SMAT Research Center
Research activities

2025
2026

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smat
RESEARCH CENTER

Research activities

2025

2026

IMQ CERTIFIED
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ISO 9001 • ISO 14001
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ORGANIZZAZIONI UNI

ISO 22000
BUREAU VERITAS
Certification

BUREAU VERITAS 1828

The SMAT Research Center: Anticipating Challenges and Building Solutions

The SMAT Research Center represents the core of the company's development and innovation, operating within a continuously evolving context marked by the intensifying effects of climate change, rapid technological advancement, and the growing complexity of environmental and regulatory challenges.

Its distinctive role lies in its ability to combine internal operational needs with the most advanced scientific knowledge and the technological solutions available, creating a point of convergence between corporate experience, academic research, and innovation. In this capacity, the Research Center not only supports current operations, but also plays a key role in guiding the company's strategic decisions by providing the tools and knowledge base needed to address increasingly complex scenarios, as demonstrated, among other issues, by the growing relevance of challenges related to PFAS.

Its activities range from the innovation of processes and technologies for the protection of water resources, to supporting infrastructure modernization, as well as the digitalization and modeling of water supply and sewer systems. These activities are complemented by studies and investigations on emerging pollutants and on adaptation and mitigation solutions related to climate change, with the aim of strengthening the resilience of the service.

Through continuous collaboration with Universities, Research Centers, and innovative organizations, the SMAT Research Center strengthens a collaborative ecosystem that enables the transfer of knowledge, the development of new expertise, and the reduction of the gap between research and practical application, with direct benefits for the served territory.

This document should not be regarded as a simple review of the activities carried out, but rather as a concrete representation of SMAT's commitment and efforts to build the foundations of a water service increasingly capable of meeting the needs of the community and the territory, from a long-term perspective of sustainability, efficiency, and quality.

Armando Quazzo
CEO

Paolo Romano
President

May, 2026

The Research Center

The mission

The mission of the Research Center is to develop and transfer advanced solutions for drinking water treatment, wastewater treatment, and water network management, contributing to improved resilience to climate change and reducing the overall environmental impact of water services.

Established in 2008, the SMAT Research Center carries out its activities with the aim of ensuring an increasingly efficient, innovative, and sustainable water service. Applied research represents a strategic pillar for addressing emerging challenges in the sector, anticipating regulatory and technological developments, improving the quality of services provided and operational efficiency, strengthening competitiveness, and fostering innovation.

The objectives

- Ensure continuous compliance with regulations in production and services.
- Introduce innovative technologies to improve the quality of water services.
- Optimize processes to increase efficiency and reduce costs.
- Test new processes at pilot scale to evaluate their effectiveness and economic sustainability.
- Promote technological solutions with low environmental impact.
- Protect water resources through a sustainability-oriented approach.
- Collaborate with institutions and authorities for environmental protection and climate adaptation.
- Develop advanced tools to analyze and ensure water quality.
- Participate in calls for proposals and projects to fund research and innovation.
- Promote training and dissemination activities and strengthen SMAT's role as a sector benchmark.

Research areas

Treatment

Innovation in drinking water and wastewater treatment processes is aimed at improving efficiency, sustainability, and compliance with increasingly stringent regulations. Projects in this field include the scouting and implementation of new treatment technologies, the development of specific solutions for the removal of emerging pollutants, the optimization of plants, the valorization of by-products, and the reduction of process waste.

Water Networks

The digitalization and modeling of water distribution networks, sewer networks, and urban drainage systems represent a fundamental pillar for improving service management. In this area, particular importance is given to the development of predictive systems for the early detection of failures and leaks, which allow anomalies to be identified and enable the company's operational teams to intervene promptly.

Climate Change | Energy | Environment

Projects aim to reduce SMAT's environmental impact and energy and carbon footprint while strengthening the resilience of the water service. Activities include improving the energy efficiency of drinking water treatment and wastewater treatment plants, analyzing climate risks and extreme events affecting infrastructure and processes, developing early warning systems for emergency management, and adopting climate change adaptation strategies. Particular attention is given to sustainability and circularity, including the promotion of the reuse of treated wastewater.

Quality

Research activities in this area aim to monitor and control the quality of drinking water and wastewater and to enhance service safety through the implementation of, among other things, innovative analytical methods for detecting emerging pollutants across the entire supply chain, as well as the development of increasingly effective and predictive control tools.

Distribution Networks

Projects in this area involve the collection and processing of data from IoT sensors, SCADA systems, hydraulic models, and predictive analytics platforms, with a specific focus on interoperability between different corporate systems, promoting connectivity among data platforms (GIS, SCADA, etc.) to enable an integrated and advanced view of the service.

The SMAT research numbers in 2025–2026

Treatment

4 Completed projects

5 Ongoing projects

11 National partners

26 International partners

Water Networks

1 Ongoing projects

1 International partner

Quality

2 Ongoing projects

1 National partner

34 International partners

Climate Change | Energy | Environment

3 Completed projects

6 Ongoing projects

27 National partners

14 International partners

Distribution Networks

3 Ongoing projects

1 National partner

1 International partner

The partners

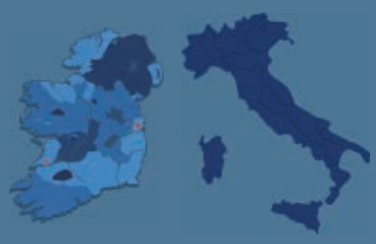
Partnership Agreement for Advanced Research (APRE)

4
Ongoing activities

6
Utilities of the integrated water service sector involved

The APRE Agreement, signed with six other utilities (HERA, Iren, A2A, MM, Nepta, AQP), aims to promote innovative ecosystems and spread a culture of innovation within the water service sector. The implementation of the agreement is based on operational research activities focused on areas of common interest, aimed at sharing technological scenarios and analyzing regulatory issues related to the Integrated Water Service, in order to engage more effectively and innovatively with national and European regulatory authorities.

National and Regional Research Projects



12
Ongoing projects

13
Academic partners involved

Partnerships with national and regional universities and research centers make it possible to implement research ecosystems that provide access to advanced expertise and cutting-edge methodologies, strengthening the innovation capacity of the SMAT Research Center.

International Research Projects

5
Ongoing projects

49
International partners involved

The Research Center actively participates in projects funded at international and European level, leveraging opportunities offered by public and private research programs. This ability to attract funding makes it possible to develop innovative solutions and address emerging challenges with an interdisciplinary, long-term approach.

The Water Academy

With the establishment of the SMAT Water Academy, an important strategic initiative was launched aimed at strengthening and enhancing SMAT's presence at national and international level as a benchmark for specialized training in the water sector.
Promoted and coordinated by the SMAT Research Center, the Academy is designed as a center of excellence for training, with a strong operational and management focus, intended to support the professional growth of utility staff and foster the development of advanced technical skills.
The main objective is to contribute to innovation and competitiveness in the water sector by offering training programs capable of addressing both current and future challenges. Through continuous updates on regulations, technologies, and best practices, the Academy aims to support ongoing service improvement while promoting the creation of a network of professionals and companies engaged in the exchange of experience and practical solutions.
The project also stands out for the involvement of key academic, scientific, and institutional partners, including the Politecnico di Torino, the University of Turin, Utilitalia, Utilitatis, and other national and international players in the water sector.
This network of collaborations further strengthens SMAT's strategic positioning in the field of training, establishing it as a promoter of an integrated model that combines research, innovation, and practical application.

The activities of the Water Academy officially began on 20 March 2026 with a study day on EU Directive 2024/3019 on urban wastewater, organized in collaboration with the Order of Engineers of Turin.

Through contributions from national and international experts, the study day focused on the analysis of regulatory and governance aspects, the new treatment requirements and plant impacts associated with the introduction of advanced quaternary treatment processes, the objective of energy neutrality for wastewater treatment plants, the extension of obligations and regulations related to the reuse of treated wastewater, and the role of analytical monitoring as a driver for design and operational decisions.

Group photo of the speakers from the study day.

Institutional greetings. From left: Eng. Paolo Romano (*SMAT President*), Dr. Armando Quazzo (*SMAT CEO*), Cllr. Matteo Marnati (*Piedmont Region*), Councillor Francesco Tresso (*City of Turin*), Dr. Roberto Ronco (*ATO 3 Torinese*).

Photo of the session "*Energy neutrality and net-positive plants*", held in the SMAT Water Academy rooms and moderated by Eng. Marco Acri (*SMAT General Director*).

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Pilot study on the use of monochloramine in distribution networks with high water residence times and elevated temperatures

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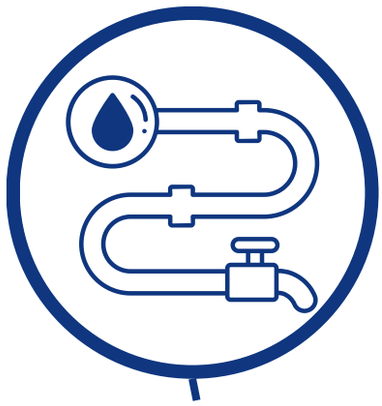
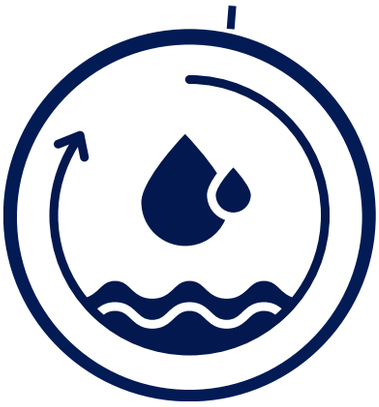
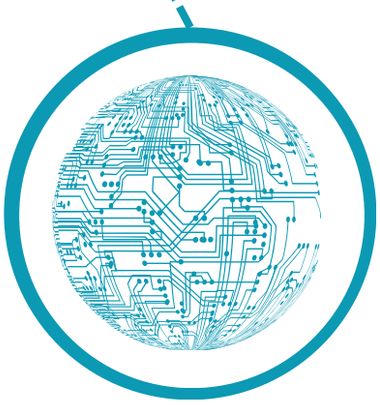
Energy neutrality in wastewater treatment plants: guidelines for defining achievable targets for self-production of energy from renewable sources

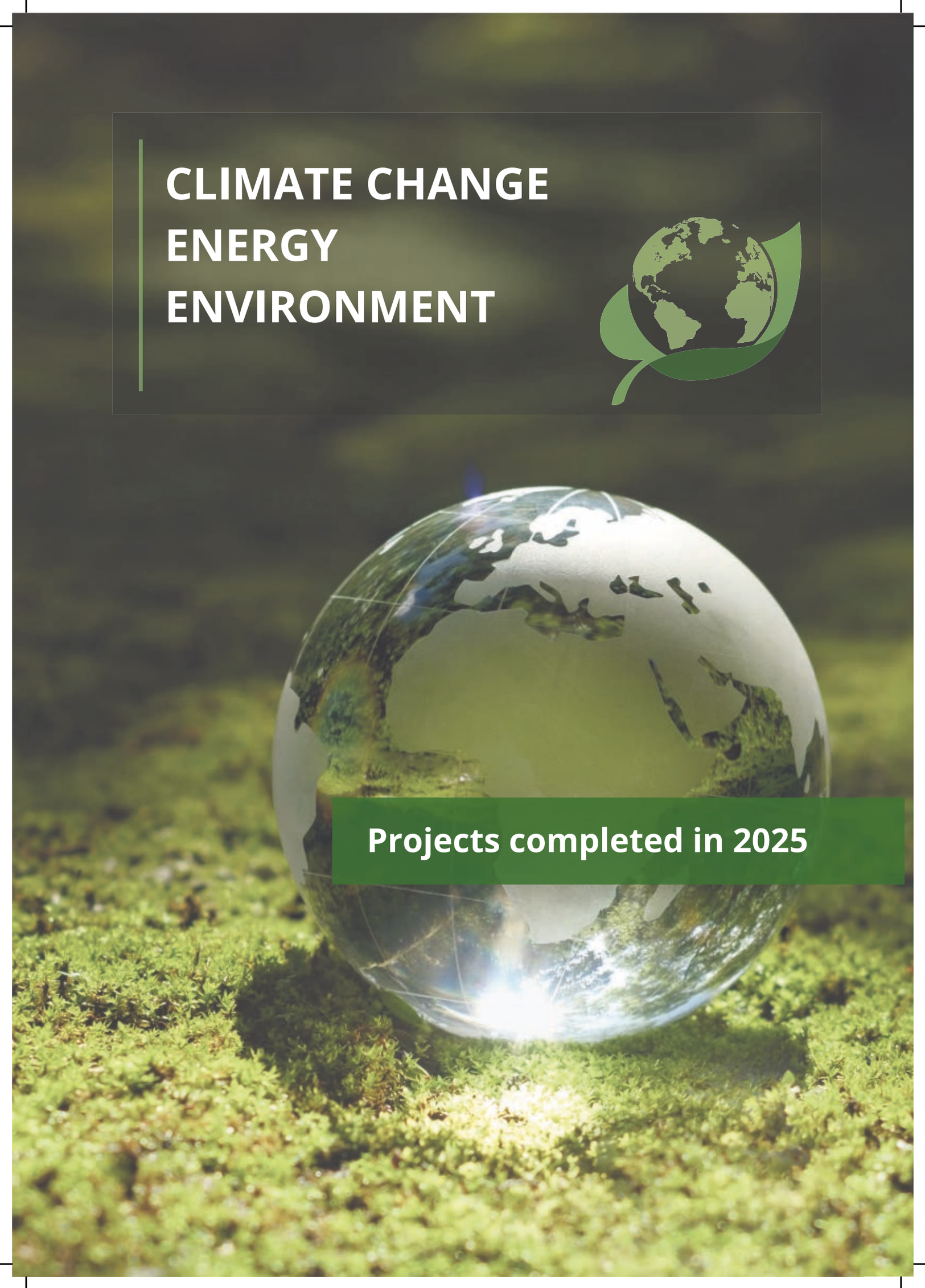


Projects completed in 2025





CLIMATE CHANGE
ENERGY
ENVIRONMENT



Projects completed in 2025

FUTURCLESP - The FUTURe of CLimatic Extreme eventS and their impacts in Piedmont

STATUS	Completed
STARTING DATE	march 2023
DURATION	20 months
FINANCING	Yes
PARTNER	UNITO, ARPA Piemonte, ISAC-CNR, CentroScienza, Regione Piemonte

The FUTURCLESP project, selected for funding by the Fondazione CRT, analyzed the recent and future evolution of extreme meteorological and climatic events in Piedmont, with particular focus on precipitation and its related impacts.

The study was based on the integration of observational data (ERA5 reanalysis) and climate simulations from global models (CMIP6) and high-resolution regional models (EURO-CORDEX), in order to capture the specific characteristics of a territory defined by high orographic complexity and diverse climatic influences.

The analysis focused on the most intense precipitation events, using internationally recognized climate indicators and statistical methods to describe their trends. Different climate models were also compared and grouped according to their behavior in order to obtain a more comprehensive view than that provided by the simple ensemble mean.

For the recent period (1961–2020), the results show an overall slight decrease in average precipitation, accompanied however by an increase in the intensity and variability of extreme events. In Piedmont, this translates mainly into more variable and, in some cases, more intense heavy rainfall events, with differences across the various areas of the region.

The comparison between models and observed data highlights some limitations, particularly in global models, which tend to underestimate precipitation. Some improvements are achieved by applying bias-correction techniques. Regional models, thanks to their higher resolution, generally provide a better representation of spatial variability, although some uncertainties remain.

Future projections, analyzed under the highest emissions scenario, show fairly consistent trends: on one hand a possible increase in extreme precipitation events, and on the other longer dry periods, confirming a tendency toward an intensification of the hydrological regime. Mean precipitation shows less clear and more variable signals over time and across models. Toward the end of the century, these changes tend to become more pronounced.

Overall, the results suggest potentially significant changes in precipitation patterns, albeit with some margins of uncertainty. The study contributes to strengthening knowledge useful for risk management and for planning adaptation measures at the regional level.

"Support policy decisions by making updated and reliable regional-scale climate projections available, processing them to extract useful information for decision-makers and stakeholders."

INOPIA: customisation of a water crisis early warning and decision support tool

STATUS	Completed
STARTING DATE	june 2022
DURATION	36 months
FINANCING	-
PARTNER	CNR-IRSA, Protezione Civile, Arpa Piemonte

In the last two decades, numerous water crises have occurred at national and regional levels, affecting the main areas of water use and intensifying conflicts related to the management and prioritization of resource allocation. In many cases, this situation has made it necessary to resort to extraordinary measures to mitigate the negative impacts.

The identification of early warning indicators of water scarcity risk—understood as the inability of a system to meet user demand—requires consideration of meteorological variability, medium- to long-term climate trends, and the infrastructural and management specificities of individual systems.
In this context, INOPIAQGIS is a decision-support tool developed within the collaboration between the Department of Civil Protection and CNR-IRSA, designed for the analysis of complex water systems characterized by multiple sources and different types of users. The software enables rapid assessments of water shortage risk in the event of significant resource reductions, for example following prolonged periods of below-average precipitation.

The research project aimed to test the tool in a real-world context, evaluating its applicability for modeling scarcity scenarios and supporting the planning of preventive and emergency measures. The case study focused on a water supply chain for the city of Turin potentially exposed to drought conditions and characterized by specific operational, environmental, and infrastructural constraints, with particular reference to the abstraction and conveyance system of the Pian della Mussa area.

Overall, the application highlighted interesting methodological and modeling aspects, while also revealing some limitations regarding potential large-scale operational use. In particular, critical issues emerged related to input data integration and limited interoperability with real-time information flows (e.g., telecontrol systems and meteorological-hydrological data), factors that may reduce the tool's effectiveness in dynamic management contexts. Moreover, its use appears more straightforward in relatively simple configurations, while further investigation is required for applications to complex systems.

"The numerous water crises in recent years have affected the main water-use sectors and have required the implementation of emergency procedures to manage their impacts."

IRRISAFE: from use to re-use: development of a model for an urban wastewater Risk Management Plan

STATUS	Completed
STARTING DATE	december 2023
DURATION	24 months
FINANCING	-
PARTNER	University of Turin Regione Piemonte

The IRRISAFE project, carried out in collaboration with the Department of Chemistry of the University of Turin (UNITO), had two main objectives:

1. **The development of a model for preparing a Risk Management Plan (RMP) for the reuse of treated wastewater in agriculture, through the implementation of selected steps of the risk assessment process, namely the system description and identification of stakeholders with roles and responsibilities (KMR 1 and 2), hazard identification (KMR 3), and identification of additional control parameters (KMR 6).**
2. **Laboratory studies on contaminant removal treatments to support preventive interventions (KMR 7).**

Within the project, the needs of the agricultural sector were first assessed in order to define the required water quality. Once the target quality level was established (Class C of EU Regulation 2020/741), an evaluation of historical monitoring data from the treatment plant was conducted to verify both compliance with the Minimum Requirements set by the European Directive and the Italian Ministerial Decree (DPR MASE, pending transposition), and the plant's performance with reference to the parameter values established by Ministerial Decree 185/2003, which—although to be repealed upon entry into force of the DPR MASE—still provides a useful benchmark.

Based on this preliminary analysis, further investigations were carried out to deepen knowledge of parameters measured with insufficiently sensitive methods or to assess substances for which additional monitoring requirements may be relevant, such as pesticides, microplastics, antimicrobial resistance, viruses, and other priority substances.

These analyses are not explicitly required by current regulations, but they provide valuable support from a risk-prevention perspective and contribute to building a robust knowledge base for future Risk Management Plans.

In parallel, an assessment was also conducted on the water quality of the Rio Moneta, which is currently used for irrigation purposes.

Overall, the IRRISAFE project highlighted that, with minimal interventions, the effluent from the wastewater treatment plant could already be suitable for the production of reclaimed water meeting Class C quality requirements, with a quality even higher than that of traditional irrigation canals. Furthermore, with an enhanced final disinfection stage, it would be possible to achieve the highest quality level (Class A).

"Overall, the project highlighted that, with minimal interventions, the effluent from the wastewater treatment plant could already be suitable for the production of reclaimed water meeting Class C quality standards."

TREATMENT

Projects completed in 2025

BioEnPro H_2O

STATUS	Completed
STARTING DATE	december 2023
DURATION	24 months
FINANCING	Yes
PARTNER	Sea Marconi, CIDIU, Orchestra

The BioEnPro H2O project, funded under the NODES research call (Next Generation EU – PNRR, within SPOKE 2 – Green Technologies and Sustainable Industries), is based on circular economy principles with the main objective of extracting and valorizing renewable energy, products, and water from various types of residual resources and waste, through technologies and processes developed and evaluated within the project.

The project partners combined their industrial and research expertise and experience with the aim of studying, building, and testing industrial prototypes of innovative technologies for the treatment of residual materials and waste to be valorized, such as sewage sludge, biomass, leachates, organic fraction of municipal solid waste (OFMSW), and absorbent sanitary products (ASP). The purpose of the developed mechanical-physical-chemical treatments is to obtain material and water streams suitable for recovery and reuse, directly contributing to the reduction of waste volumes and to the closure of material cycles.

During the last year of activities, the project partners tested several treatment technologies for these matrices (mainly sewage sludge and compost), aimed at extracting water for reuse, as well as a plasma technology designed to oxidize the organic substances contained within them.

The SMAT Research Center and laboratories were responsible for chemical, biological, and respirometric analyses (to assess biodegradability) of the different types of wastewater and leachates, including those resulting from the experimental treatments.

Finally, the SMAT Research Center evaluated and defined treatment sequences, processes (chemical-physical-biological), and polishing technologies suitable for making the recovered water appropriate for various types of industrial and agricultural reuse. The identified treatment train includes attached-growth biological treatment with nitrification and denitrification, filtration, ozonation, biological activated carbon (BAC) filtration, and final disinfection using UV or peracetic acid.

"The project is based on circular economy principles with the aim of extracting and valorizing renewable energy, products, and water present in various types of residual resources and waste."

Website

Follow on

Interaction between sludge pre-treatment and thermal oxidation

STATUS	Completed
STARTING DATE	october 2023
DURATION	18 months
FINANCING	-
PARTNER	Polytechnic of Turin

In a previous research project in collaboration with the Politecnico di Torino, a low-temperature thermochemical pretreatment technology for biological (excess) sludge had been developed and tested upstream of anaerobic digestion, with the aim of increasing biogas production, improving sludge dewaterability, and minimizing the residual quantity.
Indeed, in view of the upcoming construction of the sludge thermal oxidation plant at the Castiglione T.se central wastewater treatment plant—whose permitting process by the competent authorities was completed in early 2026—it is essential to assess the advantages and disadvantages, in terms of mass and energy balance, that sludge pre-treatment would bring to the overall system.
The technical-economic analysis carried out within the project therefore considered the benefits provided by the sludge pre-treatment stage (increased biogas production during anaerobic digestion and improved sludge dewaterability), its costs (thermal energy and reagents), and its impact on the final thermal oxidation stage (reduction of the sludge flow to be treated and decrease in calorific value).
The study compared different plant and process configurations, including, across the various scenarios, mechanical thickening sections, thermo-chemical pre-treatment, anaerobic digestion, dewatering, and thermal oxidation. The results highlighted the energy and economic advantages of introducing low-temperature thermo-chemical pre-treatment of biological sludge.
However, due to the reduction in sludge calorific value resulting from the pre-treatment, and in order to ensure the correct thermal load of the oxidizer—and thus the technical feasibility of the proposed pre-treatment—the analysis also highlighted the need to include in the thermal oxidation process the dewatered sludge stream from other SMAT wastewater treatment plants.

"The interactions between a potential sludge pre-treatment section and the future thermal oxidation plant will be evaluated from a technical, energy, and economic perspective."

Sewage sludge thermal oxidation

STATUS	Completed
STARTING DATE	september 2024
DURATION	6 months
FINANCING	-
PARTNER	Polytechnic of Turin

This research project, carried out in collaboration with DIATI – the Department of Environment, Land and Infrastructure Engineering of the Politecnico di Torino – focused on the coordination of technical-scientific activities and on the necessary in-depth analyses within the permitting procedure, which was completed in the early months of 2026, for the sludge thermal oxidation plant thatwill be installed at the SMAT Castiglione Torinese wastewater treatment plant.

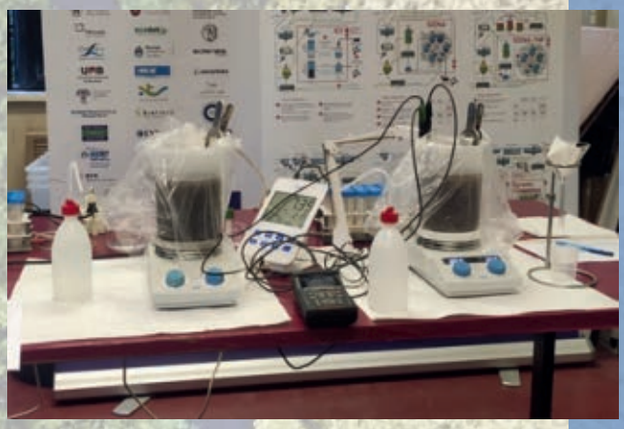
The first part of the project activities focused on an odor measurement campaign related to potentially significant sources within the wastewater treatment plant. The results were compliant with sector regulations and guidelines and confirmed the values reported in the Environmental Impact Assessment submitted by SMAT.

The second part of the activities focused on the study of PFAS occurrence in wastewater and sewage sludge, as well as on the behavior of these micropollutants along the thermal oxidation process and flue gas treatment chain (presence in different matrices: sludge, ash, flue gas treatment residues, and stack emissions). To this end, several laboratory-scale thermal oxidation tests on sludge were carried out, along with an in-depth monitoring campaign of PFAS in sludge, atmospheric emissions, and residues (ash and flue gas treatment residues) at a thermal sludge oxidation plant of similar size and technology located at the wastewater treatment plant in the city of Zurich (Switzerland).
The results showed excellent removal efficiencies, highlighting the effectiveness of the thermal oxidation process for the treatment and destruction of PFAS (over 99%) present in sewage sludge.

"The results showed excellent removal efficiencies, highlighting the effectiveness of the thermal oxidation process for the treatment and destruction of PFAS."

Biological phosphorus removal

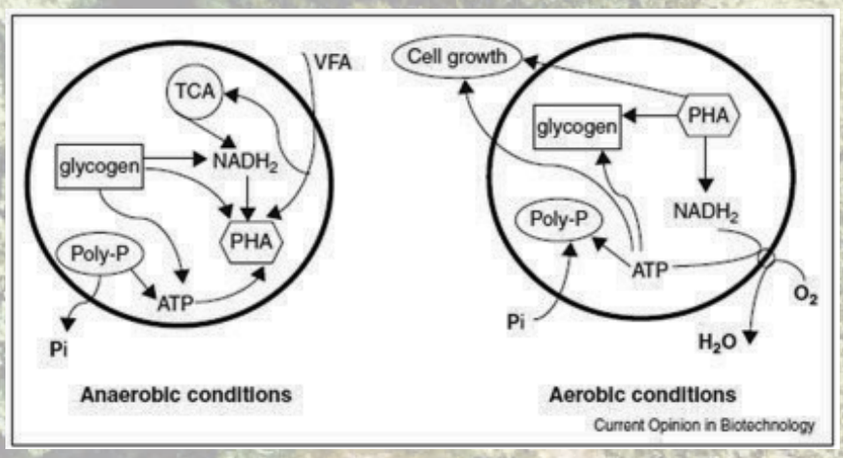
STATUS	Completed
STARTING DATE	june 2023
DURATION	36 months
FINANCING	-
PARTNER	HERA, IREN, A2A, University of Marche



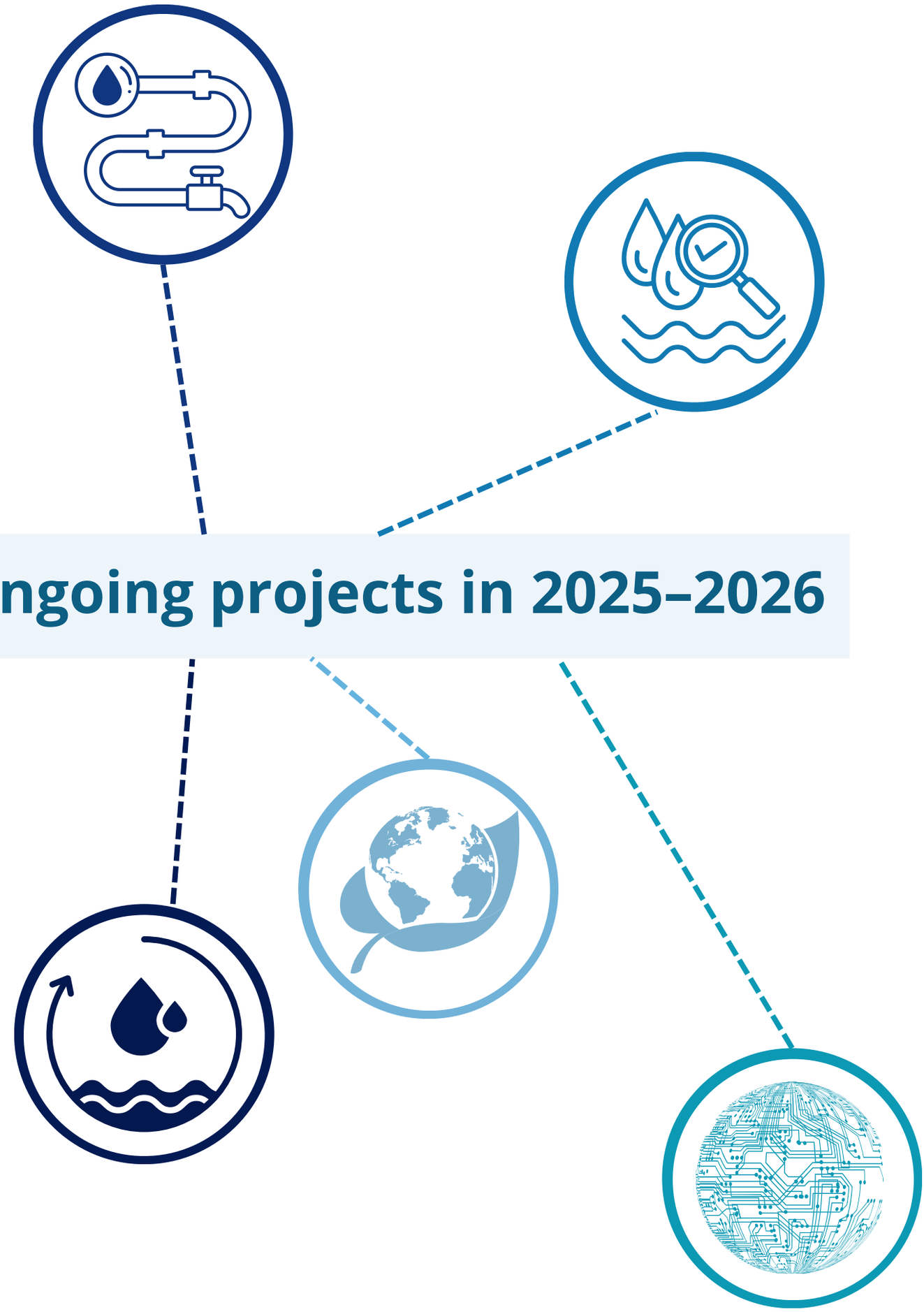
Phosphorus removal plays a key role in wastewater treatment processes for the protection of receiving water bodies. In addition to the conventional chemical precipitation process, increasing attention is being given to biological phosphorus removal, which—besides reducing reagent consumption—enables phosphorus recovery in the form of struvite, which can be used as a fertilizer in a circular economy approach.

This research project, carried out in collaboration with HERA, IREN, A2A, and the Marche Polytechnic University, focused on the study of configurations for biological phosphorus removal in urban wastewater treatment plants, assessing operational, process, and economic aspects.
Particular attention was given to monitoring and control systems and parameters, limiting and inhibitory factors, as well as the identification of strategies for optimal process management.
An initial phase of the project was dedicated to identifying and studying the wastewater treatment plants to be assessed for feasibility. Regarding SMAT, the Castiglione T.se and Chieri wastewater treatment plants were analyzed.

The techno-economic assessment of the implementation of this process in the selected plants was also based on mathematical modeling of the processes and experimental measurements, through respirometric techniques, of the specific characteristics of wastewater and activated sludge.
The activities during the final year of the project were focused on identifying and studying the best plant configurations for implementing the technology, as well as evaluating the possible need to introduce a sludge fermentation process to ensure the production of VFA (readily biodegradable COD) to support the biological process carried out by phosphorus-accumulating bacteria in the liquid line.



"This research project aims to study configurations for biological phosphorus removal in urban wastewater treatment processes."



Ongoing projects in 2025–2026

CLIMATE CHANGE
ENERGY
ENVIRONMENT

Ongoing projects in 2025 - 2026

Adaptation of some wastewater treatment plants for reuse purposes

STATUS	Ongoing
STARTING DATE	january 2025
DURATION	24 months
FINANCING	-
PARTNER	-

The main objective of the project is to assess the techno-economic feasibility of upgrading three wastewater treatment plants for irrigation reuse purposes, by analyzing the plant and technological modifications required to achieve the necessary treatment performance.
The plants were initially selected based on the presence of irrigation canals in their vicinity. After a preliminary screening that excluded facilities whose upgrade would require overly extensive interventions, the analysis focused on a single wastewater treatment plant, the Carmagnola CEIS plant. Based on the assessments carried out within the IRRISAFE project (LRC_FD_2023_13), three alternatives were evaluated:

- **Option 1: Installation of only a hydraulic connection to convey the effluent from the treatment plant to the Rio Moneta, without additional treatment processes beyond those already in place;**
- **Option 2: Installation of the hydraulic connection to the Rio Moneta and introduction of a second disinfection stage using UV lamps in a closed tubular reactor;**
- **Option 3: Installation of the hydraulic connection to the Rio Moneta, connection to the existing contact tank, and introduction of a second disinfection stage using peracetic acid.**

Option 1 would only be feasible for producing water compliant with reuse Class C (which can be used for food crops whose edible part is produced above ground level, not in direct contact with reclaimed water, and where irrigation techniques prevent direct contact with the edible portion), and only if Salmonella monitoring—carried out specifically for this purpose—does not show any critical issues.

Options 2 and 3 would instead be required if higher-quality reclaimed water were to be produced, for which more stringent microbiological limits apply.

"The reuse of wastewater is emerging as one of the solutions to address the growing water demand and reduce the pressure on natural aquatic ecosystems."

Analysis of the correlation between meteorological and process parameters on the formation of bulking caused by filamentous bacteria at the Chieri-Fontaneto wastewater treatment plant.

STATUS	Ongoing
STARTING DATE	may 2025
DURATION	10 months
FINANCING	-
PARTNER	University of Naples “Parthenope”

The project, born from a collaboration within a thesis work at the University of Naples “Parthenope,” aims to understand the mechanisms that led to the formation of bulking phenomena caused by filamentous bacteria at the SMAT Chieri-Fontaneto wastewater treatment plant.
The plant was recently upgraded through the introduction of an intermittent aeration system in the biological tanks, allowing nitrification and denitrification reactions to take place within the same reactor. This system uses sensors capable of detecting dissolved oxygen and ammonia levels, enabling the automatic activation and deactivation of aeration.
Following the implementation of this system, bulking (foaming) phenomena were observed in the tanks during the spring period, although such events are typically associated with the winter season. In this context, the possible role of ongoing climate change and extreme rainfall and drought events has been considered, as these may have contributed—together with the new plant configuration—to an increased frequency of such phenomena even in seasonal conditions that are not typically favorable to filamentous bacterial growth.
To this end, correlations between meteorological parameters (daily, monthly, and seasonal precipitation accumulation, and average temperatures on daily, monthly, and seasonal bases) and plant process parameters will be analyzed, with particular attention to those associated with bulking formation caused by filamentous bacteria.
Multivariate analyses (PCA and PLS) will be used to compare meteorological and process parameters in order to identify the factors that have favored the occurrence of bulking events, with particular reference to extreme climate events, and to identify possible strategies to mitigate future occurrences.

“The project will identify the climatic and plant process factors that promote bulking phenomena caused by filamentous bacteria, in order to mitigate the occurrence of future events.”

Bio-hydrogen

STATUS	Ongoing
STARTING DATE	october 2023
DURATION	20 months
FINANCING	-
PARTNER	University of Turin

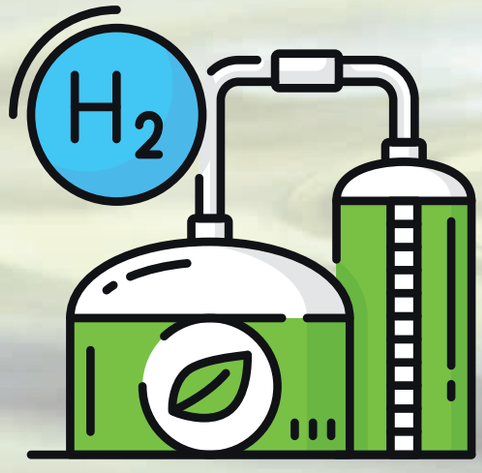
The project aims to develop and test a process for producing low-environmental-impact hydrogen based on the biological conversion of organic substances present in municipal wastewater sludge. This approach is proposed as an alternative to traditional methods such as water electrolysis or fossil-based reforming of organic sources. The study focuses on enhancing dark fermentation, a biological process for hydrogen production through the anaerobic fermentation of organic matter.

Unlike conventional anaerobic digestion, which is oriented toward biogas production, the fermentation process is characterized by very short hydraulic retention times (2–4 days). These conditions favor the conversion of organic matter into volatile fatty acids (VFAs) and hydrogen, while inhibiting their transformation into methane. In particular, the growth of methanogenic organisms is limited due to their longer growth times, which prevent them from persisting in a reactor operating under such short retention conditions.

The project also aims to optimize hydrogen production via dark fermentation through an approach based on the latest metabolic and biotechnological engineering techniques, aimed at the genetic modification of specific microorganisms belonging to the genus Clostridium.

During the last year, the most suitable microorganism (*Clostridium beijerinckii*) was selected based on productivity results and fermentation performance observed in laboratory cultures using wastewater sludge. This strain was subsequently genetically modified by introducing genes capable of enhancing biohydrogen production.

Fermentation processes using genetically modified bacterial strains were also initiated in order to evaluate biohydrogen production, optimize operating conditions, and assess process stability with a view to future sustainable industrial-scale application.



"The project aims to optimize hydrogen production via dark fermentation through a genetic modification approach targeting specific microorganisms belonging to the genus Clostridium."

LIFE CLIMAX PO:
CLIMate Adaptation for the PO river basin district

STATUS	Ongoing
STARTING DATE	march 2023
DURATION	108 months
FINANCING	Yes
PARTNER	AdBPo, AIPO, ARPAE, Arpa Piemonte, CMCC, UniBo, ANBI, Polito, Regione Piemonte, others

Climate change adaptation is one of the most important environmental challenges at both global and local scales.
The LIFE CLIMAX PO project was created with the aim of promoting adaptation to climate change through "climate-smart" water resource management at the scale of the Po River District, in line with the National Strategy for Climate Change Adaptation (SNAC) and the National Climate Change Adaptation Plan (PNACC).

CLIMAX PO is a strategic integrated LIFE project involving 25 partners, including public bodies, competent authorities, research institutes, utilities, and technical organizations operating at different levels of territorial governance.
One of the key elements of CLIMAX PO is the strengthening of adaptation governance, understood as the ability to structurally coordinate institutional levels, technical expertise, and different stakeholders around shared climate resilience priorities.

In this context, during the first three years of the project, a stable framework for discussion was established through the creation of district and regional Stakeholder Boards (Piedmont, Lombardy, Emilia-Romagna), with advisory, informative, and supporting functions for project activities. These boards helped structure stakeholder engagement, gather input for priority setting, and strengthen the institutional and technical capacity of the territory on adaptation issues.
In 2025, the Stakeholder Boards were further consolidated, the range of involved actors was expanded, and capacity-building and consultation activities were strengthened. The meetings held during the year allowed key topics to be explored in depth, including climate scenarios, multi-level governance, planning tools, Nature-Based Solutions, stormwater management, and complementary funding opportunities, contributing to a shared knowledge base and network of relationships supporting the subsequent implementation phases.

Within the project, SMAT participates both in cross-cutting work packages on adaptation governance and stakeholder engagement, and in technical work packages focused on strengthening the resilience of urban drainage networks, contributing the expertise of its Research Center in forecasting extreme rainfall events, monitoring, and defining intervention strategies for risk reduction.

"The LIFE CLIMAX PO project was created with the aim of promoting adaptation to climate change through climate-smart water resource management at the scale of the Po River Basin District"

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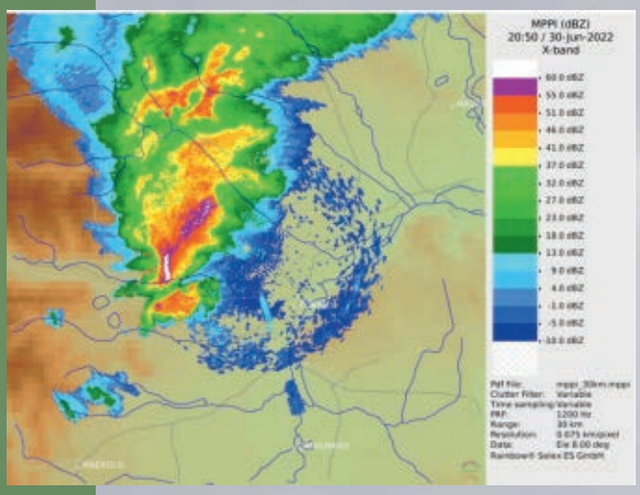
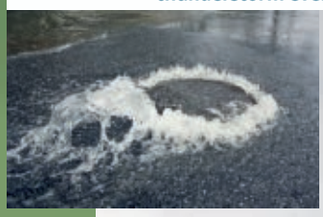
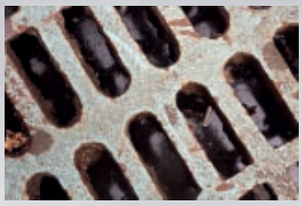
PrecipiTO: monitoring and nowcasting of high-impact precipitation phenomena



Vertical atmospheric scan detected by the Druento radar during the thunderstorm event of 30 June 2022.





STATUS	Ongoing
STARTING DATE	october 2022
DURATION	36 months
FINANCING	-
PARTNER	Arpa Piemonte

Due to its particular geographical position, the Turin metropolitan area is especially exposed to intense meteorological phenomena such as convective precipitation and hailstorms, whose frequency and intensity are increasing due to climate change.
Such events, which are becoming increasingly frequent in a changing climate and within a highly urbanized territory, place significant stress on urban drainage systems and are less precisely predictable, requiring high- and very high-resolution models in order to develop truly effective early warning systems.
In this context, the PrecipiTO project, developed by the SMAT Research Center in collaboration with the Natural Hazards Department of ARPA Piemonte, aims to reduce the risk of infrastructure damage and the costs associated with extreme precipitation events. The initiative provides SMAT operational departments with an advanced monitoring and nowcasting system for highly convective, high-impact, and rapidly evolving precipitation events, through the development of an early warning system for operational management of such critical situations, integrating data from rain gauges, weather radar, and nowcasting models.

Within the project, several key components have already been developed and completed, including:

- **the hydraulic model of the Turin urban drainage network (previously developed through a dedicated research project in collaboration with the Politecnico di Torino);**
- **the definition of reference meteorological datasets and the installation of an urban monitoring network composed of approximately 20 rain gauges;**
- **the identification of a pilot catchment for testing the solutions.**

Methodological development activities are also ongoing, aimed at integrating different data sources (rain gauges, radar, and forecasting models), local calibration of the model through sensors in sewer collectors, analysis of the spatial and temporal variability of precipitation, automation of hydraulic model-building pipelines, and correction of radar data using ground-based measurements.

Future activities include the integration of nowcasting models (also in collaboration with ARPA Piemonte) into hydraulic modelling, the development of real-time forecasting chains, the identification of bottlenecks in the drainage network, and support for the design of adaptation measures, including nature-based solutions (NbS).

"Predicting and managing water crises through a bottom-up approach based on the analysis of the risk of supply failure for drinking water use."

Seasonal-to-decadal climate predictability in the Mediterranean: process understanding and services (MEDUSSE)

STATUS	Ongoing
STARTING DATE	october 2024
DURATION	48 months
FINANCING	Yes
PARTNER	University of Barcellona, CNR-ISAC, CMCC, CIMA Foundation, University of Siviglia and others

The MEDUSSE project, selected for funding under the European COST Action program—a scheme supporting interdisciplinary research and innovation networks—aims to enhance the production, availability, distribution, and application of climate forecasts and climate services by creating a network of researchers and users.
The objective is to ensure that climate knowledge and information meet the operational needs of utilities and decision-makers, supporting the adoption of policies and plans adapted to climate challenges.
MEDUSSE aims to build a European network of experts on climate variability and predictability (MedFOR), seasonal and decadal climate forecasting (useful for operational applications such as estimating expected snow levels near mountain reservoirs), and climate services. The project, structured into three Working Groups (WG1: Climate Variability and Predictability, WG2: Climate Forecasting, WG3: Climate Services), will promote a continuous flow of information, expertise, and knowledge between researchers, stakeholders, and end users.
The project aims to:

- **Support national hydrometeorological agencies**
  - **Objective: Strengthen the capacity of national agencies in climate management and forecasting.**
  - **Action: Provide training and support to improve agency expertise.**
- **Promote continuous communication between researchers and stakeholders**
  - **Objective: Improve dialogue between scientific research and stakeholders.**
  - **Action: Facilitate ongoing communication between climate researchers and stakeholders to integrate scientific knowledge into decision-making practice.**

The initiative focuses in particular on the development of innovative and integrated approaches to address emerging challenges, promoting dialogue between different disciplines and between the scientific community and decision-makers. Main activities include the creation of thematic working groups, the organization of workshops and training schools, and the funding of Short-Term Scientific Missions aimed at knowledge exchange and strengthening cooperation between institutions.
A key role is also assigned to stakeholder engagement, in order to promote the transfer of results into practical applications and public policies. The action further places strong emphasis on the training of young researchers and the dissemination of results, contributing to the development of a more integrated European scientific community capable of jointly addressing emerging challenges in the field.
The SMAT Research Center actively participates in WG3 on climate services, contributing to the harmonized identification of target socio-economic sectors and specific application fields for seasonal-to-decadal climate forecasts, as well as the definition of indicators, methodologies, and the effective use of these forecasts in decision-making processes.

"To build a European network of experts on climate variability and predictability, seasonal and decadal climate forecasting, and climate services for operational applications."

QUALITY

Ongoing projects in 2025 - 2026

AQUAMON: Advanced QUAlity MOnitoring system of water in urbaN areas

STATUS	Ongoing
STARTING DATE	june 2025
DURATION	42 months
FINANCING	Yes
PARTNER	16 international partners

The AQUAMON project, funded by the EU under the Horizon Europe Programme, aims to ensure safe drinking water, improve wastewater treatment—including for reuse purposes—protect urban bathing waters, and restore aquatic ecosystems.
Thanks to integrated data and innovative control systems, AQUAMON contributes to strengthening the quality and resilience of water resources in Europe.
The project plans to test and validate technologies in five European cities: London, Paris, Lviv, Limassol, and Turin. SMAT, in addition to being responsible for implementing the Turin pilot, also acts as coordinator for all five use cases.

The Turin pilot is divided into three scenarios for the use of AQUAMON-developed technologies, which will be demonstrated in 2027:

- **Integrated monitoring of wastewater treatment plants and risk assessment: testing of innovative sensors for chemical quality analysis (basic chemical parameters, PFAS, and microplastics) and microbiological water quality, use of a drone for automated sludge level analysis in sedimentation tanks, and application of a tool for wastewater reuse risk assessment.**
- **Identification of illegal connections or parasitic inflows in the sewer network through the installation of a microbiological sensor and a fiber-optic-based technology for spatial temperature analysis.**
- **Application of a surface drone for monitoring a potable water storage basin, through the collection of both surface and vertical water quality data in the lagoon, as well as bathymetric data.**

"Thanks to integrated data and innovative control systems, AQUAMON contributes to strengthening the quality and resilience of water resources in Europe."

IIN2AQUAS: Human footprint on water from remote cold areas to the tropical belt. INtegrated Approach TO secure water QUAlity by exploiting Sustainable processes

STATUS	Ongoing
STARTING DATE	september 2023
DURATION	48 months
FINANCING	Yes
PARTNER	University of Turin and other 18 international partners

The IN2AQUAS project focuses on studying and developing innovative technologies against water pollution, with attention to sustainability (within a circular economy framework), through water reuse, nutrient recovery, and the green synthesis of functional materials.

The technologies developed will be adapted to diverse scenarios, with a focus on three case studies: aquaculture, arid areas, and cold (remote) regions.

The general research objectives involve three main phases:

1. **Assess water quality and predict its response to increasing environmental pressures;**
2. **Create new materials using "green" approaches;**
3. **Develop "green" water treatment technologies and integrate them into processes.**

Research activities are carried out by 15 PhD candidates. Experts from 10 universities, 4 national research centers, 1 associated university, and 4 companies collaborate in the implementation of the training program, which will allow the PhD candidates to obtain a joint doctoral degree in two different countries. SMAT, as an associated partner in the project, hosts 4 PhD candidates in its laboratories, providing state-of-the-art equipment for specialized analytical investigations and offering hands-on training.
During 2025, two PhD researchers completed their internship periods focusing on the investigation of PFAS and pesticides in raw water and wastewater, within their respective research projects.
In 2026, SMAT will host two additional PhD candidates and will organize training activities on water monitoring practices based on a risk-based approach.

"SMAT provides its state-of-the-art laboratory equipment for research and offers PhD candidates hands-on "on-the-job" training."

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TREATMENT

Ongoing projects in 2025 - 2026

iMERMAID: Innovative solutions for Mediterranean Ecosystem Remediation via Monitoring and Decontamination from Chemical Pollution

STATUS	Ongoing
STARTING DATE	june 2023
DURATION	36 months
FINANCING	Yes
PARTNER	26 international partners

The iMERMAID project, funded by the European Union under the Horizon Europe programme, aims to develop innovative solutions for water monitoring and treatment, with the goal of protecting and decontaminating the Mediterranean Sea basin from emerging contaminants (CoEC).
In the first phase of the project, innovative technologies were developed and adapted for the prevention, monitoring, and reduction of emerging contaminants in water.
SMAT, as an end-user, installed a pilot plant in spring 2025 at the Brandizzo wastewater treatment plant in order to test and validate two technologies: an electrochemical sensor for monitoring Cd, Cu, Pb, and Zn developed by the University of Florence, and a treatment system for the removal of Al, Cu, and Zn developed by the Finnish partner Weeefiner using 4D Scavenger technology.
The final treatment stage (final disinfection tank) was identified as the optimal installation point, and all preparatory activities were carried out, including electrical and hydraulic connections, procurement of reagents and equipment, and preparation of safety documentation. The technologies were successfully installed between April and May 2025.
Thanks to the pilot-scale experimentation and subsequent tests carried out by the technology providers, both technologies reached a Technology Readiness Level (TRL) of 7 (demonstration of a system prototype in an operational environment). Key Performance Indicators (KPIs) were also achieved for both technologies, specifically:

- **Monitoring of heavy metals in wastewater with detection limits below the predicted no-effect concentration (PNEC) values of 0.19 µg/L, 6.3 µg/L, 2.4 µg/L, and 14.4 µg/L for Cd, Cu, Pb, and Zn respectively.**
- **Removal efficiency of Al, Cu, and Zn from wastewater greater than 95%.**

In parallel, awareness-raising activities among young people on the responsible use of chemical substances continued.

"In spring 2025, SMAT installed a pilot plant for the monitoring and removal of heavy metals from wastewater."

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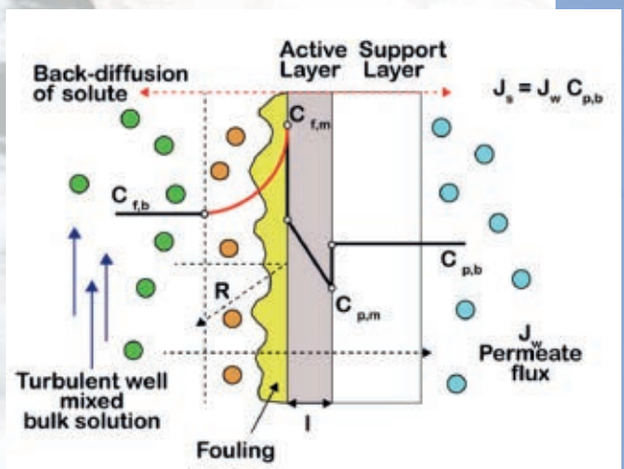
Membrane PoliTo: Hydrodynamic methods for reducing fouling in cross-flow membrane filtration processes

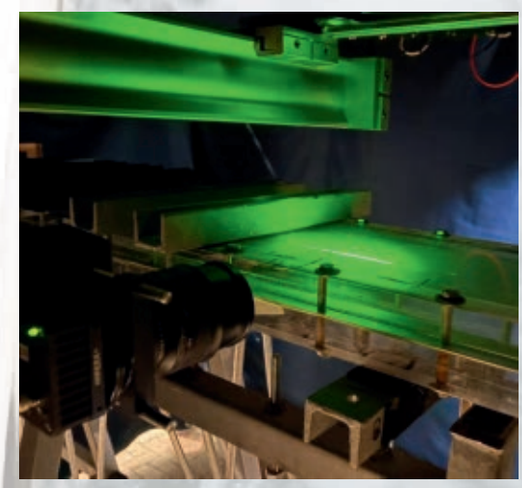
STATUS	Ongoing
STARTING DATE	november 2024
DURATION	36 months
FINANCING	Yes (co-funding)
PARTNER	DIATI - Polytechnic of Turin



The project is an industrial PhD co-funded by the Politecnico di Torino, aimed at continuing the research activities carried out in a previous PhD project by a SMAT engineer within the Clean Water Center of the Politecnico di Torino.
The previous research analyzed the response of a flat membrane in terms of fouling under different pulsating flow regimes. The distinctive feature of the study is the operation of the system under pulsating flow conditions, i.e., not in steady-state conditions, but with controlled variations in velocity characterized by amplitude and frequency. The results obtained so far show a correlation between pulsation frequency and membrane fouling: lower frequencies are more effective in reducing fouling compared to higher frequencies.

The present work aims to develop a pilot-scale industrial plant to replicate the results obtained on flat membranes. Optimizing the membrane filtration process could bring significant benefits, both in terms of reduced energy consumption and, consequently, lower operational costs.

To date, laboratory experiments have been conducted on flat membranes to isolate the effects of filtration on tangential flow characteristics under laminar, transitional, and turbulent regimes. These tests were performed both under steady-state and pulsating flow conditions. In the latter case, filtration was found to have a negligible influence compared to the effects induced by pulsation itself; conversely, under steady-state conditions, even low-intensity filtration was observed to produce measurable effects on the transition from laminar to turbulent flow. Data analysis is currently underway to clarify the underlying physical mechanisms and to support the design of a new test section that will host future experiments on pulsating-flow filtration.



"Optimizing the membrane filtration process would bring clear benefits in terms of reduced energy consumption and, consequently, lower operating costs."

QIMERA (Quaternary treatment and Intelligent Monitoring of Emerging pollutants through Reinforcement learning and AI)

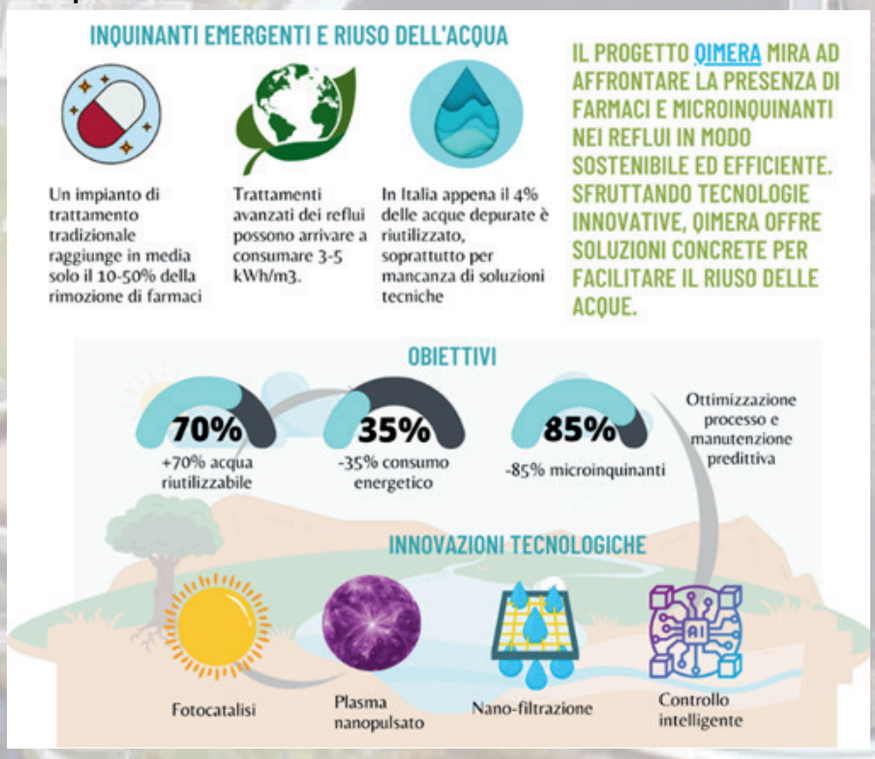
STATUS	Ongoing
STARTING DATE	december 2025
DURATION	24 months
FINANCING	Yes
PARTNER	4 Partners

QIMERA is a project funded under the SWIch call (2024 edition) of the Piedmont Region's ERDF 2021–2027 Regional Programme.
The project aims to address the presence of micropollutants in wastewater in a sustainable and efficient way, leveraging innovative technologies with the goal of developing practical solutions to facilitate wastewater reuse.

The innovative technologies for micropollutant removal involve a nanofiltration process coupled with PDP (pulsed discharge plasma) technology.
Nanofiltration will be used to separate micropollutants from the main stream entering the pilot plant, while advanced treatment systems will be applied to the permeate resulting from nanofiltration, in order to optimize the pollutant separation process.

SMAT will be responsible for installing the pilot plant fed with wastewater effluent from the Castiglione Torinese wastewater treatment plant and will collaborate with partners in monitoring and fine-tuning the system.

In addition to process innovation, QIMERA will involve a partner specialized in digital solutions, who will develop an intelligent control system with real-time monitoring to optimize performance based on artificial intelligence and machine learning.
The main innovation areas of QIMERA include pollutant removal efficiency, technology scalability, and energy consumption optimization.



"SMAT will install an innovative pilot plant for the removal of micropollutants, whose operation is regulated by a digital sensor based on artificial intelligence and machine learning."

SCAVIS: Study of the Self-Purification Capacity and Valorization of quarry lakes for the sustainable use of water resources.

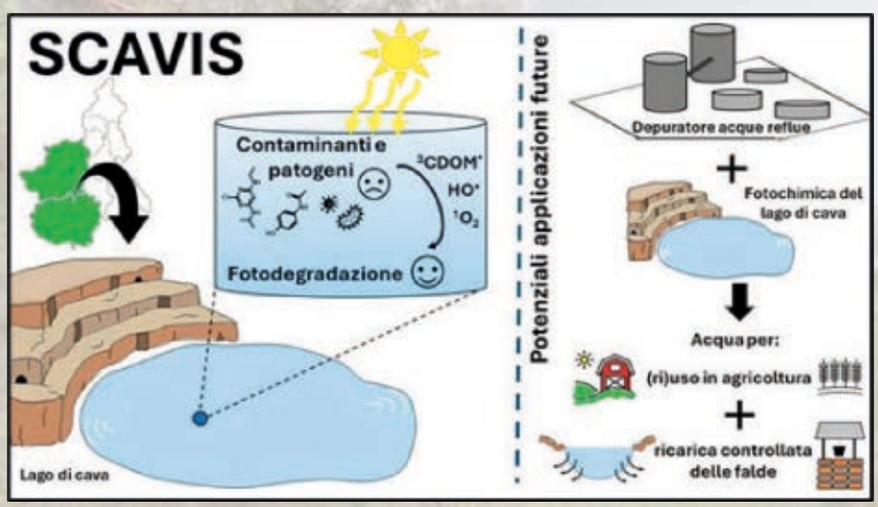
STATUS	Ongoing
STARTING DATE	march 2025
DURATION	18 months
FINANCING	Yes
PARTNER	University of Turin, Regione Piemonte

The interdisciplinary SCAVIS project, carried out by the University of Turin in collaboration with SMAT and the Piedmont Region, has the main objective of understanding whether quarry lakes (QLs) located in the Turin and Cuneo plains can be considered—either as they are or supplemented with eco-compatible oxidizing agents—potential reactors for the advanced treatment of urban wastewater.

In a natural context, photochemical processes play an important role in the degradation of emerging contaminants as well as in the reduction of microbial loads in natural waters, including lake waters. Photochemical processes are likely active in quarry lakes, although very little information is currently available on this topic. Further investigation will therefore make it possible to acquire the knowledge needed to develop predictive models of photo-induced self-purification capacity (PIC) in quarry lakes.

Based on these models, it will be possible to assess the potential use of quarry lakes as natural photochemical reactors for the removal of emerging contaminants and/or the inactivation of viruses and bacteria still present in wastewater after the full treatment cycle, including tertiary treatments, and to evaluate their possible application as a nature-based solution for quaternary water treatment.

After mapping the main quarry lakes and their hydrogeological characterization, a chemical, photochemical, and microbiological characterization of the lake waters will be carried out, together with an assessment of their ability to photodegrade such pollutants. The experimental results will then be used to develop a photochemical model capable of predicting the degradation of chemical and microbiological pollutants as a function of seasonality and possible variations in water chemical composition.



"Photochemical processes play an important role in the degradation of emerging contaminants and in the reduction of microbial loads in natural waters."

Quaternary treatments for the removal of PFAS and other emerging contaminants from wastewater.

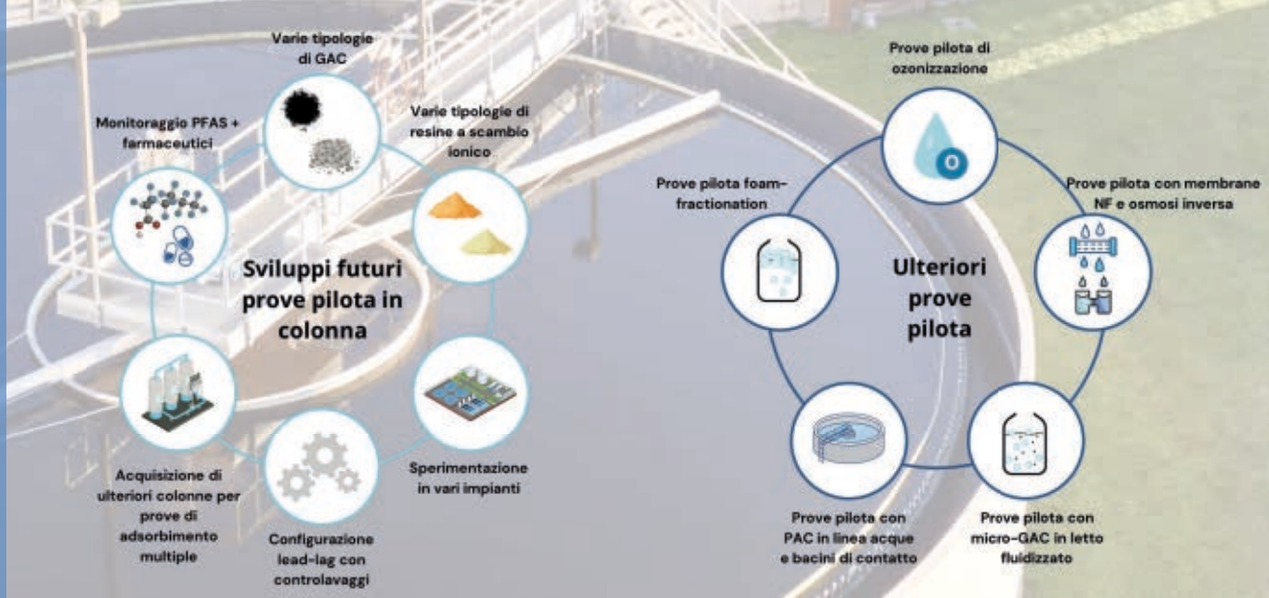
STATUS	Ongoing
STARTING DATE	may 2025
DURATION	24 months
FINANCING	-
PARTNER	-

Directive (EU) 2024/3019 introduces a significant change in urban wastewater management in Europe, shifting from a purely environmental protection approach to an integrated vision that considers wastewater as a resource, in line with circular economy principles. Among the main innovations is the introduction of a hierarchical treatment system, with more stringent requirements depending on plant size, and the progressive obligation of quaternary treatments for the removal of emerging micropollutants such as PFAS, pharmaceuticals, and microplastics.

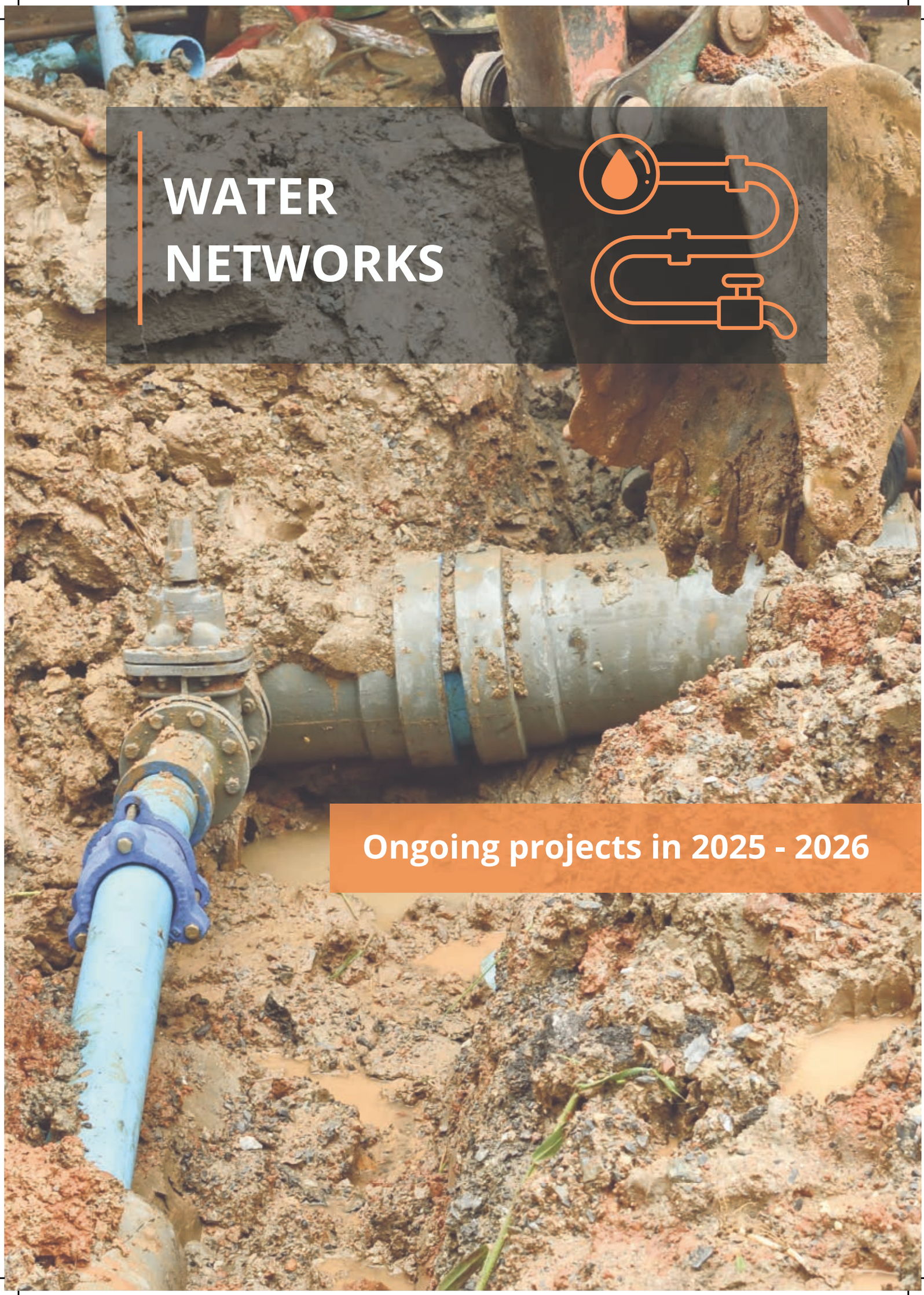
In parallel, regional legislation (Regional Law 19 October 2021, No. 25, and its subsequent extension, Regional Law 8 July 2025, No. 9) has already introduced specific limits for PFAS, making it urgent to identify effective and sustainable removal technologies. In this context, it becomes essential to develop and test plant solutions capable of meeting both current and future regulatory requirements, considering that many technologies can be applied to different categories of contaminants.

This research project fits within this framework and aims to identify the most suitable technologies for PFAS and other emerging micropollutant removal, evaluating their effectiveness across different types of wastewater streams. In particular, the focus is on quaternary treatments applied to effluents from treatment plants, as well as to more concentrated streams, in order to optimize both costs and performance.

Experimental activities include monitoring campaigns, laboratory tests on real matrices, and comparisons of different adsorption solutions such as activated carbon and ion exchange resins, as well as pilot-scale and full-scale in-plant trials. This approach enables more representative results under real operating conditions and supports the selection of the most promising technologies for industrial-scale application.



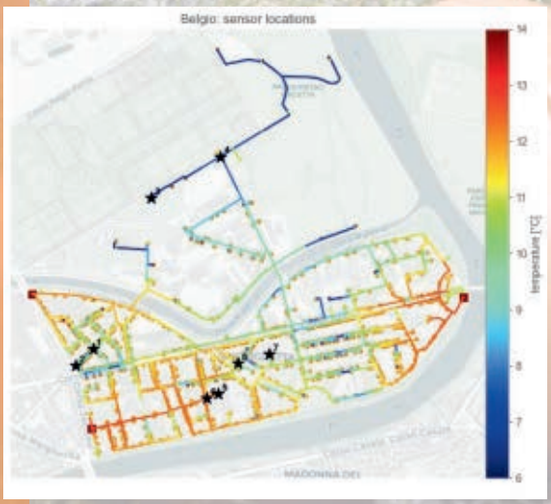
"The project aims to identify the most suitable technologies for the removal of PFAS and other emerging micropollutants, enabling the selection of the most promising solutions for industrial-scale application."



WATER NETWORKS

Ongoing projects in 2025 - 2026

Thermodynamic Digital Twin for predicting water temperature in the water distribution network.



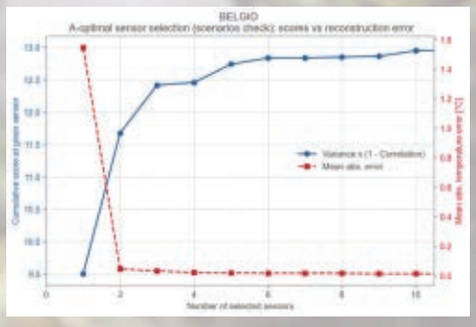
STATUS	Ongoing
STARTING DATE	april 2025
DURATION	12 months
FINANCING	-
PARTNER	OmegaLambda Tech GmBH

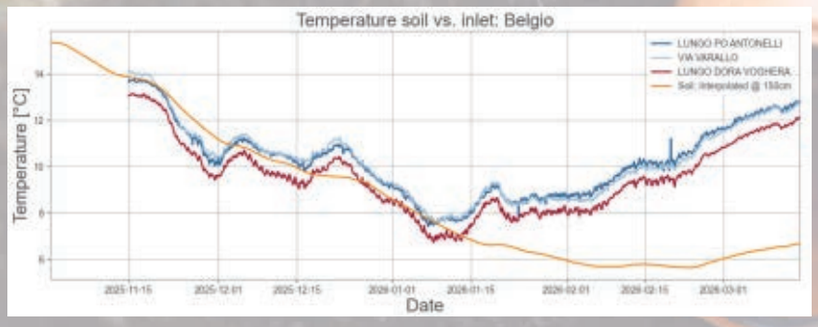
The project aims to develop an advanced digital model based on hydraulic and thermodynamic data to improve the understanding, prediction, and prevention of high-temperature hotspots in the drinking water distribution network. This innovative solution enables optimal water resource management, improving drinking water quality and mitigating the impacts of climate change. The project includes the experimental application of this technology in four pilot districts of the Turin water network:

- **Belgio (22 km network, 3 inlet points)**
- **Santa Giulia (18.8 km network, 3 inlet points)**
- **Madonna del Pilone (11.2 km network, 1 inlet point)**
- **Falchera Bassa (6.9 km network, 2 inlet points)**

The experimentation was first launched in the Belgio district, where all algorithms and analyses are being developed initially. Early results show that from mid-November to mid-January, inlet water temperature and soil temperature behave similarly, while afterward water temperature increases more rapidly than soil temperature.

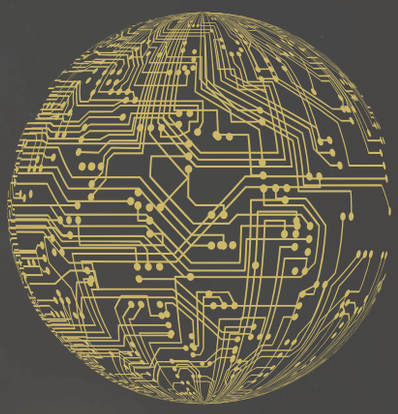
A significant part of the project focuses on optimizing sensor placement in order to minimize uncertainty in reconstructing the thermal field across the entire network. The adopted approach combines the Fisher information matrix, a noise matrix based on topological distance, and a pseudo A-optimal strategy using a greedy algorithm, validated over 64 scenarios. The key finding is that, despite the high dimensionality of the system, the observable behavior of the network is low-dimensional: a limited number of sensors (6–8) is sufficient to accurately reconstruct the entire temperature field, and the optimal sensor locations remain stable across different modeling assumptions.





"The project aims to develop an advanced digital model to improve the understanding, prediction, and prevention of high-temperature hotspots in the water distribution network."

DISTRIBUTION NETWORK



Ongoing projects in 2025 - 2026

Ecostar3 follow-up – integration of the full calculation of energy supply costs within the Ecostar3 platform.

STATUS	Ongoing
STARTING DATE	april 2025
DURATION	12 months
FINANCING	-
PARTNER	OmegaLambda Tech GmBH

The project aims to integrate the full calculation of energy cost billing into the existing platform called Ecostar3.
Ecostar3 is a web application that allows SMAT to monitor and forecast energy consumption and costs at the level of individual delivery points (PODs). The application is further enhanced with anomaly detection functionalities and scenario simulation capabilities based on EEX futures price projections.
Currently, energy cost assessment within the application is based on a simplified model in which costs are calculated by multiplying energy consumption by the energy price component. However, this approach does not fully account for the complexity of final electricity bills, which include additional cost components such as network service charges, dispatching charges, general system charges, and taxes.
The objective of this project is to integrate these additional cost components into Ecostar3, creating a comprehensive tool for the verification and forecasting of final energy bills. The project introduces an innovative approach based on scaling relationships, which represent the weight of these additional components on the final bill as a function of energy price, rather than traditional algebraic operations. This approach enables a more effective estimation of final electricity costs. Moreover, the use of scaling relationships ensures seamless integration of billing processes into the scenario simulation tool.

"The project aims to integrate the full calculation of energy cost billing into the existing Ecostar3 platform, creating a comprehensive tool for the verification and forecasting of final energy bills."

Kamstrup: technological scouting of water meters with integrated leak detection system

STATUS	Ongoing
STARTING DATE	november 2024
DURATION	24 months
FINANCING	-
PARTNER	-

The project aims to validate a new water meter recently introduced to the market by the Danish multinational Kamstrup. It is a static ultrasonic meter that integrates a leak detection technology based on the recording of noise measured by each individual meter.

The technical validity of the proposed solution was investigated within the HISA project "Optimization of leakage detection plans and water network replacement strategies," where IREN and HERA provided positive feedback on the use of this tool. Further confirmation came from a pilot project carried out by Lario Reti Holding.

As part of this project, 1,000 smart meter units will be installed across four districts in the municipality of Ciriè. The study involves replacing traditional meters with smart meters on connections with 13 mm and 20 mm diameters. The meters will be remotely read through the LoRaWAN network infrastructure that SMAT is deploying across its entire service area. The selected network districts were chosen to represent a diverse mix of residential, commercial, and industrial users.

The data collected from these meters will also be analyzed within a research project focused on advanced statistical analysis of smart meter data, with the aim of developing a leakage detection algorithm calibrated for a typical SMAT network.

"It is a static ultrasonic water meter that integrates a leak detection technology based on the noise recorded by each individual meter."

Smart Meter Big Data: Statistical Analysis and Modeling for the Analysis and Prediction of Data Collected from Water Users in the Metropolitan City of Turin.

The research project aims to apply advanced statistical analysis techniques to data from new smart water meters for end users, which use the LoRaWAN protocol for high-resolution communication. These devices provide detailed hourly consumption profiles and alarm data, with the aim of improving water resource management, preventing leaks and system anomalies, and providing customers with useful information about their consumption patterns.

STATUS	Ongoing
STARTING DATE	november 2025
DURATION	36 months
FINANCING	-
PARTNER	Polytechnic of Turin

The project is developed in collaboration with the Department of Mathematical Sciences (DISMA) of the Politecnico di Torino, within the framework of a three-year industrial PhD co-funded by SMAT.

This study proposes a Bayesian statistical approach aimed at clustering users based on temporal water consumption patterns, with particular attention to the handling of incomplete data. The method focuses on describing general usage dynamics, distinguishing between the presence of consumption and its intensity, and consistently managing missing information without requiring the disclosure of sensitive data.

Unlike most approaches in the literature, the developed model successfully addresses two key challenges of digital meter data:

- **the nature of the data recorded as cumulative water volume consumption;**
- **the handling of missing readings, due to positioning or transmission issues, which often result in incomplete datasets.**

Since classical Machine Learning algorithms are not well suited to handle these specific characteristics, a tailored approach based on recent Bayesian statistics techniques was adopted. This allows maximization of estimation accuracy while optimizing performance.

The current focus is on:

- **billing validation: comparison between observed and billed readings per user;**
- **anomaly detection: early identification of structural changes in the system or household leaks.**

The model's internal parameters provide probability estimates that, once appropriately processed, are translated into operational indicators for rapid issue detection. The developed model is currently being integrated into the company's new Meter Data Management (MDM) system.

"Apply advanced statistical analysis techniques to data from new smart water meters in order to reduce water losses and improve network efficiency."

Partnership Agreement for Advanced Research (APRE)

Ongoing activities in 2025 - 2026

1 Definition of guidelines for the calculation of the M0 macro-indicator

february 2025 - january 2026

Coordination

In partnership with

STATUS	**Ongoing**
STARTING DATE	**february 2025**
DURATION	**12 months**
FINANCING	**No**
RESEARCH AREA	**Quality**

The project aims to define a shared methodology for the calculation of the M0 macro-indicator, introduced by ARERA to assess the water resilience of water management systems, in order to support decisions related to water resource management and its sub-indicators M0a (resilience at the integrated water service management level) and M0b (territorial-level resilience).
Through a structured technical exchange between utilities, their respective EGATOs, and River Basin Authorities, the project analyses calculation criteria, estimation models, and the availability of the data required to assess resilience, addressing the main challenges related to indicator representativeness, management fragmentation, and the reliability of information on water concessions and resource availability.

Activities include the sharing of operational strategies, the analysis of scientific models and territorial data, alignment with new ARERA guidelines, and the development of evolving approaches for estimating the two sub-indicators M0a and M0b. The project also aims to establish a common methodological framework that enables water utilities to improve planning and adaptation capacity in response to climate change impacts and increasing pressure on water resources.

The project will remain active until the end of the experimental phase of the M0 macro-indicator implementation, with the sharing of strategies and critical issues ensured through at least two annual meetings.

Implementation timeline of the M0 macro-indicator within ARERA's technical quality framework.

2 Pilot study on the use of monochloramine in distribution networks with high water residence times and elevated temperatures

february 2025 - january 2026

Coordination

In partnership with

STATUS	**Ongoing**
STARTING DATE	**febuary 2025**
DURATION	**12 months**
FINANCING	**No**
RESEARCH AREA	**Distribution network**

The environmental context, characterized by climate change, increasing surface water temperatures, and new regulatory requirements (Legislative Decree 18/2023), has led water utilities to revise their disinfection strategies. In particular, the need to limit disinfection by-products while ensuring consistent water quality across increasingly extensive distribution networks has driven the evaluation of monochloramine as an alternative or complementary disinfectant to conventional methods.

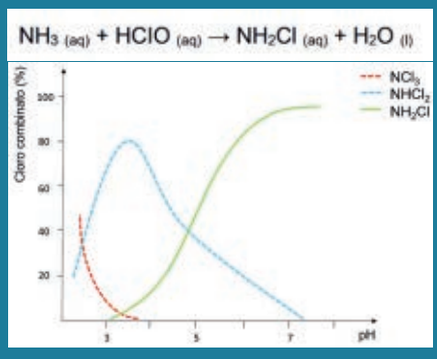
The main objective of the project activity is to compare different operational experiences in order to define shared criteria for the application of monochloramine and, ultimately, to develop a guideline that can support utilities already using or considering the adoption of monochloramine.

Conditions of use, dosing and control strategies, monitoring systems, and communication procedures with authorities and end users were analysed. This made it possible to build a comprehensive framework of benefits, limitations, and technical requirements necessary for proper implementation.

From an operational perspective, monochloramine has proven particularly effective in networks with long residence times and microbiological issues or problems related to disinfection by-product formation. Its greater stability compared to other disinfectants allows for a more persistent residual, improving biofilm control and ensuring water quality even in the most distal parts of the network. However, its implementation requires careful management, especially during the initial phases, to prevent transient effects such as taste and odour variations or mobilization of deposits.

A key outcome of the project is the importance of a structured preparatory phase, including network cleaning, baseline ("time zero") monitoring, coordination with health authorities, and effective stakeholder communication. Continuous monitoring, both analytical and operational, is also essential to ensure process control and drinking water safety.

In the future, the work carried out will serve as the basis for a shared operational guideline. This guideline will standardize procedures for the design, start-up, and management of monochloramine treatment, including technical criteria, monitoring protocols, and guidance for managing critical issues. The final goal is to provide a practical and harmonized tool to support utilities in the informed adoption of this technology, while facilitating dialogue with regulatory and health authorities.



Formation of monochloramine as a function of water pH.

3 Characterization of wastewater and management of abnormal discharges for effective plant protection and environmental safeguarding

febbraio 2025 - aprile 2028

Coordination

In partnership with

STATUS	**Ongoing**
STARTING DATE	**february 2025**
DURATION	**40 months**
FINANCING	**No**
RESEARCH AREA	**Quality**

Public sewer networks convey wastewater from domestic and industrial users, characterized by highly variable flow rates and quality. The parameters defining sewer effluents are increasingly diverse, particularly for industrial discharges, as over the past decades production technologies and chemical products used in manufacturing processes have evolved significantly, thereby altering the characteristics of wastewater entering public sewer systems.

This scenario requires integrated water utilities to develop a deeper understanding of their sewer networks and the wastewater they convey, which can vary significantly from one territory to another.
This project aims to implement more frequent and detailed monitoring of sewer systems. This approach not only enables the detection of abnormal discharges and tracing of their sources, but also improves the understanding of wastewater flows and pollutant concentrations, supporting more effective sewer network management. It also facilitates the development of engineering solutions to long-standing issues that have rarely been addressed (e.g. sulfuric acid formation, accumulation of oils and fats, etc.).
This approach enables a new paradigm in sewer network management, where wastewater can be partially managed and treated before reaching wastewater treatment plants. To ensure efficient management under this new framework, it is necessary to develop good monitoring practices capable of being sustained over medium- to long-term periods, using equipment suitable for sewer environments and with manageable costs for utilities.

The project consists of two main phases:

1. **Identification of the most efficient commercially available instrumentation to support monitoring activities in sewer networks.**
2. **Development and implementation of reliable and dynamic monitoring processes for public sewer systems while maintaining internal know-how within water utilities.**

Wastewater sewer automatic sampler

4 Energy neutrality in wastewater treatment plants: guidelines for defining achievable targets for self-production of energy from renewable sources

february 2025 - march 2026

Coordination

In partnership with

STATUS	**Ongoing**
STARTING DATE	**february 2025**
DURATION	**12 months**
FINANCING	**No**
RESEARCH AREA	**Climate change Energy Environments**

This research project, carried out in collaboration with A2A, Acquedotto Pugliese, MM, HERA, IREN, and Nepta within the APRE Research Partnership, aims to analyse the technical, economic, and regulatory implications arising from the introduction of the new European Directive 2024/3019 on urban wastewater treatment, with particular focus on the energy neutrality requirements for treatment plants.
The Directive sets the goal of achieving energy neutrality (100% of energy consumption covered by renewable sources) by 2045 for urban wastewater treatment plants serving a population equivalent of 10,000 or more. This objective is to be pursued through progressive implementation, aiming to reduce energy consumption and improve energy efficiency via operational and process optimisation and the introduction of advanced technologies. This target is particularly challenging for smaller plants, especially considering that the quaternary treatments introduced by the same Directive are expected to increase overall energy demand.

One of the main objectives of the project is to provide national policymakers with objective, data-driven insights to support the transposition of the Directive into feasible and realistic regulations. In the first phase, the project focused on a technological review and mapping of solutions currently implemented or implementable in the wastewater treatment plants operated by the partner utilities, with regard to renewable energy production and energy efficiency improvements. In this context, a comparison among utilities was conducted to consolidate strategies, technologies, and operational data from over 270 plants, with the aim of establishing a shared baseline of current energy self-sufficiency levels and identifying realistic development pathways.

In parallel, a regulatory analysis was carried out to identify potential amendments or integrations to existing legislation, in order to facilitate the implementation of the Directive's requirements, particularly concerning permitting procedures for self-production of energy.

One of the treatment line modules of the Castiglione Torinese wastewater treatment plant.

New partnership

Industrial research partnerships represent a key factor in supporting technological innovation in the Integrated Water Service and in addressing the challenges posed by evolving regulations and the increasing vulnerability of water resources. In an increasingly complex context, these collaborations enable the acceleration of the development of advanced operational solutions and promote a more efficient management of water systems.

Within this framework, the agreement with Intesa Sanpaolo Innovation Center aims to foster the development of innovation ecosystems and promote an innovation culture within the water sector. The collaboration with Thales Alenia Space renews a particularly fruitful partnership from recent years and supports the transfer of space-derived technologies to terrestrial applications, particularly in water treatment and management in extreme environments, water production from non-conventional sources, and the removal of complex contaminants using innovative materials.

INTESA SANPAOLO INNOVATION CENTER THALES

Last but not least, the collaboration agreement with the European Commission's Joint Research Centre (JRC) establishes a regular exchange of information and technical support on strategic areas of interest such as advanced technologies for wastewater treatment and reuse, water resource protection, the promotion of low-environmental-impact technologies, process optimisation, and energy efficiency.

JRC EUROPEAN COMMISSION

Publications and proceedings

E. Arnone, M. Cravero, G. Saglietto, N. Cortesi, V. Kumar Kushwaha, O. Ferguglia, E. Palazzi, R. Cremonini, **E. Brussolo** and Silvia Terzago: *A multi-model view of future extreme precipitation in the Greater Alpine Region,* EMS Annual Meeting, September 2025, oral presentation, DOI: 10.5194/ems2025-621

D. Poggio, G. Mastrantonio, **E. Brussolo** and **E. Burzio**: *A Bayesian Non-Parametric Approach to Water Consumption Clustering, Statistical Science: From Theory to Applied* Research I: SIS-FENStatS 2026, Short Papers, submitted

R. Sethi, G. Pigozzi, A. Amendola, **E. Brussolo**, **E. Burzio**, A. Casasso, D. Cocca, **D. Colombano**, D. De Luca, E. Egidio et al.: *Assessment of groundwater storage to estimate water availability for the Metropolitan City of Turin* (NW Italy), EGU general assembly 2026, oral presentation, DOI: 10.5194/egusphere-egu26-22580

D. Tiranti, V. Botto, **E. Brussolo** and C. Ronchi: *Global warming influence on shallow landslide events in northwestern Italy*, SISC 13th Annual Conference - Salerno, 22-24 October 2025, poster presentation

E. Burzio, R. Cremonini, R. Bechini, V. Campana, **E. Brussolo**: *Impact of intense convective storms on urban drainage system in Turin – Integrating meteorological data and predictive modelling,* Urban Drainage Modelling Conference (UDM) – Innsbruck, 15-19 September 2025, poster presentation

Oral presentation

S. Steffenino: "*Esperienze dei gestori del Servizio idrico integrato sui PSA", presentazione nel webinar di Utilitalia "Piani di Sicurezza dell'Acqua*", on-line 26 giugno 2025

E. Brussolo: *Acqua: la nuova grande sfida Il futuro dell'acqua, tra prevenzione, gestione e adattamento ai cambiamenti climatici. Buone pratiche di gestione delle risorse idriche e del ciclo idrico integrato in un clima che cambia.* The Water Code, 21 gennaio 2025, Perugia

E. Brussolo: *River Cafè del Piemonte*, 21 novembre 2025, @ Life CLIMAX PO, Museo Regionale di Scienze Naturali, Torino

E. Brussolo: *Perché ci manca l'acqua?* Podcast Festival della letteratura di Mantova, https://www.festivaletteratura.it/it/podcast/gocce/

E. Brussolo: *CLIMate Adaptation for the PO river basin district (ClimaX PO)*. Notte dei ricercatori, Torino – 27 settembre 2025

G. Scibilia: *Circular economy and resource recovery in SMAT urban wastewater treatment*. International Forum on Industrial Biotechnology and Bioeconomy, 26 settembre 2025, Torino

M.C. Valoroso: *Sviluppo di un processo di dark fermentation di fanghi di depurazione per la produzione di bio-idrogeno mediante clostridio ingegnerizzato*. Notte dei ricercatori, Torino – 27 settembre 2025

E. Burzio: *Esempi di Nature Based Solutions (NBS) e buone pratiche nel servizio idrico integrato, II Seminario per le PA -Piemonte* -LIFE Climax Po –7 maggio 2025

G. Cecconi: *Presentazione "iMERMAID Use Case 3 - Demonstration of innovative solutions for the removal and monitoring of heavy metals from wastewater*. 5th Stakeholder Event Water Bridges: Connecting Communities for Sustainability", Banja Luka (Bosnia Ed Herzegovina) – 26 Agosto 2025

G. Cecconi: *iMERMAID: Soluzioni innovative per il monitoraggio e la decontaminazione del Mar Mediterraneo dai Contaminanti Emergenti.* Notte dei ricercatori, Torino – 27 Settembre 2025

G. Cecconi: *Presentazione "iMERMAID Use Case 3 - Demonstration of innovative solutions for the removal and monitoring of heavy metals from wastewater"* nel webinar di Blue Mission AA "Unmanned Systems & Digital Innovation: Enabling Advanced Monitoring and Sustainable Solutions in the Blue Economy", on-line, 1 Ottobre 2025

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Inauguration of the Orco Valley aqueduct

With the ribbon-cutting ceremony held on Saturday, 28 March at the new drinking water treatment plant in Locana (Praie hamlet), the Orco Valley Aqueduct has officially become a reality. The project, presented in November 2023, was completed in just twenty-eight months—an important milestone that demonstrates SMAT's operational efficiency in responding to the territory's infrastructure challenges.

The infrastructure, one of the most significant projects included in SMAT's Industrial Plan, involved the construction of a water intake structure at Bardonetto, a large treatment plant with a capacity of 800 L/s, a storage reservoir in Locana (Praie hamlet), and a distribution network approximately 140 km long, interconnected with the networks of 50 municipalities and serving a population of around 130,000 inhabitants.