LIFE VERTALIM: Prevention and integral management of high polluted effluents from food SMEs to urban sanitation systems

Technical summary of the results

LIFE15ENV/ES/000373

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PROJECT LOCATION: Basque Country

BUDGET:

Total: 1,958,998 €

% EC Co-FINANCED: 56.02

DURACION: July 2016 – December 2019

PARTNERS OF THE PROJECT

CORE GROUP

Coordinator   Technical Coordinator

INDUSTRIAL PARTNERS

COFINANCER

INTRODUCTION

The Water Framework Directive (WFD) and other water-related directives have contributed to strengthening the protection of European Union waters. However, due to decades of degradation and the persistence of inefficient management, there is still a long way to ensure the quality of EU waters. At present, the provision of this vital resource can not be guaranteed at 100%, and there are factors that suggest that, in 2030, the demand for water could be 40% higher than the available supply.

The urban wastewater treatment Directive (91/271 / EEC), which entered into force in 1991, is one of the most important European environmental laws that has brought more benefits to member countries. In Spain, approximately the 15% of urban wastewater treatment plants (WWTP) are still struggling to achieve the compliance of this directive.

The WWTP of Ondarroa usually complies with the regulations. Nevertheless, during periods of high industrial activity or when spring tides, the sanitation network has difficulties in carrying out the adequate treatment of the wastewater.

Among the aspects that affect the water quality, the industrial sectors have a significant environmental impact mainly caused by high water consumption, waste and wastewater generation. Specifically, tuna canning industry is one of the most important food sectors on the coast of the Cantabrian Sea. Particularly, the Basque Country tuna canneries are characterized by maintaining an artisanal character from fishing to processing, through small businesses, family in many cases, whose main objective is to obtain a high-quality product.

However, some of the main challenges facing the sector are the rise in raw material prices, the increasingly restrictive environmental regulations and the higher sustainability standards demanded by society. In this context, discharges are one of the most significant environmental aspects of these activities due to the coastal location and the water bodies where treated waters are discharged.

In the case of the VERTALIM project, environmental aspects are especially relevant because the sanitation systems are located in specially protected environmentally sensitive areas such as the Artibai Basin (Special Conservation Area ES2130011) belonging to the Natura 2000 Network or near a coastal bathing area, such as the case of the estuary of the Artibai river (Directive 2006/7 / EC on the quality of bathing water).

With this framework, the LIFE VERTALIM project was born to:

- Reduce the environmental impact associated with canned fish products, since the production until the return of treated water to the water bodies following the criteria established in the WFD.
- Make a positive contribution to those sanitation facilities and assist their operators in the implementation and assurance of the Directive on the treatment of urban wastewater (91/271 / EEC).

The main objectives set by the VERTALIM LIFE project were:

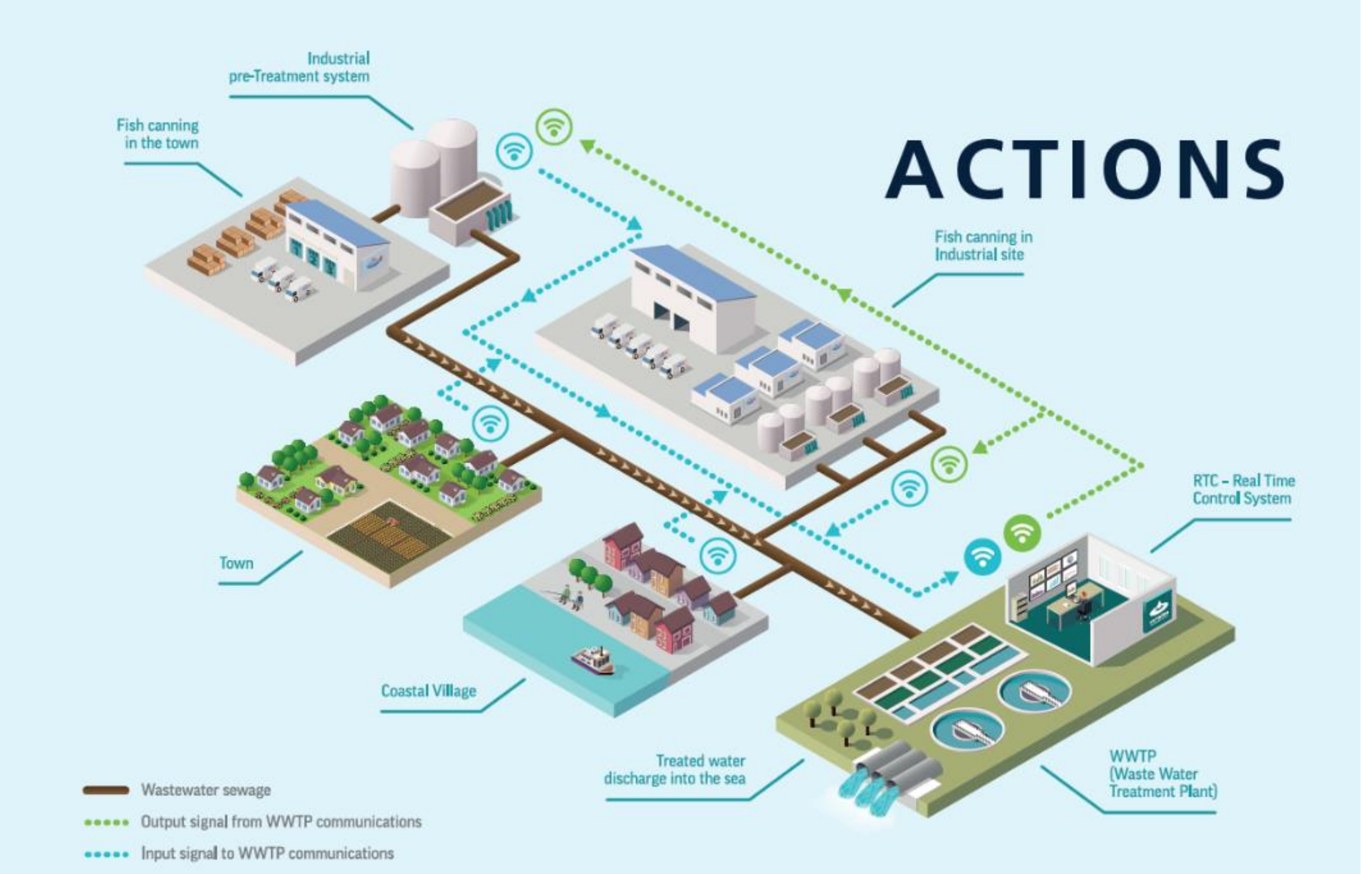
Provide **innovative solutions** to minimize the canning industry effluents at the origin, through eco-efficient production and the 3 Barriers System.

Reduce pressure on water sanitation infrastructures.

Reduce the environmental impact on the affected water bodies, ensuring the discharges are properly treated before returning to the natural environment.

Provide a tool based on the digitalization of the sanitation network for Water Entities, improving the intervention capacity and the effective-ness of the wastewater treatment facilities and the collector network.

Create a **dialogue framework** that integrates all the agents involved in the problem to solve it in an active and collaborative way.



The main tasks developed in the LIFE VERTALIM project have been:

1 **MINIMIZATION OF EFFLUETS AT THE ORIGIN**

- Identify inefficiencies at source to reduce water consumption, and the volume and pollution of the industrial effluents.
- Apply the 3 barriers system for the canneries effluent reduction at the origin.

2 **SANITATION NETWORK SYSTEM DIGITALIZATION**

- Characterization of the sanitation network system (collectors and WWTP).
- Digitalization of the sanitation network system: Online instrumentation, Communications by GPRS and software
- Validate and demonstrate the LIFE VERTALIM solution in real conditions in the Artibai area.
- Track the recovery of the ARTIBAI water bodies from the industrial effluents.

3 **GUARANTEE THE PROJECT REPLICATION AND TRANSFERABILITY**

- To constitute an external panel, composed by the main stakeholders from food sector and the integral water cycle to validate the actions and results of the project. Representatives from the food sector, water management entities, administrations and scientific agents participated in the table.
- Disseminate and communicate the project results through the presence and participation in international congresses, technical-scientific conferences and three External Panel meetings.

PROJECT LINE

2016
Diagnosis

Detailed study of the initial situation: companies, collector, discharges, WWTP and Artibai river. Deficiencies and strong points.

2017
VERTALIM Solution

Search for a solution to the environmental problem:

1. Sewerage collector construction
2. Implementation of eco-efficient production
3. iWWTPs design and construction
4. System modelling: Collector-WWTP- Salt intrusion

2018
Instrumentation

Characterization of the collector circulating water in different scenarios:

1. To feed data to the modellization
2. Critical points and remote-control instrumentation

2019
Demonstration

VERTALIM solution test to avoid situations of stress in the WWTP and relief to the river and the sea.

2020
Replicability

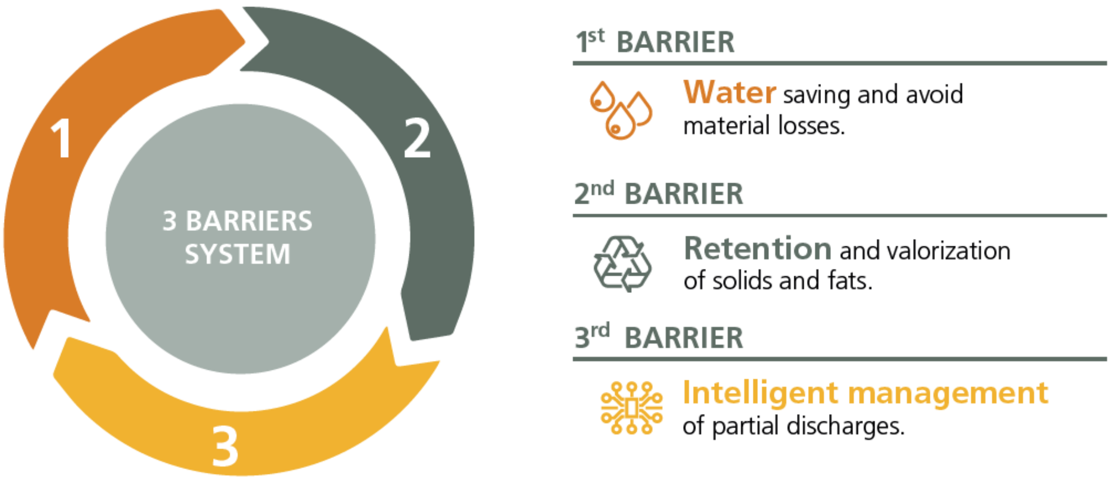
- Analysis of the project impact after the VERTALIM solution implementation
- Replication in other areas affected by the same problem

PROJECT RESULTS

AT FACTORY LEVEL

In this project we had validated the 3 Barrier System, a specific methodology developed by AZTI, for the improvement of ecoefficiency in the food industry.

3 BARRIER SYSTEM



The 3 barriers system is a methodology based on productive efficiency strategies to achieve the reduction
of emissions at source in the food industry in general. This methodology is carried out by applying improvement actions to minimize the consumption of natural resources such as raw materials and water, and the reduction of the wastewater pollution, so that they are returned to nature in good condition.

During the project, a 3 Barrier System guide for fish sector was edited (accessible on the project website).

During the first part of the project, we had been working in the attainment of the environmental diagnosis of each canning industry: MARMAR, AGUIRREOA, HEISA and GUENAGA. The environmental diagnosis collected the identification of the production aspects that might generate an impact in the environment. Several visits were made to each company to collect the production information:

- Detect possible inefficiencies by process
- Collecting wastewater samples to analyse their contamination
- Quantify the water consumption of each process
- Detect sources and causes of pollution generation

In this way, we obtained the qualitative data of each company regarding its production and processes in terms of consumption of water, energy, waste, discharges, and emissions.

Based on these reports, a series of recommendations had been made regarding the minimization of water consumption and reduction of pollution in discharges. These recommendations had been transferred to companies with the involvement of several employees with different levels of responsibility and position: production, cleaning staff, head of maintenance and even, general manager. AZTI advised and followed the selection of improvement actions, the roadmap development, and the monitoring of their implementation over time.

The improvement areas that were common for each company:

- the water consumption and reuse of autoclave cooling water
- Separation of fats directly from the tuna cooker
- Management of brine from tuna cooker

As a result, some of the improved ecoefficiency indicators for fish cannery production:

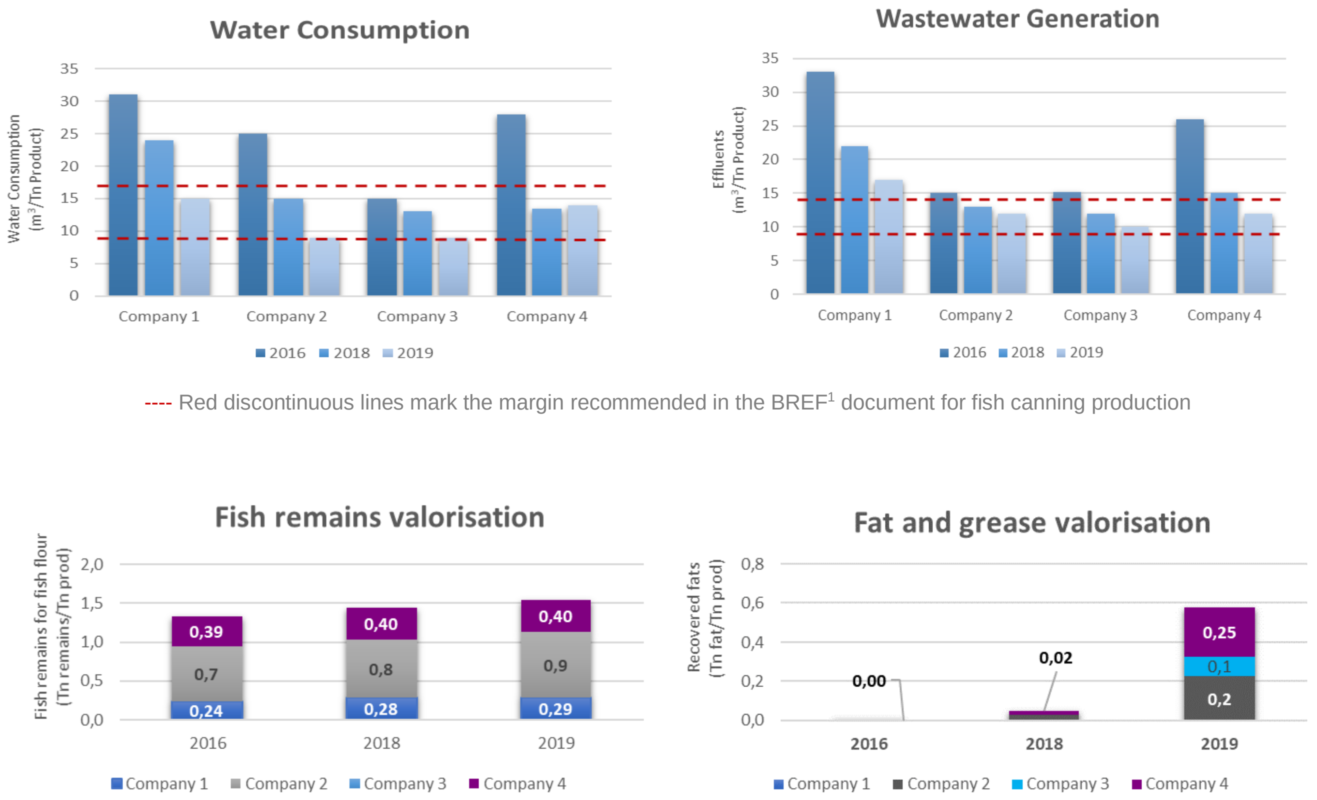


FIGURE 1: Ecoefficiency indicators: water consumption, wastewater generation, and fish remains and fat valorisation

[1] Integrated pollution prevention and control Reference document on Best Available Techniques in the Food, Drink and Milk Industries, August 2006. European Commission

The pollution of fish canneries effluents also improved significantly:

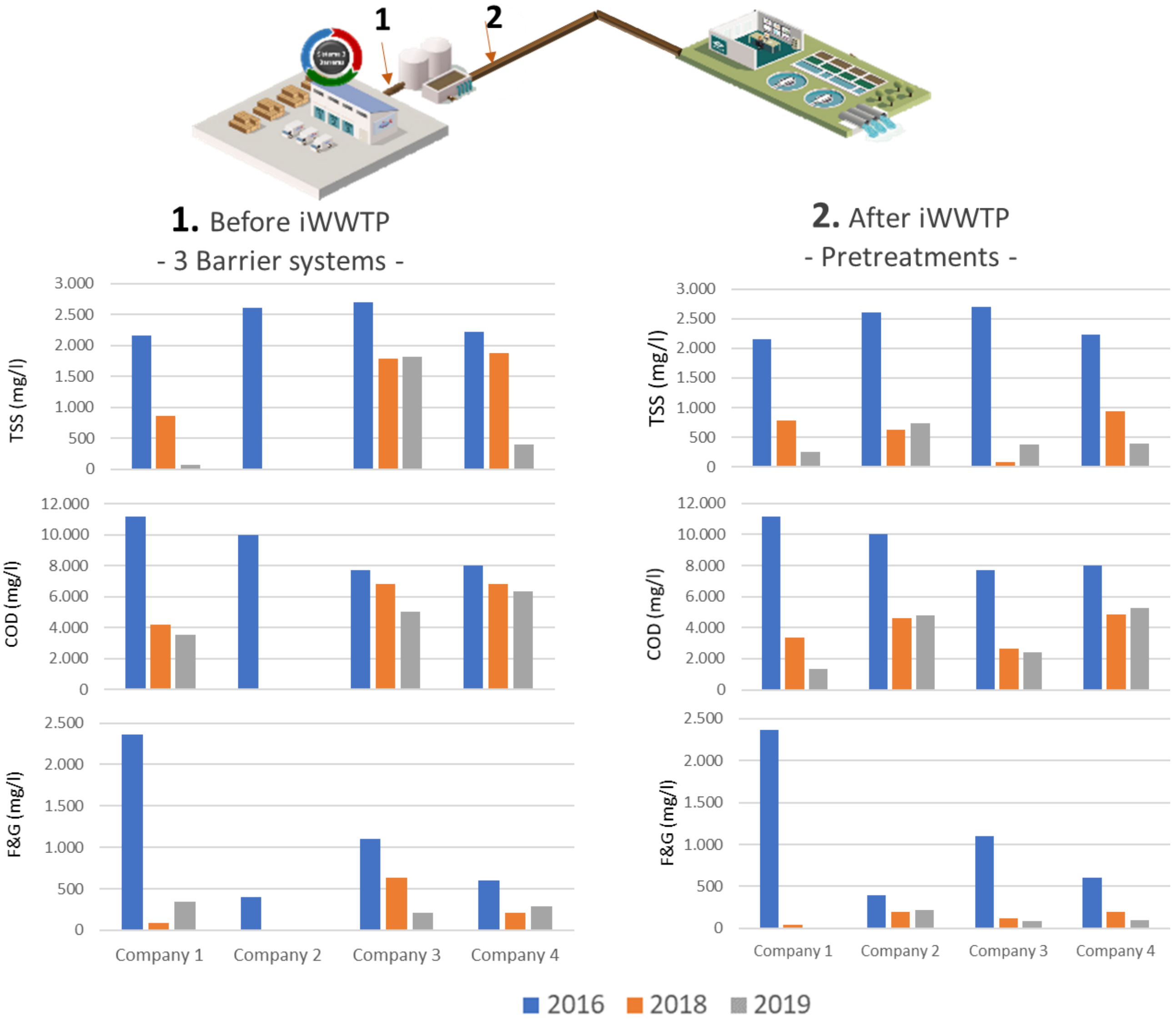


FIGURE 2: Evolution of canneries wastewater pollution (TSS, COD and Fats), 1. before (graphics on left) and 2. after (graphics on right) the industrial WWTP along the project

As a conclusion, direct benefits of the application of the 3 barriers system:

Reduction **20-40%** water consumption	Decrease **30-45%** pollution load	Recovery: **50%** by-products	Reduction **25-35%** effluent volume

AT SEWERAGE SYSTEM LEVEL

DIGITALIZATION OF THE SANITATION NETWORK FOR CONTROL AND DECISION ASSISTANCE

FIGURE 3: CABB´s Central Control station for the sanitation network with the new trend data and screens generated within the LIFE VERTALIM project

Digitization consists of:

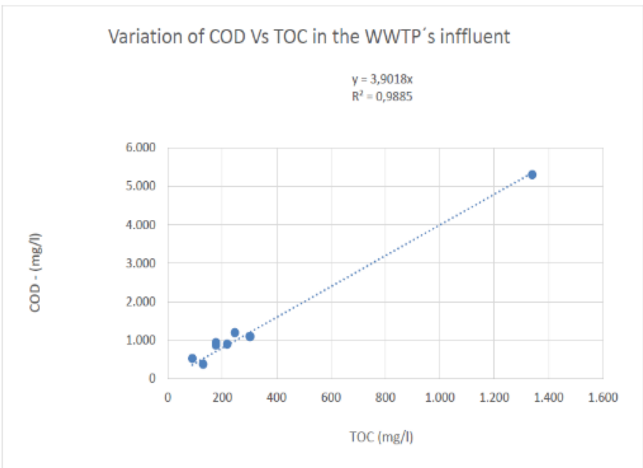
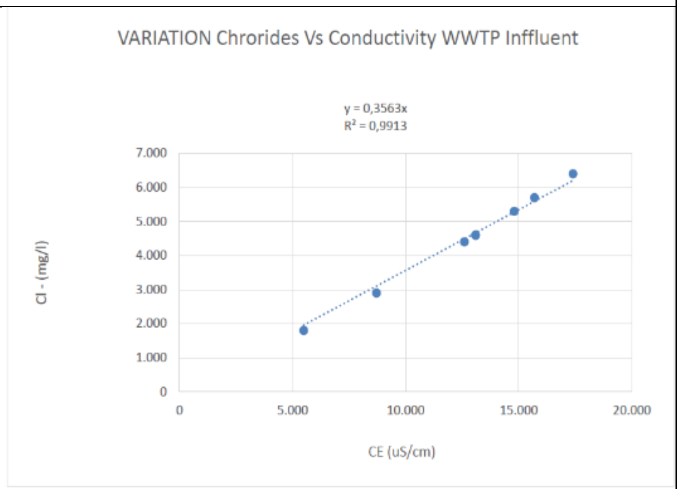
1. Real Time Control System (RTC)

Sensors and analysers that send the relevant parameters to the control station. This information allows to receive data on the wastewater composition, the behaviour of the pumping stations and the WWTP in real time.

A robust, reliable, and easy to maintain analytical instrumentation that allows us to remotely control the organic and chloride load has been implanted. For the control of organic load COD, we decided to do it by a TOC analyser after studying the most reliable technologies despite the conceptual differences between COD and TOC and how theoretically samples of pure chemical compounds may have the same TOC (same number of moles of C) and different COD. The characterization via TOC, compared to the other existing option consisting of the measurement of UV absorbance of the sample, offers us much more guarantee of precision.

For the control of the salinity of the residual water and more specifically of the concentration of chlorides, the most suitable technology has been the indirect measurement by means of a conductivity probe with high robustness and reliability, in addition to being widely implemented in the sector.

FIGURE 4: Devices implemented for on-line measurement for the control of trade effluents, sanitation network and WWTP´s influent.

COD	CHLORIDE
	
• COD (mg/l) = TOC (mg/l) * 3.9 • COD instant (Kg/h) = (TOC (mg/l) * 1 kg / 1000 mg) (Kg/m^3) * instant flow rate (m^3/h)	• Chloride (g/l o Kg/m^3) = Conductivity (mS/cm) / 3.6 • Chloride instant (Kg/h) = Chloride (Kg/m^3) * instant flow rate (m^3/h)

Daily total load for COD and Chloride

1. COD and Chloride daily based on instant COD and chloride values. The daily total COD and Chloride circulating is updated every second taking into account that ‘increase per second’ = kg / h / 3600s = xx. x kg.
2. The Daily Total COD and chloride load values are reset every 24 hours when the time indicated in the COD and chloride Daily Totalizer Reset Time Setpoint is reached.

FIGURE 5: Correlation for COD and Chloride measurement

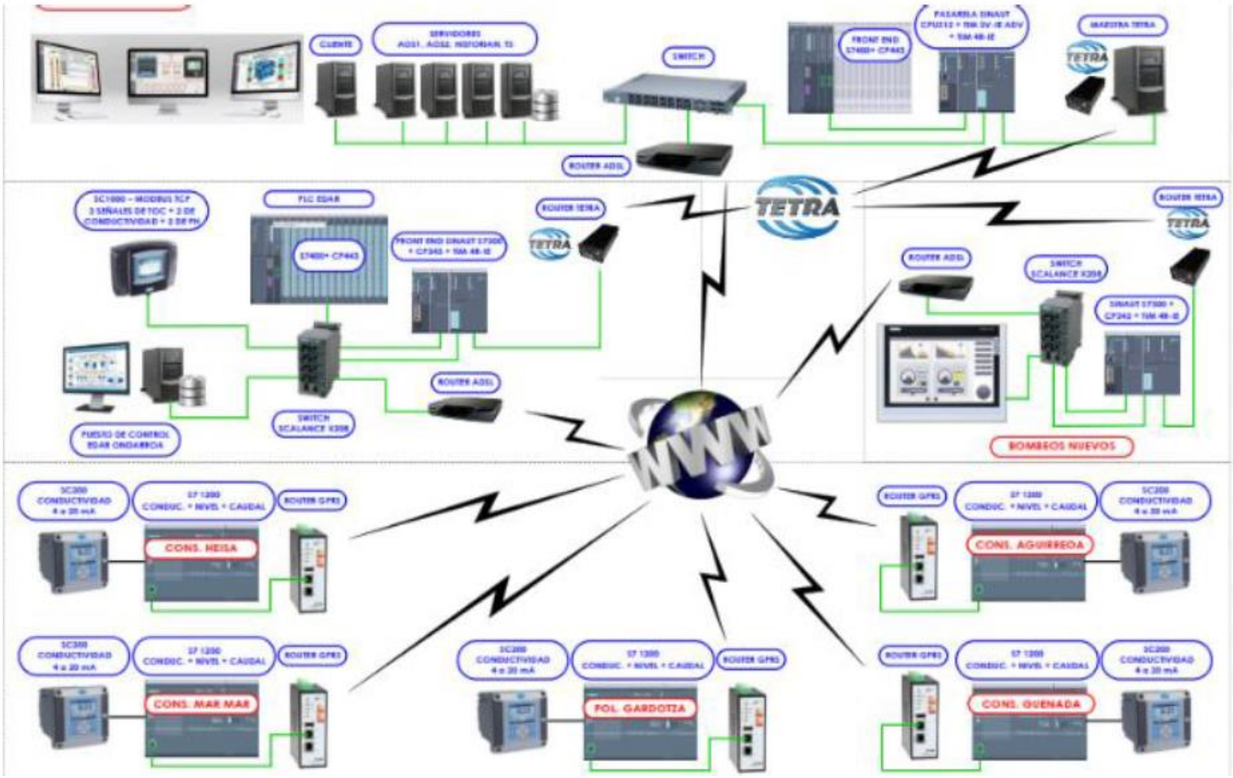


FIGURE 6: Communication outline: remote management tool for data sending to WWTP SCADA

2.- Simulation platform

A simulation platform has been developed based on the basic construction and design information of the Galtzuaran WWTP (Ondarroa) and the network of collectors. The platform has been built based on commercial software that reproduces the real system in order to:

- **Analyse the existing problem** in the Artibai area and the effect of canneries effluents integration into the sanitation system
- **Explore different strategies in the management** of pumping system and wastewater treatment to improve the sanitation network current performance.

The simulation platform reproduces the effect of different inputs that affect the sewer network that are:

- Dry weather wastewater flow based on data from water consumption in the Ondarroa-Berriatua area and from dry weather wastewater flow data obtained in the SCADA for one year.
- Rainwater input in sewer network baes in data from weather station pluviometry.
- Industrial wastewater input from cannery (data measured in Ondarroa SCADA)
- Sea water infiltration in pumping station estimated from a model based in tide high and pumping station level difference and calibrated with conductivity data from Ondarroa SCADA.

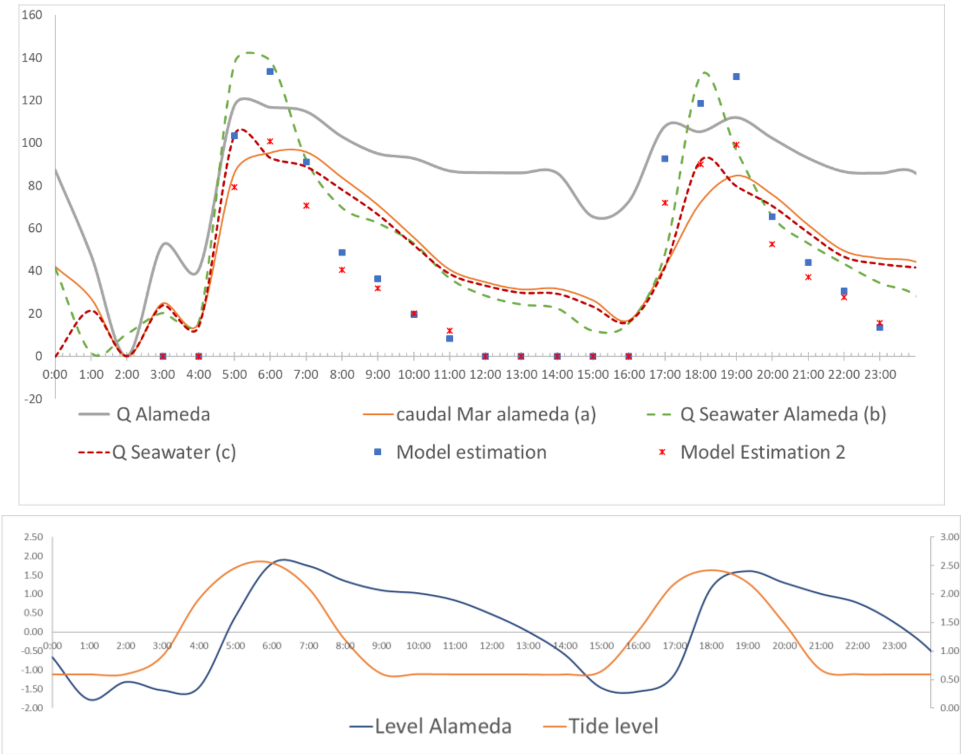


FIGURE 7: SEA WATER INFILTRATION MODEL FOR ALAMEDA PUMPING STATION (COASTAL PUMPING STATION WHERE SEA WATER INFILTRATION OCCURS).

3. Management and decision support system software and rules:

The exploration of different scenarios reproducing events that includes combinations of different dry weather flow, different rain episodes, different industrial campaigns and high tides with the simulation platform allowed to establish different strategies to:

- Reduce the effect of tides on seawater infiltration in pumping stations by governing levels in the stations as a function of the tide high.
- Minimize the effect of industrial wastewater discharges on the conductivity and COD variation in the influent to WWTP.
- Establish new strategies to avoid conductivity peaks in the influent wastewater to WWTP by using the holding tank and establishing new logical rules based in the conductivity measurement in different pumping stations.

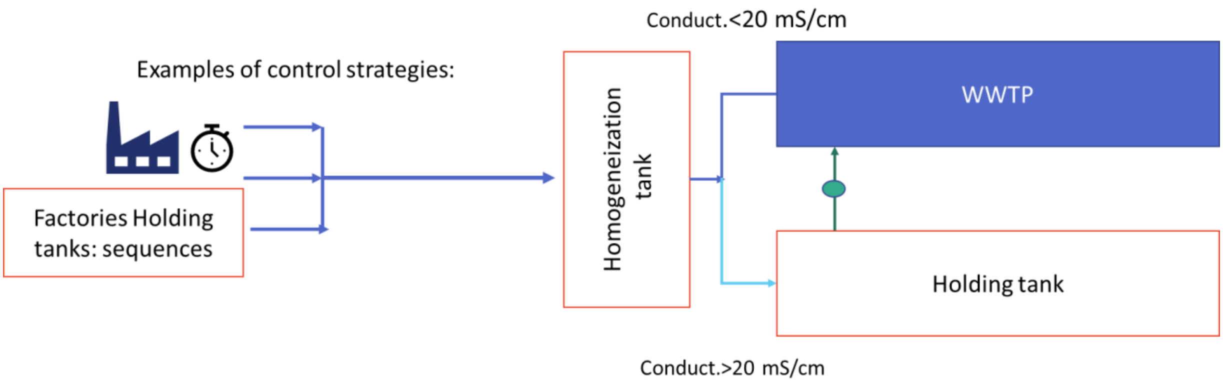
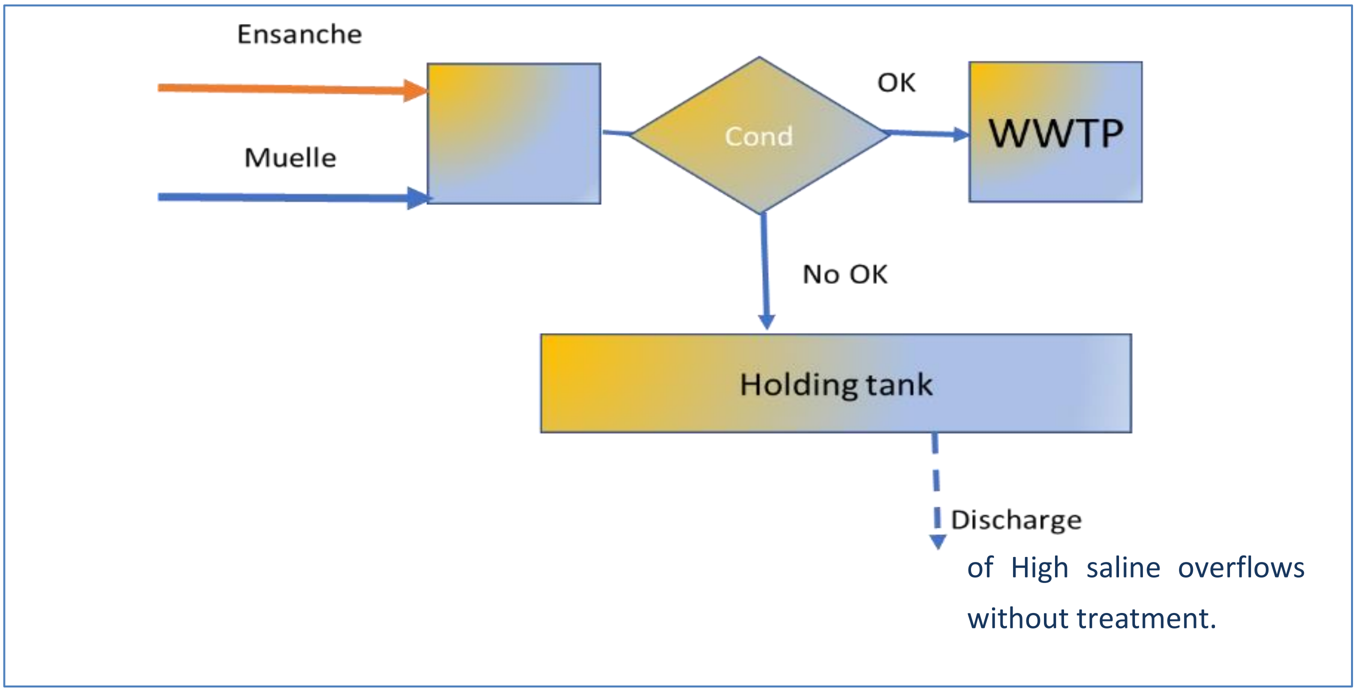
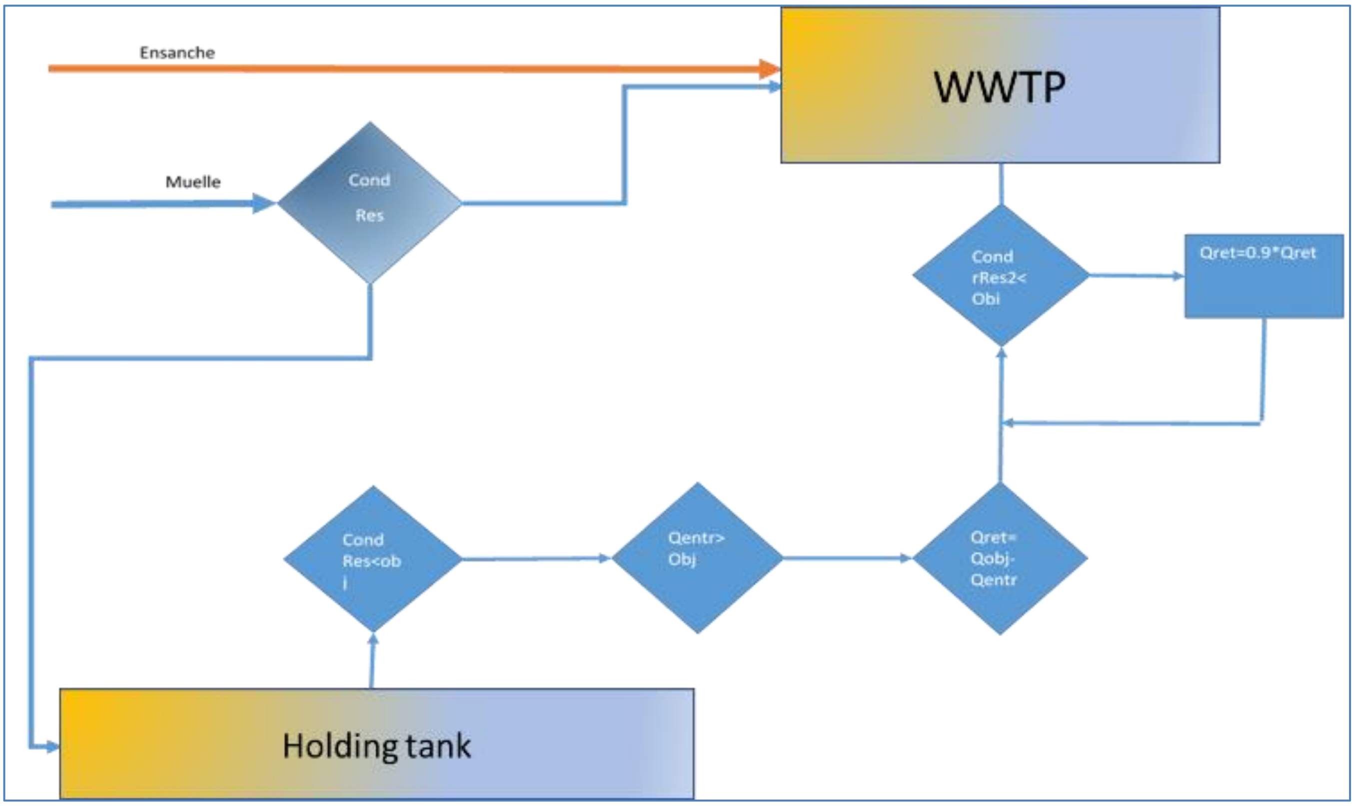


FIGURE 7: WWTP operation rules based on conductivity of the influent



Old WWTP influent configuration



New WWTP influent configuration

FIGURE 8: Configuration changes in uWWTP influent input based on the management of two main pumping stations: Ensanche (with cannery industrial wastewater) and Muelle (coastal pumping) by Conductivity measurements (Cond) and a new closed-loop control point.

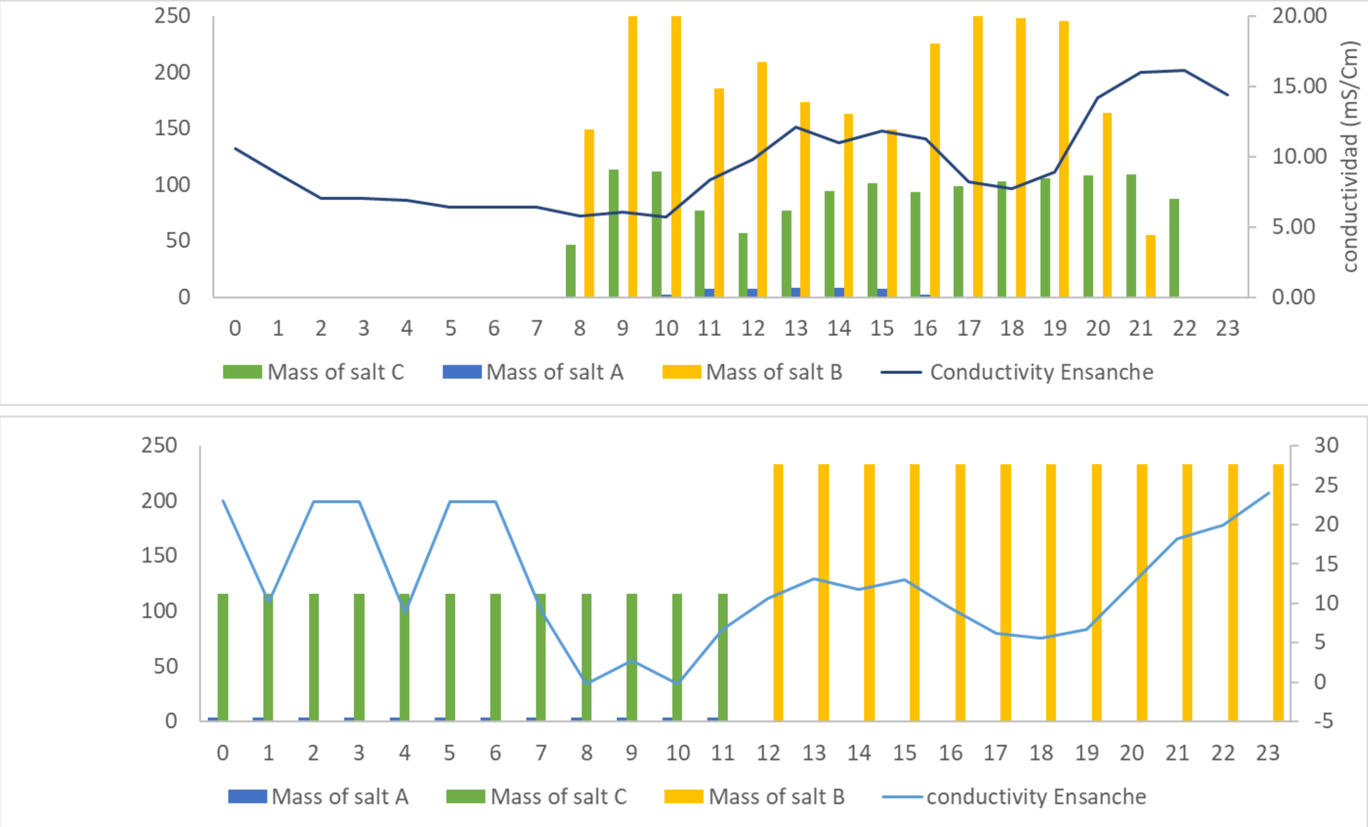


FIGURE 9: Industrial discharge equalization of three canning industries (A, B and C) using the management and decision support system.

Additionally, the digitalised signs allowed to establish alarm system by sending SMS to report incidents to the WWTP technicians and even to the personnel responsible of canneries discharges to provide solutions and promote the commitment and awareness of the industrial users.

Digitalization has allowed to detect the following improvements that have been implemented throughout the project:

- INTEGRATED MANAGEMENT OF INDUSTRIAL AND URBAN EFFLUENTS
  Effluents with high conductivity to minimize the impact on the WWTP of Galtzuaran through a sequential discharge protocol of canning companies.

- PUMPING STATIONS MANAGEMENT PERFORMANCE
  to minimize the water relief to the entrance of the WWTP in situations of high cannery production and spring tides with infiltration of saline water in coastal collectors.

The better integration of canneries discharges and the management of saline infiltration from tides during the project have as result an improved removal of organic and nitrogenous matter thanks to the stabilization of biological treatment, the nitrification/denitrification performance improvement, and the minimization of high saline overflows.

The chlorides come mainly from the saline infiltration into the sewerage system, mainly during the spring tides episodes. The effect of salinity on the biological treatment performance is severe and the management tool developed in the project for avoiding unwanted saline overflows (to protect the biological treatment) has minimized the frequent inhibitory processes suffered by the plant in the past. This led the change of the strategies of the management of saline streams.

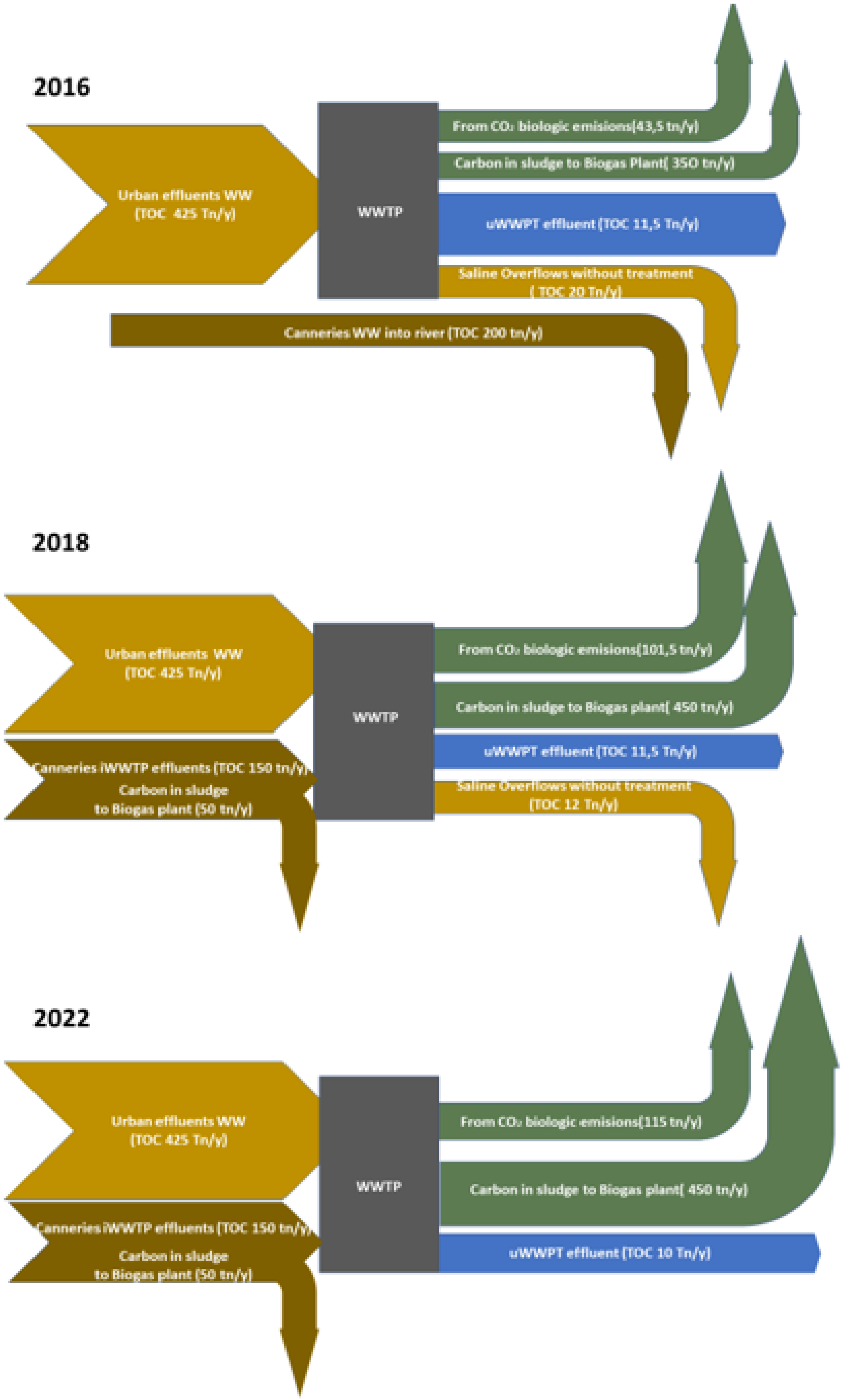
The implementation of these actions during the project demonstration period has meant:

Up to 50% reduction of pumped saline water from seawater infiltration in the coastal area (Muelle and Ensanche pumpling stations).

20% Reduction in the relieved water flow corresponding to the first half of the year.

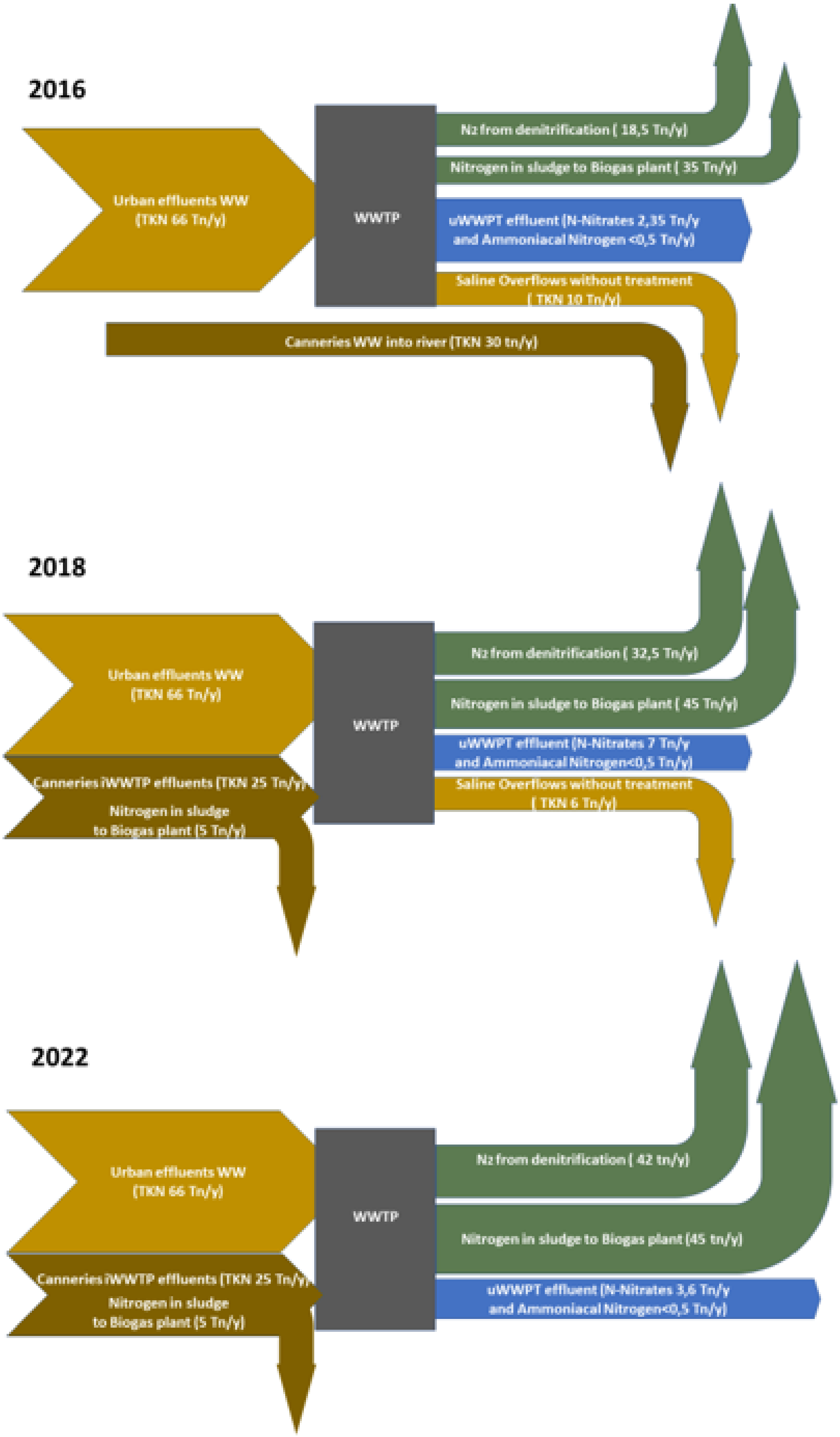
Both events represent a significant reduction in the overall impact on the sanitation system.

The evolution of the integration of organic discharges (carbonaceous and nitrogenous matter) from canneries into the uWWTP´s line and the management of saline infiltration during the project are summarized in the following figures:



Note: The carbon that goes to Biogas plant from the canneries comes from the sludge of theirs iWWTPlants and its final destiny is biogas and fertilizer production.

FIGURE 10: SANKEY DIAGRAM for the evolution of carbon inputs and outputs throughout the LIFE VERTALIM project implementation**.**



Note: The nitrogen that goes to Biogas plant from the canneries comes from the sludge of theirs iWWTPlants and its final destiny is biogas and fertilizer production.

FIGURE 11: SANKEY DIAGRAM for the evolution of nitrogen inputs and outputs throughout the LIFE VERTALIM project implementation**.**

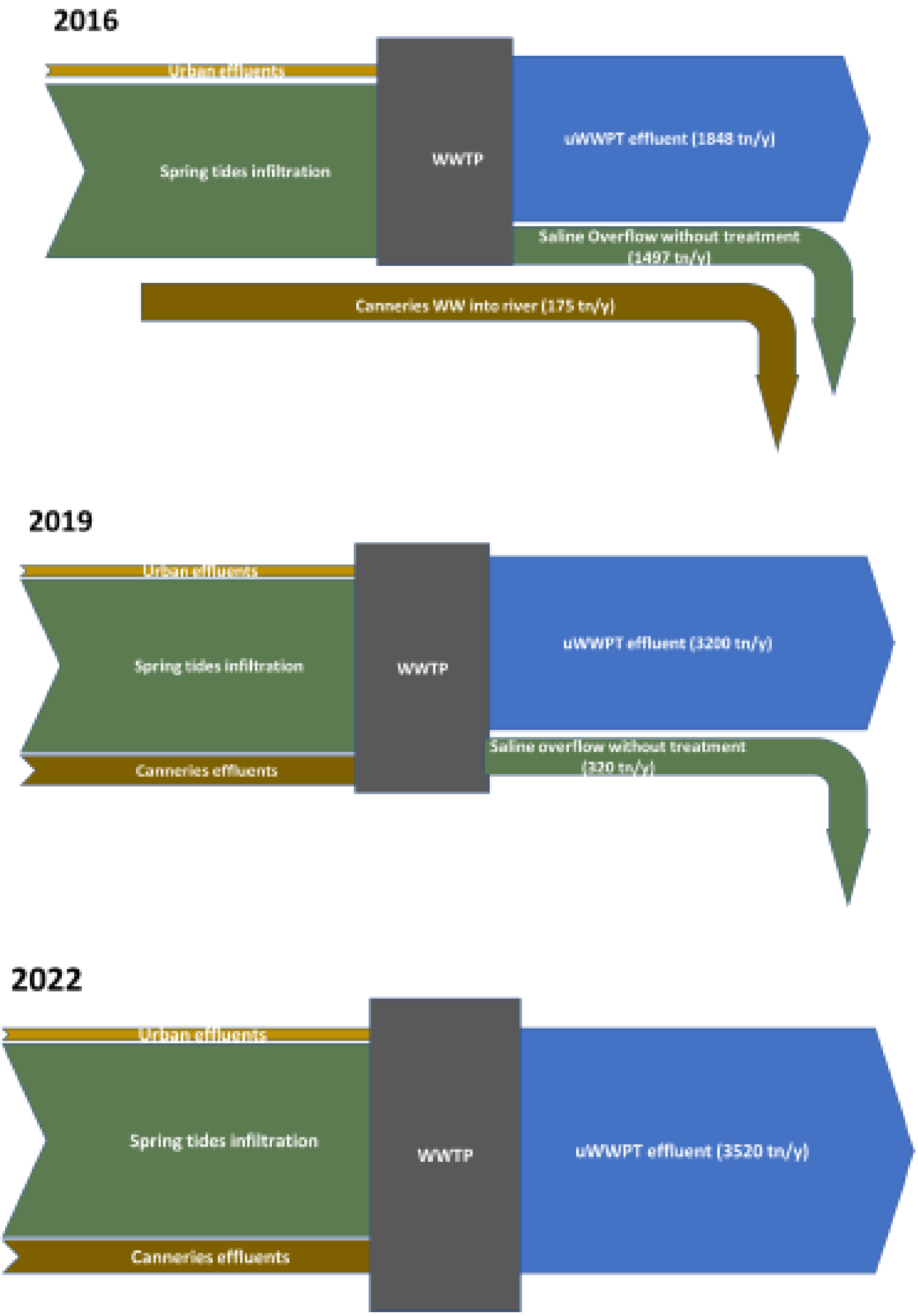


FIGURE 12: SANKEY DIAGRAMS for the evolution of chloride discharges into the environment throughout the LIFE VERTALIM project implementation.

AT ENVIRONMENTAL LEVEL

ENVIRONMENTAL IMPROVEMENTS

During the performance of the project, the physical-chemical state of the surface waters of the Artibai Basin have been monitored to follow the river recovery and to verify the impact of the activities of the project.

FIGURE 13: Artibai basin and location of 8 sampling stations

In this context, different campaigns have been carried out in 8 sampling stations along the area: river affected by industrial discharges, the estuary and the WWTP disposal area at sea, which they have in common receiving spills of anthropic origin, including those from canning companies.

FIGURE 14: Pictures of sampling stations in one of the sampling campaigns.

An improvement in surface water quality along the course of the Artibai River has been observed for 3 years. Among the water quality parameters measured, BOD (biochemical oxygen demand) and ammonium concentration were the ones that best revealed the effect of the project actions on the environmental improvement.

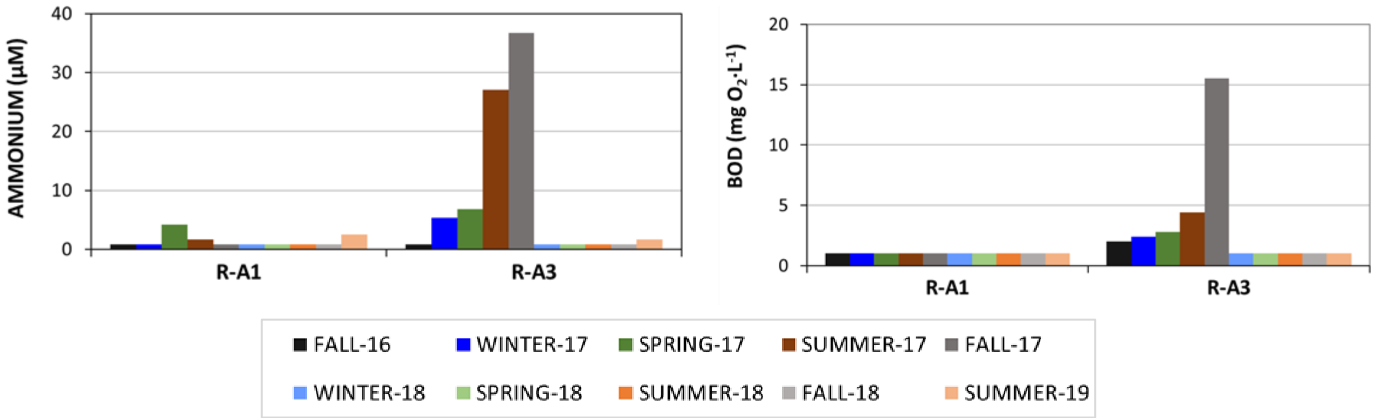


FIGURE 15: Artibai surface water quality before and after the canneries site

At the same time, no greater impact in the sewage disposal area at sea has been found, despite larger volume and pollutant load in the receiving wastewaters in the WWTP.

When comparing the potential environmental impact in comparison before and after the project implementation, a substantial improvement was observed in the main three environmental impacts studied.

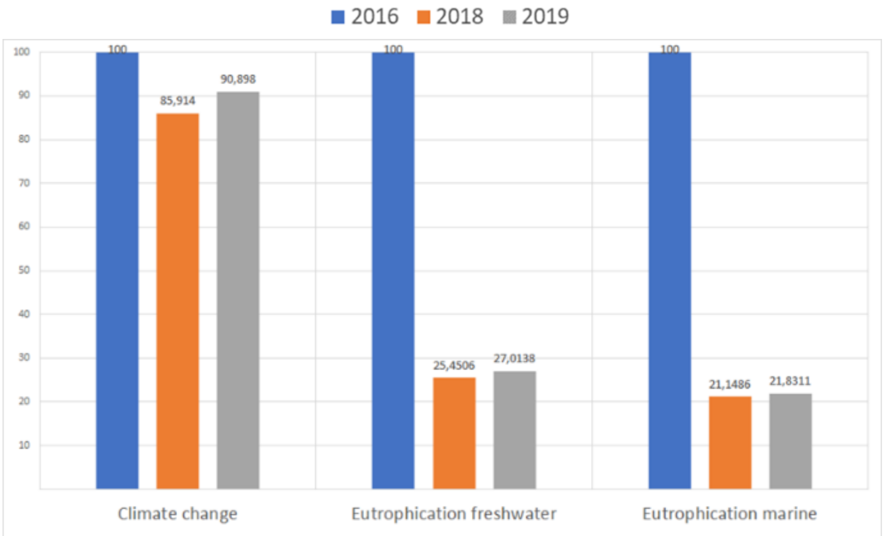


FIGURE 16: Evolution of main environmental impacts during the LIFE VERTALIM project

The implementation of these actions during the project demonstration period has meant:

5-10 %
Climate change reduction
due to the production of the canneries and the discharges of the inhabitants of the area

80 %
Reduction
of aquatic and terrestrial eutrophication improvement compared to the initial situation

BENEFITS AND TARGECTED SECTORS

FOOD INDUSTRIESS

· Identification of the **causes and origins** related to main environmental impacts.
· Orientation for future **improvement actions** to reduce environmental impacts.
· Increase of the **productive efficiency** of the food industries.
· **Safe integration of industrial discharges** into the urban sanitation network, with previous treatment at the company before discharge to collector.
· The **corporate image** improvement in the administration and society.
· **Relationship improvements** with the main stakeholders (customers, suppliers, regulatory agencies, media)
· Facilitates the environmental management and **compliance with current regulations**.

WATER MANAGEMENT BODIES

· Identification of the problems associated with **global sanitation management**.
· Methodology development for **integrated management** of sanitation systems.
· Strategies for **dialogue and co-responsibility** with companies for their safe integration in sanitation network.
· Tools for decision making and problem solving quickly and easily, thanks to the **global vision** of all sanitation facilities.

ADMINISTRA-TIONS

· **Compliance with current regulations** in especially sensitive areas: protected areas, bathing areas, etc.
· **Development of solutions** to the demands of citizens, local entities, large administrations, companies, and water services.

COST-BENEFIT ANALYSIS

2 economic scenarios for canning effluents 50 m^3/day:

1. **The company completely cleans its waters before discharging to the environment**

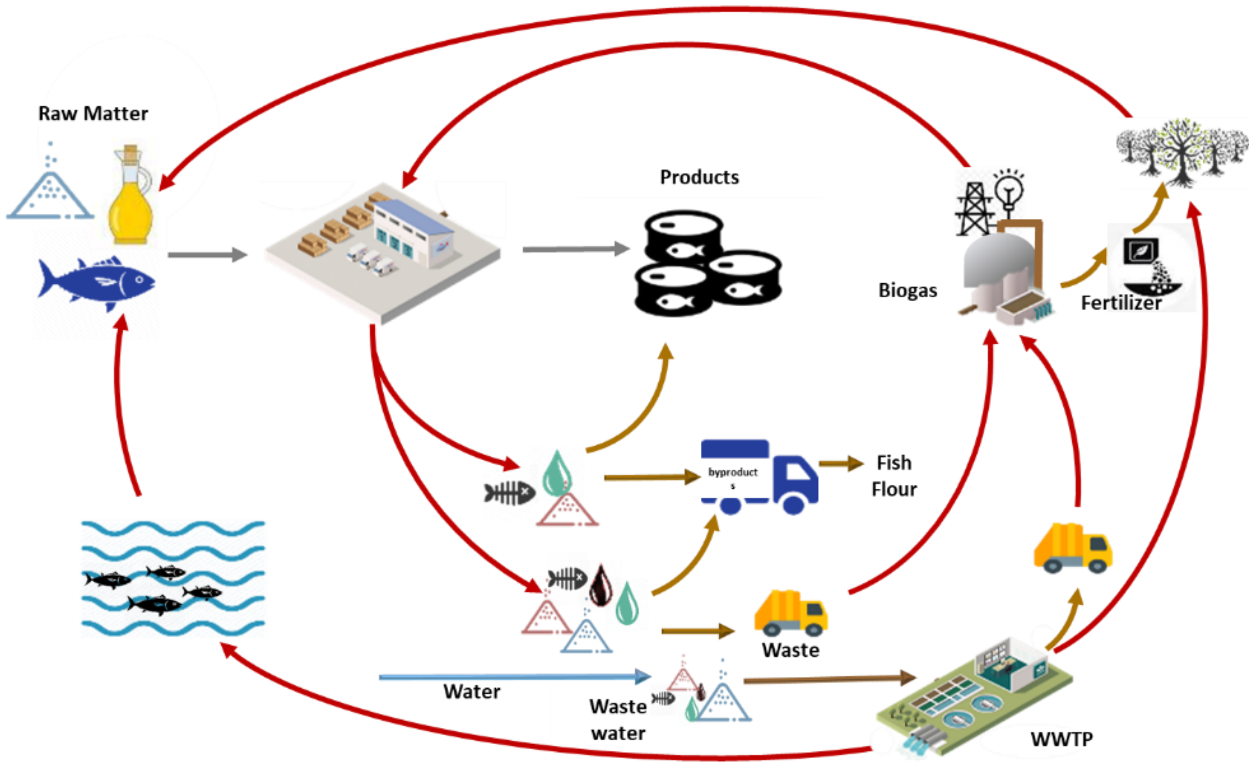
Pretreatment + biological tank MBR
- **Investment: 350.000 €**
- **Annual operating costs: 108.000 €/año**

2. **The company with 3 BARRIERS SYSTEM: pre-treats its waters and discharge them to an urban WWTP**

Pretreatment
- **Investment: 150.000 €**
- **Annual operating costs: 60.000 €/año**

SAVINGS:
- Investment 200 000 €
- Annual operatin costs 48 000 €

FISH CANNING AND CIRCULAR ECONOMY



IMPACT

The results have been widely disseminated in various events at local, national and international levels:

CONGRESS

Oral presentations: EU Water innovation conference 2019, CEST 2019, HERAKLION 2019, CONAMA Local 19, EWaS 2018, UDM 2018, YWP 2017, Eureau 2017.
Posters: WATERMATEX 2019, CONAMA 2018, iWATER 2016.

WORKSHOPS

Organization of a workshop for the canning industry 2019, celebration of the 25th anniversary of the LIFE program, 2017.
Assistance with conference presentation: Food4Life 2019 Platform, META 2019, Meeting between environmental managers of the food industry, 2017.

EXTERNAL PANEL MEETINGS

3 Contrast tables for presentation and validation of the results (Mach 2017, April 2019 y December 2019).

COLLABORATIONS

Contact and sending information (project brochures, newsletters) to **more than 100 organizations and companies.**

MEDIA

20 media appearances, including press, radio and television programs.
Scientific Article in WATER (Water 2019, 11, 223; doi: 10.3390 / w11020223) and **Technical Articles** in specialized journals (FUTURENVIRO and RETEMA).


«Proiektua egiaztatu ondoren, gauzatzea gustatuko litzaiguke»

PROJECT COORDINATOR

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HEISA

vertalim

Safe discharges, life source

LIFE15ENV/ES/000373

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01/07/2016 - 30/12/2019

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1.958.998 € (56,02% UE Co-financed)

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