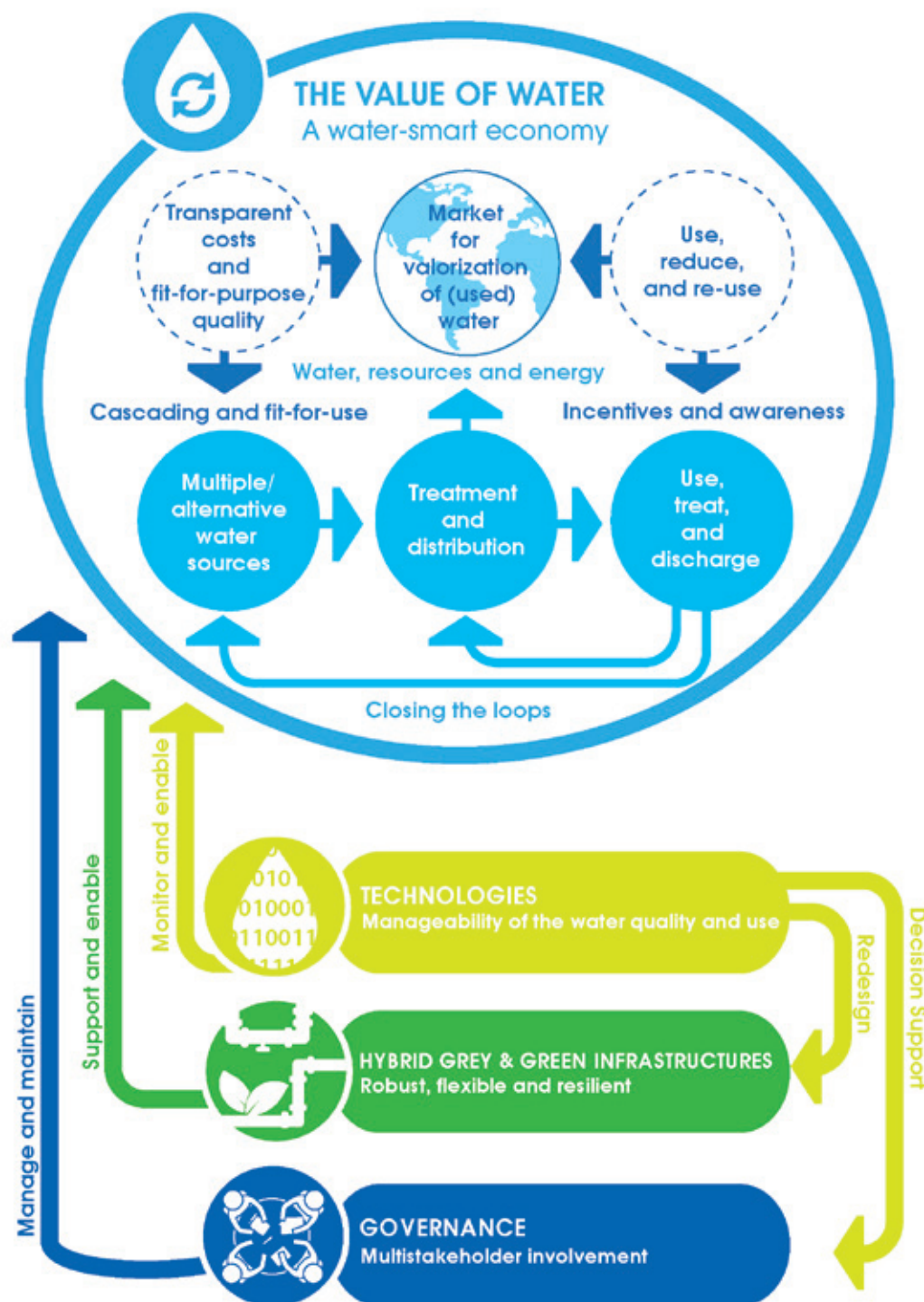
Water Europe model for a future-proof water-smart society

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

1. **A more water-smart society and economy (market)** that combine 5 elements to optimise water management:

- efficient water use (use, reduce, reuse);
- 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;
- exploitation by businesses of the value that is in water (energy, nutrients, chemicals, metals, etc.);
- source control measures minimising diffuse emissions and residual contamination, contributing to good ecological status of freshwater 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 various new alternative water sources available for multiple uses;
- innovative digital technologies (e.g. sensors, data analysis and support tools) to enable measurements and near real-time monitoring of – and insight into – water extraction, treatment, distribution, quality and use;
- new digital technologies for better planning of water infrastructure and allocation aiming at resilience under changing circumstances;
- new solutions for source control measures to prevent water cycle pollution (or to prevent pollution from entering water cycles) and prevent 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 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 of multiple (local) water loops, integrating central and decentralised water treatment into existing infrastructure, 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 to 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, representatives of nature and appropriate public/user participation mechanisms in decision-making processes;
- coordinating freshwater 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 Water Europe Water Vision

The Water Europe vision stimulates the development of myriad state-of-the-art technological and non-technical solutions for building a 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

Water Europe aims to contribute to realising real impact in Europe through **three key impact parameters**[14]:

1. Reducing the impact of European society on our natural water resources by:

a. increasing reuse from the current 5% to up to 30%, making up to an additional 100 km^3/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 of 20% across Europe to lower levels, taking into account regional differences of sustainable water availability (which could make another estimated 50 km^3/yr of water available for multiple uses;

c. valorising much higher levels of alternative water sources (brackish, saline water and brine and rainwater), potentially making an additional 15-30 km^3/yr of water available for various purposes;

d. reducing water consumption in agriculture, industries and cities through more effective irrigation and agriculture, as well as raising users' awareness, reducing overall impact on water consumption by 50 km^3/yr;

e. reducing the amount of water used for energy production by 10-20% (currently 25% of 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 freshwater sources and ensuring appropriate recharging of natural water reserves.

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

a. developing new advanced water treatment technologies (by reducing water pollution and promoting reuse for various purposes), management models, infrastructure 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 global water management market (i.e. market for water-related equipment and services;

b. five-to-tenfold 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-Million markets in Europe for recovered resources. This will create new businesses and jobs while realising a true circular economy for both biological and technical nutrients[15] in used water streams.

"Non-exploited phosphate in Europe's waste water has a potential value of hundreds of Millions of Euros"

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

a. making the water system robust, flexible and adaptable to external influences such as droughts and floods by combining engineered, man-made and natural green infrastructure with advanced digital solutions such as sensoring, ICT and DSS systems, leading to: 50% less flood damage, 50% fewer occasions in which droughts result in lower agricultural production, 50% fewer occasions in which droughts affect shipping abilities, 50% fewer occasions in which heat waves endanger electricity production due to lack of cooling water;

b. drastically reducing pollution and eutrophication and restoring bio-diversity while including nature as one more component asset of the durable future water system;

c. capitalising on the value of water through increased resource efficiency of our industrial system, and a five-to-tenfold increase in harvesting the value in water, as new sources of 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.
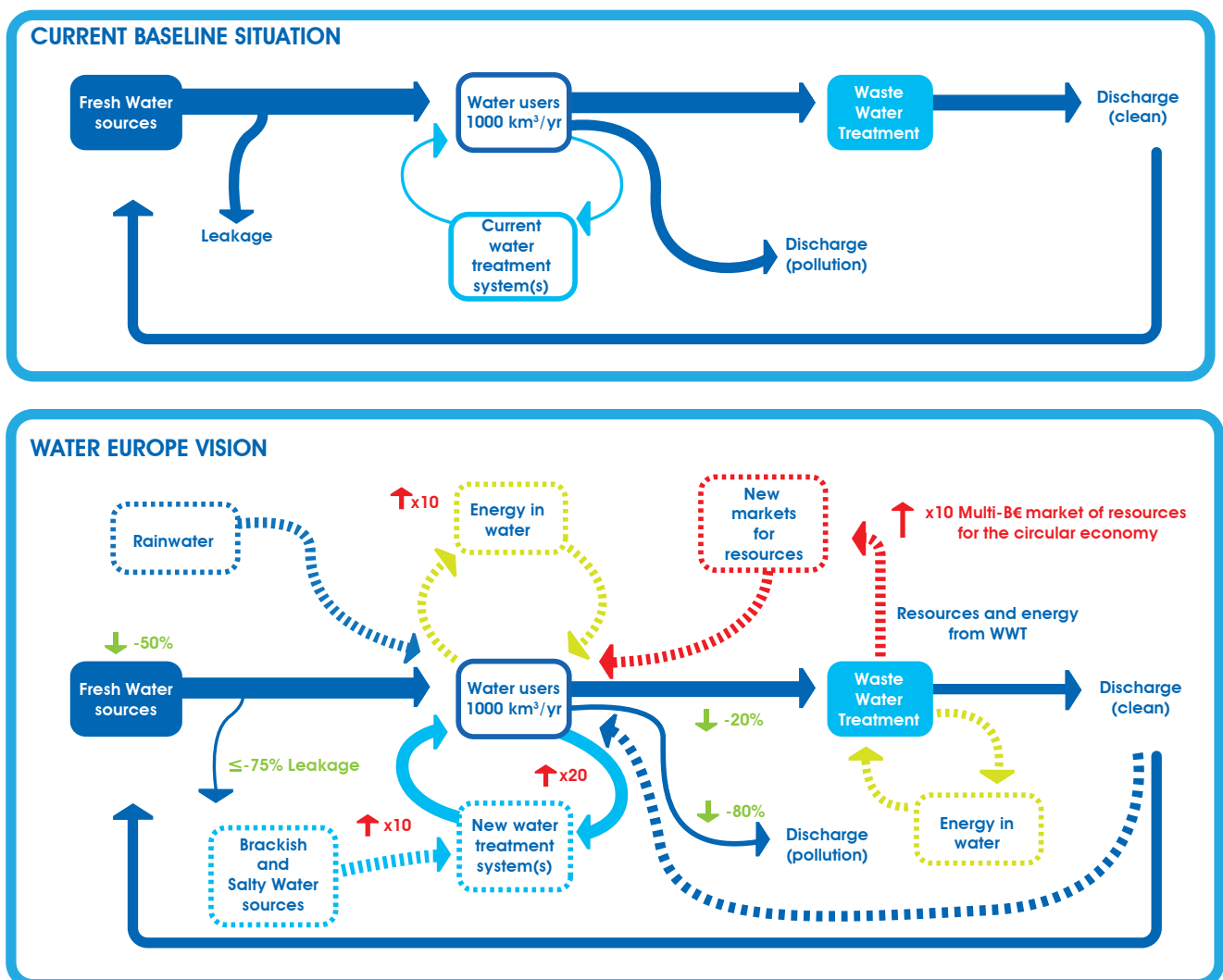
An opportunity for Europe: Increasing water resource efficiency and circularity

Economic and Market Impacts

Up to now, nothing near the true potential value of water has been fully explored. The Water Europe Vision intends to open up new pathways to recognising the true value of water, leveraging its economic importance with considerable economic impact for Europe. This ranges 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 the negative economic impacts of **climate change events** on our cities, industries, agriculture and waterborne transport.

• 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 rainwater offer a large amount of underexploited water sources that could be used to complement freshwater use. Innovative water treatment technologies are emerging that enable increasingly economic solutions for adapting different water qualities for use while avoiding pollution. A large number of industries in Europe depend on 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 several manufacturing and transformation industries including food, pharmaceuticals and textiles. Mitigating water scarcity through the multiple waters concept helps to reconfirm the crucial value of water, while boosting the competitiveness of the water industry through innovation, including new investment 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, phosphate and other nutrients which often remain unexploited. The total available phosphate in sewage streams in the European Union is estimated[18] at 506 kilotonnes per year, or 36% of the phosphate currently imported by the EU via mineral fertiliser[19]. Combined with the current prices of phosphate[20] this means a **potential theoretical value of €346 million of non-exploited phosphate in EU sewage streams**. Western Europe depends on imports for more than 80% of its phosphate requirements[21], 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 and critical raw materials (e.g. from mining wastewater 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 earth from mining, which is critical for our high-tech industries such as electronics, wind energy and photovoltaics.

• Last but not least, significant economic impact can be achieved by **avoiding the costs of climate change events for cities, industries and farmers**. Over the last 15 years, floods have led to at least €25 billion worth of insured damage[22] in addition to uninsured costs, with an estimated annual damage of €4.9 billion in 2014, which is predicted to grow fivefold by 2050[23]. It is evident that developments and investments in a future hybrid grey and green water infrastructure that is resilient against the effects of climate change 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 Water Europe Vision builds on these opportunities, as such generating a considerable 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.

Making the Water Europe vision a reality will contribute significantly to establishing a sustainable European water market, but also to economic development, growth and jobs. The EU's "traditional" water sector includes a large number of players, including 9,000 active SMEs[24], and provides almost 500,000 full-time equivalent jobs[25]. Stimulating various industries in the water value chain to develop novel solutions, business models and even new value chains will benefit all stakeholders by:

- Boosting the market for providers of water technology **solutions** (water treatment, software systems for decision support systems, etc.);

- Boosting the market for providers of digital technology **solutions** directly applicable to, and/or specifically 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 reuse 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 and 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 to 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 human and natural green infrastructure, 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, also recognises the need for such solutions to be developed by "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 patterns).

Advanced smart technology 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

The lifetime of water service assets is long, and these assets cannot be redesigned or transformed in short periods of time. There is a real need for a transition period in which the water industry can implement innovative solutions and integrate them into long-lasting infrastructure, services and practices.

To facilitate migration to its vision, Water Europe promotes a Strategic Innovation and Research Agenda (SIRA) outlining the key challenges, research and innovation priorities for each challenge, but also proposing modes of implementation. A novel but, in our view, important mode of implementation to drive the migration path towards the Water Europe vision are the ambitious **European living labs** which will be set up to demonstrate how the current water ecosystem, infrastructure and governance can migrate to future water-smart societies, as an example for others to follow.

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

1. Support from key policy makers and politicians at the municipal, regional, national, European and global levels;

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, European manufacturers of water and thermal energy meters etc.;

3. Coalition building to shape policy with relevant NGOs and governmental organisations such as UNESCO and WHO;

4. Financial support from regional, national, European and global political decision makers, based on a 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 and the World Bank, as well as large private investors);

5. Coalition building for research and innovation, by discussing the Water Europe Vision and SIRA with funding organisations
   and/or mechanisms: H2020 (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. Fostering vibrant, fair and open knowledge development and a 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.

Water Europe leadership – including selected ambassadors and opinion leaders – will invest its own energies and relationship capital in building momentum, recruiting influential supporters and assuring the Water Europe itself evolves as an entrepreneurially-minded, results-oriented and visionary platform. The Water Europe Vision envisages co-investment from key stakeholders, such as cities, industries, river basin 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 and market power. Europe's RBDs will be categorised as 'advanced', 'gazelle' and 'catch-up' districts, and various strategies shall be devised to support them.

Water Europe will evaluate and contribute to proposed regulatory measures which will provide a stable and attractive investment framework for public and private sector investment.

6• Conclusions

The Water Europe vision of a future-proof European model for a 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. Considerable **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 the adequate water quality and safety levels required for different water uses;

2. Developing **state-of-the-art technologies and solutions**, that enable more efficient and economical treatment of multiple waters, to make them suitable in "fit-for-purpose" water allocation, to combat source point pollution and enable significant reductions in 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 conjunction with long-term resilience forecasting and planning, to gear our system up for the impact of ever more intense climate change events;

4. Rolling out a vast network of sensors and metering systems targeted to the level of individual users, be they users at home, industries or farmers, and developing advanced data analytics and real-time management information systems at different governance levels to enable advanced water management;

5. Designing and deployin **new economic, business and governance models** at the regional, national and European levels to secure appropriate inclusion of cost recovery, costs of externalities and the "polluter pays" principle, within a level playing field market environment, inclusive governance.

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

These important changes will offer a boost for Europe's industry, which will require significant investment in redesigned infrastructure and innovative technologies. They also pose complex challenges that require a longer-term programme to foster 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 estimates within the Water Europe stakeholder group regarding the potential benefits that may be expected when the Water Europe Vision 2030 is 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) Wetsus, European centre of excellence for sustainable water technology, 2017.

19) Wetsus, Based on "Phosphorus flows and balances of the European Union Member States" Kimo C. van Dijk, Jan Peter Lesschen Oene Oenema (Alterra, Wageningen University and Research Centre), in "Science of the Total Environment" 542 (2016) 1078–1093.

20) http://pubdocs.worldbank.org/en/151321483568157298/CMO-Pink-Sheet-January-2017.pdf

21) Current World Fertilizer Trends and Outlook, Food and Agriculture Organization, 2008, p. 12.

22) Water Information System for Europe, European Commission.

23) European Environmental Agency, 26 January 2016.

24) COM(2012) 216 final.

25) '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 Water Europe

Water Europe is the European Technology Platform for Water, initiated by the European Commission in 2004 as an industry-led stakeholder forum. 12 years later and with over 200 members, Water Europe has become the recognised voice and promoter of water-related RTD and innovation in Europe. We strive to increase coordination and collaboration, to enhance the performance of water service providers, water users and technology providers in a sustainable and inclusive way.

Water Europe has developed different Programs which are key to the functioning, objectives, and implementation of the Water Europe 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 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 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 investment in the sector.

Notes

Water
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Technology & Innovation

Water Europe – The European Technology Platform for Water
B. August Reyers 80.1030 • Brussels, Belgium
www.watereurope.eu • info@watereurope.eu
+32 (02) 7068291

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