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European Commission

CORDIS Results Pack on

digital transition in water

A thematic collection of innovative EU-funded research results

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Digitalisation through the ICT4WATER cluster to boost innovation in the water sector

Research and Innovation

Contents

Editorial

Water is key for society and for the economy. We need to address the pressing water challenges, adapt water resource management to mitigate the effects of climate change, combat resource pollution and depletion, manage demands for water, address the water–energy nexus, and prevent degradation of ecosystems. Digital solutions can play a vital role in addressing some of these challenges.

This CORDIS Results Pack highlights 12 projects funded under the Horizon 2020 programme and showcases their innovative ICT solutions. These solutions include applying low-cost sensors, Big Data analytics, applications for consumers and novel approaches to identify leaks and reduce water loss and improve forecasting of water demand. These solutions will also allow for more efficient water monitoring, use and treatment, contribute to pollution reduction, promote resource recovery and reuse, and support climate change adaptation of water and related sectors.

The solutions achieved are in line with the priorities of the von der Leyen Commission "European Green Deal" and "A Europe Fit for the Digital Age". In particular, these projects support the digital transformation as a critical enabler for attaining the sustainability goals of the European Green Deal by contributing to the EU's climate ambition and the zero-pollution ambition, as well as mobilising industry for a clean and circular economy.

A high-tech approach

The projects included in this Result Pack are part of the ICT4WATER cluster, a hub for EU-funded research and innovation projects that demonstrate the need for the digital transformation of the water sector. At the same time, the water sector is going through transformations targeting resource efficiency and water reuse in the context of a more circular rather than linear value chain approach. These transformations bring new challenges in terms of automation and digitalisation requirements, similar to what has happened in other industries and sectors. To face these challenges, the ICT4Water cluster has developed an Action Plan that contributes to the Digital Single Market strategy. The cluster involves researchers, water utilities, local authorities and active citizens collaborating to develop and test new ideas.

EU research - innovation and application

The SWAMP project showcased Internet of Things (IoT) methods and approaches for smart water management and precision irrigation and piloted them in Spain, Italy and Brazil. Another project, SIM4NEXUS, applied model-based analysis to predict society-wide impacts of resource use and relevant policies on sectors such as agriculture, water, biodiversity and ecosystem services. INNOQUA developed a modular system using earthworms, zooplankton and microalgae to treat wastewater in both urban and rural environments.

SMART-Plant explored how technologies for recovering valuable materials from wastewater can be applied to existing sewage treatment plants to form marketable products. Meanwhile, the WADI project developed cost-effective aerial surveillance systems to rapidly find leaks and minimise loss. INTCATCH built 'smart' boats equipped with multi-parameter sensors to monitor water pollution.

The Ground Truth 2.0 project co-designed and implemented citizen observatories that help local stakeholders achieve sustainable natural resource management through the collection of data by citizens. POWER investigated new ways of raising awareness and transferring knowledge among citizens to enable effective exchange between stakeholders. Then we have INCOVER, which developed innovative and sustainable technologies for resource recovery-based treatment of wastewater.

INTEGROIL created a smart platform for producing fit-for-purpose water that will reduce the oil and gas industries' water demand. AquaNES demonstrated innovative water and wastewater treatment processes and management based on improved, combined natural and engineered systems. Finally, CENTAUR developed a new approach to the real-time control of sewer networks to reduce local flood risk in urban areas.

Flexible IoT platform supports open innovation in farmland irrigation

Agriculture is the biggest consumer of fresh water. Add to this the energy needed to irrigate crops and the environmental impact becomes evident. An EU-Brazil research team is piloting systems that gauge irrigation needs and prevent unnecessary loss of water.

Spanning work in Bahia and Sao Paulo (Brazil) and in Spain and Italy, the SWAMP project is piloting Internet of Things (IoT)-based precision irrigation systems. Introducing the project, coordinator Juha-Pekka Soininen notes: "The main objective is to save water and energy and to maximise the yield and quality of the crop. Saving water is the first priority, as climate change is drastically limiting the availability of water."

Project work and key innovations have resulted in an open and flexible platform for smart water management for irrigation. Specifically, SWAMP targets the creation of very accurate situational awareness related to soil and crop status. Multiple sources are used to gather the information needed, some of which represent key project innovations: water need estimators, and autonomous drone and image-processing systems.

Meeting different needs

Another major SWAMP development is the integration of farm-level water-need data with open canal water distribution network management. The processes are fuelled by water flow simulations and machine-learning algorithms. A soil moisture forecast is created on the basis of the collected data, which in turn is used to create an irrigation plan for the different areas in the field.

© Kari Kalehmainen

This leads to yet another key innovation: SWAMP's IoT-based, automated high-granularity precision irrigation system – i.e. irrigation as and when it should be implemented. "In one pilot we have instrumented sprinkler valves and pumps so that irrigation can be done automatically by the SWAMP system," Soininen reports, adding: "Farmers have mobile applications for visualisation of field status, and for adjusting the proposed irrigation plans."

The pilots are being used as a starting point for developing systems that meet the different needs of specific areas. Soininen offers the Italian pilot as an example. This is centred on an open canal-based water distribution network optimised according to measured water needs of the crops of farms situated along canals. The farms provide accurate data for canal operators, for optimal management of the network. "In an optimal case, all the farms should irrigate at the same time, so that the time the canal is full is minimal," he explains.

Overcoming challenges

Several available technologies were less mature than expected. SWAMP had to implement its own soil moisture probes, for example, as the commercial offering did not meet the requirements. Nevertheless, Soininen says that "after 2 years of the 3-year project, we know that the goal is achievable."

SWAMP impacts are global. The use of IoT and systems supporting open innovations will be key in making changes in this domain as well.

The IoT platform is based on FIWARE and is aimed at providing flexibility so it can be adapted to all pilots. The main challenges have to do with cost-sensitivity, heterogeneity and scale of farming. Additional technical and infrastructure considerations as well as the cyclical processes inherent in farming have focused partners' efforts on developing a solution baseline that could meet the demands of farming with mass production.

Project work is helping to reduce the waste of water and energy consumption. "SWAMP impacts are global," Soininen enthuses. "The use of IoT and systems supporting open innovations will be key in making changes in this domain as well," he concludes.

PROJECT
SWAMP - Smart Water Management Platform

COORDINATED BY
VTT Technical Research Centre of Finland, Finland

FUNDED UNDER
H2020

CORDIS FACTSHEET
cordis.europa.eu/project/id/777112

PROJECT WEBSITE
swamp-project.org/

Multi-sector natural resource management – the nexus concept and serious games

An EU team is taking a unique approach to the study of the interlinkages among water, energy, food, land and climate. Through case studies and the use of serious gaming, the initiative is driving change in the way we understand and manage natural resources.

Introducing the SIM4NEXUS project, coordinator Floor Brouwer says: "The nexus concept aims to develop a holistic and comprehensive understanding of how the use of natural resources interact, within the context of a changing climate." Alongside the multi-resource approach, the concept allows consideration of the sustainable management of natural resources as well as policy coherence.

The overall goal is succinctly stated in the full project title: Sustainable Integrated Management for the nexus of water-land-food-energy-climate for a resource-efficient Europe. These resources are closely connected, meaning actions in one area impact all the others. In addressing this, SIM4NEXUS also takes into account the possible impact on these elements in response to climate and relevant policy changes.

A two-pronged approach involving case studies and serious gaming will elucidate and help address barriers to a resource-efficient and low-carbon Europe. Designed to deliver something beyond pure entertainment, serious games help to connect ideas from different domains. The team has established gaming as a means for understanding policies, resulting in acceptance, mitigating conflicts and avenues for compromise. This marks an apparent first: "To the best of our knowledge, never before has a serious game been developed for the nexus and based on such an extensive list of scientifically sound models, data and methodologies," Brouwer states.

The nexus concept aims to develop a holistic and comprehensive understanding of how the use of natural resources interact, within the context of a changing climate.

Game-based understanding and training

Used to connect ideas from different domains, serious games offer the opportunity to debate and compare alternative solutions with a view to co-creating shared solutions. These games should enable stakeholders to understand and learn about the medium- and long-term implications of nexus-related policies.

The serious games are being developed to explore a long-term (30-50 years) integrated approach to business and policy planning. At the same time, this aspect of project work also addresses the need to train practitioners and students to address societal challenges with complex features. They can be used as a training tool for local educators, to consider resilience, environmental protection and low-carbon development. SIM4NEXUS games are being tested in 12 case studies, involving practitioners from policy, business, civil society and research.

Nexus-wide policy goals

SIM4NEXUS is testing how a nexus approach might contribute to successful policy implementation, which should engender greater nexus-awareness across the whole policy cycle. Policy goals across all related sectors are focused on transparency regarding implementation and the means of achieving them, as well as maximising synergies and managing conflicts. Additionally, coherent policy processes should ensure equal respect for the different interests of all the sectors.

Just as important, science-based decisions will take into account the relations between the sectors in this nexus. The coordinator effectively sums it up when outlining what he expects the project's most significant achievement will be: "The scientific understanding of the water-land-food-energy-climate nexus is improved, and applicable at a range of scales (regional, national, transboundary, European and global)."

The goal of bringing together all sectors understandably renders this a data-intensive project. Commenting on this, Brouwer says: "SIM4NEXUS does support targeted sharing of multi-sector data, with the objective to create synergies with knowledge and improve decision-making in the private and public sectors." Partners are also developing training activities for exploitation of provided data and knowledge regarding the nexus in specific cases.

PROJECT
SIM4NEXUS - Sustainable Integrated Management FOR the NEXUS of water-land-food-energy-climate for a resource-efficient Europe

COORDINATED BY
Wageningen University & Research, Netherlands

FUNDED UNDER
H2020

CORDIS FACTSHEET
cordis.europa.eu/project/id/689150

PROJECT WEBSITE
sim4nexus.eu/

Recruiting microorganisms in wastewater treatments

More than 1 billion people across the globe do not have access to clean water, while over 2 billion people do not have access to adequate sanitation. A European initiative comes to address this through a modular sanitation system that employs microorganisms.

© Scottish Water

In the EU, 75-90 % of the population is connected to sewerage and treatment systems. Despite the EU Water Framework Directive, there are still approximately 20 million rural inhabitants who lack proper sanitation systems.

A modular purification system

The INNOQUA project developed a modular system that harnesses the potential of earthworms, zooplankton and microalgae to treat wastewater in both urban and rural environments. The system combines four technologies, namely lumbrifiltration, daphniafiltration, bio-solar purification and UV irradiation. “Natural purification systems have been used for years to improve the quality of wastewater before discharge or reuse,” explains Germain Adell, project coordinator and Deputy Manager of coordinating RTO, NOBATEK/INEF4.

The lumbrifilter consists of a layer of woodchip that contains earthworms and bacteria which digest organic matter, preventing waste production. The daphniafilter is based on the action of Daphnia species to reduce suspended solids and pathogen bacteria, while the bio-solar purification unit uses sunlight and CO_2 in specific bioreactors to degrade organic waste and effectively destroy faecal contaminants. Alternatively, to allow the reuse of treated water for irrigation, the INNOQUA wastewater purification system can use UV irradiation to destroy the pathogens.

INNOQUA advantages

Since INNOQUA relies on the purification capacity of biological organisms, it hardly emits any CO_2, bringing ecological, safe and affordable sanitation capacity to different environmental conditions. The lumbrifilter module doesn’t produce any sludge and, compared to traditional systems,

Natural purification systems have been used for years to improve the quality of wastewater before discharge or reuse.

it requires very low levels of maintenance and energy consumption, thus reducing the environmental impact of INNOQUA.

Importantly, the modular configuration of the system addresses the water treatment needs of areas that lack centralised facilities for wastewater collection and treatment. INNOQUA can be scaled up and its configuration can be adapted to local contexts and markets.

Furthermore, the system can be implemented in decentralised facilities, water-stressed communities or developing countries to reduce pressure on ageing wastewater networks while supporting sustainable population growth by reducing water and energy consumption. "Considering the economic constraints that such rural areas or developing countries face, it is of paramount importance for the wastewater treatment system to be affordable with minimum implementation costs," emphasises Adell.

System implementation and performance

Following development and testing of lab-scale units, project partners have generated two prototypes in Spain and in Ireland, where all four technologies have been combined to treat wastewater in test beds under controlled conditions. During the demonstration phase, the INNOQUA system has been installed in 11 sites across 10 countries in real conditions. Testing in a wide range of climates, wastewater types and pressure has so far produced excellent performance results.

According to Adell, "INNOQUA can provide a serious alternative to existing sanitation solutions for different contexts." Apart from the EU, prototype pilots are running in Africa, Asia and Latin America, with governments and various water actors already expressing great interest. The next steps are to finish the industrial scale-up of the system and proceed with a clear business strategy for product commercialisation. A series of videos will help communicate the INNOQUA system worldwide and impact the lives of thousands of people.

PROJECT
INNOQUA – Innovative Ecological on-site Sanitation System for Water and Resource Savings

COORDINATED BY
NOBATEK/INEF4, France

FUNDED UNDER
H2020

CORDIS FACTSHEET
cordis.europa.eu/project/id/689817

PROJECT WEBSITE
innoqua-project.eu/

Closing the loop: Wastewater treatment becomes more sustainable and nearly carbon neutral

Resource recovery during wastewater treatment is becoming more critical than ever. Thanks to new technologies, this is now a brilliant reality.

SMART-Plant believes that water utilities can become the engines of the circular economy if operators replace hesitance and scepticism with an overall positive attitude towards eco-innovative solutions for resource recovery.

Wastewater treatment plants are one of the most expensive industries in terms of energy requirements – large energy amounts are spent on treating wastewater for reuse or disposal into the environment. According to the International Energy Agency, global electricity consumption for wastewater collection and treatment will require over 60 % more electricity in 2040 than in 2014, as the amount of wastewater in need of treatment increases.

Waste in, resources out

Viewing wastewater treatment plants not merely as waste disposal but rather as resource recovery facilities is important. This means that they have the potential to produce clean water, recover nutrients and safe materials, and reduce reliance on fossil fuels through energy-efficient processes and renewable energy production.

Pan-European wastewater treatment innovators came together through the EU-funded SMART-Plant project to explore how technologies that recover valuable materials from wastewater to produce marketable products can be retrofitted into existing sewage treatment plants. What's more, the project developed new systems for monitoring the energy use and carbon footprint of wastewater treatment.

Smart material recovery technologies

"SMART-Plant developed innovative eco-friendly solutions that provide evidence of how utilities can convert their wastewater treatment sites to become resource recovery facilities, reduce their energy and carbon footprint and digitalise their operations," notes project coordinator Francesco Fatone. The project demonstrated different technologies (SMARTechs) in seven pilot plants.

In the Netherlands, project partners developed a process to separate the cellulose from the incoming sewage water and turn it into clean cellulose fibres. In Israel, partners demonstrated a patented anaerobic biofilter that transforms wastewater into renewable energy (biogas). Spanish partners demonstrated a process called SCEPPHAR to treat wastewater while simultaneously recovering products (up to 50 % of phosphorus and sludge enriched with PHAs, the most promising biopolymers as substitutes for oil-based plastics). The UK pilot demonstrated an ion exchange process to recover ammonia and phosphorus from secondary wastewater, for possible reuse in chemical and fertiliser industries.

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In Italy, the sidestream SCENA and SCEPPHAR treat sludge liquor, highly loaded with nitrogen and phosphorus nutrients, to remove up to 85 % of nitrogen, recover phosphorus as struvite and produce a sludge enriched with PHA, while decreasing the energy costs up to 20 %. In Greece, thermal hydrolysis coupled with SCENA is developed to treat sludge reject water with high ammonia content.

The resources extracted by the SMARTechs (cellulose, nutrients and PHAs) are then formed into products by two 'Downstream SMARTechs'. The first technology uses cellulosic and PHA materials to make biocomposite plastic that can be used in the construction industry or for consumer goods. The second one consists of dynamic composting to produce commercial fertiliser or biofuel out of cellulosic and phosphorous-rich sludge.

Clearing the hurdles to circular wastewater treatment

The water industry plays an important role in the emerging circular economy that helps keep resources in use for as long as possible. "SMART-Plant believes that water utilities can become the engines of the circular economy if operators replace hesitance and scepticism with an overall positive attitude towards eco-innovative solutions for resource recovery," explains Fatone. To achieve this, project partners engaged local water utility staff in the large-scale pilot installations, providing training sessions and manuals. "This helped operators perceive how resource recovery systems can gradually change the wastewater management paradigm without disrupting existing assets and workload," notes Fatone.

SMART-Plant's wide range of technologies reveals that wastewater should not be treated as waste, but rather as a resource.

PROJECT
SMART-Plant - Scale-up of low-carbon footprint material recovery techniques in existing wastewater treatment plants

COORDINATED BY
Marche Polytechnic University, Italy

FUNDED UNDER
H2020

CORDIS FACTSHEET
cordis.europa.eu/project/id/690323

PROJECT WEBSITE
smart-plant.eu/

Drones can support massive reductions in lost drinking water

Billions of cubic metres of drinking water leak out of transmission systems every year and are lost before reaching the consumer. EU-funded technology could cut that volume in half in a timely and effective response to increasing water scarcity.

© Air Marine

Nearly one fifth of the world's population already lives in areas of physical water scarcity at a time when global climate change is making water availability less and less predictable. Almost 800 million people worldwide currently lack access to safe drinking water.

Better water resource management is required. Non-revenue water (NRW), water that is produced in a network but never reaches the consumer, is a surprisingly simple and effective target. Globally, nearly 32 billion cubic metres of water is lost each year. This water has already been processed and treated, incurring financial and energy costs.

The EU-funded WADI project has developed cost-effective aerial surveillance systems to find leaks quickly and minimise loss. The technology promises an impressive 50 % reduction in NRW, with important environmental, societal and economic benefits.

An eagle eye for water

Drinking water travels long distances in large transmission mains from treatment facilities to storage tanks. Distribution mains, typically smaller in diameter, carry the water under city streets and into homes. "Leaks on large-diameter pipelines can account for more than 50 % of the total water lost from leaks. They are difficult to locate with traditional terrestrial,

WADI developed a new method to detect damage in water pipes using small planes and drones that identify the leaks by evaluating the change in surface moisture from above. This methodology is especially useful in large rural and inaccessible or dangerous places where current detecting methods fail.

acoustic-based technologies and they are costly to detect, locate and repair. In fact, utilities often simply exclude transmission mains from leak detection programmes for these reasons," according to project coordinator Elena Gaboardi, project manager Christian Chatelard and scientific coordinator Jean-Claude Krapez.

Fortunately, water leaks affect the local environment in ways that can be detected with remote sensors. According to Krapez, leaks increase the soil moisture content and/or the water content in plants and vegetation. This causes changes in light reflectance at optical wavelengths and infrared emission due to changes in temperature, largely related to evaporation (from soil) or transpiration (in plants).

"WADI developed a new method to detect damage in water pipes using small planes and drones that identify the leaks by evaluating the change in surface moisture from above. This methodology is especially useful in large rural and inaccessible or dangerous places where current detecting methods fail," Chatelard explains.

Innovation takes flight

WADI scientists worked closely with end-users to tailor technologies to meet market needs. Combining thermal infrared sensors with visible and near-infrared data from multispectral cameras significantly increases water detection accuracy. The systems were tested in two operational environments. Preliminary tests show the technology is competitive with satellite-based systems in terms of both cost and performance, whereas it is superior to conventional ground-based leakage detection systems.

In Europe, around 23 % of clean drinking water is lost due to leakage from water pipes. Implementation of WADI technology could reduce that by 50 %. The technology also turned out to be very good at detecting underground water in general and could be used to locate water in arid regions. Overall, WADI outcomes are poised to reduce the effects of water scarcity and increase access to drinking water, mitigating one of the top five risks predicted to have the biggest impact in the very near future.

PROJECT
WADI - Innovative Airborne Water Leak Detection Surveillance Service

COORDINATED BY
AIMPLAS - Technological Institute of Plastics in Spain

FUNDED UNDER
H2020

CORDIS FACTSHEET
cordis.europa.eu/project/id/689239

PROJECT WEBSITE
waditech.eu/

User-friendly boats seek out water pollutants in European rivers and lakes

An EU-funded project developed 'smart' boats to measure and track pollutants in European lakes and rivers.

Water quality is a crucial indicator of the health of river ecosystems, yet a large number of European bodies of water do not meet a 'good ecological status'. Despite billions spent on testing water quality, current monitoring approaches lack spatial and temporal resolution, which means pollution is not being sufficiently detected and fixed.

INTCATCH's high-tech approach takes floating 'smart labs' out to rivers and lakes to test water quality, making it easier to trace causes of pollution.

Reliable, real-time water quality data from sensors serves as an evidence base to enable effective tackling of pollution on a catchment-wide basis. The EU-funded INTCATCH project exploited advances in monitoring technology to develop cost-effective, user-friendly, automated 'smart' boats equipped with multi-parameter sensors. The technology is not built from scratch; rather, it uses commercially available boats with low-cost sensors.

Dealing with water in a smart way

Conventional water quality monitoring strategies usually involve an officer going to site and sending a sample to a lab, with test results becoming available two or three weeks later. This approach can help map local pollution but has limited impact in improving water quality across a larger area.

© Tymos Lytras

"INTCATCH's high-tech approach takes floating 'smart labs' out to rivers and lakes to test water quality, making it easier to monitor and trace pollution," notes project coordinator Mark Scrimshaw. "Rather than relying on experts, ordinary citizens will be able to use the boats to collect evidence themselves and find out just how healthy their local river is," adds Scrimshaw.

The autonomous boats controlled by a handheld radio device provide better access and coverage of water bodies. Innovative sensors enable mobile, real-time water quality monitoring and mapping – for example, they detect *Escherichia coli* and pesticides. Next-generation DNA test kits provide fast and accurate analysis of the genome of the bacteria in the water. All the evidence collected is then transferred to the cloud and can be processed by decision-support software to help communities and authorities make decisions about how to best help the river.

Catching up with INTCATCH technology

Demonstration activities focused on analysing the health and quality of the strategic water reservoir Lake Yliki in Greece, surface waters in Berlin, urban rivers in London, and the river TER in Spain.

Algal blooms, suspended solids and turbidity in Lake Yliki are just some of the challenges that need to be addressed. The high urban runoff carrying pollutants such as oil, dirt and chemicals directly to the urban rivers seriously harms water quality. Increased conductivity caused by surface mining activities adversely affects water quality in the river Ter.

Other potential sources of pollution that affect catchments are wastewater from kitchen sinks and washing machines or even from industrial drainage erroneously connected to the surface water drain. These pollutants cause high concentrations of ammonia, phosphate and nitrate to build up in the rivers.

The data generated on water quality will be stored in an online database that can be accessed by anyone using a web or mobile interface. People will also be able to query the database to improve their knowledge about the aquatic ecosystems in their vicinity. This knowledge base will prove invaluable to stakeholders in effective water management.

PROJECT
INTCATCH – Development and application of Novel, Integrated Tools for monitoring and managing Catchments

COORDINATED BY
Brunel University, United Kingdom

FUNDED UNDER
H2020

CORDIS FACTSHEET
cordis.europa.eu/project/id/689341

PROJECT WEBSITE
intcatch.eu/

Co-designing citizen participation in environmental monitoring

An EU-funded multi-actor consortium is co-designing citizen observatories for sustainability. Enhancing the flow of information in this way will facilitate improved management of land and natural resources.

The overall objectives of Ground Truth 2.0 are to co-design and implement citizen observatories that are helpful for (local) stakeholders in achieving sustainable natural esource management, noted project coordinator Uta Wehn. Citizen data is collected through mobile apps and social media analytics, giving citizens the opportunity to contribute important information and play a part in environmental monitoring.

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From Europe to Africa

Specifically, efforts of the project's 14-strong multi-actor consortium have resulted in citizen observatories in Europe and Africa. The initiative demonstrates that such observatories are technologically feasible, can be implemented sustainably and that they have many societal and economic benefits.

Via carefully designed citizen observatories, citizens – and not just scientists and professionals – can take on new roles in knowledge creation, environmental decision-making and cooperative planning.

The Belgian citizen observatory, Meet Mee Mechelen, focuses on improving dialogue between citizens and decision-makers through a platform enabling information sharing related to air quality and noise in Flanders' heavily urbanised living environment. KlimaatRobuust St-Andries in Antwerp is being developed to provide a physical and online meeting place for citizens, scientists and policymakers to gather and share knowledge on heat stress. In Spain, through the citizen observatory RitmeNatura.cat, data collected by citizens on related phenomena will be used to create collective knowledge on local impacts of climate change and to improve local policies and practices.

Kenya's Maasai Mara Citizen Observatory is aimed at balancing the conservation of biodiversity as well as sustainable livelihoods by getting all stakeholders to work together. The Niti Luli citizen observatory in Zambia will comprise a platform supporting existing initiatives and a community-based approach to the management of natural resources, giving communities more influence in decisions affecting their lives and livelihoods.

High-tech Resource Management

Climate change has been linked to excessive local rainfall in the Netherlands, causing severe floods. The Grip Op Water Altena citizen observatory is therefore aimed at data and knowledge sharing to create action perspectives. The resulting platform includes a website with information on pluvial flooding (including historical events), information on projects from the municipality and the water board, measures that citizens can take, online questionnaires and observations. "Information that was previously only available for experts is now available to the wider public. In the case of a future flooding event, an infrastructure for communication is now available," states Wehn.

Sweden's citizen observatory, VattenFokus, is focused on water quality management in socio-ecological systems. Covering the region of Södermanland, the platform targets stakeholder collaboration through data collection and access as well as knowledge exchange to complement formal governance of the area's aquatic ecosystems. Wehn explains: "The FreshWater Watch application by EarthWatch allows citizens to measure and record the quality of water bodies and has been successfully adapted and tailored to user requirements." It integrates a field kit to conduct measurements, with a web and a mobile application to record and submit data, including geolocation, environmental parameters and a picture of the site.

Outreach and engagement

Project partners are raising awareness about ongoing work and developments taking place at the citizen observatories. Ground Truth Week 2019 hosted webinars, local events and workshops. The 5-day event spanned developments in Africa and Europe and provided occasion for the launch of videos capturing local celebrations from several citizen observatories.

Ground Truth 2.0 has collaborated with other EU-funded projects to produce the policy brief 'Citizen Observatories – A voice for citizens in environmental monitoring'. When sums up the project's immediate benefits: "Via carefully designed citizen observatories, citizens – and not just scientists and professionals – can take on new roles in knowledge creation, environmental decisionmaking and cooperative planning."

PROJECT
Ground Truth 2.0 Environmental knowledge discovery of human sensed data

COORDINATED BY
IHE Delft Institute for Water Education, Netherlands

FUNDED UNDER
H2020

CORDIS FACTSHEET
cordis.europa.eu/project/id/689744

PROJECT WEBSITE
gt20.eu/

Water-savvy knowledge is POWER – for citizens, communities and policymakers

EU-funded researchers are working to empower citizens and policymakers on water-saving and flood preparedness actions.

Citizens are not commonly aware of important issues regarding one of our planet's prime natural resources: water. Often, the topic of urban water sustainability comes to their attention only when related events impact their lives or livelihood. The POWER project is taking a proactive approach to increase knowledge on the subject.

Project coordinator Ljiljana Marjanovic-Halburd, professor of Building Energy and Information and Head of School of Engineering and Sustainable Development at De Montfort University in Leicester, underlines the need to engage people in learning about such actions. However, this requires incentives and strong powers of persuasion. "POWER as a user-driven project," she reports, "has been investigating new methods to raise awareness and transfer knowledge among citizens and to enable effective exchange between politicians, local administrations, water professionals and citizens on water-related sustainability issues."

The project's vision is driven by a participatory approach, exemplified in an inspiring POWER overview video. Supporting this is a novel 'Digital Social Platform' (DSP), or 'Water Community Platform'. "This facilitates the exchange of citizen and expert knowledge and the dialogue between varieties of stakeholders," the coordinator states.

Resilient communities

Project efforts have led to the DSP's successful implementation in four pilot cities: Leicester and Milton Keynes (United Kingdom), Sabadell (Spain) and Jerusalem (Israel). Each DSP offers location-based and timely information on related topics such as local flood-risk assessment maps or real-time river levels. "The platforms provide the nucleus to build strong and resilient local communities around the water issues at hand in each city," Marjanovic-Halburd relays.

Various platform mechanisms support such online engagement in an innovative and empirically validated gamification approach. Activities are supported at different levels, from simply reading up to co-creating solution approaches. This enables more informed, inclusive and effective participation.

Additionally, the POWER Best Practice Repository makes available expertise and experience on solution approaches that have been successfully implemented in over 70 cities worldwide. The POWER platform has been released in full as open-source software through GitHUB. This makes it possible for any city or water utility to download and set up their own local Water Community Platform.

The most significant achievement of the project lies not in one single tool but in providing cities with a comprehensive framework to strengthen citizen engagement in urban sustainability challenges.

Beyond the digital world

POWER is also engaging citizens offline. This is taking form in "measures for cities to connect digital interaction with knowledge exchange and impact in the real world," notes the professor. A prime example is the POWER Idea Contest for Sustainable

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Communities. The Idea Contest attracted 140 submissions, from which 10 winners were chosen and announced at the final project conference in October 2019.

Another example is the local Councils for Citizen engagement in Sustainable Urban Strategies (ConCensus). More on ConCensus is available in a scholarly article published in the journal 'Futures'.

Sustaining momentum

"The most significant achievement of the project lies not in one single tool but in providing cities with a comprehensive framework to strengthen citizen engagement in urban sustainability challenges," Marjanovic-Halburd sums up.

Concrete indications of this success include an array of future planned initiatives beyond POWER's original scope. The city council of Jerusalem has decided to widen the positive experience with its local ConCensus and establish a bigger, regional entity: the Middle East Regional Water Forum. Recognising the benefits offered by such an online community, the city of Hanau in Germany will also leverage the platform's potential in efforts to mitigate the health-related impacts of climate change.

PROJECT
POWER – Political and sOcial awareness on Water EnviRonmental challenges

COORDINATED BY
De Montfort University, United Kingdom

FUNDED UNDER
H2020

CORDIS FACTSHEET
cordis.europa.eu/project/id/687809

PROJECT WEBSITE
power-h2020.eu/

Innovative technologies take the 'waste' out of wastewater

EU-funded researchers have created a circular wastewater economy with cost-effective and environmentally friendly technologies and processes that turn wastewater into bioenergy and high-value bio-products.

INCOVER transforms wastewater into valuable products in a 'circular economy' approach.

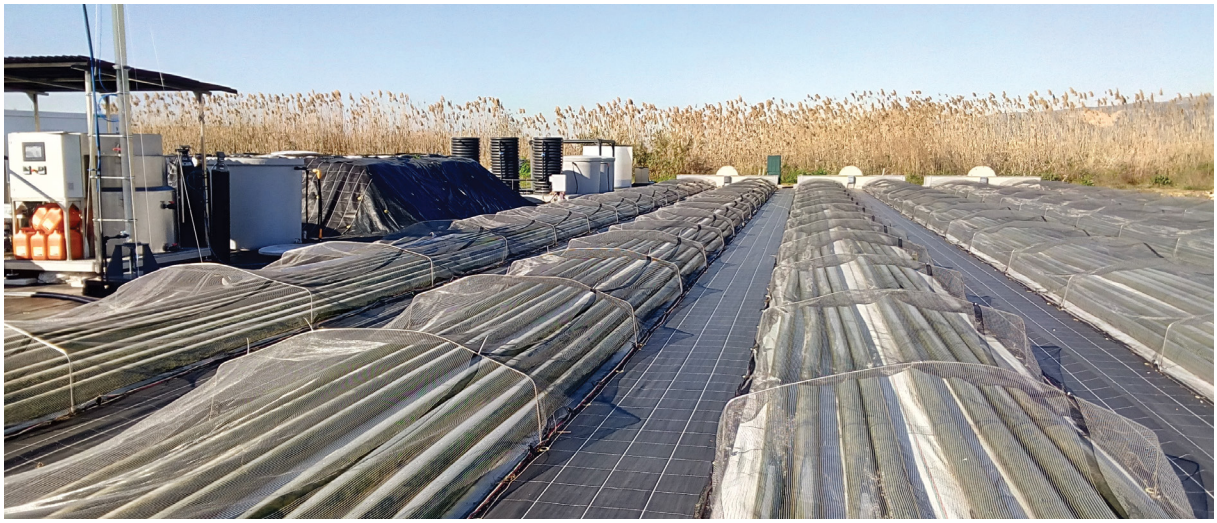
Water demand is expected to increase significantly over the coming decades. At the same time, almost one fifth of the world's population already lives with water scarcity and the situation is likely to worsen. The EU-funded INCOVER project identified a win-win situation in moving the mission of wastewater treatment from sanitation to bioproduct recovery and water recycling.

Value from wastewater

As project coordinator Juan Antonio Alvarez Rodriguez explains, "INCOVER transforms wastewater into valuable products in a 'circular economy' approach." Scientists developed innovative technologies for biomass production, anaerobic digestion, and nutrient and water recovery for effluents from municipal, industrial, and agricultural wastewater.

Bioplastics such as compostable and marine-degradable polyhydroxyalkanoates (PHAs) are still struggling to compete with conventional fossil fuel-based polymers, largely due to costly production mechanisms. INCOVER used wastewater high in organic content to provide carbon as a low-cost substrate for microalgae-bacteria communities without the need for costly sterilisation.

According to Alvarez, "The innovative PHA production process enabled successful recovery of 2.6 kg of PHA per day from phototrophic microalgae-bacteria systems treating domestic



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wastewater and other wastewater with high organic content. With 85 % efficiency of PHA extraction, plants can expect a revenue of EURO 1.06 per cubic metre of wastewater." Thanks to INCOVER, the plastics industry can cost-effectively source sustainable and environmentally friendly PHA.

INCOVER also delivered cost-effective and environmentally friendly biogas-cleaning technology to help meet increasingly strict regulation worldwide. "The biogas cleaning technology can provide eight cubic metres of high-quality biomethane per day suitable for injection into natural gas grids or use as biofuel in vehicles," says Alvarez. This biomethane can also be used to power the wastewater plant itself, significantly offsetting operating costs as well as the plant's carbon footprint.

Agricultural water consumption accounts for 38 % of global freshwater withdrawals. INCOVER developed a solar-powered ultra-filtration and anodic oxidation system. As Alvarez explains, "INCOVER's cost-effective disinfection systems can provide 10 cubic metres per day of pathogen-free wastewater effluent for irrigation and industrial use."

In addition to technologies for PHA, biomethane, and water purification, INCOVER also developed processes to recover 30 kg per day of organic acids in high industrial demand and 60-70 % recovery of phosphorus and nitrogen to be used directly as biofertilisers. These added-value technologies were demonstrated in real scale at three different European sites.

Supporting implementation

To assist authorities and facilities managers in choosing technologies and support discussions for market uptake, INCOVER also developed a tailored-to-technology decision support system (DSS) based on a life cycle sustainability assessment (LCSA) framework. INCOVER technologies and products are expected to reduce the overall costs of municipal and industrial wastewater treatment plant operation and maintenance by at least 50 %.

INCOVER presented technologies at 101 events and issued 73 press releases. Outcomes garnered international acclaim, including winning the first Sludge & Resource Recovery Initiative of the Year Water Industry Award 2018 and being one of 10 winners of the POWER Idea Contest for Sustainable Communities 2019. INCOVER's innovative processes and products are poised to close the loop on a circular economy for wastewater, exploiting its hidden treasures.

PROJECT
INCOVER – Innovative Eco-Technologies for Resource Recovery from Wastewater

COORDINATED BY
AIMEN Technology Centre, Spain

FUNDED UNDER
H2020

CORDIS FACTSHEET
cordis.europa.eu/project/id/689242

PROJECT WEBSITE
incover-project.eu/

Smart water treatment solution expands water reuse in the oil and gas industry

The oil and gas industry offer fertile ground for the development of ingenious water treatment technologies. An EU-funded project has stepped up with a smart platform for producing fit-for-purpose water that promises to reduce the industry's water demand by 60 %.

Oil and gas are the lifeblood of modern society. However, their industrial water consumption is a major drain on limited water supplies. In particular, this industry is considered one of the eight most intensive water users – large amounts of water are required for both upstream (oil extraction) and downstream (refining of petroleum crude oil) operations.

Transitioning to a 'one-water' paradigm

The variability of wastewater from the oil and gas sector is one of the most critical issues that hinder the production of fit-for-purpose water – treating used water to a quality acceptable for the intended reuse. Examples of reuse include irrigation, firefighting flow testing, gas reinjection, cooling and boilers.

"Applying circular economy principles to water is the only way to ensure the sustainability of this resource. INTEGROIL clearly helps industries reuse wastewater for valuable applications, closing the circle and reducing the pressure on natural resources," says Ana Jiménez-Banzo, Head of Innovation Management at ACCIONA Agua. Fit-for-purpose water is therefore a critical transitional step towards this paradigm.

Applying circular economy principles to water is the only way to ensure the sustainability of this resource. INTEGROIL clearly helps industries in reusing wastewater for valuable applications, closing the circle and reducing the pressure on natural resources.

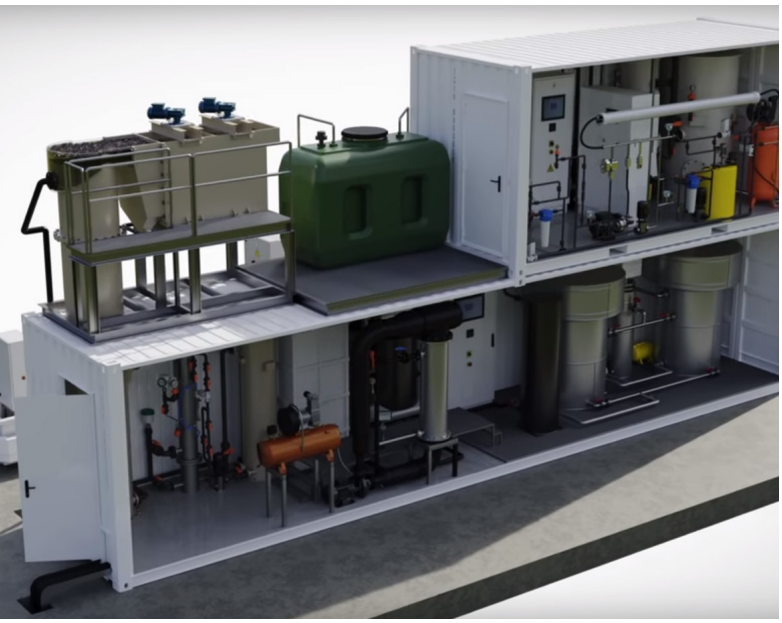
With EU funding of the INTEGROIL project, the Spain-based company together with other partners developed an integrated solution that can treat highly complex and variable industrial waters, producing water of acceptable quality for many uses. "Reuse of treated wastewater typically accounts for 5-15 % in the oil and gas industry. INTEGROIL's solution will increase this amount by around 40-60 %, dramatically helping reduce the industry's water dependence on fresh resources," notes Jiménez-Banzo.

Key technologies of the treatment platform

INTEGROIL technology is a plug-and-play integrated solution that comprises five different technologies operating in a smart way thanks to a decision support system (DSS). "The DSS is a key component that brings intelligence to our solution. It can dynamically adjust the treatment scheme needed to achieve the water quality targets for a particular water reuse application and provides advice on the specific technology that should be activated, depending on the case," explains Jiménez-Banzo.

Each of INTEGROIL's five technologies is aimed at removing a specific fraction/contaminant of the wastewater. The DSS element is in charge of identifying and activating/deactivating the most suitable combination of individual technologies (16 possible combinations), depending on the wastewater to be treated, the reuse application and operational efficiency criteria.

In short, there is a dissolved air flotation module for removing suspended solids and a ceramic membrane filtration module, alone or as part of a membrane bioreactor, for removing suspended or colloidal matter. Furthermore, there are two different advanced oxidation processes (catalytic wet air oxidation and ozone/hydrogen peroxide) for removing different types of organic matter, and a reverse osmosis step for reducing salinity.



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Demonstration activities

The five technologies that the DSS effectively manages were successfully tested in a pilot demonstration plant in two representative applications from the oil sector. Results showed that wastewater reuse exceeded 50 %. "An additional advantage that makes the deployment of INTEGROIL technology at large scale easier is that it does not require a high degree of expertise in water treatment – the DSS can activate and deactivate processes on its own," concludes Jiménez-Banzo.

PROJECT

INTEGROIL – Demonstration of a Decision Support System for a Novel Integrated Solution aimed at Water Reuse in the Oil & Gas Industry

COORDINATED BY

ACCIONA Agua in Spain

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PROJECT WEBSITE

integroil.eu/

Nature gives technology a hand to enhance water treatment processes

Europe's water service providers are under increasing pressure to provide better and affordable water services to a growing population. Simultaneously, they must also reduce the amount of energy used, thereby lowering the environmental impact of their activities to mitigate their impact on climate change.

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The EU-funded AquaNES project conducted demonstrations of innovative water and wastewater treatment processes and management based on improved combined natural and engineered systems (cNES). "The natural component can consist of soil aquifer treatment coupled to managed aquifer recharge (MAR), constructed wetlands (CW), or bank filtration (BF)," says project coordinator Thomas Wintgens.

Typical applications of cNES involve the use of BF in drinking water production from surface waters, MAR to augment groundwater resources, and CW to treat wastewater and add buffering capacities in drainage systems. "Such combinations can complement one another by reducing the level of organic matter that is detrimental in membrane post-treatment or degrade or adsorb transformation products generated in advanced oxidation steps," explains Wintgens.

Tested under different conditions

Project partners focused on 13 demonstration sites across Europe, India and Israel, covering different combined natural and engineered water treatment systems across a representative range of regional, climatic, and hydro-geological conditions that respond to issues such as water scarcity, excess water in cities, and micropollutants in the water cycle. These are located in densely populated areas with semi-closed water cycles as well as in more rural areas and regions with seasonal populations due to tourism. These were operated and monitored for 12 to 14 months.

The natural component can consist of soil aquifer treatment coupled to managed aquifer recharge, constructed wetlands, or bank filtration.

All the AquaNES demonstration activities enhanced the likelihood of full-scale implementation of cNES and promoted it as part of a holistic approach. Project partners also developed guidelines to ensure that the full value of combined treatment systems is taken into account, including a water quality assessment framework to identify relevant water quality parameters. This also comprises a web-based quantitative microbial risk assessment tool to help utilities and authorities better understand treatment performance and related health risks.

Multiple benefits

From its demonstration activities, the project consortium adapted design guidelines for CW-based systems, in water reuse schemes or set-ups for micropollutant removal. They also developed procedures for analysing the ecosystem services provided by cNES and demonstrated that natural treatment systems such as CW or retention soil filters can act as low-energy alternatives to purely technical systems.

The project revealed how bank filtration schemes can be operated with around 20-50 % less pumping energy when using siphon wells – and how to design such system. Most of the output was integrated into the AquaNES decision support system's planning procedure. This helped assist potential users like local authorities and funding agencies to evaluate the feasibility of cNES.

Global warming and melting ice caps coupled with unpredictable weather have highlighted the need to transition to sustainable eco-friendlier lifestyles, an endeavour in which AquaNES solutions could play a key role. "The project will enable cNES to compete with more traditional solutions, while helping both the environment and by reconnecting citizens to nature and providing space for recreation," Wintgens concludes.

PROJECT
AquaNES – Demonstrating synergies in combined natural and engineered processes for water treatment systems

COORDINATED BY
University of Applied Sciences and Arts Northwestern Switzerland, Switzerland

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cordis.europa.eu/project/id/689450

PROJECT WEBSITE
aquanes.eu/

Adaptable, scalable and cost-effective local solution to urban flooding prevention

Efforts to prevent urban flooding have often resulted in costly and complex systems based on rainfall forecasts, which are often inaccurate. A new approach offers more agility, at a fraction of the investment.

There are several Real-Time Control (RTC) sewerage systems in European cities. These systems comprise networks of sensors and control hardware. Control decisions are centralised, driven by network models and rainfall radar data. The systems have high capital cost and demand high levels of expertise for operation.

The EU-funded CENTAUR (Cost Effective Neural Technique for Alleviation of Urban Flood Risk) project developed a market-ready, decentralised, autonomous system. CENTAUR has shown that it is possible to get additional urban flood protection from existing piped networks.

Introducing intelligent data-driven controls

The CENTAUR system works by installing a flow control device (FCD) upstream of a flooding location in a section of the piped drainage network which would have spare capacity if the downstream network was flooding. The FCD is fitted directly into an existing manhole and uses wireless communications to dynamically respond to water level measurements in the local drainage system.

The water level monitoring system identifies high water levels in a flood-prone site and available capacity upstream. The operating algorithm can then take the decision to close the FCD and store water, reducing flow and water levels at the flood-prone location, minimising the likelihood of flooding.

As the communication system is solar powered and can be attached to nearby infrastructure, such as lamp posts, it is very agile and therefore quickly deployable. Crucially, the CENTAUR system can be operational without the need for structural changes to the existing drainage and sewer system.

As Simon Tait, project coordinator, explains, "Urban areas can benefit from additional flood protection without the need to build expensive new structures, such as storage tanks. Focusing locally means that interventions can be implemented with more limited finances and quickly, without waiting to obtain the large capital sums and for the permissions necessary for new construction." Another major advantage of the technology is that its autonomous design means that it can be scaled to cover increasing flood-prone locations in a network. As each system works autonomously, no system depends on another at any time, in contrast to existing RTC approaches that frequently optimise whole system performance.

As CENTAUR is data-driven, flow control decisions are made based on actual measurements of water levels at the flood-prone site and at locations upstream of the flow control device, not based on uncertain model predictions, as in previous large scale RTC systems.

"As CENTAUR is data driven, flow control decisions are made based on actual measurements of water levels at the flood-prone site and at locations upstream of the flow control device and not based on uncertain model predictions, as in previous large scale RTC systems," says Tait.

Both the pilot in Coimbra (Portugal) and the demonstrator in Toulouse (France) have proven that the technology works. In the Coimbra pilot over 60 storms were controlled, with the downstream flow rate and depth reduced by up to 37 % and 19 % respectively. The Toulouse demonstrator is still collecting data and its performance is being evaluated.

Flexibility for wide implementation

CENTAUR contributes directly to meeting the requirements of the EU's Floods Directive and the system's web-enabled visualisation dashboard offers water utilities the opportunity to display how the system is protecting citizens and property.

Additionally, in the future the local dynamic control of sewer networks offers the potential to control intermittent discharges from combined sewer overflows into watercourses, supporting the implementation of the Urban Wastewater Treatment Directive and the Water Framework Directive.

"Often in urban areas when drainage and sewer systems fail, the same properties get repeatedly flooded. The rapid, cost-effective CENTAUR solution means that effective flood protection can now be offered to locations that see flooding in only a small number of properties," Tait adds.

CENTAUR's SME partners have started marketing the system at the project target price of under EUR 100 000, compared to a small centralised RTC system in excess of EUR 1 million. The team is currently looking to investigate the use of the CENTAUR system at multiple locations in a sewer or drainage network for flexible, adaptable control over a wide area. It is also exploring usage of CENTAUR for better management of combined sewer overflows to reduce the impact on receiving waters, and also to see if manipulating sewer network flows can reduce pumping and treatment costs (energy and chemicals) within wastewater treatment plants.

PROJECT
CENTAUR – Cost Effective Neural Technique for Alleviation of Urban Flood Risk

COORDINATED BY
The University of Sheffield, United Kingdom

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