The **AIGUANEIX** Newsletter

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CONSORCI D'AIGÜES COSTA BRAVA GIRONA

Diputació de Girona

INTERVIEW

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IN DEPTH

The impact of climate
change on water resources

UNDER THE MICROSCOPE

Advanced oxidation:
a deep clean
at the molecular level

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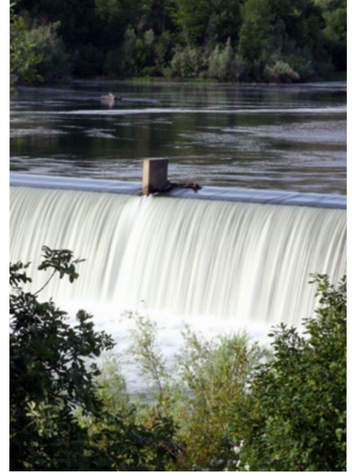
Editorial

Circularity to secure the water supply



We live in a finite world, but we don't fully appreciate it, and in our everyday lives we often act as if everything were limitless. Resources we extract from nature, if not recovered or recycled, ultimately become pollution, contaminating land, air and water.

All environmental, social and economic indicators have surged in recent decades, driven by overpopulation and unbridled human advancement. Our impact on the environment is so significant that the scientific community has named this era as if it were a new geological period: the Anthropocene, the age of humans.

Water is the most basic resource, and continental freshwater, though vital, represents just 2.5% of all available water. Furthermore, only 0.3% of this water is accessible, with 30.8% located underground and the remaining 68.9% held in glaciers and permanent snow.

Unsurprisingly, the advent of the Anthropocene has impacted water consumption, which has risen due to both population growth and the increased demands of food production and economic and industrial activity. The darker side of this is the overuse of water resources and the pollution of water which is then released back into the environment. Rising demand for fresh water, mounting pollution and increasing resource scarcity combine to present us with a problem that has no answer if consumption flows continue along a linear route. As such, the linearity of the past and present must give way to the circularity of the future.

The drought that recently hit the Alt Empordà region is undeniable proof of this. During times of greatest stress, when towns and cities risked exhausting their water supplies, the only fresh water available was treated wastewater, which was dumped into the sea and lost due to insufficient purification capacity and the absence of circular management.

At its core, sustainability means living off the renewable resources that are available to us in the present. However, achieving the much-needed circularity of water requires careful planning and gradual development to overcome the numerous technical challenges involved. It is a technology still in its infancy, requiring full support to ensure that in the future it can be properly integrated into public supply systems and provide the resilience that was sorely lacking during the recent drought.

"We live in a finite world, but we don't fully appreciate it, and in our everyday lives we often act as if everything were limitless"

"Just 2.5% of the Earth's water is fresh, with only 0.3% readily accessible"

Getting to know the project

How does water quality change in the pilot plant?

Water quality is monitored throughout the purification process at the pilot plant, using physical, chemical and biological parameters to assess the system's effectiveness in removing pollutants.

The first tests have been carried out on the full water purification cycle, and the resulting water met the requirements of current legislation drinking water quality: Royal Decree 3/2023 of 10 January, which establishes the technical-sanitary criteria for the quality of drinking water, its control and supply.

The following table presents the results for a selection of parameters representing the various types of substances that must be monitored in water intended for human consumption. It highlights the effect the full purification cycle has on the levels of salts, metals, disinfection by-products, pesticides, pharmaceuticals, chemical contaminants and microorganisms.

Parameters		Entry to pilot plant	Exit from pilot plant after remineralisation	Regulatory reference levels (RD 3/2023)
Physical	pH	7.5–8.0	7.5	6.5–9.5
	Electrical conductivity (µS/cm)	7,000–10,000	200–300	2,500
Chemical	Sodium (mg/l)	1,200	1.9	200
	Chlorides (mg/l)	2,800	0.6	250
	Ammonium (mg/l)	40	0.07	0.5
	Iron (µg/l)	420	< 5.0	200
	Total trihalomethanes (disinfection by-products) (µg/l)	—	< 2.0	100
	Glyphosate (pesticide) (µg/l)	2.3	< 0.010	0.10
	Oxypurinol (drug) (µg/l)	16	< 0.050	—
	Sum of 20 PFAS (chemical pollutants) (µg/l)	—	< 0.002	0.10
Biological	*Escherichia coli* (CFU/100 ml)	2.6×10^5	0	0

Units of measurement

— µS/cm (microsiemens per centimetre): Unit of measurement of electrical conductivity, that is, the ability of a material – in this case, water – to conduct electricity. The higher the salinity of the water, the greater its electrical conductivity.

— mg/l (milligrammes per litre).

— µg/l (microgrammes per litre).

— CFU/100 ml (colony-forming units per 100 millilitres): A common way to quantify live, active microorganisms in a sample relative to its volume. Some parameters are quantified per millilitre of sample.

The team leading the AIGUANEIX research

Investigating and analysing the processes in the pilot plant requires knowledge and supervision from organisations with extensive experience in hydrological studies. The consortium, comprising the Catalan Institute for Water Research (ICRA), Kompetenzzentrum Wasser Berlin (KWB) and Eurecat – three of the foremost institutions in this field both nationally and internationally – oversees and conducts the planning, execution, evaluation and reporting of the AIGUANEIX project. Together, these three institutions guarantee that AIGUANEIX meets the highest international standards.

Wolfgang Gernjak

- Research professor at ICREA (Catalan Institution for Research and Advanced Studies) and scientific director of AIGUANEIX.
- Expert in advanced water treatment and water chemistry applied to the production of drinking and reclaimed water.

Mira Petrovic

- ICREA research professor and deputy scientific director of AIGUANEIX.
- Expert in water quality and micropollutant management.

Mireia Mesas Juárez

- Head of environmental and industrial risks at Eurecat's WAS Unit.
- Chemical engineer with a master's degree in natural resource engineering. Involved in projects assessing the effects of pollutants on both human health and the environment, applying methodologies to study chemical risks to people and ecosystems, along with microbiological risks.

Ulf Miehe

- Scientific advisor.
- Expert in advanced water treatment for the removal of micropollutants and disinfection, with over fifteen years' experience in European water research collaborations.

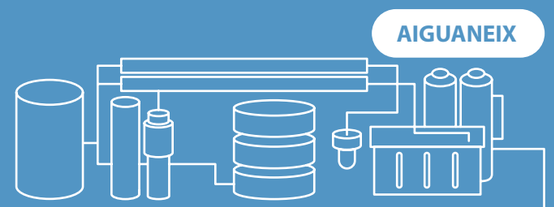
Taking a look at AIGUANEIX

What is the purpose of quality control for purified water?

Purified water, like that produced in the AIGUANEIX project pilot plant, must be subjected to thorough and exhaustive analysis. This process includes:

67 parameters
established by Royal Decree 3/2023, together with others specifically defined in the Catalan Institute for Water Research work plan.

This extensive database makes it possible to monitor changes in water quality through all stages of the treatment and to accurately assess the effectiveness of each process.



In addition to the reports on completed tests, the scientific management is also responsible for drafting the following documents, aimed at ensuring the safety and reliability of the treatment:

- Protocol to minimise the formation of disinfection by-products.
- Procedures for membrane integrity control.
- Assessment of chemical and microbiological risks.
- Theoretical evaluation of the capacity to remove indicator and pathogenic microorganisms.
- Proposal for future lines of applied research.

The ultimate goal is for health and water authorities to have the necessary tools to assess the implementation of this type of water purification facility. This would enable them to propose adjustments or improvements and, where necessary, validate its operation.

If successful, this initial effort should streamline the processing and authorisation of full-scale installations in the future. This stage, which is more administrative in nature, will commence once the AIGUANEIX project is completed and all associated technical documents are available.

What stage are we at?

"The goal of the Costa Brava Girona Water Consortium (CACBGI) is to have a full-scale facility by 2027"

Lluís Sala

Construction

April 2024. The base container for the pilot plant arrives at the workshop.

May–November 2024. Assembly of the pilot plant and the treatment and control systems.

July 2024. Modifications to the Roses Wastewater Treatment Plant (WWTP).

November 2024–January 2025. Installation of the pilot plant at the Roses WWTP.

January–May 2025. Commissioning of the pilot plant at the Roses WWTP.

Experimentation and analysis

May–September 2025. Start of the experimentation stage. The technical team tests the different operating conditions, takes samples and analyses the water to make the necessary adjustments to achieve the project's ultimate aim.

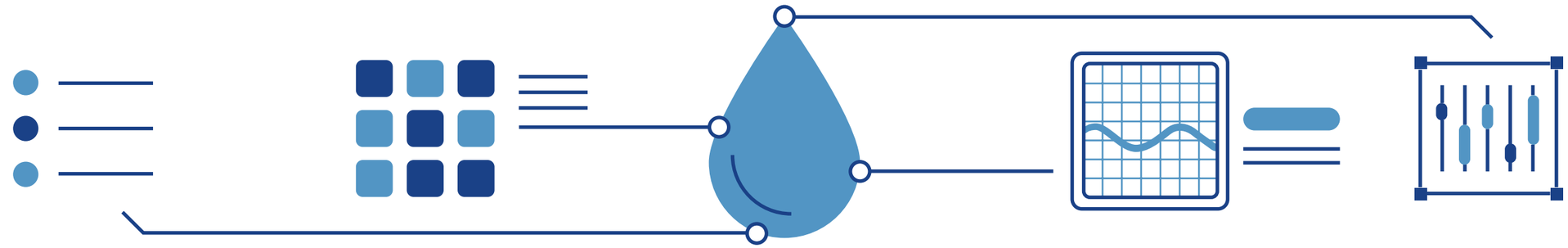
September 2025–May 2026. Analysis of the results obtained. Additional tests to assess the ongoing viability of the chosen operating regime.

Completion

May 2026. Assessment of the plant's performance and full-scale implementation of the project, and presentation of results.

2026–2027. Construction of a full-scale purification plant in Llançà to recharge aquifers in the northern Costa Brava region.

General information



Between 2022 and 2025, 61.8 hm³ were added to the Llobregat River – a volume comparable to the annual output of the El Prat de Llobregat desalination plant

In the Barcelona metropolitan area, measures combining desalination, water reuse and restrictions on consumption prevented the activation of emergency phase 3

Alternative water regeneration systems are vital in water emergency situations – as demonstrated in the Barcelona urban area during the drought between July 2021 and March 2025 – and will continue to be essential in the future, with projects such as AIGUANEIX or similar initiatives playing a key role in ensuring a reliable water supply.

The Barcelona Metropolitan Area (Àrea Metropolitana de Barcelona, AMB) public administration has contributed by supplying regenerated water to the Llobregat River for non-potable uses, while AIGUANEIX focuses on water purification for aquifer recharge.

Metropolitan water resilience

During the drought, the Catalan Water Agency implemented essential measures to ensure the water supply in the Barcelona urban area. By combining desalination, the reuse of reclaimed water and successive restrictions on water use, the Special Drought Plan helped prevent a situation of severe shortage (emergency phase 3) and possible water cuts between autumn 2023 and March 2025.

A particularly significant action was the addition of regenerated water to the Llobregat River. Between December 2022 and early 2025, more than 61.8 hm³ were supplied for non-potable uses – a volume equivalent to the maximum annual output of the El Prat de Llobregat desalination plant (60 hm³/year). This regenerated water was subsequently treated at the AMB's drinking water treatment plants (DWTP), undergoing advanced treatment processes that ensured its potability. This measure helped preserve reservoir reserves and avoided the activation of emergency phase 3. All stages of the process – regeneration, discharge, capture and supply – were subject to a rigorous and comprehensive quality control system, including analysis of up to 300 chemical compounds and microbiological indicators, in addition to those required by regulations.

AIGUANEIX employs a multi-barrier purification process before releasing water into the environment

The AIGUANEIX project: intensification of treatment before discharge

With the AIGUANEIX project, the Costa Brava Girona Water Consortium proposes a further step in resource management, carrying out purification treatment prior to discharge into the environment rather than at the DWTP, as is done in AMB's infrastructure. This difference arises because, in the municipalities of northern Costa Brava, the most suitable points for aquifer recharge are far from the Empuriabrava DWTP.

Tests at the Roses WWTP pilot plant aim to prove that it is possible to produce purified water suitable for aquifer recharge through multi-barrier treatments – chloramination, ultrafiltration, reverse osmosis, advanced oxidation, activated carbon filtration and remineralisation – with continuous online monitoring.

This approach guarantees water quality before it reaches the environment and adds a layer of security and control that differs from the strategy used in Barcelona, where reuse is implemented later at the DWTP.

Furthermore, AIGUANEIX provides the foundation for developing similar strategies at other WWTPs on the Costa Brava, promoting decentralised, flexible management with local involvement.

Unlike the AMB's model, where advanced treatment takes place at DWTPs, the AIGUANEIX project performs intensive treatment prior to discharge

Debunking myths

In this section, we aim to debunk some of the most common misconceptions about water purification through the use of facts and scientific studies

1 "It would be more effective to fix the existing infrastructure and prevent leaks"

It is true that improving supply networks is a necessary measure to reduce leaks. However, this is not incompatible with water reuse – on the contrary, they complement each other. In the current context, a comprehensive strategy is needed that guarantees water availability in situations of scarcity and drought, such as the ones we have experienced. Water purification, as proposed by AIGUANEIX, will help diversify supply sources and reduce pressure on aquifers and reservoirs. This measure, however, must be accompanied by other actions that improve service efficiency, conserve resources and repair networks. Relying solely on one solution – such as preventing leaks by improving infrastructure – is not a sufficient strategy in the event of severe or prolonged droughts.

2 "Recharging aquifers with purified water will contaminate existing waters"

No. Purified water undergoes highly intensive treatment processes and meets even stricter health quality standards than those typically required for drinking water. Not only does this technique prevent aquifers from being contaminated, it also helps recover and preserve them for future use. The entire purification process is continuously monitored and is regulated by European and national legislation. In fact, the main objective of AIGUANEIX is to produce water that complies with current regulations for human consumption and can be validated by the Catalan Public Health Agency as suitable for aquifer recharge. As such, replenishing aquifers with purified water poses no risk of contamination.

3 "Water quality can be affected by plant malfunction"

The AIGUANEIX pilot plant is equipped with real-time security and control systems, which can be replicated in full-scale facilities. So, if any anomaly is detected in the purification process, the system automatically stops and the water is not reused until its quality is assured. In addition, the protocols anticipate possible eventualities, enabling swift action and minimising any potential impact. It is not a matter of trusting blindly – it is about designing robust systems with multiple barriers of protection and continuous supervision to guarantee water safety at all times.

The interview

Ulf Miehe

Head of Process Innovation at
Kompetenzzentrum Wasser Berlin

"Drinking water is the safest and most tightly controlled"

Ulf Miehe is a leader in the field of innovative urban water management. His work connects cutting-edge research, engineering practice and practical solutions relevant to water policy, particularly in wastewater treatment, reuse, micropollutant removal, risk management and the development of circular systems.

Potable reuse requires advanced treatment technologies and detailed safety planning, even though the resulting water meets the quality standards required by drinking water regulations

How is safety guaranteed in the management of drinking water?
Maintaining safe drinking water relies on a multi-barrier approach. This means that protection is built into every stage – from the water source to the tap – so that if one step fails, the others ensure the water remains safe.

The main difference between drinking water from traditional sources, such as rivers or groundwater, and water derived from reuse is its quality. The basic principles of water safety remain the same, but in order to reuse water for potable purposes, some additional steps are required, such as advanced treatment technologies and more detailed safety planning.

What does not change are the strict safety standards – reused water must meet the same strict requirements for chemical and microbial safety as all drinking water under the European Union's Drinking Water Directive. In other words, reused water must be as safe as traditional drinking water.

To what extent can risks in drinking water supply be adequately assessed and controlled?
Risks can be reliably assessed and controlled to levels where the probability of adverse health effects is negligible. The goal is not to eliminate all risks completely, but to ensure continuous monitoring, the application of multiple protective barriers, rapid response systems and effective regulatory oversight. This approach means that drinking water in developed countries is not only safe for human consumption, but is also subject to exceptionally rigorous control.

It should be noted that regulations governing drinking water have evolved significantly over the past 50 years. A recent example is the inclusion of per- and polyfluoroalkyl substances (PFAS) in the new European Union Drinking Water Directive. PFAS, which are found in contaminated water bodies, can pose serious health risks, which is why regular regulatory updates are essential. However, the use of advanced treatment technologies – such as reverse osmosis – reliably reduces these compounds to levels well below the limits set by the Directive and, in many cases, even below the detection thresholds of modern laboratories.

What is the best way to communicate risks to society?
Communicating the risks associated with drinking water is just as important as managing them technically. The way information is shared can make the difference between building trust and sowing doubt. The most effective way to talk about drinking water safety is openly, clearly, consistently and responsibly, establishing genuine dialogue with the community.

Will citizens be able to clearly understand the risks – or lack thereof – associated with the AIGUANEIX project?
This is a timely and sensitive issue – drinking water reuse projects are often affected by what is known as the *luck factor*, even when they are scientifically safe. Public understanding of risk depends largely on how a project is explained and experienced.

There are three main challenges. The first is the perception gap: Even if advanced treatment removes pathogens and chemicals to safer levels than many natural sources, people may still associate potable reuse water with the idea of a *flush toilet*, which creates a sense of unease. The second challenge is the risk–trust relationship. Scientific evidence shows that well-designed potable reuse systems can be as safe, or even safer, than conventional water supplies. But without trust in the water companies or public authorities, public acceptance is unlikely. The third challenge is the invisibility of safety. Citizens cannot see pathogens or chemicals, so reassurance must come from the transparency and trust generated in communications.

Not everyone interprets technical risks in the same way – for some, feelings of discomfort or disgust can outweigh scientific evidence. Ultimately, risk perception depends more on trust, values and emotions than on technical details. Pilot projects such as AIGUANEIX are highly effective in building confidence. Visiting pilot plants, observing treatment processes or even taking part in water-tasting events allows citizens to experience reuse in a tangible way.

In conclusion, citizens can understand that potable reuse is safe – but only if communication is transparent, consistent and participatory, if risks are explained in clear, accessible language, and if trust is built through independent oversight and community involvement.

Risks can be reliably assessed and controlled to levels where the probability of adverse health effects is negligible

News roundup

We bring you the latest updates for the water sector, featuring the most significant local, national and international news from recent months.

Strengthening water resilience, the objective of the RECREATE project

Last June, the first meeting of the European RECREATE project took place, coordinated by the Catalan Institute for Water Research together with Eurecat. The project aims to promote the use of unconventional sources – such as reclaimed water and aquifer recharge – to guarantee supply during periods of drought. The event was attended by organisations including the Catalan Water Agency, the Catalan Water Partnership and Aigües de Barcelona. Further meetings will be held periodically to update stakeholders on the project's progress.

The Costa Brava Girona Water Consortium took part in this initial meeting and presented the AIGUANEIX project which, through a pilot plant at the Roses WWTP, produces water suitable for aquifer recharge. As part of the project, two monitoring stations equipped with spectrophotometers will be installed to monitor water quality in real time.

Improvements in the Portbou water supply system

The Costa Brava Girona Water Consortium has completed emergency works to guarantee the water supply in Portbou. A new osmosis plant has been installed to treat well water, which at certain times of the year contains a high level of salts. The testing phase has been successfully completed, allowing the plant to begin operating.

At the same time, measures have been taken to improve the reservoir's floating intake and convey water to the new drinking water treatment station (DWTP), which has already been built, and to the associated pipeline network. The works, now fully completed, have successfully addressed several significant technical challenges.

Strengthening the northern Costa Brava water supply against future droughts

The Costa Brava Girona Water Consortium has completed the installation of four ultrafiltration and four reverse osmosis modules in El Trabuc park in Castelló d'Empúries, located next to the Empuriabrava DWTP.

With an investment of almost 6.5 million euros – 75% financed by the Catalan Water Agency – this initiative strengthens supply security during drought episodes. The new modules will not only improve water quality but also enable additional resources to be implemented during emergencies, contributing to a more robust and resilient system prepared for structural drought conditions.

Under the microscope

We explain scientific and technical concepts related to AIGUANEIX in a straightforward and engaging way.

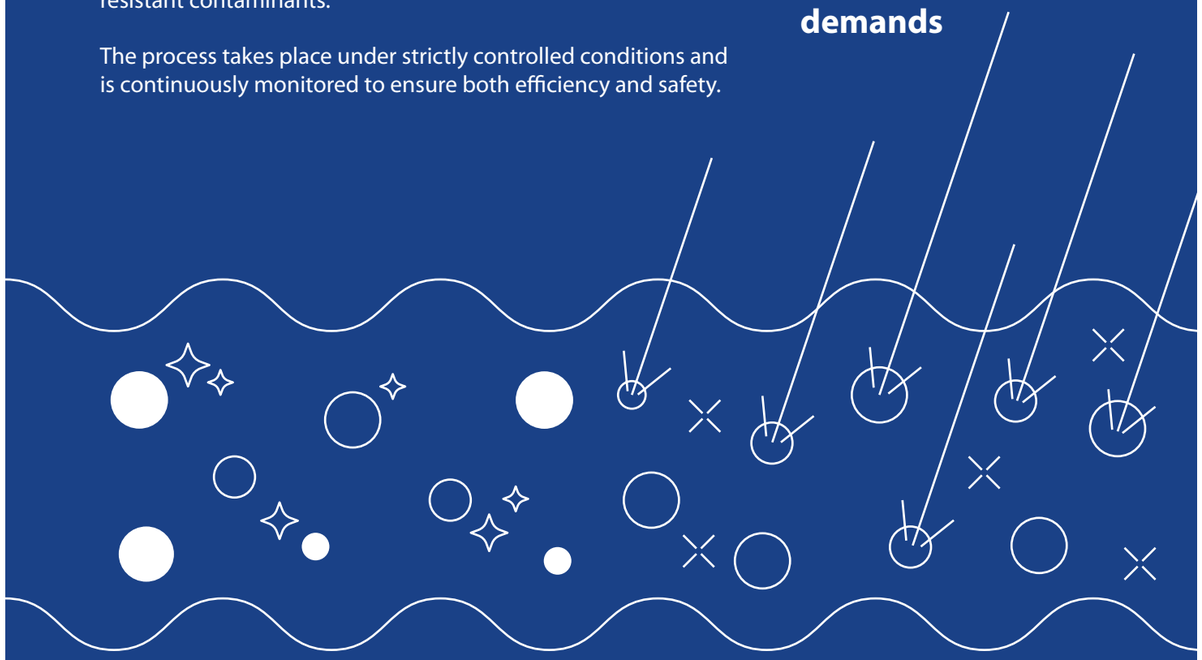
Advanced oxidation: a deep clean at the molecular level

Although water leaves treatment plants meeting the quality standards required by sanitation regulations, some compounds can persist through conventional treatment processes. This is where advanced oxidation processes (AOPs) come into play – a key technology for removing substances present at very low concentrations, such as pharmaceuticals, pesticides or other emerging contaminants.

These processes rely on the generation of highly reactive species, such as hydroxyl radicals (–OH), which are capable of attacking and breaking down even the most persistent molecules. To generate them, oxidising agents – such as hydrogen peroxide, sodium hypochlorite or ozone – are combined with ultraviolet (UV) radiation. The result is a highly efficient degradation of resistant contaminants.

The process takes place under strictly controlled conditions and is continuously monitored to ensure both efficiency and safety.

This technology represents an important step towards more circular and sustainable water management, particularly in a future marked by increasing scarcity and environmental demands



The impact of climate change on water resources

Climate projections are remarkably consistent in one key aspect: they all foresee a substantial rise in global temperatures, albeit with differences between regions.

The trend in the western Mediterranean

The sustained increase in temperature has been evident for years. According to the June 2025 bulletin of the Copernicus Climate Change Service, the average temperature that month in Western Europe was 2.81 °C higher than the 1991–2020 reference period, making it the warmest June on record.

Similarly, the Catalan Weather Service published in June 2025 its *Study Note* 76: "Analysis and climatic context of the 2021–2024 drought", which concluded that "drought – a phenomenon inherent to the Mediterranean climate – is undergoing transformations that point to the possible aridification of Catalonia. Recent episodes show unusual intensity and frequency, with characteristics typical of megadroughts."

Assuming this thermal scenario for the western Mediterranean, the perception of dryness will inevitably increase, even if global rainfall over the long term remains similar to current levels. Greater direct evaporation from surface waters and higher evapotranspiration from vegetation will alter landscapes and shift biomes typical of drier climates further north. In short, we will lose greenery.

The AIGUANEIX project proposes the storage of purified water in aquifers, reservoirs protected from the effects of global warming

Impact of rising temperatures on water

The global increase in temperature will also have a direct effect on aquatic ecosystems. Warmer water accelerates chemical and biological reactions, producing more pronounced changes in quality.

One consequence will be longer periods of stratification in lakes and reservoirs, with a higher risk of anoxia in deeper areas and the consequent deterioration of water quality.

Naturally, these new environmental conditions will alter the biodiversity of local ecosystems, favouring species adapted to warmer environments with greater nutrient circulation, to the detriment of those typical of temperate, nutrient-poor systems.

Groundwater as a refuge

By contrast, the impact on groundwater is expected to be much lower, or practically negligible. For this reason, groundwater represents a resource of great strategic importance. The AIGUANEIX project therefore proposes the storage of purified water in aquifers, natural reservoirs protected from the effects of global warming.

The magnitude and intensity of current climate change, together with scientific projections for the coming decades, indicate that the conditions of the past no longer exist – at least for the next few generations.

This means that supply infrastructures designed during the 20th century will not be adequate to meet the challenges of the 21st, and that new visions and approaches are urgently needed. The ideas underpinning the AIGUANEIX project can play a key role in this shift.

Now is the time to anticipate challenges and continue innovating to make new water supply systems a reality – systems that offer greater resilience for citizens.


PROTEC
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DANGER
HIGH PRESSURE


PLANTA CI Nº4


itm
Filters

Relevant experiences

Industrial water treatment plant (Tarragona)

Strategic water reuse for the chemical industry

6 hm³
of reclaimed water in 2024

€30 million
contributed by chemical industry companies

2012
the first AITASA regeneration plant in the area is inaugurated

In 2023, a new water treatment plant was inaugurated in the Camp de Tarragona region to reduce the pollutant load of water from the chemical industry by 70% before it is discharged into the sea.

The Tarragona chemical complex is one of the largest in southern Europe, consuming between 30 and 35 hm³ of water annually for cooling, production, use as a raw material and as energy in the form of steam.

It is expected that chemical industries will be able to reuse 40% of the water they consume annually, reducing both resource use at the source and the volume released through the outfall

Since 2012, thanks to collaboration between the Catalan Water Agency, the Tarragona Chemical Companies Association (Associació d'Empreses Químiques de Tarragona, AEQT) and Aigües Industrials de Tarragona, SA (AITASA), the Tarragona, Vila-seca and Salou water regeneration station has been operating, receiving wastewater from these three municipalities and applying a decantation and filtration process, a double reverse osmosis treatment and ultraviolet disinfection before allocating the water for industrial reuse.

The project continues to progress towards circularity and now plans the construction of a new regeneration plant specifically for industrial waters, allowing them to be reused and reintegrated into the industrial water cycle.

Profile

Lluís Sala
Head of the Supply and Regeneration Service of the Costa Brava Girona Water Consortium since 2019 and head of the AIGUANEIX project

Lluís Sala is a biologist who has become a leading authority on water regeneration and sustainability in Catalonia. After completing his degree in 1989, he worked on the first golf course irrigation project using regenerated water in Catalonia, as a research trainee under Professor Rafael Mujeriego, and since 1993 he has been at the Costa Brava Girona Water Consortium, focusing on water reuse. Sala is committed to water circularity as an essential tool to address climate challenges and ensure the resilience of urban and industrial water resources.

His work is notable not only for its technical efficiency, but also for its ability to connect institutions, companies and society around a shared goal – making intelligent use of water. With exceptional communication skills, Lluís Sala has become an influential voice at conferences, forums and debates on sustainability. He has authored several national and international publications on water regeneration and the sustainable management of water resources.

"We must explore new ways of producing drinking water that can guarantee supply in the medium and long term"

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This initiative has been developed by the Costa Brava Girona Water Consortium and has received a subsidy from the Catalan Water Agency under file no. REU001/20/000139. This subsidy was awarded within the framework of the call for investments in the implementation of actions designed to reuse recycled water, as published in Resolution TES/642/2021 of 4 March (Official Gazette of the Government of Catalonia [DOGC] no. 8362 of 11 March 2021, ref. BDNS 552136).

Project management and funding:

CONSORCI D'AIGÜES COSTA BRAVA GIRONA

Diputació de Girona

With support from:

Agència Catalana de l'Aigua

Generalitat de Catalunya

Scientific management:

ICRA Institut Català de Recerca de l'Aigua

Construction and maintenance:

Agbar

Protecmed

Works management:

Energi

Experimental operation:

transparenta
UTE Transparenta Sanejament Costa Brava

Creation of outreach materials:

Anthesis

Linguistic advice and correction:
Linguistic Services of Girona Provincial Council