



Research activities

2023 | 2024

SMAT Research Center

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Research activities

YEAR 2023/2024



SMAT Research Centre

The SMAT Research Centre is a reference point in the field of water resources management and innovation in the integrated water service, with a multidisciplinary team facing the challenges posed by the effects of climate change, increasingly stringent regulations and the emergence of new criticalities. Water utilities must guarantee the quality and continuity of the service, in spite of these impacts, while contributing to the achievement of the objectives of the 2030 Agenda for Sustainable Development.

Through the study, adoption and development of new technologies and warning and forecasting systems, the implementation of innovative processes, digitalisation and process optimisation, SMAT, as a public company, aims to find efficient solutions for waterworks, treatment and sewerage services, to maximise energy efficiency while reducing climate-changing emissions, and to minimise the impact of climate change on water resources, infrastructure and water services as a whole. This proactive approach will enable us to address current challenges related to the sustainable management of drinking water, expand research areas and potential, contribute to the industrial development of the country's water sector and be at the forefront of innovation, helping to preserve and protect water resources for present and future generations.

The SMAT Research Centre stands out for its ability to integrate a wide range of scientific and technical expertise, working closely with universities, public and private bodies and international organisations. This synergy makes it possible to develop cutting-edge solutions for the management of water resources, which are essential to address critical issues at a time when water scarcity and extreme weather events are becoming more frequent.

Through the use of innovative and digital technologies, the SMAT Research Centre is able to efficiently monitor and manage water resources, improving the resilience of the managed area, communities and ecosystems as a whole.

The sustainability approach developed through the projects carried out by the SMAT Research Centre not only promotes the conservation of resources, but also helps to reduce the environmental impact of processes and encourages the development of more environmentally friendly practices, adopting a flexible and adaptive approach that translates into a decision-making process based on solid scientific knowledge, capable of bringing tangible benefits both at company level and for the territory in which SMAT operates.

Armando Quazzo

CEO

Paolo Romano

President

May, 2024

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Energy/Environment/Climate Change



A bottom-up approach for water scarcity risk management

STATUS	Completed
STARTING DATE	July 2021
DURATION	24 months
FUNDING	No
PARTNER	Arpa Piemonte

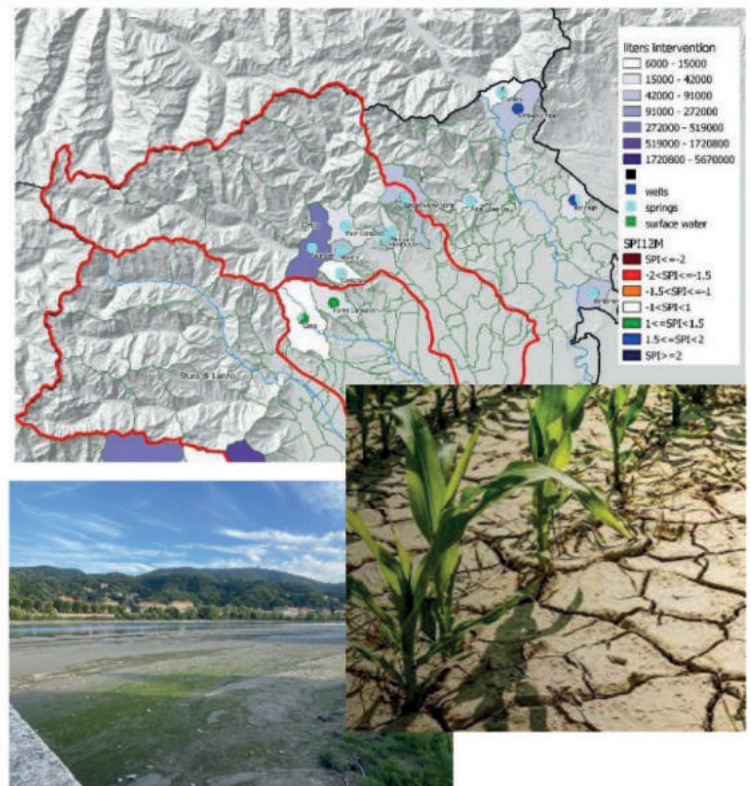
Piedmont is located between the Alps and the Mediterranean, two areas recognized as climatic hotspots that are showing increased signs of climate change, with environmental, social and economic impacts.

The numerous water crises that have affected the Italian territory over the last two decades have exacerbated conflicts in different areas over the priority use of water resources. The most recent droughts (2017, 2021 and 2022) have plunged areas not normally prone to this type of phenomenon, such as the Piedmont region, into a crisis involving all water users and human activities.

The implementation of decision support systems that are both simple and effective in anticipating severe drought events, and capable of supporting the management of these events, emergency planning and management, are key aspects in the development of adaptation strategies that are useful in reducing vulnerability to drought and its impacts.

Drought can be defined in different ways (meteorological drought, agricultural drought, hydrological drought, socio-economic drought) depending on the intensity, duration and impact of the phenomenon and the assessment of the characteristics of these events is done through the analysis of selected drought indices and hydro-meteorological observations. The goal was to identify the most functional meteorological-hydrological precursors of water crises for the area managed by SMAT, in order to move from meteorological-hydrological drought to socio-economic drought, and to guide water management and decision making with a sound scientific basis.

After identifying the events that led to the distress of drinking water supply sources, the most appropriate standardised drought indices for the study area were analysed: the index related to (i) the effective precipitation (SPEI - Standardised Precipitation-Evapotranspiration Index), (ii) the runoff processes (SRI, an index based on the assessment of the probability of observing a certain average monthly flow) and (iii) the snow resources accumulation (SSPI, an index based on the probability of observing a certain value of snow water equivalent). Finally, a blended drought index was developed by combining the three standardised indices mentioned above (at different time scales), thus reconstructing the entire hydrological cycle of an area such as the one managed by SMAT, where snow resources play a key role. This index proved to be sufficient to predict the most critical events 1-2 months in advance. In fact, analyses have shown a delay in the response of the supply system, particularly for networks fed by springs, which go into crisis when the index takes negative values (and remains so for at least two months).



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

Ecostar3 – European incubator REACH 3rd round

STATUS	Completed
STARTING DATE	February 2023
DURATION	12 months
FUNDING	No
PARTNER	OmegaLambdaTec GmbH

REACH is a second-generation European incubator for startups and SMEs that use Big Data and aims to facilitate the development of reliable and secure innovative solutions based on industrial data. The funding mechanism provides economic support to a startup (OmegaLambdaTec GmbH or SME, which deals with solving a challenge proposed by a third party (SMAT).

The screenshot shows a 'Scenario Definition' form with the following elements:

- Choose Scenario Year:** Radio buttons for 'This year' and 'Next Year' (selected).
- Price [%]:** A slider ranging from -100 to 300, with a value of 0 selected.
- Uptake Energy Efficiency (Captazione) [%]:** A slider ranging from -30 to 30, with a value of 0 selected.
- Depuration Energy Efficiency (Depurazione) [%]:** A slider ranging from -30 to 30, with a value of 0 selected.
- Distribution Energy Efficiency (Distribuzione) [%]:** A slider ranging from -30 to 30, with a value of 0 selected.
- Purification Energy Efficiency (Potabilizzazione) [%]:** A slider ranging from -30 to 30, with a value of 0 selected.
- Self-Production (PV, Hydro, Wind) [kWh]:** A slider ranging from 0 to 1600, with a value of 0 selected.
- Update:** A blue button at the bottom.

Find out more: <https://www.reach-incubator.eu/>

SMAT CHALLENGE: develop a tool capable of estimating the expenses for energy procurement over a specific period (e.g., a month), based on historical consumption data and providing a graphical overview and report analysing the variation in energy prices.

The complex challenge or sub-challenge consists of developing a model that compares a short-term energy consumption period (e.g., the first three months of the current year) with a historical energy consumption profile (e.g., the entire previous year), evaluating the deviation (increase in energy demand or energy-saving policies for each distribution point). Additionally, the model must predict the impact on expenses based on the different future evolution of market prices, relying on EEX energy market futures.

The project partner OmegaLambdaTec GmbH, with the support received during the incubation period, has developed a new web platform consisting of five modules focused on monitoring, managing, and optimizing energy consumption:

Overview: provides a dashboard for a summary of consumption across all SMAT plants.

Anomaly Detection: flags consumption anomalies, facilitating the identification and correction of inefficiencies.

Accounting: simplifies electricity billing verification, improving accounting transparency.

Forecast: provides a forecast of the remaining annual expenditure for electricity procurement.

Scenario Simulator: allows future simulations of electricity expenditure with varying parameters.

This platform offers more accurate control over energy consumption, with obvious economic benefits. Thanks to its ability to identify anomalies, optimize billing, and predict future costs, the developed solution is a valuable resource for companies looking to reduce energy costs. Moreover, the project has been selected among the 6 winners of the incubation process.

"The solution is a valuable resource for companies looking to reduce energy costs"

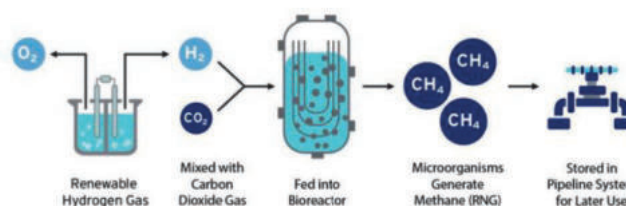
POWER-TO-GAS: hydrogen production and methanation

STATUS	Completed
STARTING DATE	June 2020
DURATION	36 months
FUNDING	No
PARTNER	Polytechnic University of Turin



“Power-to-gas” is a promising approach as a solution to the lack of programmability of renewable energy sources, especially photovoltaic and wind power. This is the possibility to convert the renewable source energy over-productions into combustible gas (therefore transforming the electrical energy into chemical energy) that can be stored and transported.

An example is the electrochemical production of hydrogen which is, however, an energy vector with a still limited diffusion because of the lack of infrastructures.



Until hydrogen economy will be fully developed, combining “green” hydrogen with biogenic CO₂, to produce renewable methane enables the use of natural gas distribution grid for storing and transporting, in chemical form, the excess of renewable energy in case of overproduction. With this perspective, wastewater treatment plants represent an excellent location for power-to-gas installations, for at least a couple of reasons:

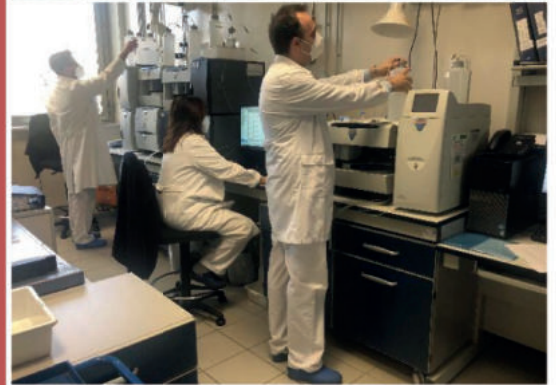
in plants equipped with anaerobic digestion, CO₂ in biogas could be combined with hydrogen in order to produce additional renewable methane (biological methanation).

besides hydrogen, also oxygen is generated from water hydrolysis, which can be favourably used for the aeration of aerobic biological processes of wastewater treatment.

During the project we set up two laboratory reactors and we performed tests of biological in-situ and ex-situ methanation of hydrogen. The first type of process involves the injection of hydrogen into an anaerobic digester in which part of the CO₂ in the biogas binds with the injected hydrogen, forming new biomethane. The second type of methanation (ex-situ) involves the use of a reactor (often with attached biomass) dedicated to hydrogen conversion. During tests, process operating parameters were optimised and energy yields were measured. Finally, preliminary technical-economic evaluations were carried out for the introduction of the technology in wastewater treatment plants.

“Wastewater treatment plants represent an excellent location for power-to-gas installations”

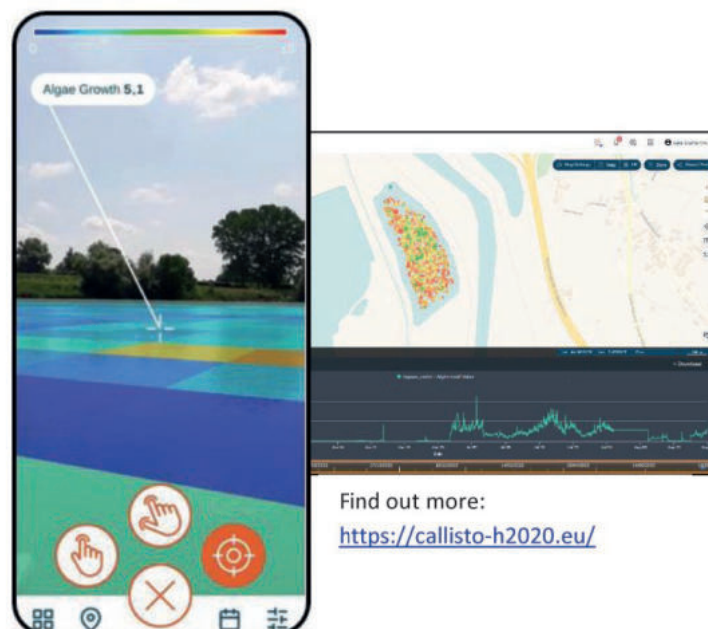
Analysis/Quality



CALLISTO: Copernicus Artificial Intelligence (AI) Services and data fusion with other distributed data sources and processing at the edge to support DIAS and HPC infrastructures

STATUS	Completed
STARTING DATE	January 2021
DURATION	36 months
FUNDING	Yes
PARTNER	Serco S.p.A and other 15 international partners

The ever-increasing availability of satellite data and the existence of initiatives that contribute to the dissemination of useful services, even for non-specialist users, provide an opportunity to explore the possibilities offered by Earth Observation in various application areas.



Find out more:
<https://callisto-h2020.eu/>

With this in mind, over the last three years SMAT has participated in a project funded by the European Union under the Horizon 2020 programme, CALLISTO; the aim of the project is to bridge the gap between data providers (DIAS providers) and end users by creating four scenarios in which satellite data, integrated with other types of data (from in-situ sensors, drones, social media), are processed through the use of Artificial Intelligence with the aim of providing services. The four selected sectors are very diverse, ranging from agricultural policy monitoring to water quality monitoring, from journalism to border surveillance.

SMAT, together with another Integrated Water Service operator, De Watergroep, participated in the testing of products developed for monitoring water quality in drinking water reservoirs; a platform was created for the integration of the various products developed by the technical partners, together with the data already available to the operator, in order to create an integrated monitoring system.

Thanks to this project, it was possible to evaluate, for example, how to use chlorophyll concentration maps (which provide spatial information with a temporal frequency > 5 days) and integrate them with existing monitoring (which provides continuous but point-type information), as well as how to exploit Augmented Reality to visualise this information directly in the field and, finally, how to use information from social media which, if properly managed, can provide useful information on events concerning water quality in the area of interest.

“SMAT participated, together with another Integrated Water Service operator, De Watergroep, to test products developed for monitoring water quality in reservoirs for drinking water purposes”

Development of an information technology platform for the implementation of water safety plans

STATUS	Completed
STARTING DATE	January 2023
DURATION	12 months
FUNDING	No
PARTNER	NeraTech srl



powered by



Since 2016, SMAT Research Center has been working on the Water Safety Plans (WSPs) with the aim of defining a model to be applied, over time, to all aqueduct systems. This activity was first carried out with internal resources and later expanded through a collaboration with the Istituto Superiore di Sanità (ISS), thanks to which the WSP of the City of Turin was verified and completed.

In 2023, as a result of the experience gained, the need arose to develop an IT tool to support risk assessment and management, in order to ensure the homogeneity of the WSP implementation and to decrease the time required to implement them, given the significant amount of aqueduct systems managed by SMAT.

The tool was realized as a web-application thanks to the collaboration with a company specializing in the development of GIS and custom software solutions.

The application was designed by SMAT Research Center and was built completely in an open-source environment, from the programming language to the database supporting the data.

This type of architecture allows for lower operating costs and maximum flexibility and compatibility with third-party applications. Automated tasks included the construction of the risk matrix and the analysis of historical analytical data managed by SMAT Laboratories.

The platform guides the user through the compilation of the risk matrix in all its stages, from the identification of hazardous events and hazards, the calculation of the initial risk, the definition of control measures to the recalculation of the final risk and finally the definition of improvement actions. In addition, it is customizable with the specific evaluation criteria established by SMAT.

"The application was designed by the SMAT Research Center and was implemented completely in an open-source environment. Automated tasks included the construction of the risk matrix and the analysis of historical analytical data managed by SMAT Laboratories"

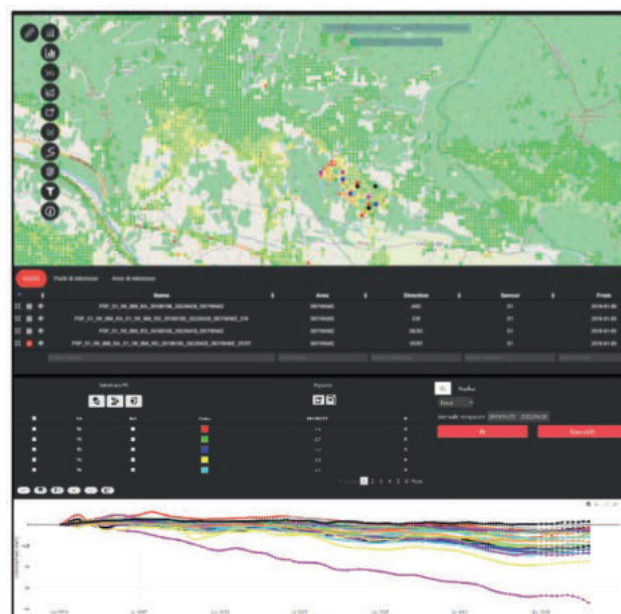
Water networks



Feasibility study for the provision of a remote monitoring service for leakage detection in the water distribution network

STATUS	Completed
STARTING DATE	November 2021
DURATION	20 months
FUNDING	No
PARTNER	DigiSky, ESA, EnelX, e-Geos

In 2021 SMAT joined a feasibility study, promoted by DigiSky together with ESA and EnelX, in collaboration with e-Geos, to assess the effectiveness of remote sensing systems in detecting leaks in the distribution network. The current approach to leak detection is costly because it must be carried out step-by-step to cover the whole distribution network; the use of remote sensing, on the other hand, would make it possible to investigate large areas in a short time.



The project focused on three remote sensing technologies: an airborne thermographic camera to detect thermal anomalies on the surface, an airborne L-band Synthetic Aperture Radar (SAR) to detect changes in the dielectric constant of the ground in areas with known leaks, and satellite remote sensing to detect subsidence phenomena using an X-band SAR.

The first technology tested did not produce significant results, while the data acquired by the L-band SAR radar was pre-processed but requires more advanced processing techniques to extrapolate accurate information. On the other hand, the data collected by the X-band SAR radar (three-year historical series from 2019 to 2022) were processed and made available on a platform dedicated to the analysis of subsidence in the area served.

"Satellite data, combined with data acquired by aerial systems, were processed in order to identify water leakages in the water distribution network"

Methodologies and tools for the optimisation of leak detection and water network replacement plans

STATUS	Completed
STARTING DATE	March 2022
DURATION	22 months
FUNDING	No
PARTNER	No



The project is part of the initiatives envisaged by the partnership agreement between A2A - Hera - Iren - Smat aimed at management effectiveness and efficiency, favoring the adoption of innovative solutions in terms of technology and management practices.

The project aims to analyze and select the best practices and the most effective tools for optimization:

- the scheduled search plans for leaks;
- network replacement plans.

The activity underlying the project consists of sharing significant experiences related to:

- tests (of any level and extension) of innovative technologies proposed by the market;
- methods and algorithms developed in-house.

The project intends to develop the following macro-themes:

- methods and technologies for pre-localization and localization of losses;
- algorithms and tools for selecting and prioritizing "critical" sections in support of the definition of planned loss research plans and water supply network replacement plans.

The sharing of project partners' experiences has been summarized in a document that collects all the technologies tested and assigns a score from 1 to 5 for each in terms of effectiveness and cost. For each technology, a brief overview has been provided regarding its application methods to contextualize the results more precisely. In total, 9 aspects have been evaluated: predictive maintenance, SAR from aircraft, SAR from satellite, cosmic rays, smart ball, counters with acoustic sensors, transient pressure analysis, fixed multi-correlators, materials for network renewal. The final document remains available to partners to guide future applications towards the technologies that have proven most effective and reliable.

"The project is part of the Partners' initiatives oriented towards effectiveness and management efficiency, favouring the adoption of innovative solutions in terms of technology and management practices"

Hydraulic modelling and criticality analysis of the drainage network of the city of Turin

STATUS	Completed
STARTING DATE	December 2020
DURATION	36 months
FUNDING	No
PARTNER	Polytechnic University of Turin



The last large-scale analysis of Turin's urban drainage network was carried out about 50 years ago. Since then, three events have occurred that have significantly altered the hydraulic framework: (i) the change in land use in the drained area, (ii) the construction of new works, and (iii) climate change.

The urban change that the town has undergone in the last 50 years is evident, with a sharp increase in the waterproofing of the surfaces and the growth of the drainage areas. In several areas of the Turin area, the situation is so compromised that the establishment of new residential and / or industrial areas could be fatal for the urban drainage system.

Another key aspect is the imminent construction of the new Turin median collector. This is a work destined to have a strong impact on the structure of the urban outflow and which, if properly harmonized with the hydraulic context of the existing network, can make a fundamental contribution to making the Turin drainage system safe in future decades.

Finally, there are climate changes, which are evident to everyone in daily experience. In particular, the increase in very intense events, precisely those that most create problems for the drainage network.

In this framework, a thorough and complete analysis has been carried out of the current network, how it can respond to the increasing pressure in the coming years, what measures can be taken to reduce the risk of overflows and bursts, and how it can hydraulically interact with the new median collector.

"A thorough and complete analysis has been carried out of the current network, how it can respond to increasing pressure in the coming years, what measures can be taken to reduce the risk of flooding and bursting, and how it can hydraulically interact with the new median collector"

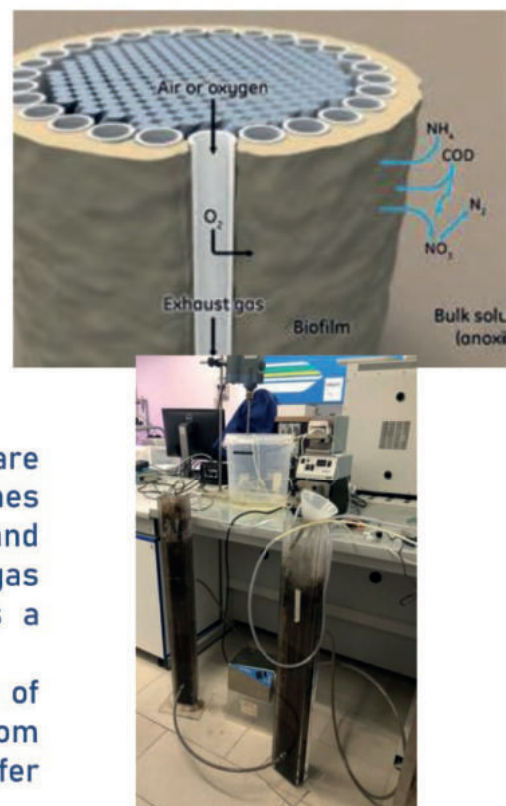
Treatment



MABR

Membrane Aerated Biofilm Reactor

STATUS	Completed
STARTING DATE	June 2020
DURATION	36 months
FUNDING	No
PARTNER	Polytechnic of Turin



Biological wastewater treatment processes are notoriously energy intensive, especially the aerobic ones that consume oxygen for the oxidation of organic and nitrogen substances. In fact, oxygen transfer from gas phase to liquid phase (namely the dissolution) is a relatively limiting factor.

Common aeration systems, based on the production of small air bubbles through diffusers installed at the bottom of the tanks, are characterised by an oxygen transfer efficiency generally in the order of 20%.

A recent and really promising technological innovation, called MABR (Membrane Aerated Biofilm Reactor), provides for the use of hollow fibre membrane for oxygen transfer in liquid phase. Air is blown inside the hollow fibres immersed in oxidation tanks and oxygen is directly consumed by biomass developed on membrane external surface. By this way there is not more need for producing air bubbles to achieve oxygen transfer, and aeration energy efficiency is greatly increased. Moreover, oxidising conditions develop only inside the biofilm at membrane interface, making possible the denitrification, in anoxic conditions, in the same biological reactor.

As part of the project, we set up a laboratory pilot MABR and, in a first experimental phase in fed-batch mode (semi-continuous) with synthetic wastewater, we performed oxygen transfer efficiency measurements in order to identify optimal aeration conditions. Lately, with real wastewater sampled at the Castiglione T.se plant, we performed experimental tests with a continuously fed reactor, finding oxygen transfer efficiencies (OTE) of over 17 kg O₂/kWh, well above conventional aeration systems.

"The research project aims to test the performance of MABR technology to increase oxygen transfer efficiency in wastewater treatment processes"

Ongoing projects in 2023

Energy/Environment/Climate Change

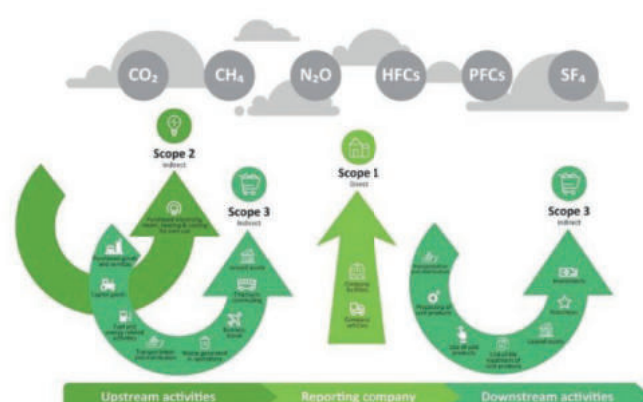


Greenhouse gas emission reporting: identification of shared methods for applying international guidelines (GHG protocol, IPPC) to the integrated water service and quantification of emissions from biological wastewater treatment

STATUS	Ongoing
STARTING DATE	April 2022
DURATION	24 months
FUNDING	No
PARTNER	Hera SpA, Iren SpA, A2A ciclo idrico



GREENHOUSE GAS PROTOCOL



The project is part of the Partners' initiatives to share experiences and develop common methodological approaches.

The objective of the project is the identification of a shared methodology among the Partners for reporting greenhouse gas emissions in order to obtain comparable results.

The carbon footprint of integrated water service companies is closely linked to a not entirely standardised declination of reference guidelines.

One of the reference standards, also referred to in the ARERA resolution (917/2017/R/idr), indicates that the calculation must follow the 2012 UNI EN ISO 14064-1 standard, which expresses the emissions in terms of CO₂ equivalent. However, this standard contains general prescriptions, not specifically declined for the SII or for the wastewater service, and therefore requires assumptions and hypotheses in order to contextualise its application to the reference production context.

The project aims to define a common approach, for the integrated water service sector, that will make it possible to overcome the variability associated with the calculation methodologies applied, the emission factors used, the scope categories taken into consideration and the organisational and operational boundaries which, in the various applications, may have taken on different dimensions.

"The project aims at defining, for the integrated water service sector, a common line of approach for the calculation of greenhouse gas emissions"

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

STATUS	Ongoing
STARTING DATE	June 2022
DURATION	24 months
FUNDING	No
PARTNER	CNR-IRSA, Protezione Civile, Arpa Piemonte

In the last two decades, the national and regional territory has been affected by numerous water crises, which have affected the main water-using sectors, exacerbated conflicts between these sectors in different territories (regarding the priority use of the resource) and required the implementation of emergency procedures to manage the consequences. The term water crisis is used to identify the phenomenon of water scarcity reaching a level of severity that requires a series of procedures to manage the phenomenon.



The identification of early warning indicators of scarcity, understood as the inability of a system to meet the water needs of its connected users, must take into account the variability of meteorological forcings and medium- to long-term climatic trends, as well as the specific infrastructure and management characteristics of each system.

The decision support tool called INOPIAQGIS, developed within the framework of the collaboration agreement between the Department of Civil Protection and the Water Research Institute of the National Research Council, allows an immediate assessment of the risk of failure to meet demand (water shortage) caused by conditions of significant resource depletion as a result of persistent precipitation anomalies.

The subject of the INOPIAQGIS analysis is a multi-resource-multi-utility system that allows the implementation of the topological scheme of any water system that draws on different types of resources (surface reservoirs, underground reservoirs, springs, drinking water treatment plants, etc.) and feeds a multiplicity of resources. INOPIAQGIS incorporates the indications of the Guidelines on Water Droughts and Scarcity Indicators to be used in the activities of the District Observatories for the Use of Water Resources drawn up by ISPRA.

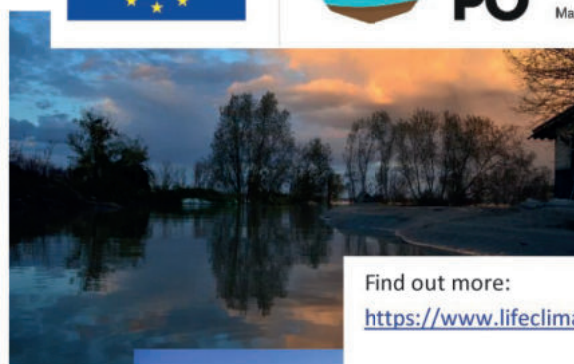
In this context, this research project foresees the application and customisation of the INOPIAQGIS operational decision support system on a first case study, in order to have an early warning system for water crises, in order to increase the ability to anticipate and manage risks in the Turin area. In collaboration with IRSA-CNR, the Department of Civil Protection and Arpa Piemonte, the feasibility of using within INOPIAQGIS the rainfall deficit quantification indices already calculated by Arpa and used to issue monthly hydrological bulletins will be evaluated.

The case study identified the city of Turin as a priority area for this type of project, in order to test the system on a supply chain with a very high level of complexity and supply from multiple sources.

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

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

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



Find out more:
<https://www.lifeclimaxpo.adbpo.it/>

Adaptation to climate change is one of the most important environmental challenges, both globally and locally, requiring urgent responses and extensive governance and planning activities.

The Mediterranean area is one of the so-called hot spots of climate change, and the LIFE CLIMAX PO project has been set up with the aim of promoting adaptation to climate change through "climate-smart" management of water resources at the scale of the Po River Hydrographic District, supporting the implementation of the National Strategy for Adaptation to Climate Change and working in collaboration with the National Plan for Adaptation to Climate Change (PNACC).

CLIMAX PO is an integrated strategic LIFE project involving 25 partners, including water management agencies and companies at all levels of government, national, inter-regional, regional and local public bodies, research institutes, environmental and consultancy associations.

CLIMAX PO aims to promote and support a multi-level governance arrangement with dedicated task forces to strengthen a coordinated planning approach at national, regional and local levels and to ensure:

- Financial and technical coordination
- The production of shared climate knowledge through the implementation of specific tools and methodologies;
- Capacity and awareness building;
- Improving water security and climate resilience through pilot actions that can be replicated within and beyond the river basin;
- Mobilisation of complementary funding and activation of public participation.

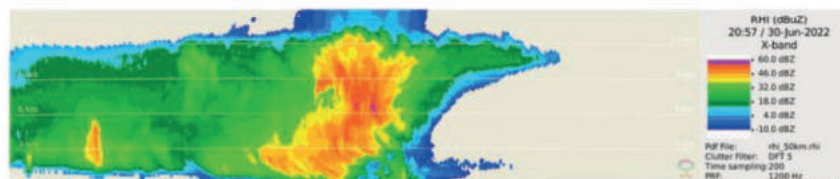
Within the project, SMAT will improve the climate resilience of urban drainage networks by providing adequate monitoring tools and effective intervention plans for risk management. In this context, the SMAT Research Centre will provide its expertise in predicting extreme weather events affecting urban drainage infrastructures and in defining and sharing intervention strategies.

"The Life ClimaX Po project was created with the intention of promoting adaptation to climate change through climate-smart management of water resources at the scale of the Po River Basin District"



PrecipiTO: monitoring and nowcasting of high-impact precipitation phenomena

STATUS	Ongoing
STARTING DATE	October 2022
DURATION	24 months
FUNDING	No
PARTNER	Arpa Piemonte



Precipitation phenomena capable of creating criticality and risk situations can be divided into: (i) meteo-pluviometric events with a large spatio-temporal extension and longer forecast times (flood-type phenomena), and (ii) meteo-pluviometric events that are highly localised in space and of short duration, of a strongly convective type, with very rapid evolution and associated with destructive phenomena (hail, flash floods, downbursts, ...).

These latter events, which are becoming more frequent in a changing climate and in a highly anthropized area, are less predictable and require high and very high resolution models in order to develop truly effective early warning systems.

In this context, SMAT manages some infrastructures that are particularly critical to intense and localized precipitation events, such as underpasses, and in order to improve the management and safety of these infrastructures, PrecipiTO aims to provide the company with an alert system for the best possible management of meteo-hydrological criticalities related to intense and rapidly evolving precipitation events. To this end, a short-term forecasting service (nowcasting) will be developed, integrating high-resolution numerical models and observed precipitation data with an equally high spatial resolution, homogeneous over the territory and accurate, in order to carry out an appropriate validation (and calibration) of the modelling chain.

The project, developed with the Natural and Environmental Risks Department of ARPA Piemonte, consists of three phases:

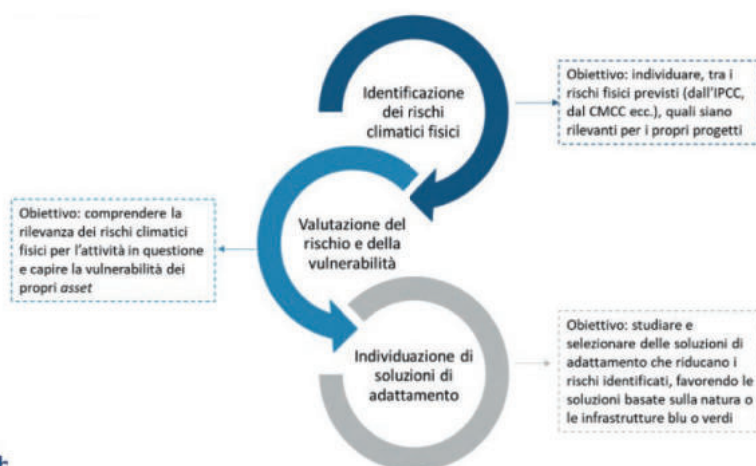
1. Construction of spatially uniform and highly accurate precipitation fields: this will be achieved by cross-referencing data from the ARPA Piemonte radar mosaic (resolution 800 m, frequency 5 minutes), the X-band search radar installed at the SMAT wells field in Druento (resolution 150 m, frequency 2 minutes), the ARPA Piemonte precipitation network and the SMAT precipitation network;
2. Development of a nowcasting model on the areas/points of greatest interest for SMAT.
3. Integration of the early warning system into the company's remote-control system.

To date, a first nowcasting algorithm has been developed based on the operational radars of the ARPA Piemonte mosaic, integrated with data from the research radar. In this way, a more stable and accurate estimation of the displacement vectors of thunderstorm phenomena has been obtained, with a spatial resolution of 750 meters and a temporal resolution of 5 minutes (with a reduction of the current forecast time of 8 minutes). The model data are collected in the SMAT databases and implemented in SMAT Scada.

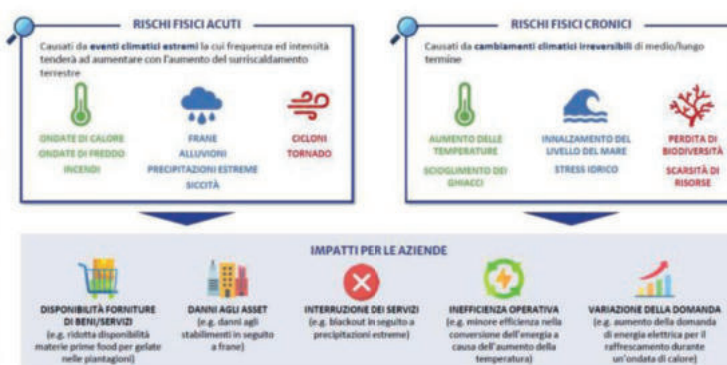
"To develop truly effective early warning systems, highly localised convective precipitation phenomena require very high resolution models"

Climate risk analysis and adaptation plans

STATUS	Ongoing
STARTING DATE	June 2022
DURATION	24 months
FUNDING	No
PARTNER	CMCC (Centro Euro-Mediterraneo sui Cambiamenti Climatici)



It is well known in the scientific community that the Mediterranean area is a climate change hotspot. Available climate scenarios indicate that the Mediterranean basin will experience a progressive deterioration of climatic conditions during the current century, with strong changes in seasonal rainfall patterns and an increase in extreme phenomena related to both precipitation and intense temperatures. The climatic changes expected according to these projections will have a direct impact on, for example, the availability of water resources (both surface and deep), floods and heat waves, with worrying consequences for the environment and the well-being of the population.



Given the multiplicity of elements and actors involved and the importance of the ultimate goal, the Integrated Water Service (IWSS) is highly vulnerable to possible disruptions, including those that may be caused directly or indirectly by climate change. It is therefore of paramount importance to quantify and analyse climate change risks and implement appropriate adaptation measures.

The aim of this research project is to provide elements that can assist SMAT in defining the Climate Change Adaptation Strategy, drafting the Climate Change Adaptation Plan to identify actions for risk reduction, also in response to EU requests for alignment with the EU Taxonomy regarding the climate change adaptation objective.

Having identified, with the support of the Euro-Mediterranean Centre on Climate Change (CMCC), the climate hazards to which SMAT's activities are directly exposed and assessed the future projections of these hazards using specific climate indicators, a climate risk assessment was carried out. It was performed taking into account the ensemble of climate models available from the EURO-CORDEX programme for three different CMIP5 emission scenarios (RCP2.6, RCP4.5 and RCP8.5) and for two time horizons (2050 and 2065), cross-referenced with SMAT data and spatial vulnerability maps.

As a result, SMAT's Climate Change Adaptation Strategy has been developed and the Climate Change Adaptation Plan is in preparation.

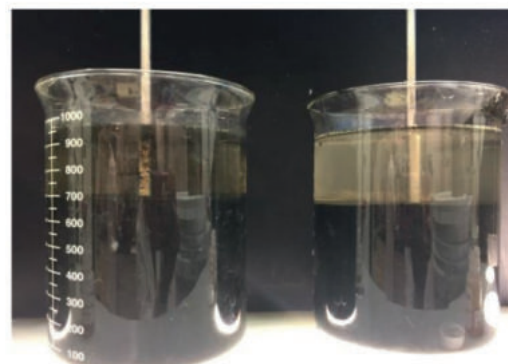
"Provide elements to support SMAT in defining climate change adaptation and risk reduction strategies"

Resource recovery and consumption reduction

STATUS	Ongoing
STARTING DATE	September 2022
DURATION	24 months
FUNDING	No
PARTNER	No



This research project, following two parallel research/experimentation lines, is focused on studying plant and process solutions to optimise chemical use for phosphorous removal in wastewater treatment plants and nutrient recovery (struvite crystallisation) coupled with biological phosphorous removal.



The first part of the activities was devoted to optimising the dosage of chemicals used to remove phosphorus. Aluminium-based coagulants were also tested in the laboratory as an alternative to the ferric chloride traditionally used. The experimental results have led to the implementation, at the Castiglione T.se plant, of a ferric chloride dosage in the sludge dewatering reject water. In fact, the recent introduction of biological phosphorous removal in the plant's water line had led, as expected, to an increase in phosphorous released during anaerobic digestion by the phosphorous-accumulating bacteria (PAO).

The new location of the reagent dosage proved to be very effective due to the high phosphorous concentrations in that stream and led to a reduction in the consumption of phosphorus-removal chemicals in the water line.

Furthermore, the residual flocculant in the flow returning to the water line upstream of the sedimentation, allowed a significant improvement in the suspended solid separation performance (chemically assisted primary sedimentation), removing organic load from the biological compartment without affecting denitrification performance.

The second phase of the project, which is still ongoing, was dedicated to studying the introduction of a crystallisation process for the recovery of phosphorous in the form of struvite (phosphorous and ammonium salt) from sludge after anaerobic digestion. To this end, an in-depth analytical monitoring campaign of the individual digesters and reject water was conducted in collaboration with the Chemical-Biological Laboratory and the Plant Operation Service. The final stages of the project are dedicated to the design of the crystallisation process and the choice of its best location in the sludge line, in order to optimise the recovery of nutrients.

"The research project is focused on studying solutions for optimising the use of chemicals and nutrient recovery"

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

STATUS	Ongoing
STARTING DATE	March 2023
DURATION	24 months
FUNDING	No
PARTNER	University of Turin, Arpa Piemonte

The Sixth IPCC Report confirms the close link between anthropogenic global warming and an increase in weather and climate extremes, and the Piedmont region will face a sharp rise in temperatures and a redistribution of rainfall in both space and time in the coming decades.

Adaptation will be complicated by the extreme component of climate change, which for precipitation will see long periods of drought alternating with periods of increasingly intense precipitation.

The year 2022 provided a new case study, with a severe drought rooted in a lack of precipitation, including snowfall, and a trend increasingly confirmed by observed transit data towards an expected regime of increased climate extremes.

The ability of societies to reduce the impacts of these changes and to transform themselves to adapt lies in the urgent availability of up-to-date and reliable regional-scale climate projections for the coming decades, and the ability to process them to extract useful information for different types of users. The FUTURCLESP project, led by the Department of Physics of the University of Turin, will make it possible to obtain high-resolution scenarios that are more easily usable at the local level by combining an analysis of the most advanced IPCC climate projections with regionalisation techniques developed by the project partners.

As a result of this work, the meteo-climatic indices associated with extreme precipitation events currently used for the preparation of SMAT's Climate Change Adaptation Strategy and Plan will be re-evaluated using more advanced climate models, with the latest generation of models simulating processes that are much more complex than those currently used for operational purposes.

The aim is to better capture some of the processes associated with extreme precipitation that operational climate projections can still capture.

In particular, the 2022 case study provides a concrete example of a future scenario in which drastic mitigation measures are not envisaged, making the effects of climate change tangible under extreme conditions.



"Study of changes in extreme weather and precipitation events using ultra-high resolution climate models"

SUPERTORET: reuse of Toret's wastewater for irrigation purposes

STATUS	Ongoing
STARTING DATE	February 2023
DURATION	24 months
FUNDING	No
PARTNER	City of Turin

The project aims to recover the unused water from some Toretts (typical public fountains in Turin) for irrigation purposes. The initiative is carried out in collaboration with the City of Turin, which has been awarded European funding for soil de-impermeabilization, including activities for greening some urban areas.



Currently, the drainage from the Toretts is connected to the sewer system, resulting in the water being reintroduced into water bodies. The project involves the construction of a storage tank near the Toret, with a capacity of approximately 10 m³, into which the unused water from the fountain will be channeled. The overflow from the tank will be connected to the sewer system, restoring the hydraulic cycle of the system.

The storage tank will be used to supply a low-water-consumption irrigation system (drip irrigation) for the surrounding area of the Toret, thereby avoiding the use of additional water for public greenery irrigation. Where the pressure provided by the elevation difference between the tank and the irrigated area is insufficient, a pump powered preferably by solar energy will be installed.

The project includes the implementation of two pilot sites, envisioned in districts 4 and 5, which can easily be replicated in other areas of interest. The City of Turin will cover the cost of the works, which will be carried out with the support of SMAT technicians.

"The project aims to recover the unused water from some Toretts (typical public fountains in Turin) for irrigation purposes"

Enhancement of mitigation and climate change adaptation activities through the recognition of Science-Based targets and the completion of CDP questionnaire

STATUS	Ongoing
STARTING DATE	June 2023
DURATION	24 months
FUNDING	No
PARTNER	No

To contribute to the mitigation of climate change, the effort towards a concrete reduction of greenhouse gases emissions derived from industrial processes is becoming more relevant.



The aim of this project is to take action in these themes and is articulated in 5 phases:

1. Strengthening the company's climate governance and strategy
2. "Science based" target definition for emissions reduction
3. Third-party recognition of greenhouse gases emissions report (ISO 14064-1 certification)
4. Completion of CDC questionnaire regarding climate change
5. Identification of further implementing actions (engagement and biodiversity)

Moreover, during the project an analysis for the subsequent improvement in terms of value chain (suppliers and end-users) and in the biodiversity theme will be conducted.

As part of the implementation of strategies for the reduction of greenhouse gases emissions, SMAT is committed in the Science Based Target initiative that provides pathways for emissions reduction. SMAT, after submitting the "Commitment" letter, in June 2023 has received the approval to develop emission reduction targets that will be then submitted for approval (within 24 months).

In 2023 SMAT Research Center has also been involved in the adaptation of greenhouse gases emissions report (Carbon Footprint) to the latest version of UNI EN ISO 14064-1:2019 Standard in order to obtain certification from an accredited body by the following year.

"The project aims to strengthen SMAT's commitment to a concrete reduction of greenhouse gas emissions from industrial processes"

Bio-hydrogen

STATUS	Ongoing
STARTING DATE	October 2023
DURATION	20 months
FUNDING	No
PARTNERS	University of Turin



The project aims to develop and test an environmentally friendly hydrogen production process based on the biological conversion of organic substances contained in municipal sewage sludge, as an alternative to classical production methods based on the electrolysis of water or the reforming of fossil organic substances.



The study focuses on the enhancement of dark fermentation, a biological process dedicated to the production of hydrogen through the fermentation (in an anaerobic environment) of organic substances.

Unlike traditional anaerobic digestion aimed at biogas production, the fermentation process is characterised by very limited hydraulic retention times (2-4 days). This ensures that the transformation of organic substances into volatile fatty acids (VFA) and hydrogen is promoted and, at the same time, their transformation into methane is "blocked", inhibiting the growth of methanogenic organisms that have much longer growth times and are therefore unable to maintain themselves inside a reactor characterised by such short retention times.

The project aims to optimise dark fermentation hydrogen production through an approach based on the most modern metabolic and biological engineering techniques aimed at the genetic modification of specific microorganisms of the genus *Clostridium*.

The first months of activity were devoted to selecting the most suitable microorganisms (available in microbial banks) and comparing, by means of laboratory-scale experiments, their fermentation capacities on sewage sludge and hydrogen production.

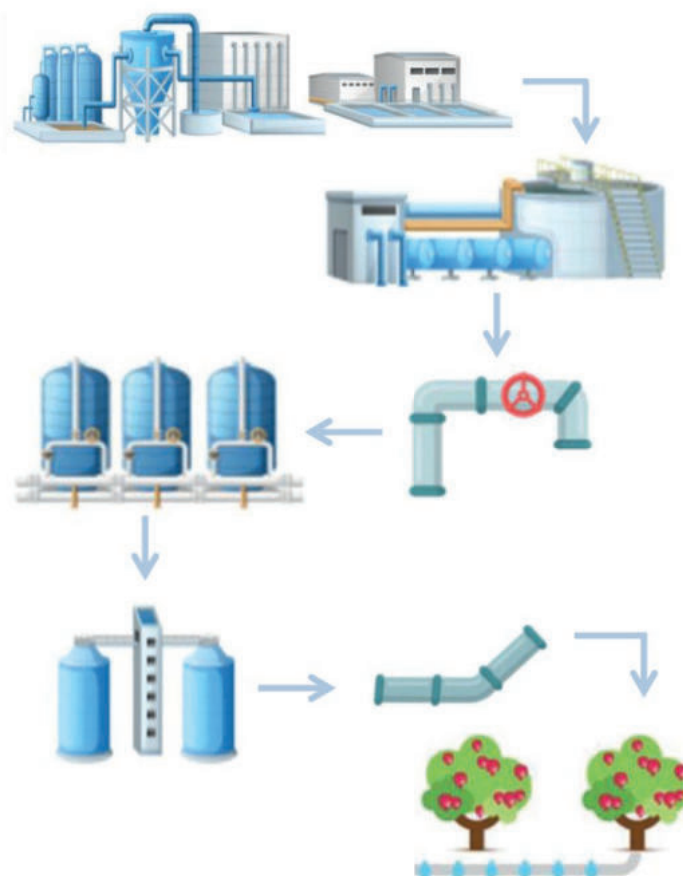
The most efficient strain will then be genetically modified in order to optimise its metabolism and increase its hydrogen production yield using strategies previously developed on clostridia (ClosTron).

Finally, sludge fermentation processes will be conducted in order to verify/optimize the process conditions in a future perspective of sustainable industrial scale application.

"The study will focus on hydrogen production through biological fermentation of sewage sludge"

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

STATUS	Ongoing
STARTING DATE	December 2023
DURATION	2 years
FUNDING	No
PARTNERS	UNITO, REGIONE PIEMONTE



As the world's population continues to grow and the climate continues to change, the efficient management of water resources has become a critical challenge, as it is essential to take a series of concrete actions to reduce water consumption, diversify supply sources and ensure greater resilience to future periods of scarcity. In this scenario, wastewater reuse emerges as one of the useful solutions to meet the growing demand for water and reduce the burden on natural water ecosystems. However, the practice of reusing treated wastewater is currently limited both in Europe (2%) and Italy (12%), and the regulatory framework is complex and evolving.

Riskless reuse requires compliance with specific requirements for certain parameters in the treated effluent and the preparation of a site-specific Risk Management Plan (RMP) to identify and proactively manage risks to ensure that the treated water is used and managed safely and does not pose a risk to the environment or human or animal health. The preparation of the RMP is necessary to obtain authorisation for reuse from the Region, which must approve the RMP after consultation with the Territorial Water Authority (ATO) and the Territorial Sanitary Authority (ASL).

The IRRISAFE project aims to support the competent authorities and managers, who will have to take on new roles and activities, by developing two aspects in particular:

1. The construction of a model for the preparation of a Risk Management Plan (RMP) for the reuse of treated wastewater in agriculture, applying the theoretical guidance provided by the regulations in a practical case study.
2. Study of refining techniques for the reduction of specific pollutants.

The model will be implemented directly in the field by carrying out a practical case study in a wastewater treatment plant managed by SMAT. The second activity will look at optimising tertiary treatment to reduce microbiological contamination and investigating innovative quaternary treatment strategies to reduce micropollutants.

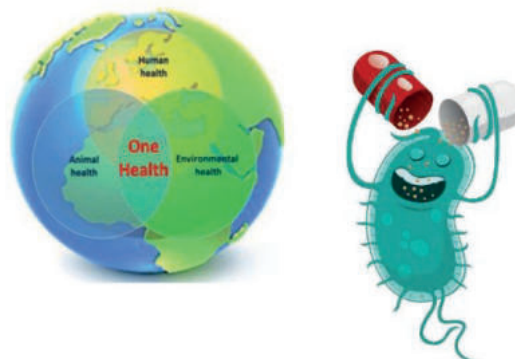
"Wastewater reuse is emerging as one of the useful solutions to meet the growing water demand and reduce the burden on natural water ecosystems"

Analysis/Quality



Environmental surveillance of antibiotic resistance through urban wastewater analysis

STATUS	In progress
STARTING DATE	November 2022
DURATION	3 years
FUNDING	Yes
PARTNER	25 Partners including national universities, public and private bodies



Antibiotic resistance has important implications for humans, animals and the environment. When a micro-organism develops the ability to resist the action of an antibiotic, the infectious disease that it causes may be more difficult to treat. This has a significant impact on people's quality of life and a significant economic impact on individuals and society. As bacteria, even resistant ones, do not recognize geographical boundaries, the phenomenon of antibiotic resistance (AR) poses a threat on a global scale.



Excessive or inappropriate use of antibiotics can lead to the potential release of these drugs into the environment, contaminating water, soil and vegetation. These residues, while still active in the environment, exert a selective pressure on the bacteria commonly found there.

A so-called "One Health" approach, which goes beyond human or animal health and promotes coordinated action across multiple sectors, including agriculture and the environment, is essential to reduce the development and spread of antibiotic resistance.

INF-ACT is a very wide-ranging project, organised into 5 interlinked work plans to address the main issues related to the spread and management of "Multi-Drug Resistance". Activities range from the evaluation of basic approaches, through pre-clinical studies, to the development of new diagnostics and innovative systems for the assessment of antimicrobial resistance.

SMAT's collaboration with the IRFMN (Mario Negri Institute) and the CNR-IRSA of Verbania focuses on "wastewater epidemiology" activities. The task is to analyse human metabolites (parent substances or metabolites) at the inlet of wastewater treatment plants and to determine the presence of antibiotic resistance genes. This approach makes it possible to characterise the presence of AR in a whole population and to correlate it directly with the use of antibiotics.

Environmental surveillance completes the partial picture derived from the clinic by describing the contribution associated with the widespread use of antibiotics in the population that can be defined as 'healthy'.

"Supporting the clinic, wastewater epidemiology provides information that completes the picture of the antibiotic resistance phenomenon"

Extension of Legionella risk assessment to all SMAT workplaces

STATUS	Ongoing
STARTING DATE	May 2022
DURATION	2 years
FUNDING	No
PARTNER	No

Legionella is the waterborne pathogen that causes the highest health burden in Europe, according to the WHO.

In the context of legionellosis prevention, risk assessment is the first step to identify and evaluate critical aspects in order to manage them appropriately and identify appropriate preventive and corrective measures to limit the risk.



A first project, "Legionella risk assessment in the workplace" (LRC_AC_2021_07), had the objective of defining a method for risk assessment and management to be applied progressively to all SMAT workplaces. The methodology, initially defined and applied to a pilot case, proposes a risk assessment based on three factors: 1) the proliferation potential of the facility, which is assessed by taking into account the characteristics of the water supply, the presence of any incoming water treatment systems, the characteristics of the water system (both cold water and domestic hot water), the maintenance activities already in place and the presence of a monitoring plan; 2) the potential for aerosol exposure; 3) the potential of the susceptible population.

This method was progressively extended to all 22 SMAT manned sites, leading to the drafting of 18 Risk Assessment and Management Protocols in December 2023. Within each protocol, the preventive and corrective measures to be applied for proper risk management were defined (ordinary and extraordinary maintenance measures) and the monitoring and sampling plan was redefined. A better knowledge of the system and a progressive application of the foreseen measures will lead to better management of Legionella risk in SMAT workplaces.

"Risk assessment is fundamental in the prevention of legionellosis"

IN2AQUAS: 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
FUNDING	Yes
PARTNERS	UNITO e other 18 international partners


IN2AQUAS



Find out more: <https://www.in2aquas.eu/>

The IN2AQUAS project will research and develop innovative technologies against water pollution, taking into account the sustainability of water management systems (in a circular economy vision), through water reuse, nutrient recovery and green synthesis of functional materials.

The developed technologies will be adapted to different scenarios, focusing on three case studies: aquaculture, arid areas and cold (remote) areas.

The overall research objectives will involve three main steps:

1. assessing water quality and predicting its response to increasing environmental stresses;
2. creating new materials using 'green' approaches;
3. developing green water treatment technologies and integrating them into processes.

The project activities will be carried out by 15 Doctoral Candidates (DCs) whose training will focus on the complex challenge of predicting the impact of contaminants on the environment and identifying appropriate treatments for the production of safe water, even in extreme environments.

Experts from 10 universities, 4 national research centres, 1 associate university and 4 companies will collaborate on the training programme, which will enable the DCs to obtain a double PhD in two different countries. SMAT, which is participating in the project as an associate partner, will host 4 PhD students in its laboratories and provide its state-of-the-art instrumentation to enable them to carry out the specific analytical studies by offering "training on the job"; it will also be responsible for the organization of 2 training sessions in the field of sustainability in water services management and water monitoring practices with a risk-based approach.

The role of the non-academic partners is crucial in achieving the research objectives and creating skills that can be used in the labour market.

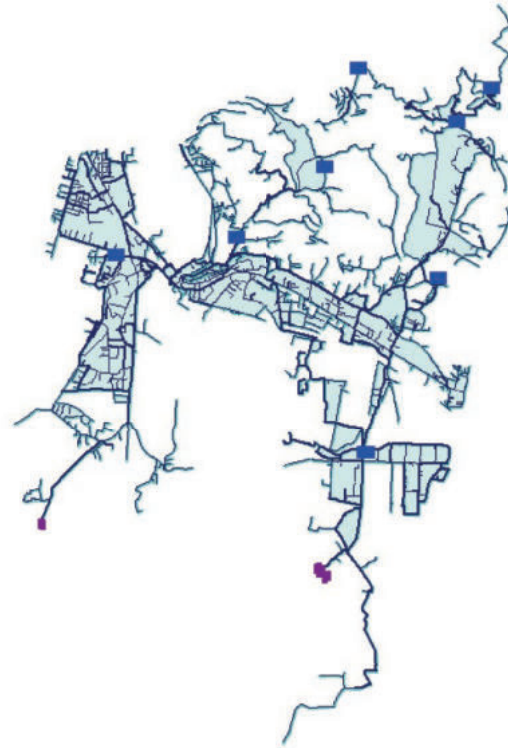
"SMAT, as a non-academic partner, will offer doctoral students the opportunity to use state-of-the-art laboratory equipment by offering them 'training on the job'"

Water Networks



Resilience CSUD: Improving resilience to drought events in municipalities in the southern area of Turin

STATUS	Ongoing
STARTING DATE	May 2022
DURATION	30 months
FUNDING	No
PARTNER	No



The aim of the project is to model the interconnections between the water supply networks of the municipalities in the southern area of Turin. The connection of different networks aims to improve the quality and quantity of the water supply sources and increase the resilience of the related water supply systems with respect to the availability of the resource and the continuity of the service.

Mathematical modelling can provide an important contribution to the interconnection of independent water networks, particularly with regards to system optimization.

Firstly, mathematical modelling can be used to analyse the performance of interconnected water networks, predicting how the system will respond to different operational conditions and emergency scenarios. This can enable system operators to identify critical areas and improve their emergency response capacity.

Secondly, mathematical modelling can be used to optimize the operation of the water system, for example by determining the optimal network configuration or control strategy to ensure a balance between water quality, available quantity, and system resilience.

During the first year of the project, three projects for interconnecting water networks were identified for modelling. The first involves connecting the networks of four municipalities and has been completed to date. The second project involves interconnecting five municipalities, with modelling currently underway for the first municipality. The third interconnection to be modelled involves merging four separate networks belonging to as many municipalities and will be addressed following the ongoing modelling projects.

“Mathematical modelling is the optimal tool to optimize the interconnection of independent water networks, improving the quality, quantity, and resilience of the water supply”

AdV modeling: pressure reduction, optimization, and expansion of the water network in the Municipality of Bardonecchia

STATUS	Ongoing
STARTING DATE	August 2023
DURATION	18 months
FUNDING	No
PARTNER	No



The project aims to model the new aqueduct for the Susa Valley and the municipalities connected to it through dispatches along the main adduction line. The mathematical modelling of a complex network offers numerous advantages, including optimizing operations, diagnosing issues, planning maintenance, managing emergencies, and supporting system expansion or upgrades.

The Municipality of Bardonecchia hosts the intake structure and the water treatment plant of the aqueduct and is the primary focus of the study. In the analysis of this water network, mathematical modelling serves a triple purpose:

- Verification of the pressure reduction project in the city network;
- Evaluation of the operation and optimization of the pumping station at the intake of the water treatment plant;
- Sizing of a new pumping station to serve two sub-networks not yet supplied by SMAT.

The first point involves using the model to verify the minimum guaranteed pressure for the most disadvantaged users after the division of the network in district metered areas (DMAs), resulting in a reduction of operating pressures through pressure-reducing valves. The verification yielded positive results, and through the model, it was possible to optimize the project by adding an additional sub-district to alleviate pressure in an area subject to high stress due to its depressed geographical location.

For the second point, a separate model of the first pumping stage of the water treatment plant was developed. Through this model, the plant characteristic curve was obtained, which will be used to verify the operating point of the pumps currently in use. Their replacement with machines capable of ensuring greater efficiency at the identified operating point will also be evaluated.

The third point involves modelling and project validation of a new booster pumping station in the network, dedicated to serving two sub-networks that will be included in the SMAT management in the coming years.

“Mathematical modelling enables the optimization, timely diagnosis, and efficient management of a complex aqueduct such as the one for the Susa Valley”

Monitoring and remote control of wastewater network connected to Castiglione Torinese wastewater treatment plant

STATUS	Ongoing
STARTING DATE	December 2021
DURATION	36 months
FUNDING	No
PARTNER	Polytechnic University of Turin

The project aims to analyze and improve the management of the wastewater network (WWN) connected to the wastewater treatment plant located in Castiglione Torinese. The WWN analyzed in this study allows the transport of wastewater produced by users distributed in 48 municipalities in a safe and controlled manner.



The aim is to improve the management of the collector system, which is made up of three main branches (North, West and South), in addition to the central canal that runs through the city of Turin, through an approach that allows the state of all the physical variables involved to be known in real time, so that operational management decisions can be made in a well-informed manner.

This will be achieved by using the data collected by the flow and water level monitoring stations installed along the collectors and by integrating the measurements with the results of the mathematical modelling of the entire system. The mathematical modelling will also make it possible to verify the functionality of the whole system by simulating certain situations in order to anticipate possible criticalities.

The project, which is in the development phase, involves the Hydraulic Research Group of the Polytechnic University of Turin, which is responsible for the mathematical modelling aspects, as well as the Research Centre, which is responsible for coordinating the various activities, the Operations Centres and the Central Technical Services.

During the first two years, the data for the North, West and South collectors were implemented. To complete the project, the city of Turin's network must be implemented and the hydraulic and geometric parameters calibrated.

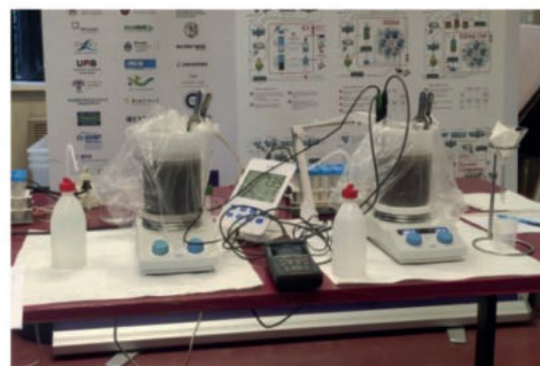
"The project aims to analyze and improve the management of the wastewater network that allows the transport of wastewater produced by users distributed in 48 municipalities in a safe and controlled manner"

Treatment

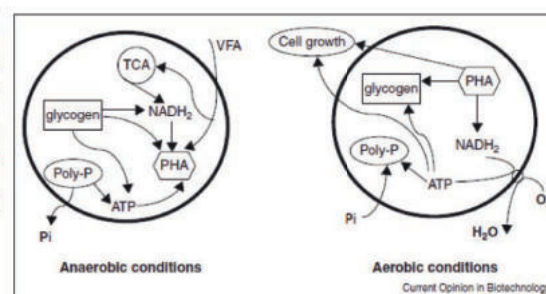


Biological phosphorus removal

STATUS	Ongoing
STARTING DATE	June 2022
DURATION	24 months
FUNDING	No
PARTNER	HERA, IREN, A2A, University of Marche



Phosphorous removal plays a major role in wastewater treatment processes for the protection of receiving water bodies. Besides the traditional process of phosphorous removal by chemical precipitation, increasing attention is being focused on biological removal process which, in addition to chemical savings, allows the recovery of phosphorous in the form of struvite that can be used as fertiliser in a circular economy vision..



This research project, in collaboration with HERA, IREN, A2A and Polytechnic University of Marche, aims to study the configurations for the biological phosphorous removal in urban wastewater treatment plants, evaluating management, technical and economic aspects.

Particular attention was paid to monitoring and control systems and parameters, to limiting and inhibiting factors, and to the identification of strategies for optimal process management.

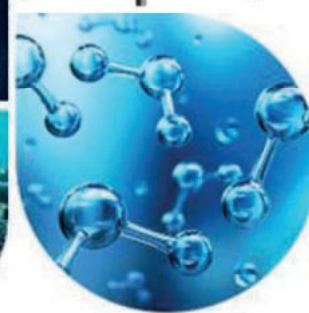
An initial phase of the project was dedicated to the identification and study of wastewater treatment plants to be subjected to feasibility assessments. For SMAT we analysed the wastewater treatment plants of Castiglione T.se and Chieri.

The technical-economic feasibility of introducing this process into the treatment system of the selected plants was also based on the mathematical modelling of the processes and the experimental measurement of the specific characteristics of the wastewaters and biological sludges, using respirometric techniques. The final stages of the project will be devoted to identifying the best plant configurations for introducing the technology, also taking into account the effects of phosphorous recovery on the characteristics of the sludge line reject waters.

"This research project aims to study configurations for biological phosphorous removal in municipal wastewater treatment processes"

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

STATUS	Ongoing
STARTING DATE	June 2023
DURATION	36 months
FUNDING	Yes
PARTNER	26 international partners



iMERMAID is a project funded by the European Union through the Horizon Europe programme, it has the focus on the development of innovative solutions both for water monitoring and treatment in order to safeguard and decontaminate Mediterranean Sea from Contaminants of Emerging Concerns (CoEC).

Find out more: <https://imermaid.eu/>

In this project innovative technologies devoted to prevention, monitoring and reduction of Contaminants of Emerging Concerns will be developed, adapted and tested.

SMAT has an “end-user” role but it is transversely involved in all work packages of the project. SMAT's main focus is on the installation and evaluation of two innovative solutions developed by partners for the monitoring and removal of heavy metals from wastewaters, as well as encouraging application of these technologies also in other contexts.

The innovative technologies will be verified in a wastewater treatment plant managed by SMAT that treats both urban and industrial wastewaters. In this pilot site an inorganic electrochemical sensor for the monitoring of Zn, Cd, Pb and Cu, developed by University of Florence, and a plant for the removal of Zn, Cu and Al, developed by the finnish partner Weeefiner using the 4D Scavenger technology, will be installed.

For the future installation of the pilot plant, some sampling campaigns have been conducted in order to characterize plant's wastewater and the subsequent technologies implementation.

Moreover, SMAT has been involved in drafting a Workbook which will be disclosed in high school with the aim to sensibilibize new generations to an aware use of chemicals.

“SMAT will install and test two innovative technologies for the monitoring and removal of heavy metals from wastewaters”

Interaction between sludge pre-treatment and thermal oxidation

STATUS	Ongoing
STARTING DATE	October 2023
DURATION	6 months
FUNDING	No
PARTNER	Polytechnic University of Turin



During a previous research project in collaboration with Polytechnic University of Turin, a low-temperature thermo-chemical sludge pre-treatment technology was developed and tested upstream of anaerobic digestion in order to increase biogas production, improve sludge dewaterability and minimise the residual quantity.

This research project aims to assess, from a technical, energetic and economic point of view, the interactions between a possible sludge pre-treatment section and the future thermal sludge oxidation plant at Castiglione T.se wastewater treatment plant.

In the perspective of the future installation of the thermal sludge oxidation plant, whose final design has recently been completed, it is very important to assess the advantages and disadvantages, in terms of mass and energy balance, that sludge pre-treatment would bring to the overall system. The analysis will therefore take into consideration the advantages brought by the sludge pre-treatment phase (increase in biogas production in the anaerobic digestion phase and increase in sludge dewaterability), its costs (thermal energy and chemicals) and the impact on the final thermal oxidation phase (decrease in the sludge flow to be treated and decrease in calorific value).

The study therefore involves the comparison of different plant configurations that include, in the different analysis scenarios, mechanised thickening, thermo-chemical pre-treatment, anaerobic digestion, dewatering and thermal oxidation sections. In particular, the appropriate mass and energy balances will be studied in order to identify the configuration that maximises the energy, environmental and economic advantages of the sludge treatment line.

"Interactions between a possible sludge pre-treatment section and the future thermal oxidation plant will be assessed from a technical, energy and economic point of view"

BioEnPro H₂O

STATUS	Ongoing
STARTING DATE	December 2023
DURATION	24 months
FUNDING	Yes
PARTNER	Sea Marconi, CIDIU, Orchestra



The BioEnPro H₂O project, funded under the Nodes Spoke 2 research call, is based on the principles of the circular economy with the main objective of extracting and valorising renewable energy, products and water from various types of residual resources and wastes, by means of technologies and processes developed and assessed within the project.



The project partners will share their industrial and research skills and experiences with the aim of studying, building and testing industrial prototypes of innovative technologies for the treatment of residual materials and wastes to be valorised such as municipal sewage sludge, biomass, leachate, urban organic wastes and sanitary absorbent materials. The aim of the mechanical-physical-chemical treatments developed will be to obtain material and water flows for recovery/reuse.

For solid residues, thermo-chemical processes will be tested for their agricultural or energy valorisation (e.g. biochar produced through thermo-chemical conversion). Similarly, for water flows, depending on the quality characteristics obtained as a result of the various types of substrate/processes treated, the most suitable technologies will be studied and applied in order to achieve the quality characteristics deemed most suitable for re-use for industrial, agricultural and energy purposes (e.g. hydrogen production).

In the first phase, the project activities will be devoted to industrial research and to the definition of processes and technologies considered suitable; then, pilot systems for the treatment of the various substrate will be designed and built, and subsequently validated.

"The project is based on the principles of the circular economy with the aim of extracting and valorising renewable energy, products and water from various types of residual resources and wastes"

Data



Development of enterprise data governance for technical data necessary for calculation of technical-operational performance indicators

STATUS	Ongoing
STARTING DATE	January 2023
DURATION	24 months
FUNDING	No
PARTNER	No

One of the biggest challenges facing water managers today is the management of the data they hold. The security and integrity of this data is essential in order to extract as much information as possible from it.



In fact, by cross-analysing available data, it is possible not only to calculate all the KPIs required today, but also to make timely and effective decisions, to have a current and objective view of the state of one's assets, and to use the information derived to build digital twins of reality. Managers are therefore increasingly aware of the importance of proper data management throughout the supply chain and are adopting long-term strategies to improve data management.

One of the biggest problems is not the collection of data or the supporting infrastructure to store it, but its placement in vertical 'silos' within the service that collected it, isolating it from the rest of the organisation. This makes it difficult and error-prone to share data from different sources. A second problem is the repetition of the same data in different databases, as there is no unique key to align all the information in the different silos to provide an overview.

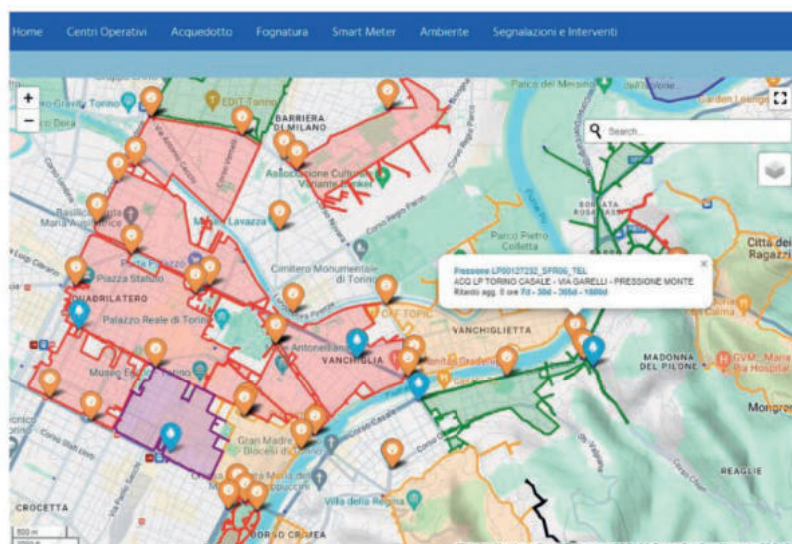
The project has a twofold objective: i) to involve some of the company's so-called data owners with the aim of initiating a process of awareness-raising with regard to the problem described and training aimed at consolidating the basic concepts of data governance; ii) to create a central repository in which a subset of the data present in some of the company's technical/operational data databases will converge.

“Consolidate the basic concepts of data governance and the implementation of a central repository to which a subset of the data present in some of the company's technical/operational data databases will converge”

Follow-up of the Octopus platform for the automatic calculation of technical and operational performance indicators

STATUS	Ongoing
STARTING DATE	January 2023
DURATION	24 months
FUNDING	No
PARTNER	No

Octopus is already an enterprise tool capable of performing many functions automatically, such as extracting and analysing data from numerous corporate databases, importing data from other information systems, preparing interactive maps for other applications, and publishing graphics, tables and reports that can be accessed from Smat's intranet website or from the company's cloud platform.



Octopus was developed at the Research Centre within the framework of the research project: "Development of an open source platform for the integration, analysis and publication of company data", using only internal resources and open source tools; its deployment in the company is therefore free of licence fees and its use can be differentiated for different functions depending on the user.

Following the implementation of the platform, the company was asked to develop new functionalities, including the calculation of specific energy consumption (kWh/m³) for the water abstraction, treatment and distribution phases, at the level of the network district and for each plant.

This data is needed for a number of purposes, including the targeting of energy efficiency investments and the development of analyses leading to the eligibility of turnover, operating costs and investments according to the European taxonomy.

In order to allow a wider use in the company, to ensure its robustness and reliability and to facilitate the implementation of new functionalities, the platform underwent a follow-up consisting in the application of the most modern and innovative concepts related to software development, such as the use of a micro-services architecture, the development of API protocols allowing the exchange of data in text format, the implementation of an orchestrator and a data visualisation and sharing platform using open source tools.

"Following the implementation of the platform, new functionalities were requested, including the calculation of the specific energy consumption for the phases of water abstraction from the environment, treatment and distribution, at the level of the network district and for each plant"

Publicazioni e proceedings

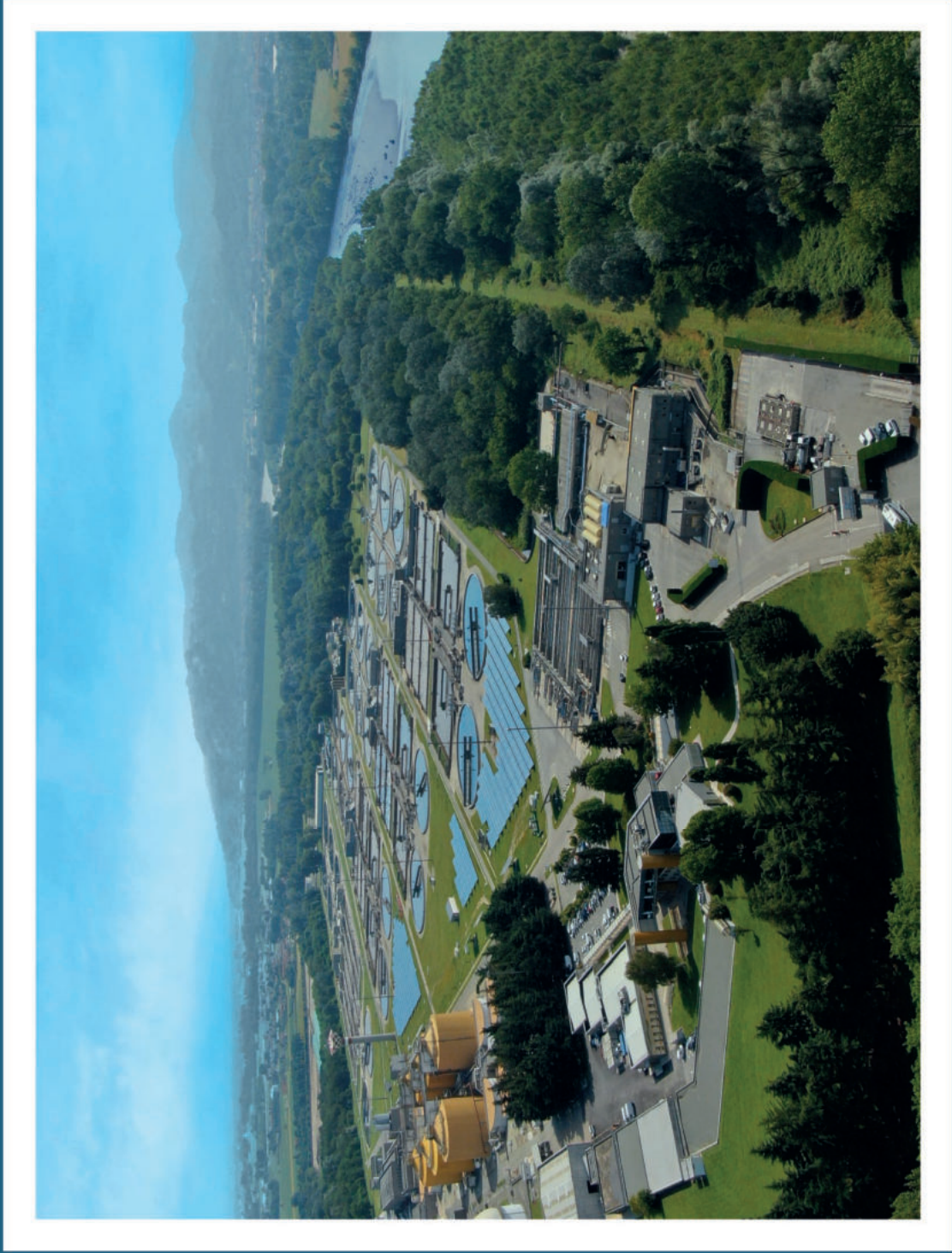
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- Binetti, R. Giornata Mondiale dell'acqua "Acqua in un clima che cambia", 21 marzo 2023, Torino, Italia. Presentazione orale: "Riuso delle Acque: le indicazioni della UE. Le nuove Direttive sulla qualità delle acque reflue e sul loro riuso"
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