D6.8 E-Book#2

"Technological and non-technological dimensions of Digital water"

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July 2022

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Project Consortium

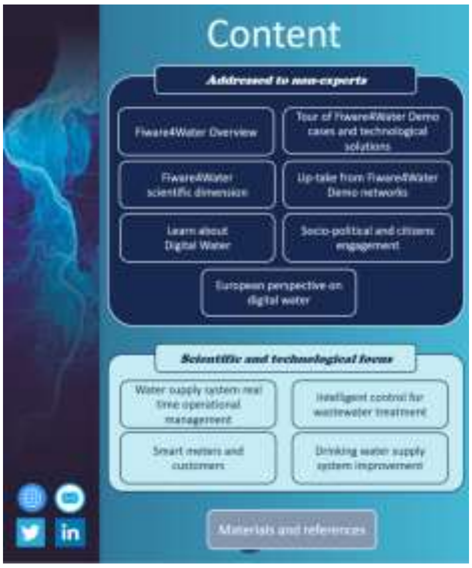
Executive Summary

Fiware4Water story has started in 2018, when partners from digital and water fields decided to build a project to further explore innovative digital solutions applied to water management and provide evidence based tools and methods.

Reaching the final lane, Fiware4Water partners aimed at presenting digital water as explored through the progress of the 4 Demo cases and 3 Demo networks.

This updated version following the one named *Digital Water for non experts* provides specific scientific and technological focusses.

The project's overview, a scientific presentation, focus on digital water, the European perspective for digital water and Fiware4Water contribution to EU water related policies are still available. In addition, partners proposed to detail the technological solutions developed at the scale of the Demo cases.



Document Information

Programme	H2020 – SC0511-2018
Project Acronym	**Fiware4Water**
Project full name	FIWARE for the Next Generation Internet Services for the WATER sector
Deliverable	**D6.8: E-Book "Digital Water for non-experts"**
Work Package	**WP6: Ecosystem building for communication and dissemination strategies and activities**
Task	Task 6.1: Communication and dissemination of project outcomes
Lead Beneficiary	P1: OiEau
Author(s)	Natacha Amorsi (OiEau)
Contributor(s)	DEVEUGHELE Stéphane (Suez), ECHEVERRIA Lluis (EURECAT), ELELMAN Richard (EURECAT), KOSSIERIS Panagiotis (NTUA), MAKROPOULOS Christos (NTUA), NANU Ciprian (BDGroup), POCOCK Joshua (South West Water), POLYCHNIATOU Vasiliki (EYDAP), SIAUVE Sonia (OiEau), TEJADO Angeles (FIWARE), VAMVAKERIDOU-LYROUDIA Lydia (KWR)., VAN DER HELM Alex (Waternet)
Quality check	Natacha Amorsi (OiEau), Evelyne Gautier (OiEau)
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Actual Delivery Date	31 May 2022
Dissemination Level	Public

Revision history

Version	Date	Author(s)/Contributor(s)	Notes
Draft1	01/04/2022	Natacha Amorsi (OiEau)	
Draft2	25/05/2022	Natacha Amorsi (OiEau)	Contributions from KOSSIERIS Panagiotis (NTUA), MAKROPOULOS Christos (NTUA), POLYCHNIATOU Vasiliki (EYDAP), VAN DER HELM Alex (Waternet)
Daft3	30/05/2022	Natacha Amorsi (OiEau)	Contributions from Stéphane DEVEUGHELE (Suez)
Final	31/05/2022	Natacha Amorsi (OiEau)	Finalisation
Final V2	20/07/2022	Natacha Amorsi (OiEau)	EU added value in a nutshell section has been added detailing WP2, WP3, WP4 and WP5 inputs.

Table of content

Introduction

Fiware4water *E-book* named Technological and non-technological dimensions of Digital Water is the deliverable n°6.8 of Work Package n°6 dealing with Ecosystem building for Communication and dissemination strategies and activities

Fiware4Water E-book is part of the learning experience on digital water proposed by the project. It completes the webinars and workshop realised during the project.

The content of the E-Book was decided by the partners in April 2021. During the meeting, the decision was made to provide a non-technical content the E-Book to reach out water stakeholders that are not digital experts. Then the E-Book would be updated to include a scientific dimension at the end of the project by adding web-links towards the scientific outcomes. D6.8 presents the final version of the E-Book.

To propose a tailored knowledge to non-expert, the dedicated content of the E-Book comes from a series of 11 interviews with partners that took place between July and October 2021. The purpose of these interviews was to promote the project's outcomes and progress through short video published on social media[1], and to grasp the latest advancement of demo networks and demo cases in a simple language, so water stakeholders can be provided with evidence based tools and methods.

The scientific focus of the E-Book has been directly prepared by the partners.

The on-line version is available on https://www.fiware4water.eu/deliverables#dissemination

[1] All the videos area available on https://www.fiware4water.eu/deliverables#videos

I. Book cover and Introduction


FIWARE 4 WATER

3 years
2019-2022

4 Demo cases
- Water Supply and Sewerage (Athens , GR)
- Water Distribution System (Cannes, FR)
- Amsterdam Wastewater Treatment (NL)
- Smart metering (Great Torrington, UK)

3 Demo networks
- Municipalities
- River basin organisations
- SMEs and innovators

Consortium
- 14 partners (experts in ITC, water and social sciences)
- coordinated by OiEau

Fiware4Water story has started in 2018, when partners from digital and water fields decided to build a project to further explore innovative digital solutions applied to water management and provide evidence based tools and methods.

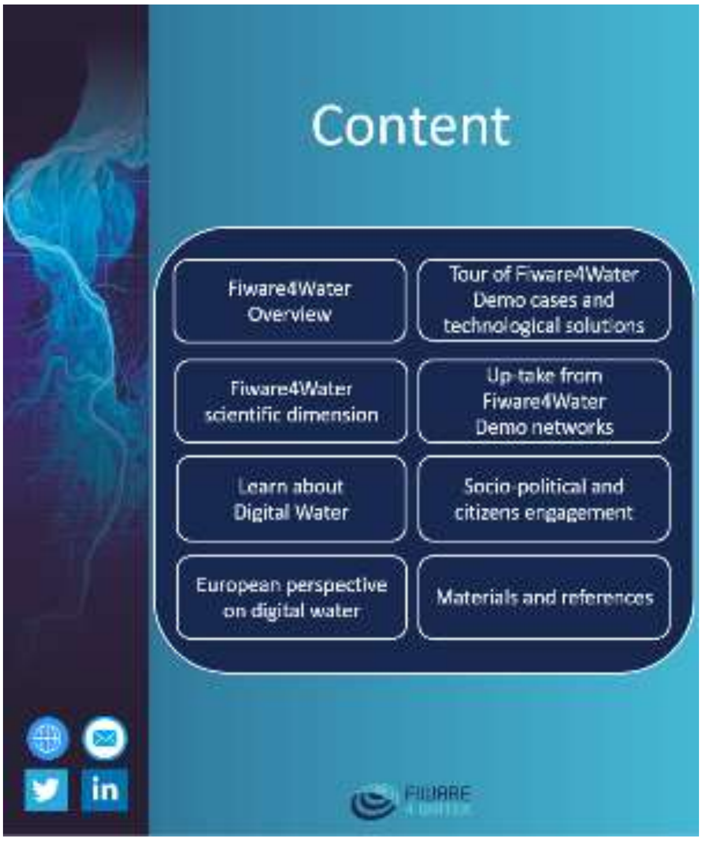
Reaching the final lane, Fiware4Water partners would like to present digital water as explored through the progress of the 4 Demo cases and 3 Demo networks. This updated version following the one named *Digital Water for non experts* provides specific scientific and technological focusses.
The project's overview, a scientific presentation and focus on digital water, the European perspective for digital water and Fiware4Water contribution to EU water related policies are still available.
In addition, partners proposes details on the technological solutions developed at the scale of the Demo cases.

Social innovation to combine technological solutions with the governance, capacity building and economic dimensions remains one key driver of Fiware4Water.

Enjoy your journey and feel free to contact Fiware4Water partners !

Natacha Amorsi
Communication and dissemination leader

II. Content

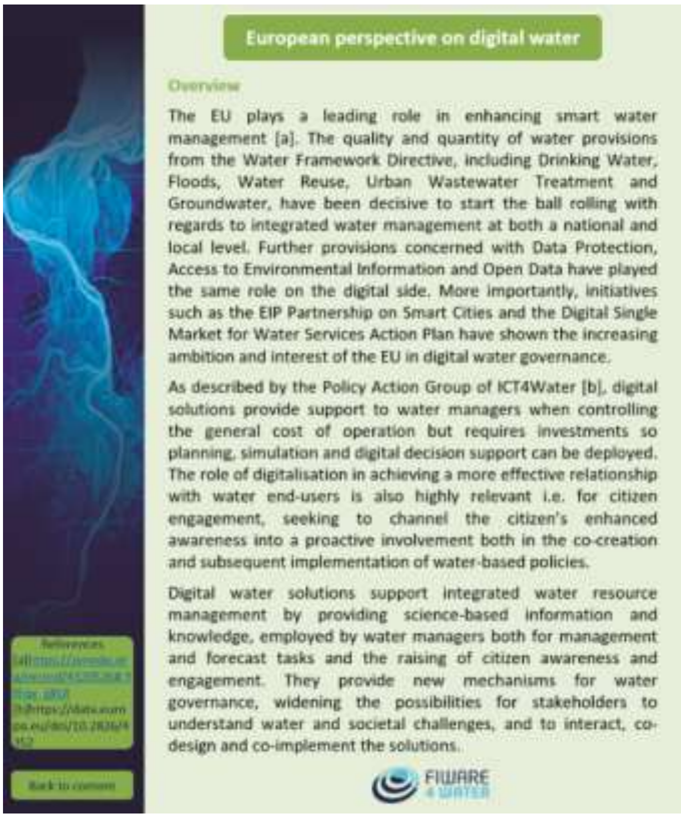


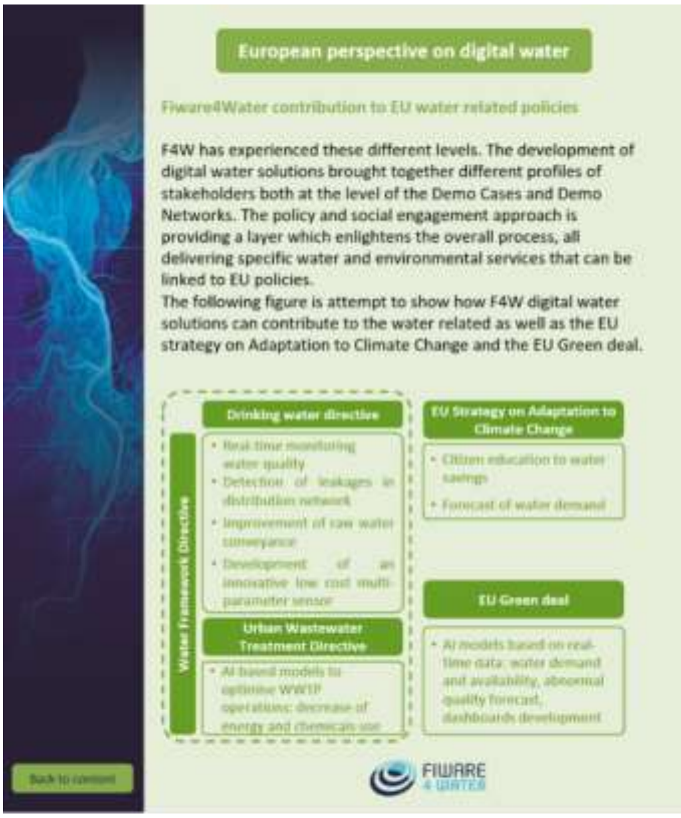
III. Fiware4Water overview

IV. Fiware4Water scientific dimension

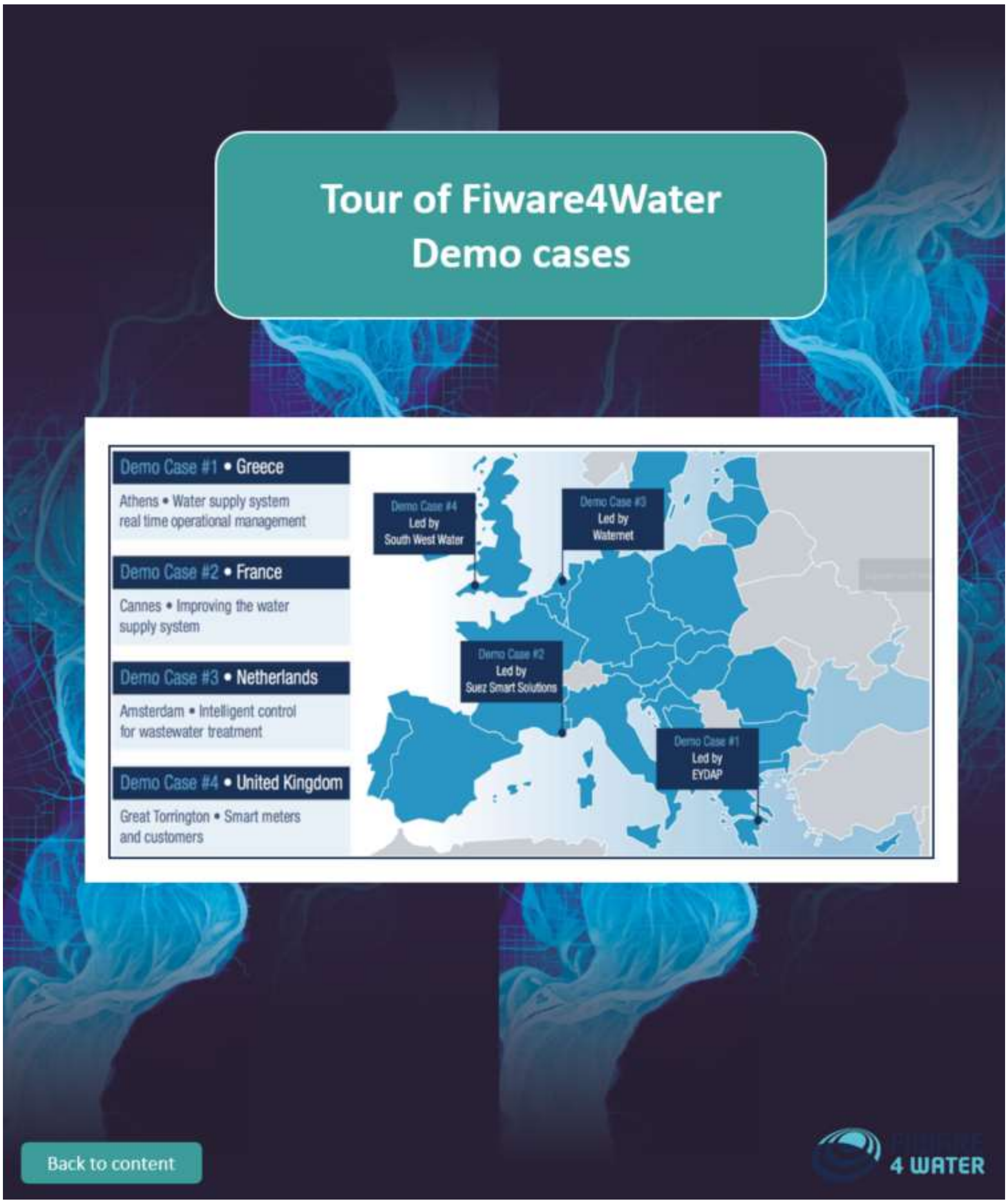
V. Learn about digital water

VI. The European perspective on digital water



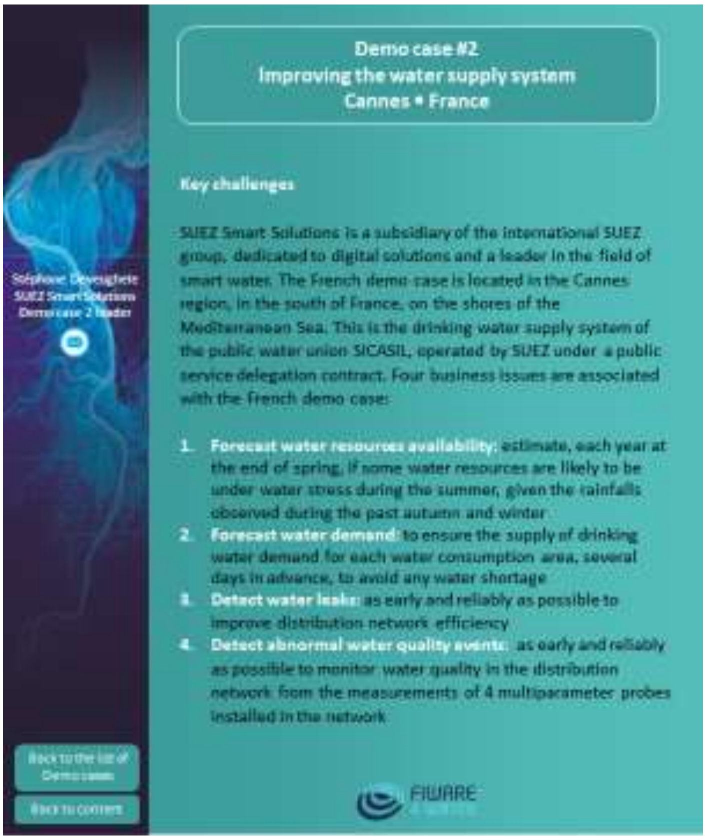


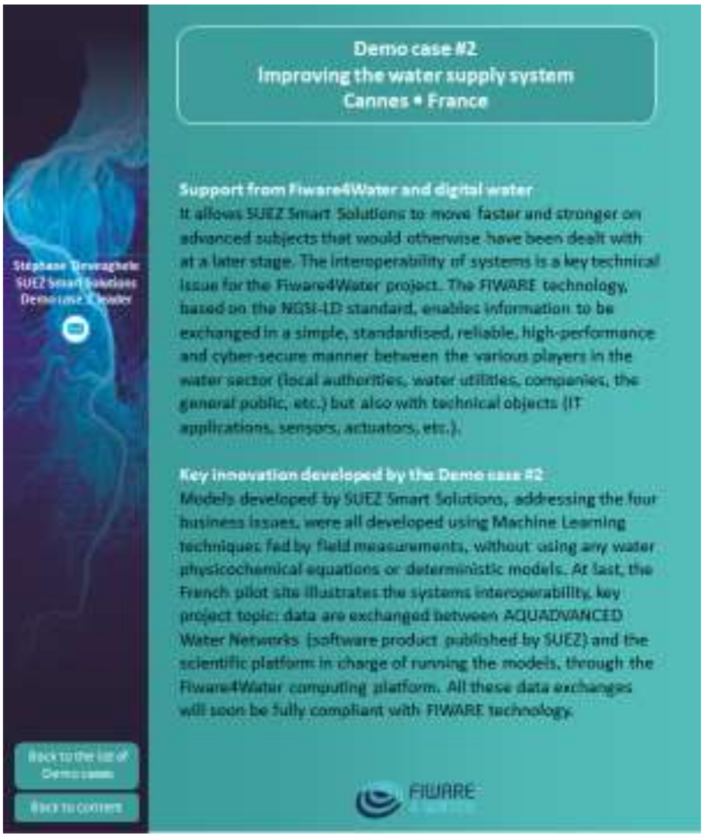
VII. Tour of Fiware4Water Demo cases



VIII. Demo case #1: Water supply system real time operational management, Athens • Greece

IX. Demo case #2: Improving the water supply system, Cannes • France

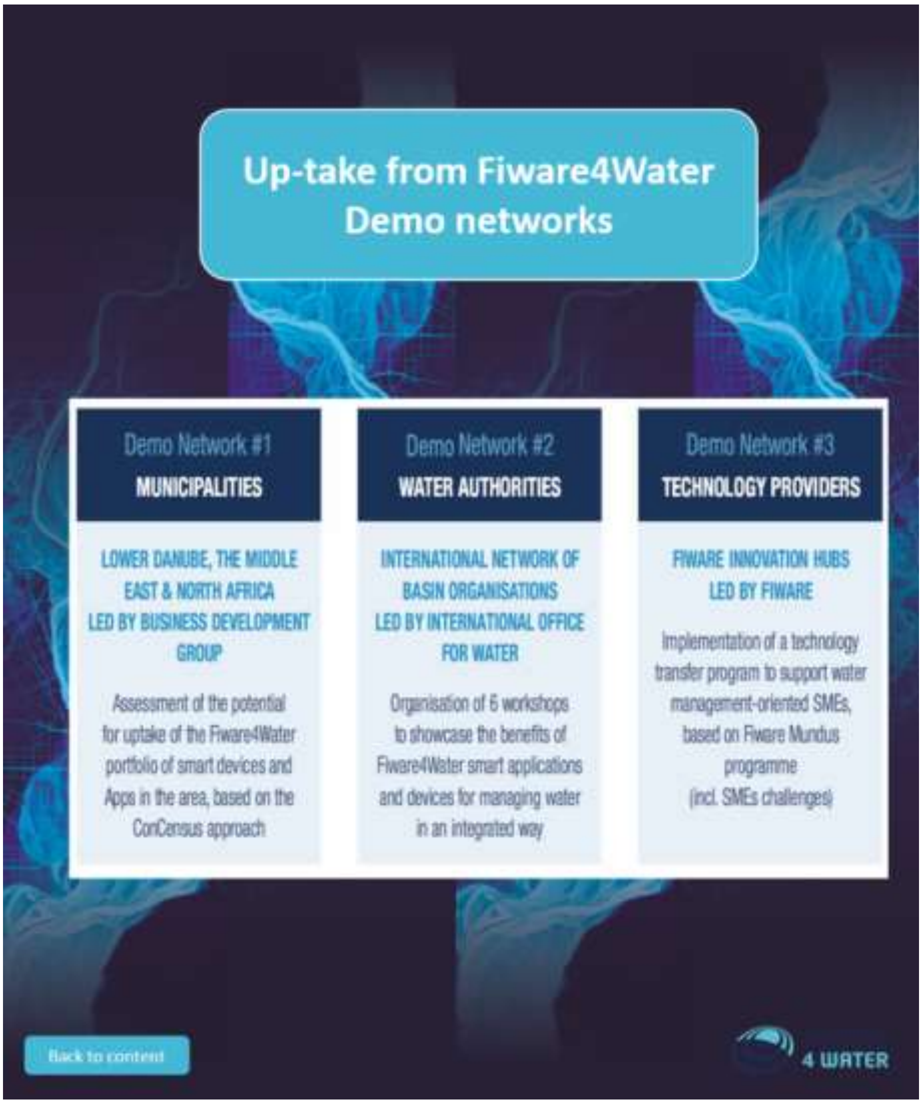




X. Demo case #3: Intelligent control for wastewater treatment, Amsterdam • Netherlands

XI. Demo case #4: Smart meters and customers, Great Torrington • United-Kingdom

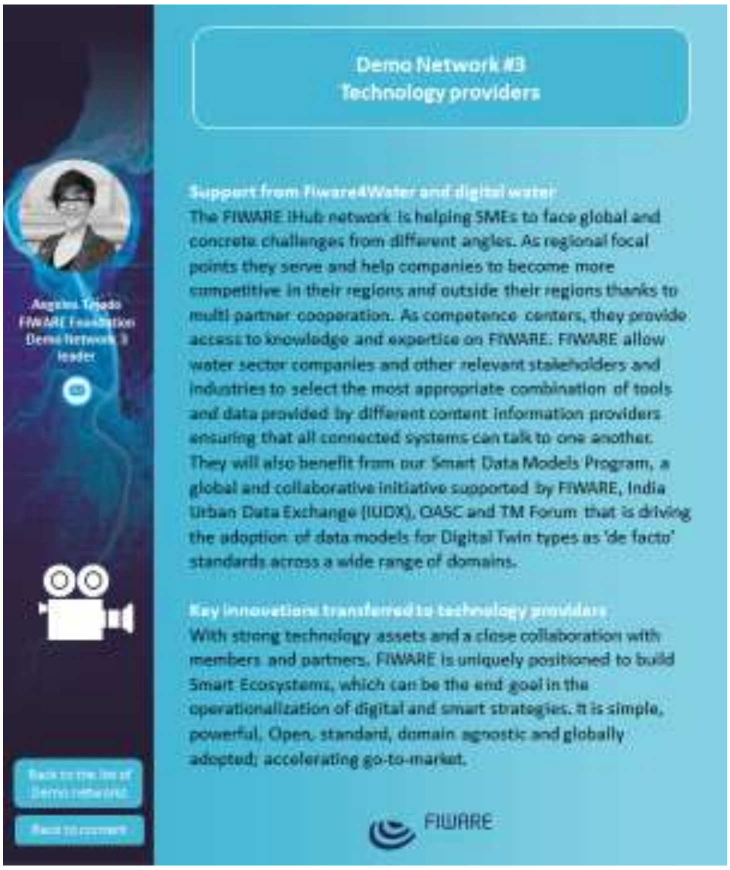
XII. Up-take from Fiware4Water Demo networks



XIII. Demo Network #1: Municipalities, Lower Danube

XIV. Demo Network #2: River Basin Organisation Network

XV. Demo Network #3: Technology providers



XVI. Socio-political and citizens engagement

XVII. Technological and scientific focus


Demo Case #1
Athens
Greece
Vasiliki Polychniatou
EYDAP
Demo case 1 leader
Christos Makropoulos
KWR
Panagiotis Kossieris
NTUA
Back to the list
scientific focus
Back to content
Water supply system real time operational management
The platform was integrated with several new applications, aiming to provide decision support on optimal sluice gates (flow regulation structures) settings, early warning for high turbidity events, forecasts on turbidity level, and estimations of water supply volumes.
The optimal operation and scheduling of the sluice gates was supported by an application following a "grey-box" approach that estimates the sluice gates openings for a target flow.
Furthermore, two deep neural network models were built to forecast the turbidity level at the two most downstream sensors of the system under study, using as predictors turbidity measurements from the most upstream sensors.
Finally, an application was developed that provides one-day ahead forecasts of the total daily water supply volumes, with focus on the annual and weekly seasonality of water outflows, during periods of exceptional demand.
Fiware4Water delivers a fully functional Fiware-enabled system architecture, which can easily be extended to cover other applications, taking advantage of the connectors developed. Similarly, third-party applications, models, tools and services can take advantage of the installed Fiware-enabled infrastructure to communicate seamlessly in a bi-directional way, following Fiware standardization protocols and not ad-hoc approaches, which lead to fragmented and isolated solutions.
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Demo Case #2
Cannes
France
Stéphane Deveughele
SUEZ Smart Solutions
Demo case 2 leader
Franck Le Gall, EGM
Benoit Orihuela, OGM
Back to the list
scientific focus
Back to content
Drinking water supply system improvement
The management of the drinking water supply system of SICASIL (Mixed Water Union of Municipalities Supplied by the Siagne and Loup Canals) which covers eight municipalities, including Cannes, is delegated to SUEZ, a private water utility. Cannes is located in the south east of France and is a touristic city known for its sunny climate, beaches and its famous Film Festival. Cannes basin has a population of 181,000 permanent inhabitants but reaches 500,000 during the peak season – making water management in this water scarce environment very challenging.
The objective of this demo case was to improve the whole system management by developing these services:
- Forecast water resources availability
- Forecast water demand
- Detect water leaks
- Detect abnormal water quality events
For these four business issues, scientific models have been developed, based on Machine Learning (ML) techniques; therefore, no water physico-chemistry equations were used. The TRL of these four models is at least 8 because they have been successfully tested on several areas of interest of the French Demo Case, but they still need to be tested on other territories to justify a TRL of 9. Nevertheless, the scientific models developed in the Fiware4Water project are of industrial quality.
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4 WATER

Demo Case #2
Cannes
France
Stéphane Deveughele
SUEZ Smart Solutions
Demo case 2 leader
Franck Le Gall, EGM
Benoit Orihuela, OGM
Back to the list scientific focus
Back to content
Drinking water supply system improvement
Multi-parameter probes (nano::stations) have been installed in the drinking water distribution network to monitor water quality and develop the abnormal water quality detection model.
The four services have been developed by integration of Big Data models where the deployment of Machine Learning models, based on the Big Data tool Spark, uses FIWARE components, Orion Context Broker and Cygnus (figure below).
Figure: Online implementation of the functional architecture
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Demo Case #2
Cannes
France
Stéphane Deveughele
SUEZ Smart Solutions
Demo case 2 leader
Franck Le Gall, EGM
Benoit Orihuela, OGM
Back to the list scientific focus
Back to content
Drinking water supply system improvement
Perspectives beyond F4W project life:
Some possible perspectives of the functional architecture implemented for the French Demo Case:
• Use of a context broker to ensure data exchanges between the numerous IT applications existing within the IT system of an operator managing a drinking water supply system: SCADA, data historian, hydraulic model, clients complaints, interventions management, GIS, etc.
• Data exchanges between a public client (municipality or water union) and its private delegate. For example, the municipality provides open data that its delegate can use; conversely, the operator sends the municipality data related to the operation of the site.
• Data exchanges between different stakeholders involved in the functioning and operation of a Smart City IT application: e.g. a municipality and its various delegates, a water utility, a street lighting operator and a parking operator.
• Data exchanges between a local agency of a water utility and the sites (i.e. the contracts) it manages. Data from the different sites are consolidated at the local agency level.
• Data exchanges between a regional agency of a water utility and the local agencies it covers. Data from the different local agencies are consolidated at the regional level.
FIWARE
4 WATER

Demo Case #3
Amsterdam
Netherlands

Alex van der Helm
Waternet
Demo case 3 leader

Intelligent control for wastewater treatment

Waternet's wastewater treatment plant (WWTP) Amsterdam West has a capacity of 1 Million population equivalent and serves the city of Amsterdam. Almost half of the Waternet climate footprint is determined by nitrous oxide emissions from the WWTPs. Nitrous oxide is a potent greenhouse gas formed during the biological nitrogen removal. Thus, minimising of nitrous oxide emissions is considered to be of key importance in reaching climate goals.

The objective of the demo case is to demonstrate the integration of the Fiware4Water architecture (F4W) using FIWARE in the legacy system with better use of real-time plant data and the use of data-driven Artificial Intelligence (AI) smart applications in practice, to achieve a more optimal plant control with respect to its nitrous oxide emissions and energy consumption.

To meet the objective, one of the seven parallel treatment lanes at WWTP Amsterdam West is made available as a full-scale research lane for the F4W project. In this research lane additional sensors are deployed and integrated, and an on-site research facility is built to gain more insight in the wastewater treatment process. Furthermore the F4W architecture is deployed and integrated in the WNT legacy system, including real-time F4W WWTP AI smart applications and F4W data models. Finally intelligent real-time AI control is implemented. The F4W AI smart applications deployed are software (soft) sensors for determining the influent flow per

Back to the list scientific focus

Back to content

FIWARE 4 WATER

Demo Case #3
Amsterdam
Netherlands

Alex van der Helm
Waternet
Demo case 3 leader

Intelligent control for wastewater treatment

lane, for prediction of the influent flow and for determining the airflow per lane. The soft sensors are virtual sensor, whose output is based on (AI) calculation of multiple observed measurements. Next to the soft sensors an AI smart application for (near) real-time data validation is deployed. The implemented AI control model has a control objective to minimize nitrous oxide emissions and energy consumption whilst meeting effluent water quality targets. From the Amsterdam demo case it can be concluded that F4W architecture can be integrated in a water utility legacy system with AI smart applications running in (near) real-time. Furthermore it is possible to use real-time AI control for optimizing nitrous oxide emissions and energy for wastewater treatment plants in practice. The methodologies, approaches, and developed technologies in the Amsterdam West WWTP demo case present a successful baseline to guide other water utilities for future digitalization processes. The demo case has also boosted the knowledge and research about the formation and reduction of nitrous oxide emissions from WWTPs. It is therefore directly contributing to the acceleration of the twin – green and digital – transition, which is seen as a necessity in order to reach the climate goals by 2030.

Back to the list scientific focus

Back to content

FIWARE 4 WATER

Demo Case #4
Great Torrington
United kingdom

Josh Pocock
SouthWestWater
Demo Case 4 leader

Smart meters and customers

South West Water (SWW) provide cleaning drinking water for 1.5 million customers across the South West of England; treating water from large impounding reservoirs and rivers and pumping this supply across a vast network to the customers tap. The stewardship of water resources has always been paramount but is increasingly challenging with Covid-19 and climate change. One of the best ways to do this is by helping customer use less water and also by reducing leakage from the network. The benefits also include lower customer water bills and reduced energy usage from treatment and pumping.

From previous studies, SWW understand that making customers more aware of their day-to-day water consumption drives positive behavioural changes and reduces overall consumption. A customer who is billed for water based on a meter will use on average 45% less than a customer who does not have a meter. However, even with a meter a customer can only view their water use over a 6-month period which if the typical meter read frequency. Smart meters provide a daily read-out present an opportunity to increase this frequency and give customers a near real time view of water use. Although prevalent in the energy utility market, smart meters are scarcely using in the water industry due to technology constraints such as battery life (no energy at source) and signal strength.

Back to the list scientific focus

Back to content

FIWARE 4 WATER

Demo Case #4
Great Torrington
United kingdom

Josh Pocock
SouthWestWater
Demo Case 4 leader

Smart meters and customers

Recognising the potential smart meters can offer, South West Water initiated a pilot and installed over 100 domestic smart meters and a sigfox mast were installed in a region called Great Torrington. Fiware enabled technology was built to collect, store, and analyse water consumption data and a number of micro-services were developed including:
A customer smart phone application allowing customers with a smart meter to view their daily usage, compare their use against others and set consumption reduction targets,
An automated leakage detection and high consumption tool which presents SWW with sensor and data driven alarms,
A machine learning tool to cluster customers into groups of similar water use behaviour to help SWW target customers with water efficiency campaigns

Back to the list scientific focus

Back to content

FIWARE 4 WATER

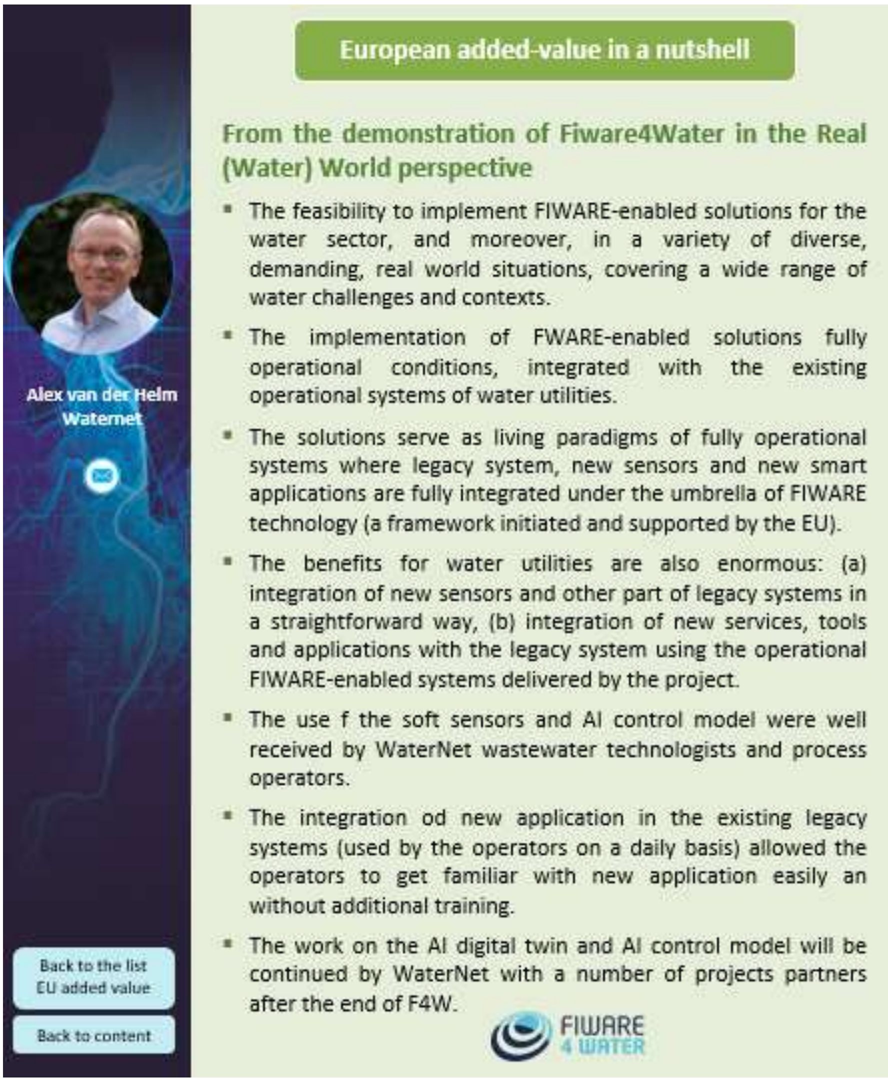
Demo Case #4
Great
Torrington
United kingdom
Smart meters and customers
The smart phone application was co-designed with the Great Torrington Water Forum which includes local residents in the area engaged with the pilot. The prototype app can be see in the figures below.
SWW expect that increased visibility of water use behaviour will help reduce water consumption, reduce overall demand on resources and treatment requirements, and help our customers reduce their annual water bill. We will also use the data to manage our water distribution system more efficiently by responding faster to events on the network (e.g. bursts, and discoloration events), predicting short term water demand, and better understanding leakage at household and area level.
Josh
SouthWestWater
Demo Case 4 leader
Back to the list
scientific focus
Back to content
FIWARE
4 WATER

XVIII. The EU added value in a nutshell

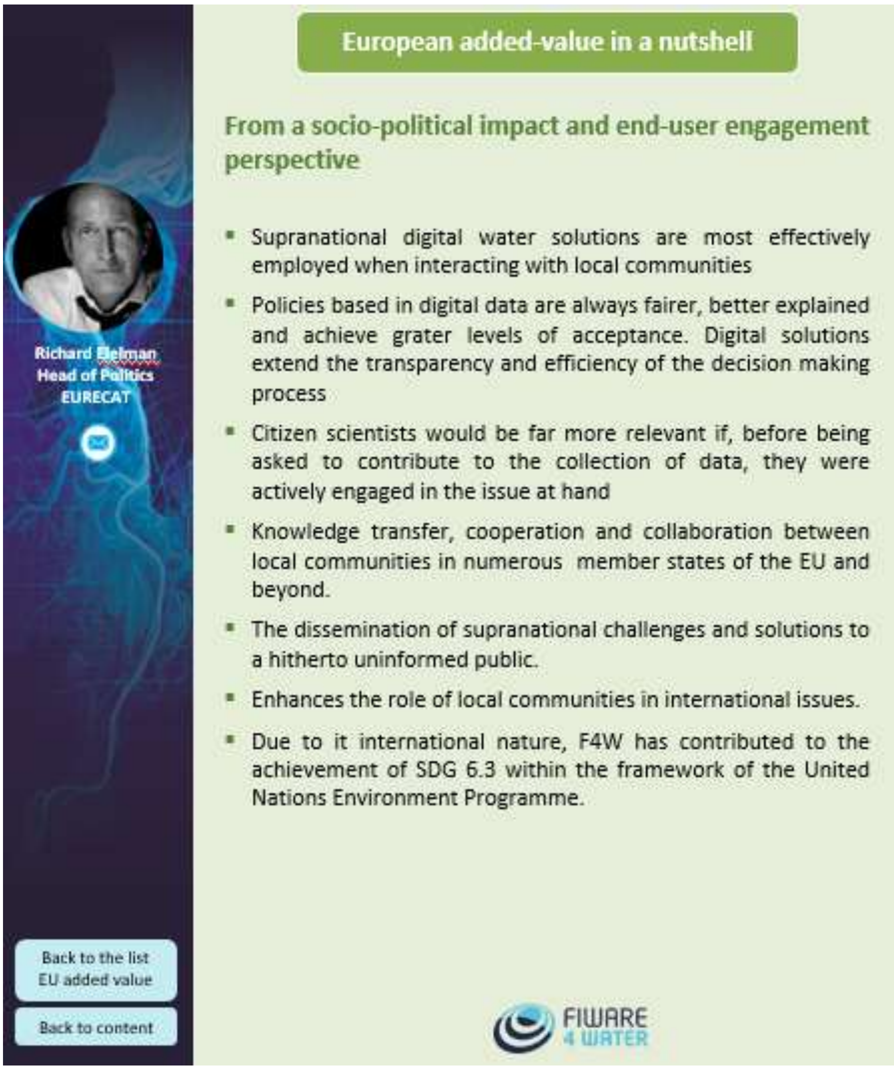
XVIII.1. From a Architecture/Data/Ontology/API/Legacy links/Standards perspective

XVIII.2. From a Smart Applications and Devices perspective

XVIII.3. From the demonstration of Fiware4Water in the Real (Water) World perspective



XVIII.4. From a socio-political impact and end-user engagement perspective



XIX. Materials & references

XX. Disclaimer

Quote

Amorsi N., Deveughele S., Echeverria L., Elelman R., Kossieris P., Makropoulos C., Nanu C., Pocock J., Polychniatou V., Siauve S., Tejado A., Vamvakeridou-Lyroudia L., van der Helm A. (2022), *Fiware4Water, technological and non-technological dimensions of Digital water*, E-Book, Deliverable No.6.8, Horizon 2020 research and innovation programme under Grant agreement No.821036, May

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Conclusion

F4W Deliverable n°6.8 is the final version of the E-Book targeting de water stakeholders as well as experts on Digital Water. Over the course of the project, it has become obvious that raising awareness on digital water still needs to be tackled. The multiple benefits of digital need to be explained in a tailored way for water stakeholders, which was the aim of the first version of the E-Book.

In this final version, the scientific and technological focus are also presented based on the latest deliveries of the partners' activities.

Added-value for the European commission

The e-book is e-document that presents the different dimensions of digital water. The different parts of the document are tailored to non-experts and experts. It goes from the raising awareness to the latest development on Digital water. The e-book explains digital water, the related issues and provides evidence based solutions for water utilities.