# E 2.3.3 Mid-term report on TWIST Living Labs

## Report on GT 2

December 2020

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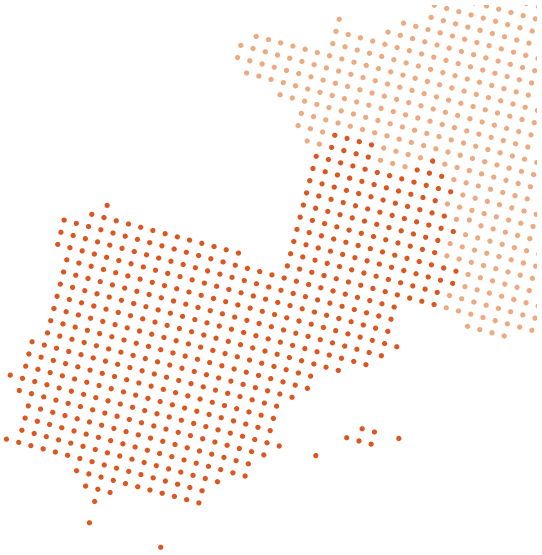

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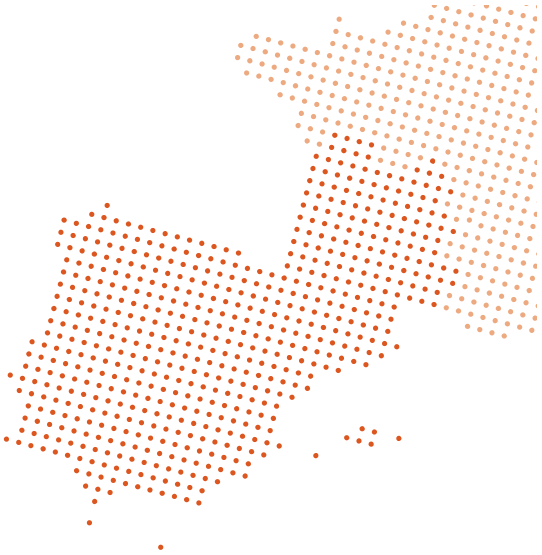

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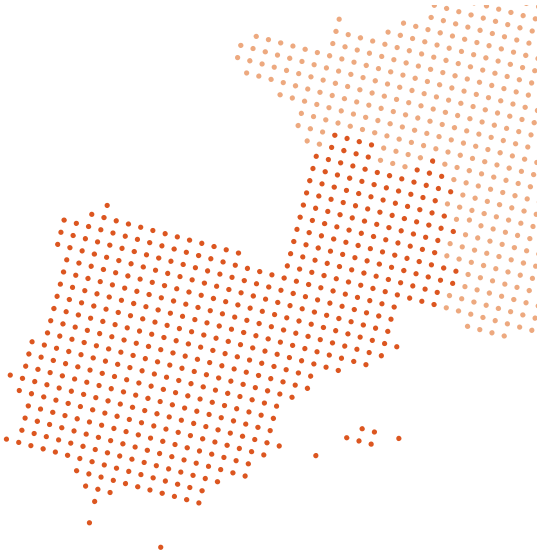

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# 1 Introduction

TWIST creates an innovative model of transnational and trans-regional organization and collaboration for the co-creation, experimentation and evaluation of innovative products through 3 Living Laboratories (l-Labs).

These take advantage of existing experimental infrastructures in Andalusia, Nouvelle-Aquitaine and Lisbon, selected for the availability of access to wastewater and the existing trans-regional cooperation between neighbouring regions (Andalusia + Murcia; Lisbon + Alentejo; Nouvelle-Aquitaine + Occitanie). Each l-Lab will specialise in different and complementary aspects:

- in Spain, Open Water Lab (OWL2) will specialise in wastewater treatment and regeneration,
- in France, Laviso Living Lab will specialise in solutions for wastewater treatment and associated infrastructure management,
- in Portugal, Urban Lisbon Living Lab (uL3) will specialise in wastewater treatment for reuse and resource recovery (water, nutrients and energy).

In each Living lab all the members of the partnership (according to their different profiles) will support these recipients in the different phases of the development of their innovations: conception, search for funding sources, implementation in the L-Lab, validation, intellectual protection and promotion in the SUDOE space market. The role of the associates will favour that the living lab is a real meeting place for all the quadruple helix agents.

The TWIST project contemplates the organization of a series of promotion and co-creation workshops to involve the key actors in the experimentation process. These participatory workshops are aimed at target groups of the Quadruple Helix in all participating regions.

This report includes the interim state of the living labs, the steps taken to implement them, which include:

- the institutions involved in the constitution of the Living Labs

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- the advances in the definition of internal management and regulation,
- the available resources and technology,
- the target groups contacted, and
- the current services offered

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# 2 The Spanish Living Lab: OWL²

## 2.1 Introduction

The TWIST Living Lab in Spain, named Open Water Living Lab (OWL2), is headquartered in the Experimental Centre of the CENTA Foundation (Carrión de los Céspedes, Seville) oriented to the co-creation, exploration and evaluation of innovations in the field of wastewater treatment for small populations and rural areas and regeneration for water reuse.

Since the beginning of the TWIST project, CENTA staff have carried out a large amount of work to define and develop the OWL2.

From the initial concept, contacts with stakeholders, workshops and activities have been developed that have resulted in the implementation and start-up of OWL2, as well as the dissemination of its activities. From these actions it follows that OWL2 provides direct service to the regions of Andalusia and Murcia (and the rest of Spain), and will work in a network with the other two L-Labs to enhance transnational projects.

During this time, OWL2 has participated in numerous research projects for the development of innovative technologies, but has also carried out many other activities, such as training, dissemination of knowledge, technology transfer and other activities to respond to the demands of society, universities, the public sector and companies in the sector of wastewater treatment and its reuse.

## 2.2 Keys to strategic planning

The TWIST project affects the development of a common methodology for Living Labs (LL). To do this, a series of common activities are carried out, such as:

- Information gathering.
- Definition of a methodology for the implementation of a LL.

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- Establishment of the catalogue of services.
- Outreach campaign that favours the recruitment of users.

In this framework, the Living Lab OWL2 is presented as a backbone for the strategic planning of the CENTA Foundation, due to the uniqueness of its facilities and the accumulated experience as a starting point.

It is a functional model that goes beyond the TWIST project, since:

- Provides added value to the CENTA Foundation.
- It is a business model, a viability plan.

The water sector has some peculiar characteristics that make it resilient to innovation:

- Faces great challenges in managing,
- It is endogamic,
- It has a strong public component,
- It is highly technical,
- It is multidisciplinary.

The challenge for OWL2 within this sector is to become an innovative ecosystem for the creation, exploration and validation of innovations in the field of water purification and reuse for small populations, which contributes to:

- Accelerate innovation processes by enhancing synergies.
- Favour the association between different stakeholders.
- Explore and create new knowledge, technologies and / or products.

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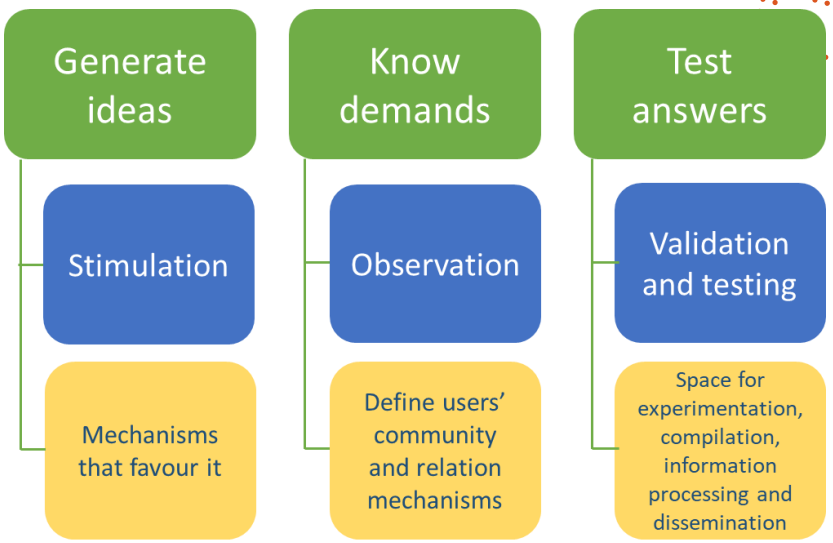


*Figure 2.1 Scheme of the process for developing the OWL2 ecosystem*

## 2.3 Institutions involved in the constitution of theLiving Lab

The CENTA Foundation is the only promoter of OWL2.

The Public Foundation Centre for New Water Technologies is a water research centre promoted by the Ministry of the Environment of the Junta de Andalucía with the support of other public and private bodies in the water sector.

With a research career backed by more than 25 years of experience in the wastewater treatment and water resources management sector, CENTA has become an indisputable international benchmark.

The CENTA Foundation works intensively as a knowledge agent and research centre and has signed collaboration agreements with eight of the ten Andalusian universities. It carries out projects in collaboration with other Spanish universities, such as the University of Alcalá de Henares in Madrid and the Polytechnic University of Catalonia; collaborates closely with other top-level research centres (the Centre for Studies and Experimentation -CEDEX-, the Catalan Institute for

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Water Research -ICRA-, the Higher Council for Scientific Research -CSIC, the Technological Institute of the Canary Islands -ITC- and the Institute for Advanced Studies in Madrid –IMDEA-, among others). And it has participated throughout its history, both as coordinator and partner in many research projects funded by all the framework programs of the European Union in this field, as well as in projects funded by national and regional research plans and by Spanish development cooperation agencies.

## 2.4 Process to define theLiving Lab

Internally, CENTA has held meetings among managers and the research and technical staff in which the strategy for planning the process has been defined.

To define and configure this ecosystem, advance in the creation of its users' community and the relationship model (functional and organizational), the CENTA Foundation opened a process of participatory debate with different actors: public entities, innovation agents, producers of technology, researchers and civil society, to analyse the possibilities of improving their competencies in R & D &i processes, strengthening synergies, as well as defining the elements that allow society to be actively involved in the innovation process.

This process began with the online workshop "Open Water Living Lab: towards an open innovation model in the water sector", which took place virtually on July 8, 2020, and whose objective was to carry out a common start-up in relation to the context in which the LL will be developed, the LL approach, the profiles of the user community, functional dynamics, etc. In this workshops the participating actors (representatives of the quadruple helix) have made a joint reflection, contributing their points of view on some of the main elements for the configuration of the Open Water LivingLab:

- Definition of the context: physical, technical and social
- Definition of the type of LL

With this virtual round table, CENTA wanted to make a first approach to the definition of OWL2, incorporating a wide "pool" of visions, interests, perspectives and experiences that contribute to the definition of the essential elements for the deployment of OWL2. To facilitate the definition process, representatives of the European Network of Living Labs (ENoLL) have participated in the event, which has constituted an important support for the better definition of the Open Water Living Lab.

In this first round table, the participants, from their personal perspectives or from the entities they represent, have shared their visions, the results of their experiences and the lessons learned, as well as their reflections, all of which will contribute to crystallize a first approach. for the configuration of the Open Water Living Lab.

In this first approach, during the workshop the debate has focused mainly on the analysis of the context for the deployment, as well as on the proposal of the type of Living Lab and its objectives.

The event was attended by 18 participants, carefully selected from the CENTA Foundation's network of stakeholders. Five of them belong to the Academy (3 researchers from Universities and 2 from research centers), one from a technology transfer agent, 2 from companies, 2 from the regional and local public administration, 2 representatives of society, a Living Lab (Guadalinfo), the president of ENoLL (in turn leader of the Library Living Lab) and 4 people from the CENTA staff involved in the development of OWL2.

## 2.5 Definition of the type of Living Lab

First of all, it is clear that co-creation is a complex process, and that the transformation of the current CENTA model towards OWL2 is an ambitious process, which requires a clear definition of its objectives and their magnitude and scope of action. For this, it is essential, first of all, to make a deep reflection in relation to innovation in the water sector which, given its singularities, is not a

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disruptive innovation, but obeys a model of sustainable and/or incremental innovation.

Defining OWL2 precisely requires establishing where innovations are needed and what innovations are needed. In fact, that's the overall goal of OWL2. It is about that this objective can be achieved through a work methodology in which the quadruple helix and all its actors are fully involved, interacting with each other, in a feedback loop.

It was also emphasized that the innovation created by OWL2 must be aligned with the objectives of European, national and regional water policies and programs. However, it must also be considered that, as a LL, through co-creation and under a multi-stakeholder approach, OWL2 also aspires to influence the orientation and development of these policies.

Another element that has been identified as fundamental to the configuration of the OWL2 design is its sizing. It is noted that it is necessary to "narrow down" and specify its scope of work. This consideration is closely related to the need to identify those areas that require innovation. In this sense, it is advocated not to lose what, until now, has been the differentiating nature of the research and work of the CENTA Foundation, focused on the field of solutions for the treatment and reuse of wastewater adapted to the needs of small urban agglomerations, providing innovative solutions to the needs of rural areas.

On the one hand, it is an area where CENTA mainly concentrates its know-how and therefore can generate a greater impact and, on the other hand, in the medium-long term, the highest demands on the quality of treated effluents from small agglomerations will require the development of new innovations that respond to the current context, which is obviously significantly different from 20 years ago.

Thus, in the debate it is affirmed that in the conception of the model for OWL2, as its promoter, CENTA cannot ignore what its reference keys are. CENTA is fundamentally a research centre and must continue to be and play this role within the framework of the Living Lab.

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Therefore, within the framework of the functional model designed for OWL2, in the process of transferring research to innovation, OWL2 must provide services or develop products (its own technologies) but at the same time consider that these technologies are not only an end in itself that obeys specific objectives, but it is also a facilitator of social changes both at the level of citizenship and at the level of each citizen.

## 2.6 Objectives of the Living Lab

The mission is to contribute, through the generation and dissemination of excellence and knowledge, to the efforts of public administrations, research centres and companies to make Andalusia a benchmark in the field of water.

**The values are:**

- Innovation: incorporating knowledge for the development of new technologies and processes, developing new solutions and / or improving existing ones.
- Transfer: with an incessant effort to bring knowledge where it is needed and should be applied, improving the competitiveness of the sector, as well as the quality of life of citizens.
- Outsourcing: incorporating a holistic view of the world and its relationships that favours the flow of knowledge and experience and the creation of collaborative networks.
- Commitment: promoting the transmission of social and environmental values and developing technologies for the most disadvantaged, thus contributing to the achievement of the Millennium Development Goals and the Europe 2020 Strategy.
- Knowledge: as the axis of its activity and understood as a public good, developed from the intellectual capacity and scientific and technical activity of its human team.

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OWL2' mission is addressed through two types of objectives, strategic and operational, which are described below:

**Strategic objectives:**

- Improve the competitiveness and internationalization of the water sector in Andalusia and generate new activities and employment through the generation of knowledge and its application to respond to market demands.
- Contribute to maximize the competitive advantages of the Andalusian water sector and position it as an area of strategic innovation in the national and international context.
- Provide independent scientific-technical support based on proven facts during all phases of the development of Andalusian policy and advice for adaptation to European standards.

**Operational objectives:**

- Generate knowledge: Developing own research projects and in collaboration with other regional, national and international entities.
- Disseminate and transfer knowledge: Creating transfer networks and enhancing its role as a dynamic sector, promoting synergies between the different scientific, economic and financial agents and society in general, promoting the concept of the LL at the Carrión de los Céspedes Experimental Plant.
- Promote R & D &i and investment in innovation in the water sector for rural areas: Seeking efficiency in our own activity, influencing the R & D &i agendas of the sector and favouring collaborative strategies between the different agents of the knowledge system .
- Promote the use of technologies, products and services to support the generation of knowledge and experimentation on a semi-industrial scale among companies, knowledge agents and administrations that act as a gateway between research and the market.

- Develop and generate training tools around innovation opportunities and the creation of new markets.

## 2.7 Advances in the definition of the structure and internal regulation of the Living Lab

### 2.7.1 Type of entity

The entity that promotes and manages the Living Lab is CENTA, a Public Foundation that depends on the Ministry of Agriculture, Livestock, Fisheries and Sustainable Development of the regional Government of the Junta de Andalucía. The Ministry is the owner of the experimental centre where the OWL2 is located and where the CENTA Foundation develops its activity.

### 2.7.2 Management body

The **promoting group** is made up of the coordinating and managing staff of the CENTA Foundation:

- Chief coordinator
- Director of technological services

The **operating group** is made up of researchers and technical experts who support OWL2's core business, providing its full range of services. Each project developed has a person in charge who coordinates the activities and the research and technical team necessary to carry them out.

The steering committee will be composed by the two persons of the promoting group and two persons of the group of researchers and technical experts.

There is **staff**to support the activities and projects:

- Support staff: auxiliary staff for the maintenance of the experimental centre and laboratories.

- Management resources: this group includes management, administrative resources, institutional relations, communication, secretariat, etc.

Within the framework of the different projects, in addition to the permanent team, there are researchers from other centres and institutions.

### 2.7.3 Management structure within the framework of research activities and projects

Within the framework of the different projects and activities of OWL2, the organization of the management and operation structure is carried out under the "Consortium Agreement" that participates in the project. This agreement establishes the conditions in which each of the partners participates.

A steering committee is elected among project partners for every project.

### 2.7.4 Corporate image

The OWL2 logo follows the corporate image of the TWIST project, including the TWIST symbol that evokes the elements water and earth in a cyclical and fluid interaction that tries to express innovation in the areas of the circular economy and Living Labs.

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The brand's signature is made up of the TWIST symbol and the Living Lab name, with the TWIST colours.

*Figure 2.2Logo OWL²*

## 2.8 Physical context of theLiving Lab

### 2.8.1 Location of the Living Lab facilities and infrastructure

The OWL2is located in the village of Carrión de los Céspedes (2,500 inhabitants), 30 km from Seville. Next to the A-49 motorway, the Experimental Centre covers an area of 41,000 m² which house its Experimental R&D&I Centre, its laboratories and the main building used as headquarters of the Foundation and for dissemination and training activities.

The Experimental Centre was constructed in 1990, as a fundamental part of the Non-Conventional Technology Wastewater Treatment Research & Development Plan run by the Andalusian Regional Ministry of the Environment (1987-nowadays). The Water Andalusian Agency is the owner of the facilities and the Centre for New Water Technologies is responsible of its management.

This experimental centre which has a treatment capacity of 700 m³/day and 40 different treatment systems is unique in the world due to its scale, its technological diversity and its traceability.

### 2.8.2 Essential infrastructures for experimentation

This technological platform, consisting of a large technology pool containing the most sophisticated systems together with the most natural ones, supports the CENTA in its research activity, and other scientific agents as well as companies working in the water sector.

Research projects or experimental developments are assessed under the same test conditions (characteristics of the effluents, climate conditions, laboratory and technical equipment), which allows for sound comparative studies.

One of its specificities is, undoubtedly, its versatility, its capacity for combining technologies and the fact that it can offer both research centres and companies the opportunity to carry out their research.

Its facilities also include a complete analysis laboratory and an official weather station. It is no doubt a centre endowed with great singularity and dynamism where technology and biodiversity go hand in hand.

The Experimental Centre has been working mainly on the development, implementation and diffusion of non-conventional technologies for the wastewater treatment, which are generated by small towns. However, since 1995, the PECC has accepted prototypes in a studying or testing step from diverse companies which commercializes wastewater treatment systems.

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*Figure 2.3 Aerial view of the experimental plant of CENTA in Carrión de los Céspedes (Sevilla)*

The experimental plant counts on a **pretreatment unit** that receives the raw wastewater from the village Carrión de los Céspedes. The preliminary treatment and distribution characteristics are:

- Screening: automatic screening with a bar screen (3 cm) and a sieve (3 mm) and a manual screening with a bar screen (2 cm).
- Grit and grease chamber: aerated grit and grease removal chamber, sand classifier and grease concentration.
- Pumping tank: 3 Pumps (2+1) (2 kW unit power)
- Distribution system: with a volume of 18 $m^3$. Level controlled by probes. 11 exits equipped whit an electro-magnetic flow meter.

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*Figure 2.4 Pretreatment unit of the CENTA experimental plant*

*Figure 2.5 Water distribution system of the CENTA Experimental Centre*

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The main primary treatment unit is an Imhoff tank that treats 60 m3/day.Two new distribution chambers have been constructed in 2020.

*Figure 2.6 Imhoff tank*

In a single area covering 41.000 $m^2$, conventional and non-conventional technologies are represented. The non-conventional are: Green Filters (GF), Stabilisation Ponds (SP), Peat Filters (PF), Constructed Wetlands (CW), intermittent sand filters (ISF) and different combinations of these, as well as Trickling Filter (TF)

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and Rotating Biological Contactor (RBC). There are also conventional systems such as Activated Sludge, MBR, etc.

*Figure 2.7 Extensive technologies at the CENTA Experimental Centre*

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*Figure 2.8 Intensive technologies at the CENTA Experimental Centre*

The plant also has a sludge treatment system that includes a centrifuge and a sludge thickener.

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*Figure 2.9Sludge centrifuges and a sludge thickener*

The experimental plant accounts on an area for testing prototypes for companies, specially prepared for the CE marking.

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*Figure 2.10 Technologies validation area*

### 2.8.3 New research infrastructures

During the last year several innovative treatment units have been implemented:

- 1 French vertical flow wetland.
- 1 bioelectrogenic wetland (METland®) with horizontal flow.
- 1 single house bioelectrogenic wetland (METland®) with vertical flow.
- 1 photobioreactor High Algal Pond.
- 1 system for drying wastewater sludge with solar energy (SECASOL project).

Two new treatment unit systems are planned for 2021, consisting of two intensified wetlands: an aerated floating helophyte filter and a Rhizoshp 'Air wetland, within the framework of the LIFE INTEXT project devoted to small populations.

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*Figure 2.11 French vertical flow wetland*

*Figure 2.12 Bioelectrogenic wetland (METland®) with horizontal flow*

*Figure 2.13 Single house Bioelectrogenic Wetland (METland®) with vertical flow*

*Figure 2.14 Photobioreactor HRAP*

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*Figure 2.15System for drying wastewater sludge with solar energy (SECASOL)*

## 2.8.4 Experimental area for water reuse

The experimental centre counts on an experimental irrigation area for water reuse of 1,200 m².

*Figure 2.16 Irrigation area for reuse of recycled water*

## 2.8.5 Facilities to hold events

The main building housing the Foundation is singular and modern, although it is integrated into the rural environment where it is located. Its design is based on elements from bioclimatic construction, which minimise its energy consumption while providing a healthy habitat.

Its surface area of over 500 m² houses researchers and administrative staff, as well as one training classroomequipped with projection and sound system, internet, tables with connection points and chargers. In the upper floor, there is a large exhibition area for dissemination and cultural activities or events.

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*Figure 2.17 Main building*

### 2.8.6 Laboratoryforwateranalysis

Its facilities also include a complete **laboratory** for analysing wastewater samples which are part of the research studies and other works carried out in its facilities. This laboratory has modern equipments for physical, chemical and microbiological analysis. The aim of this laboratory is to support the research activity of the PECC and to control the prototypes installed.

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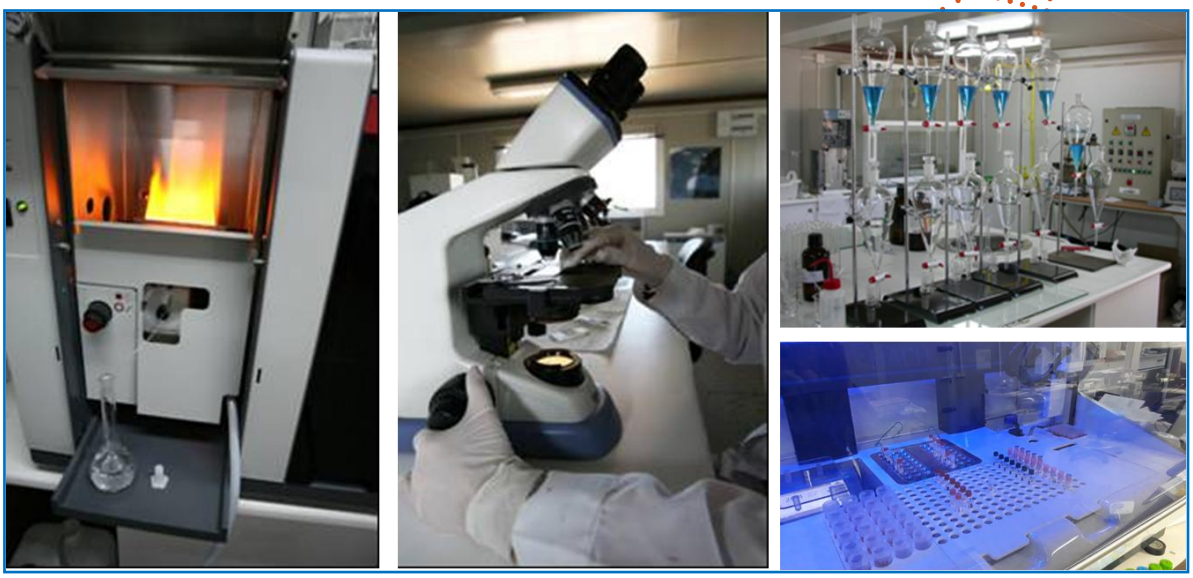

*Figure 2.18 Laboratory for wastewater analysis of the experimental centre*

### 2.8.7 Weather station

There is an official weather station, belonging to the State Agency of Meteorology of the Ministry of Environment. Each technology validation report that CENTA prepares is accompanied by a report of the meteorological parameters of the period. This information can be very important for certain technologies. The information of the weather station can be consulted online.

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*Figure 2.19 Weather station*

## 2.9 Technical/information context

### 2.9.1 Platforms to disseminate information

OWL2 has a section on the TWIST project website where it is publishing news related to the activities and projects developed in the Living Lab. Aguasresiduales.info, as a Living Lab user is committed to the dissemination of the activities developed by OWL2.

The CENTA Foundation disseminates information about OWL2 on social networks through Linkedin, Facebook and TWITTER accounts.

On the other hand, OWL2 activities are also disseminated through specialized websites of the water sector (Aguasresiduales.info) and the newsletter of the Ministry of Agriculture, Livestock, Fisheries and Sustainable Development of the

Junta de Andalucía. The CENTA Foundation has two associated blogs in the iAgua magazine of its research staff: Juan José Salas and Juan Ramón Pidre.

### 2.9.2 Technologies for the celebration of online events

The LL has hired the Webex platform for the celebration of online events up to 500 participants. It is one of the best platforms for this kind of events.

A manual for using the platform has been prepared to be provided to participants before the meetings.


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CENTRO DE LAS NUEVAS TECNOLOGÍAS DEL AGUA (CENTA)
Consejería de Agricultura, Ganadería, Pesca y Desarrollo Sostenible

Guía del usuario de WebEx
Julio 2020

GUÍA DEL USUARIO DE WEBEX

A continuación, le facilitamos algunas orientaciones para poder participar en la Mesa de Trabajo Online. Esta se llevará a cabo a través de la plataforma de videoconferencias Webex (CISCO Webex Meetings).

Recibirá una invitación por parte del organizador (Fundación CENTA) para conectarse a la reunión. Si accede a través de su PC se descargará automáticamente la aplicación de Webex. A partir de este momento puede acceder a la reunión sin necesidad de disponer de ningún usuario.

Nota: una vez reciba la invitación vía email, es probable que el mensaje se mueva automáticamente a la carpeta papelera (elementos eliminados).

**Acerca de unirse**

Puede unirse a una reunión de varias maneras. La manera más simple y rápida es hacer clic en la URL de la reunión, que el organizador puede enviarle en una invitación por correo electrónico o un mensaje instantáneo. Si el organizador le ha proporcionado solamente el número de reunión, tiene varias maneras de entrar en la reunión.

**Acerca de "Unirse a una reunión"**

Para acceder a esta página, haga clic en el enlace de la reunión de su mensaje de correo electrónico de invitación y, a continuación, haga clic en Entrar. Cuando entre en una reunión, es posible que deba ingresar algunos detalles en la página Entrar a la reunión:

i) Nombre: Introduzca el nombre con el que desea que lo identifiquen los asistentes durante la reunión.

*Figure 2.20 Screenshot of the Webex manual prepared by OWL2*

## 2.10 Advances in the creation of the community of users

### 2.10.1 Target group engaged

During the development of the workshops with stakeholders, it became clear that research and innovation necessarily require specialization and that, in the co-creation process, this aspect must be taken into account. The involvement of all the actors does not imply that all the members of the user community develop the same role, but that success also depends on each actor, on each element of the quadruple helix, developing the role that corresponds to them in the functional model. of the OWL2. In other words, it is not about citizens doing basic research, but rather that researchers can incorporate citizen research processes.

The main target groups in OWL2 are the Academia (Research Centres, University), Water companies that provide water services, Public Administration and Technological companies.

OWL2 will function as a collaborative network involving members of its user community, which will favour the opening of scientific infrastructures to the public. For this, OWL2 can incorporate citizen science processes that, in addition to facilitating the collection of data and information, can favour processes of behaviour change.

It must be considered that the effort to incorporate citizens into the co-creation and innovation process is not only the responsibility of CENTA but must be a collective effort of all the members of the network. Therefore, other actors can be integrated into the user community who may have a more appropriate role for it. In this sense, it is pointed out that, since it seems appropriate to maintain the approach oriented to the "rural water cycle", Guadalinfo can be a key element in the framework of this network and a facilitator in the citizen science processes linked to OWL2.

The OWL2 has received students from universities and secondary school, which have been reduced due to COVID-19 situation.

### 2.10.2 Methodology used for user's engagement

OWL2 has implemented different methods for user involvement:

- Workshops: an online workshop has been organized to define the Living Lab and the user community. We have emphasized the presence of the fourth leg of the Quadruple Helix (the Society) with the presence of the ENoLL network, the Aguasresiduales.info communication website and the Botín Foundation Water Observatory.
- Online events: numerous events have been held with related actors within the framework of the different projects developed at the LL(IDIAQUA, MENAWARA, EMPORIA, URBANGREENUP, TWIST, LIFE INTEXT, SARASWATI 2.0).
- News: the promoting group has shared news about the TWIST Project with the stakeholders involved through CENTA's social networks and they have shared news about projects in which the LL is involved.
- Newsletter: the TWIST Project's biannual newsletter has been sent to the network of contacts that CENTA has created over the years.
- Participation in fairs, congresses and other events.

It is still necessary to hold other workshops to get deeper in the creation of the users' community and the definition of the roles and the degree of commitment.

As of the end of 2021, it is planned to carry out a citizen participation program for the dissemination of citizen awareness on issues related to water and, especially wastewater and its reuse. Participatory workshops will be held with local stakeholders, in which citizens will be able to acquire skills and competencies to identify problems in their environment, as well as in the co-creation and design of campaigns and informative materials, to create awareness and induce behaviour. more respectful with the environment. Researchers and technicians from OWL2, citizen associations, local councils and companies related to water management will participate in these workshops.

### 2.10.3 Engaged stakeholders

No formal mechanism has yet been established to define the participation of the actors involved in the operation of the Living Lab.

The relationship with the partners in the different projects is carried out through the Agreements concluded within the framework of the respective projects.

The users' community is in its first phase of development. Among the actors who have shown a great interest in being part of the LL users'community are:

- Guadalinfo, an Andalusian LL network dedicated to the development of information and communication technologies in rural areas.
- Aguasresiduales.info, a company dedicated to the communication of the wastewater treatment and reuse sector, very active and with which the LL has already collaborated for a long time as a partner in the organization of events, training, etc. It becomes a user who will be especially dedicated to communication and the organization of trainings on water treatment for small communities and rural areas.
- The Ministry of Agriculture, Livestock, Fisheries and Sustainable Development of the regional Government of Andalusia: this public administration is a key element in the OWL2, as promoter of CENTA Foundation.
- The University of Sevilla (Academia): Enzyme Technology and Application research group.
- The University of Cádiz (Academia): Environmental Technologies research group.
- Andalusian Technology Corporation is a knowledge transfer agency.
- Imdea Agua (Research Centre): two research groups are involved in the OWL2 (Bioelectrogenesis Group and Soil and Water in the Environment Group).
- Fundación Universidad Empresa de la Región de Murcia (FUERM).

Steps to establish contact with the local stakeholders (local government, local associations) have not been taken yet.

### 2.10.4 Protocols for communication with users

The following tools are used for communication with OWL2 users:

- Website of the TWIST project
- Email list
- Newsletter of the TWIST project

In the framework of the projects, the communication protocols are established by the project coordinator. Generally, and in the case of OWL2 in particular, communication between the actors involved is carried out through a mailing list that includes all the actors involved, except for specific communications that are directed to certain actors.

## 2.11 Catalogue of services of the Living Lab

The services offered by OWL2 are the same as those listed in the initial report. These include:

1. **Generation of knowledge - Research according to demand**: OWL2 acts as a bridge to guide the R&D lines of research centres and companies. In its facilities, OWL2 has experimental plots for the development and validation of R&D&I in real operating conditions, an analysis laboratory, a reception centre for visits and meeting and training rooms. The research focuses on technologies for urban wastewater treatment, wastewater from small-scale industries, minimization of by-products generated during treatment, water reuse, resource recovery, water quality, urban water management and water management. of the ecosystem.

2. **Technological intermediation**: as a technological intermediary, OWL2 maintain aN active role as a revitalizer of the wastewater treatment for small populations sector, developing various initiatives aimed at promoting the interrelation of knowledge generators and users (public and private). By identifying the joint needs of the public sector in the field of water, OWL2 acts as a bridge to guide the R&D&I lines of research centres and companies towards the needs of the

public sector and favour the development of processes innovative public procurement.

3. **Technological transfer**: OWL2 provides advice and support for technology transfer, innovation and entrepreneurship. With this objective, the existing facilities in the Carrión de los Céspedes Experimental Plant offer technological support to companies and SMEs in the sector to carry out technical and economic feasibility studies of their technologies and services. This technological support serves its users to make a correct validation of R&D&i results before they are put on the market and therefore to develop more competitive products at European level. It is, therefore, an ideal environment to promote initiatives such as StartUps incubation or promotion of Technology-Based Companies as well as opening new lines of innovation in existing companies.

4. **Technology validation**: CENTA is recognized internationally as a technology validation entity. Its unmatched experimental facilities make it the largest testing laboratory and a true Living Lab in terms of water treatment Technological validation that provides the following competitive advantages to companies installed in the Experimental Centre:

- It serves to prove the performance of technologies at all levels of technological maturity (TRL), which differentiates them from other competing technologies.
- Validate the innovative features that make the technology truly unique.
- It serves the company both to increase market share and to facilitate the access of technologies to new national or international markets.

5. **Technological surveillance**: OWL2 performs a systematic procedure for capturing, analysing and exploiting useful information for strategic decision making: market forecast, existing R&D&i systems and products, current public-private investments at the level European, are some of the information necessary to highlight the current panorama of R&D&i and detect trends for the future. OWL2 participates on the one hand in the identification of the needs of the Administration, and on the other in the identification of innovative products and

services that are being carried out in the region and that are ready for exploitation in the market.

6. **Technical assistance**: OWL2 carries out technical, exclusive and continuous advice through the projects in which participate, as well as entities that want to apply unconventional techniques in wastewater treatment. These projects facilitate the technical training of qualified personnel, in order to guarantee both the maintenance of the facilities and to favour the implementation of these technologies in other areas of the country. Technical advisory activities include solutions to small municipalities, adaptations of treatments according to the conditions of the territory, adaptation to new regulations, etc. A task of utmost importance is technical support in new constructions.

7. **Specialized training**: One of the lines of training is the realization of comparative analyses of the different national legislations in the matter of sanitation and purification of urban wastewater, and also technical training for technicians of the public institutions and companies, or graduated students. Another training line, financed through different agents (AACID, AECID, etc.), consolidates the presence of CENTA in Latino America where, for several years, technical training initiatives have been developed in several countries.

8. **Dissemination of Knowledge**: OWL2 also disseminates knowledge through publications such as guidelines, books, contributions to scientific Conferences and publications in scientific and specialized journals. OWL2 also counts on a programme of visits intended for different sectors of society and divided into secondary and high school students, university students, technical, institutional and citizen's groups.

## 2.12 Funding of the Living Lab

The maintenance of the OWL2 is guaranteed by the nominative subsidy that CENTA obtain from the Ministry of Agriculture, Livestock, Fisheries and Sustainable

Development of the regional Government of Andalusia, which covers all the maintenance of the facilities, the laboratory and part of the staff salaries.

The funding for the rest of the salaries and the activities comes from carrying out research projects fundedby public funds, both from the National Research Plan, the Andalusian Research Plan, the European Funds of the different programs in which CENTA participates.

There are also incomes from technical assistance to municipalities or companies and validation of private companies' technologies.

## 2.13 Interrelation with other Living Labs and innovation networks in water sector

OWL2 is in the process of becoming member of the European Network of Living Labs (ENOLL) and get the Living Lab certification. ENOLL has participated in the workshop for the development of the Living Lab and is giving support to our activities.

CENTA staff attended the EU Water Innovation conference 2019 in Zaragoza (December 11-12, 2019) where participated in the Workshop organised by Water Europe on Living Labs for a Water Smart Society.

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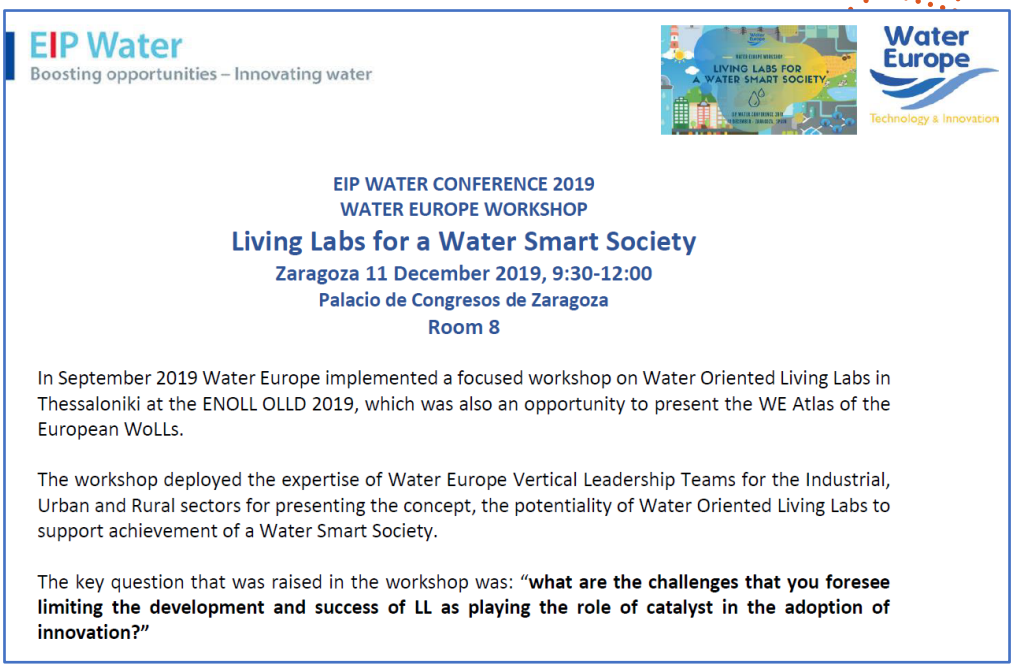

EIP Water
Boosting opportunities – Innovating water




Water Europe
Technology & Innovation

EIP WATER CONFERENCE 2019
WATER EUROPE WORKSHOP

**Living Labs for a Water Smart Society**

Zaragoza 11 December 2019, 9:30-12:00
Palacio de Congresos de Zaragoza
Room 8

In September 2019 Water Europe implemented a focused workshop on Water Oriented Living Labs in Thessaloniki at the ENOLL OLLD 2019, which was also an opportunity to present the WE Atlas of the European WoLLs.

The workshop deployed the expertise of Water Europe Vertical Leadership Teams for the Industrial, Urban and Rural sectors for presenting the concept, the potentiality of Water Oriented Living Labs to support achievement of a Water Smart Society.

The key question that was raised in the workshop was: "**what are the challenges that you foresee limiting the development and success of LL as playing the role of catalyst in the adoption of innovation?**"

## 2.14 Activities carried out in the Living Lab

This section describes the actions and activities carried out since the beginning of the TWIST project.

### 2.14.1 Research projects

Since the beginning of the TWIST project, several research projects have been developed at OWL2.

**Object of the Contract:**

Circular economy strategy applied to the conversion of slaughterhouse wastewater treatment plants into biorefineries (**Water2Return**)

**Users of the OWL2 involved in the project:**

Bioazul
Universidad de Cádiz
Universidad de Sevilla

**Starging date:**2017

**End date:** 2020

https://water2return.eu/es

**Contract number:** AMD-730398-9
**Funded by:**European Commission
Research Directorate-General
H2020 Programme

**Valueofthecontract:**

615.125,00 €.

**Object of the Contract:**

New Strategy for Re-Naturing Cities through Nature-Based Solutions (**URBAN GreenUP**)

**Users of the OWL2 involved in the project:**

None

**Starging date:**2017

**End date:** 2022

http://www.urbangreenup.eu/

**Contract number:** 730426
**Funded by.** European Commission
Research Directorate-General
H2020 Programme

**Valueofthecontract**

183.065,00 €.

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**Object of the contract:**

KETs for the elimination of emerging pollutants in reclaimed waters in the SUDOE space (**4KET4Reuse**)

**Users of the OWL2 involved in the project:**

CSIC-Instituto de Recursos Naturales y Agrobiología de Sevilla. Spain

Nanoelectra SL. Spain.

**Contract number:** SOE1/P1/E0253

**Funded by:**

European Commission

INTERREG SUDOE Programme

**Starging date:** 01/09/2016

**End date:** 31/8/2019

**Valueofthecontract:**

187.534,81 €

https://interreg-sudoe.eu/proyectos/los-proyectos-aprobados/140-kets-para-la-eliminacion-de-contaminantes-emergentes-en-aguas-regeneradas-en-el-espacio-sudoe

**Object of the contract:**

Promotion of R & D &i of excellence in the field of water purification in small urban agglomerations (**IDIAQUA**)

**Users of the OWL2 involved in the project:**

Universidad de Sevilla
Asociación de Abastecimientos de Agua y Saneamientos de Andalucía (ASA-Andalucía)
Univesidad de Cádiz
PROMEDIO - Consorcio para la Gestión de Servicios Medioambientales. Diputación de Badajoz.
ParceriaPortuguesa para a Água (PPA)
Universidad de Extremadura
Consejería de Medio Ambiente y Ordenación del Territorio. Junta de Andalucía.
Gestión Integral del Agua de Huelva, S.A.

**Contract number:** 0066_IDIAQUA_6_E

**Funded by:**
EuropeanCommission
INTERREG POCTEPProgramme

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(GIAHSA)

**Starting date:**2017

**End date:** 2021

http://idiaqua.eu/proyecto/

**Valueofthecontract:**

523.452,75 €.

**Object of the contract:**

Promotion of innovative technologies to improve efficiency in the process of drying sewage sludge and drying of urban solid waste through the use of solar technologies in Andalusia-Algarve-Alentejo(**SECASOL**)

**Users of the OWL2 involved in the project:**

Diputación Provincial de Huelva

**Starting date:**2017

**End date:** 2019

http://www.diphuelva.es/secasol/

**Number of contract:** 0029_SECASOL_5_E

**Funded by**
European Commission
INTERREG POCTEP Programme

**Valueofthecontract**

472.219,45 €

**Object of the contract:**

Identifying best available technologies for decentralized wastewater treatment and resource recoveryfor India (Saraswati 2.0)

**Users of the OWL2 involved in the project:**

**Starting date:** 1-August-2019

**End date:**31-July-2023

https://projectsaraswati2.com/

**Number of contract: 821427**

**Funded by**
European Commission
Research Directorate General
H2020

**Valueofthecontract**

2,009,472.50 €

**Object of the contract:**

Innovative hybrid INTensife-EXTensive resource recovery from wastewater in small communities (INTEXT)

**Number of contract:** LIFE18 ENV/ES/000233

**Users of the OWL2 involved in the project:**

Aqualia

**Co-Funded by**
European Commission
LIFE Programme

**Starting date:** 1-July-2019

**Valueofthecontract**

**End date:**30-June-2023

1,596,470 €

https://life-intext.eu/

**Object of the contract:**

Empower academia for knowledge transfer for value creation in the Atlantic Area (EMPORIA4KT)

**Number of contract:** EAPA_842/2018

**Users of the OWL2 involved in the project:**

Corporación Tecnológica de Andalucía (CTA)
Agencia Andaluza del Conocimiento (AAC)

**Co-Funded by**
European Commission
Interreg Atlantic Area Programme

**Starting date:** March2019

**Value of the contract**

**End date:**February 2022

2.3 million €

https://www.emporia4kt.com/

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**Object of the contract:**

Non ConventionalWAter Re-use in Agriculture in MEditerranean countries (MENAWARA)

**Users of the OWL2 involved in the project:**

**Number of contract:**

**Co-Funded by**
ENI-CBCMED Cooperating across borders in the mediterranean

**Starting date:** 1-September-2019

**Value of the contract**

**End date:**31-August-2022

2.9 million €

http://www.enicbcmed.eu/projects/menawara

REUTIVAR

**Object of the contract:**

(REUTIVAR)

**Users of the OWL2 involved in the project:**

**Number of contract:**

**Co-Funded by**

**Starting date:**

**Value of the contract**

**End date:**

http://www.enicbcmed.eu/projects/menawara

## 2.14.2 Training activities

Within the framework of the project Evaluation of sustainable sanitation alternatives for rural areas and implementation in the municipality of Cuisnahuat and San Julián (El Salvador), with file number 0C073 / 2014 and financed by the Andalusian Agency for International Cooperation for Development (AACID), OWL2

staff has carried out the following training, strengthening and awareness workshops:

| Training | Celebration date | Place |
|---|---|---|
| 1 training workshop on the technologies implemented aimed at technicians from the municipalities and water and sanitation boards | 13/11/2019 | San Julián, El Salvador |
| 1 strengthening workshop aimed at government agencies and civil society on wastewater treatment | 14/11/2019 | San Julián, El Salvador |
| 3 awareness campaigns aimed at women in the beneficiary municipality about the importance of treating wastewater | 1/11/2019<br>5/11/2019<br>7/11/2019 | Cuisnahuat, El Salvador |
| Advertising campaign to encourage the participation of women in training and strengthening workshops on water resources | Radio spots, printed material and digital products | |

The staff have participated in numerous national and international courses, masters and webinars for training in wastewater treatment systems applied to small populations and rural areas.

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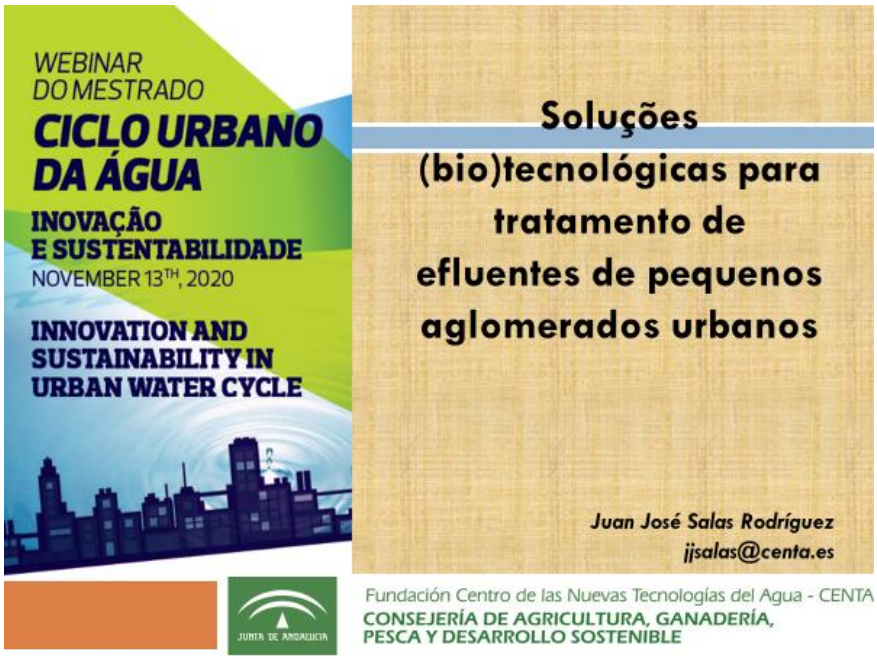


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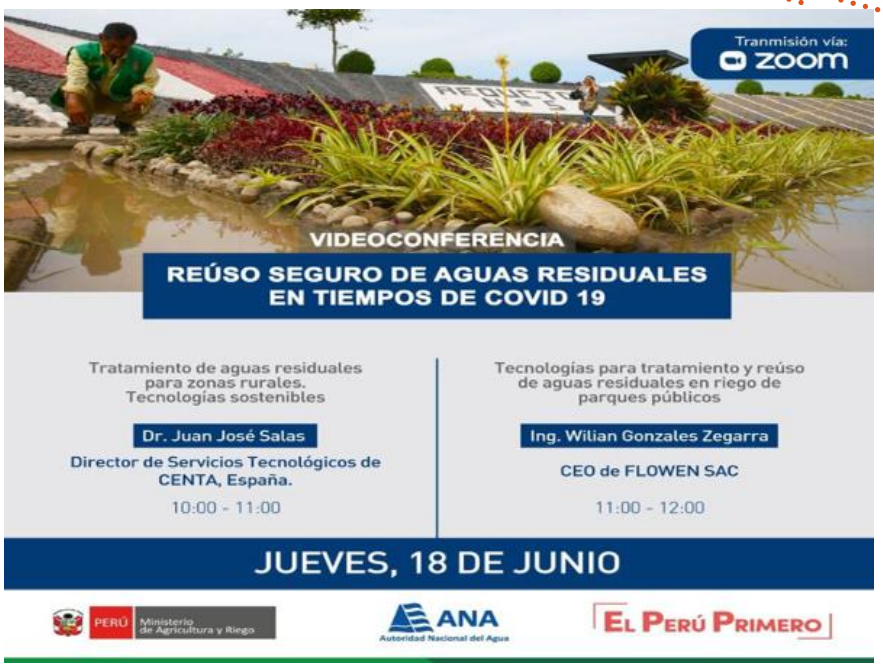



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https://www.youtube.com/watch?app=desktop&v=6GM-mVnLt2c

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https://www.youtube.com/watch?app=desktop&v=5UjUiwMWiPs&feature=youtu.be

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https://www.youtube.com/watch?app=desktop&v=SqDTQ3vcAlc&t=305s

Juan José Salas, Director of technical services at the OWL2 has developed a blog for dissemination of knowledge about wastewater treatment in small populations, in the iAgua website, the most important website in the water sector in Spain. These are the links to the published posts.

- Depuración de aguas residuales en pequeñas aglomeraciones urbanas (13/4/2020) https://www.iagua.es/blogs/juan-jose-salas/depuracion-aguas-residuales-pequenas-aglomeraciones-urbanas
- Humedales para el tratamiento de aguas residuales: preguntas y respuestas (I) https://www.iagua.es/blogs/juan-jose-salas/humedales-tratamiento-aguas-residuales-preguntas-y-respuestas-i
- Humedales para el tratamiento de aguas residuales: más preguntas y más respuestas (II) https://www.iagua.es/blogs/juan-jose-salas/humedales-tratamiento-aguas-residuales-mas-preguntas-y-mas-respuestas-y-ii

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- Humedales para el tratamiento de aguas residuales: últimas preguntas, últimas respuestas (y III) (11/8/2020) https://www.iagua.es/blogs/juan-jose-salas/humedales-tratamiento-aguas-residuales-ultimas-preguntas-ultimas-respuestas-y
- La depuración mediante macrófitas en flotación contada por su autor (10/2/2020) https://www.iagua.es/blogs/juan-jose-salas/depuracion-mediante-macrofitas-flotacion-contada-autor-i
- La depuración mediante "Filtros flotantes de helófitas" contada por su autor (y II) (20/2/2020) https://www.iagua.es/blogs/juan-jose-salas/depuracion-mediante-filtros-flotantes-helofitas-contada-autor-y-ii
- La fascinante biofactoría que todos llevamos dentro (30/12/2019) https://www.iagua.es/blogs/juan-jose-salas/fascinante-biofactoria-que-todos-llevamos-dentro
- La depuradora se nos muere: llamen a los expertos de iAguahttps://www.iagua.es/blogs/juan-jose-salas/depuradora-se-nos-muere-llamen-expertos-iagua
- Nociones básicas sobre la desinfección de las aguas residuales en tiempos convulsos (28/4/2020) https://www.iagua.es/blogs/juan-jose-salas/nociones-basicas-desinfeccion-aguas-residuales-tiempos-convulsos-0

### 2.14.3 Participation in events

During the last three months of 2020, the OWL2 has been organising the Congress SmallWat21, that will be held in June 17-18, 2021. Smallwat21v, in its fourth edition, is consolidated as a space for reflection and debate for scientists, technicians, companies, political leaders and society in general, in relation to the technological, political and management challenges of sanitation and purification services in the small municipalities.The objective of the congress is to capitalize on the results of the IDiaqua project, developed within the framework of the POCTEP

program (Interreg Spain-Portugal), as well as the sharing of innovative experiences in the field of wastewater treatment and reuse in small populations.

The activities developed by the OWL2 have been disseminated in numerous conferences and expert days, as the following.


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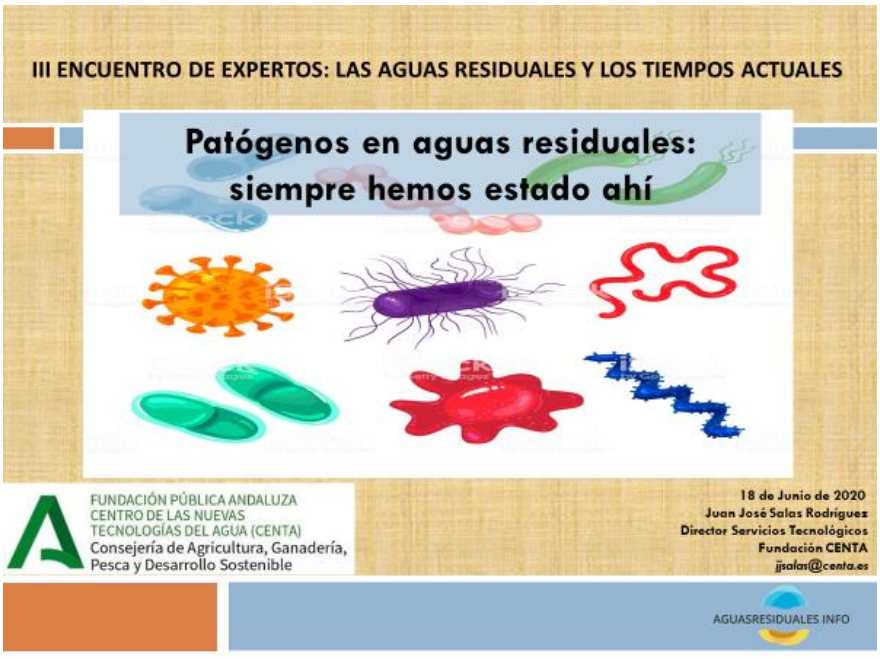
# EL REÚSO DE LAS AGUAS RESIDUALES DEPURADAS

Juan José Salas Rodríguez
Fundación Pública Andaluza Centro de las Nuevas Tecnologías del Agua (CENTA)
jjsalas@centa.es
26 de Septiembre de 2020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### 2.14.4 Visits to the Living Lab

Since the beginning of the project the OWL2 has received numerous visits.

In 2018, a total of 503 visitors visited the LL, corresponding 319 to University and Secondary students, 86 to Technical visits from the water sector, and 98 to institutional visits.

In 2019, 662 people visited the LL, corresponding 427 to the Academic Sector (students and professors of Universities and Secondary Schools), 186 to Technical visits and 49 to public sector.

In 2020, due to COVID pandemic, the LL only received visits in the first quarter of the year, 143 in total, from the three above-mentioned sectors, 18 from public institutions, 10 from Technical visits and 115 students from Universities.

### 2.14.5 Knowledge transfer

Technical Conference on nitrogen and phosphorus removal. Date: October 23, 2019. Participants: Luis Larrea, co-founder of the CEIT Environmental Engineering Group in San Sebastián, Technological Centre of the University of Navarra.

- Presentation of the Course on fundamentals and technologies of activated sludge and biofilm for nitrogen removal (nitrification and denitrification) and phosphorus for different population sizes.
- Presentation of consulting studies
- Presentation of the innovative technologies of the ACAI company in the field of purification: biodiscs, bacterial beds, moving bed.

## 2.14.6 Validation of technologies

The Forced Aeration Constructed Wetland with Filtralite-P substrate for phosphorus removal" prototype from the company Ecolagunas has been completed at the CENTA Open Water Living Lab (OWL2) facilities.The implementation of the prototype is the result of a contract between the company Ecolagunas and the CENTA Foundation to monitor and validate the prototype in real conditions, as well as to serve as a demonstration for the transfer of technology to the market.


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*Figure 2.21 Aerated Wetland H20 (Ecolagunas)*

The pilot system of the Israeli company Fluence has been tested and validated for a year at the experimental plant, thanks to the contract signed between Fluence and CENTA. CENTA technicians have been in charge of monitoring and validating the system as well as the pertinent water analyses.The heart of this treatment system is the MABR (Membrane Aerated Biological Reactor) technology, which is based on passive aeration, that is, the diffusion of oxygen through membranes using a low-pressure aeration flow.


*Figure 2.22 Membrane Aerated Biological Reactor*

Bioelectrochemical wetlands for treating wastewater (METland®) for small populations are being tested and validated in the facilities of the Spanish OWL2 in the experimental plant.

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The METland® (a registered product) is a concept developed by the start-up METfilter S.L., a technology-based company established by IMDEA Water and CENTA Foundation which objective is to design, construct and market water purification systems based on the principle of microbial electrogenesis. METfilter has solutions and applications for municipal and industrial wastewater treatments.


*Figure 2.23 Membrane Aerated Biological Reactor*

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# 3 The French Living Lab: LaViso

## 3.1 Introduction

The French team has:

- thought about the structure, organisation and governance of the Living Lab LaViso;
- implemented pilot tests
- involved different stakeholders
- implementation of different workshops, meetings, co-creation workshops

## 3.2 Institutions involved in the constitution of the Living Lab

**OIEau** is a non-profit making organization created in 1991 State approved. The missions of the association are:

- to gather competencies of public organizations and private companies
- to provide services of public interest in the water field
- to promote French know-how for sustainable management of water resources at international level

**IFTS**, the Institute of Filtration and Separative Technology, is a non-profit association founded in 1981.

- IFTS's expertise is based on a long experience of separation techniques, state-of-the-art testing facilities and a team of scientists, engineers and technicians who are among the best in their fields of expertise.
- The knowledge developed at IFTS applies to all industries. Thus, daily, the teams of the institute meet the needs of various industrial sectors such as aeronautics, agribusiness, chemistry, environment, mechanics, nuclear, pharmacy ...

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The laboratory **Peirene-Eau**, a research unit of the **University of Limoges**, brings state-of-the-art expertise in the field of the environment in various disciplines: chemistry, biology, microbiology, soil sciences and process engineering. The 40 permanent employees provide answers to environmental problems for the services of economic and social actors in the field of diagnosis as well as in that of the process. Peirene is developing in a national and international context where the environment is a priority with the existence of strong partnerships with companies as part of research, development or training courses for bachelor, engineering and PhD students.

### 3.2.1 OIEAU

The OIEau is a non-profit association under French law declared to be in the public interest by the Decree of 13 September 1991. OIEau core-activities deal with the development of skills for better water management in France, in Europe and worldwide.

**History**

OIEau was born from the merger of three organizations.

- **The Water Institute (or the Water Foundation)** in Limoges, created in 1978 on the initiative of the University of Limoges (Water curricula), local authorities, the Ministry for the Environment and of water companies.
- **CEFIGRE (International Training Center for Water Resources Management)** in Sophia-Antipolis, created in 1976 jointly by the French Government and the United Nations Environment Program (UNEP) to meet the needs of the international community regarding water resources management.
- **AFEE (French Association for the Study of Water)** in Paris, created in 1949 on the initiative of representative "industrial groups", of "industries interested in water supply and distribution" and "consumer industries with a special interest in water quality".

*OIEau was created to coordinate and synergize the resources and activities of the three organizations. From the outset, it aimed to develop skills for better water management in France, Europe and worldwide by intervening in "its four pillars": training of water professionals, institutional and technical support, dissemination and sharing of knowledge or data as well as the animation and coordination of actors' networks.*

Since its creation, OIEau has been working on the following themes

- professional training for better water management
- innovation to make documentation and information accessible to all
- efforts to improve water data management in France
- expertise and support to water stakeholders in France and Europe
- assistance to the development of training over the world
- facilitate the establishment and development of Water Information Systems
- working for a better governance of drinking water supply and sanitation utilities
- support for the effective application of the European Water and Waste Directives
- support for the implementation of Integrated Water Resources Management in river basins
- adaptation to climate change and allocation of water resources for agriculture

### 3.2.2 UNILIM

The Peirene-Eau Laboratory is made up of about 40 members, including 25 teacher-researchers and research engineer.

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## 3.3 Definition of the type of Living Lab

LaViso is a partnership between the International Office of Water (OIEau), the Institute for techniques separation and filtration (IFTS) and the laboratory Peiren-eau from the University of Limoges (UNILIM). It is in the south-west of France and its focus is on waste-water treatment technologies and associated infrastructure management. While this may be its primary focus, the living lab is not limited in its capacities and interest to provide support for solutions in a wide range of applications.

LAVISO is the name given to the Southwestern Living Laboratory This structure is set up in accordance with the objectives of the SUDOE TWIST project.

The aim of this Living Lab is to encourage business investment in Research & Development & Innovation (and associated employment), in the field of water management, by developing links and synergies between businesses, research and development centres and the higher education sector, by accelerating technology transfer, and the marketing of innovation. The topic of the expected studies concerns more particularly wastewater management, development of new wastewater treatment associated to further management ways governed by new challenges, considering particularly climate change.

## 3.4 Objectives

The Living Lab aims to:

1. Strengthen the mechanisms for coordination and transfer of knowledge and capacity in R&D&I to the society-science-policy-industry interface;
2. Ensure communication and marketing that promotes the New Aquitaine region as a major centre of innovation for water and sanitation management: "Communities working together within a territory for a better protected and enhanced environment";

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3. To guarantee collaborative work with key players in the State services, local authorities and companies involved in the field of sanitation, with the skills and capacity to act in the innovation value chain;
4. To benefit from the network built in the SUDOE TWIST project and to strengthen the capacities and opportunities for development at national and international level;
5. To work together on tenders and construction of modern and innovative technological projects by their processes or by their applications.

Each partner brings its expertise to the benefit of this collaborative vision:

- The laboratory Peirene-Eau from UNILIM with its expert role in fundamental research(chemical engineering, water treatment process development,passive sampling), pilots at lab scale, its interaction with society and the involvement of students in the innovation process. ("Participating in the production of innovation"; "Scientific production").
- OIEau has pilot platforms in Limoges and La Souterraine allowing the reception of innovative products on functional installations. Moreover, OIEau has a recognised experience in training and expertise in the fields of management and control of water and sanitation infrastructures.
- IFTS - a pilot platform in Agen with experience in the speciality of Liquid-Solid Separation issues. A tool dedicated to the testing of water treatment devices: Its Roger Ben Aïm Test Centre.

## 3.5 Advances in the definition of the structure and internal regulation of the Living Lab

### 3.5.1 Type of entity

LaViso is a partnership between the International Office of Water, the Institute for techniques separation and filtration and the University of Limoges. It is in the south-west of France and its focus is on waste-water treatment technologies and

associated infrastructure management. While this may be its primary focus, the living lab is not limited in its capacities and interest to provide support for solutions in a wide range of applications.

A memorandum of understanding between the partners is in the process of being validated by the three entities.

The studies developed in LaViso will answer to issues from public and private companies involved in wastewater treatment and management, especially in the south west of France.

### 3.5.2 Management body

The steering committee will be responsible for evaluating the actions implemented in the operational annexes. This steering committee will meet at least twice a year and will be able to decide on possible communications within the LAVISO laboratory.

The steering committee is responsible for the following mission:

- to be a force of proposal in the actions aiming at the validation of the innovation,
- to validate proposals for new joint actions or to make the necessary corrections.

A report on the experience will be drawn up at the end of each year; the evaluation may lead to the amendment of this agreement.

**STEERING COMMITTEE**

The Steering Committee is composed of:

- OIEau :
  - Jean-Marc Berland
- UNILIM
  - Véronique Deluchat
- IFTS

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- Pascal Ginisty

Depending on the agenda, it may be supplemented from time to time by qualified persons representing the services or institutions associated with the implementation of the Innovation Contract.

A report of the steering committee's discussions will be systematically distributed to its participants.

**THE CONVENTION MENTORSHIP COMMITTEE**

Le comité de Suivi de la Convention est composé de :

- OIEau :
  - Marc-Yvan Laroye
- UNILIM
  - Michel Baudu
- IFTS
  - Vincent Edery

### 3.5.3 Corporate image

The LaViso logo follows the corporate image of the TWIST project, including the TWIST symbol that evokes the elements water and earth in a cyclical and fluid interaction that tries to express innovation in the areas of the circular economy and Living Labs.

The brand's signature is made up of the TWIST symbol and the Living Lab name, with the TWIST colours.


*Figure 3.1 Logo of LaViso*

## 3.6 Living Lab physical context

### 3.6.1 Infrastructures

**OIEau:**

The infrastructures of the living-lab are located in Limoges and La Souterraine. The technical experts that will be involved for testing the pilots are member of the National Training Centre for Water Professions (CNFME –Centre National de Formation aux Métiers de l'Eau).

CNFME:

- employs 30 permanent trainers;
- owns 30 000 m² of pedagogical units:
    - 18 training rooms;
    - 20 technical plants.
- open 600 training sessions (on catalogue and on demand) each year;
- trains 6 000 professional a year.

In Limoges, the presentation materials and operational installations are gathered in two technical halls, representing 800m² of covered and heated educational space. Outdoors, the centre has an experimental network of mesh,

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buried and leaking drinking water pipes and a functional ditch (for stormwater management).

In La Souterraine, the centre brings together educational facilities dedicated to the laying of pipes, sanitation networks (self-monitoring, control and inspection, intervention, etc.), non-collective sanitation and operational pilots dedicated to the production and refining of drinking water and processes, urban and industrial wastewater treatment, WWTP sludge treatment, flow-metering and remote management. In 2010, an additional 700m² was created, a large part of which is dedicated to laboratory and analytical techniques. OIEau have made classical technical studies involving the pilots before 2018 but clearly the civil society was not involved as a co-creation actor. Technical training plants: Pumping and hydraulic regulation plant.

*Figure 3.2 Pumping and hydraulic regulation plant*

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*Figure 3.3 Show room for leak research and pipe detection materials*

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*Figure 3.4 Place dedicated to drinking water supplies*

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*Figure 3.5 Plant for laying out of drinking water pipelines*

*Figure 3.6 Unit dedicated to water meters and metrology*

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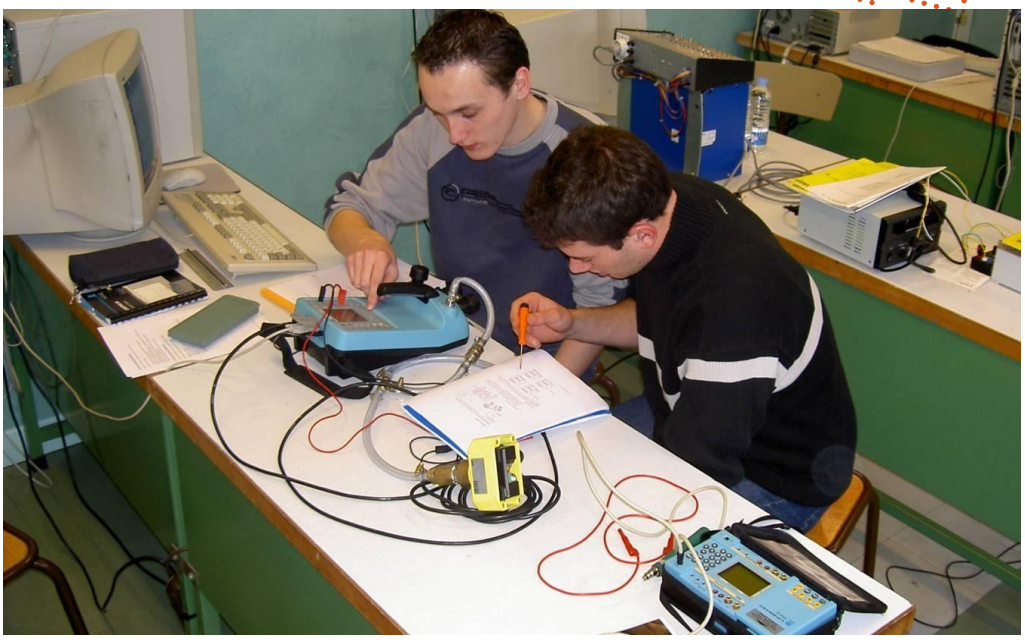

*Figure 3.7 Automation and remote management training session*

*Figure 3.8 Process and drinking water production plant*

*Figure 3.9 Metrology canal*

*Figure 3.10 On-site sanitation systems*

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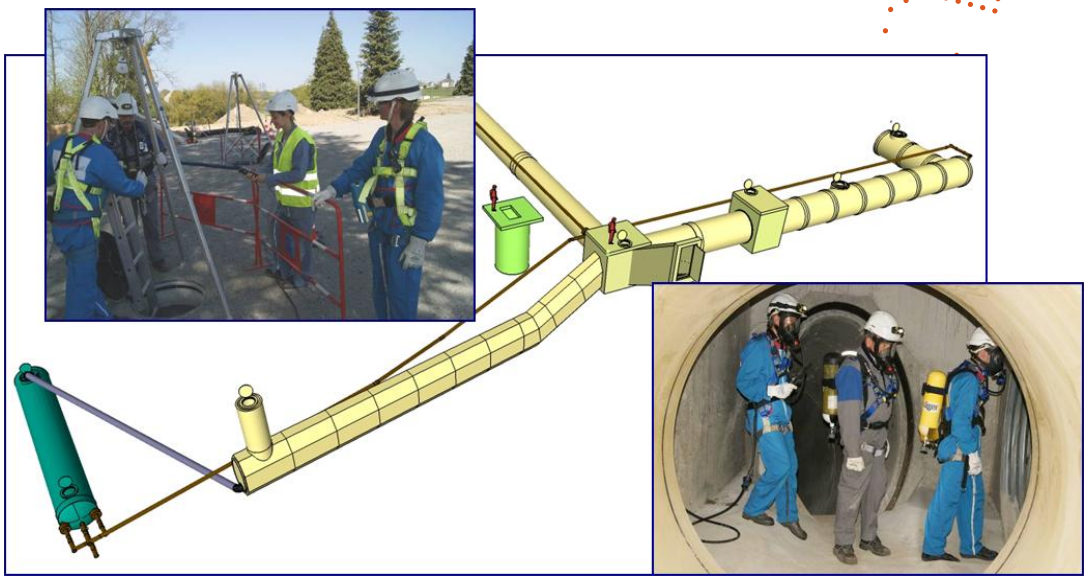

*Figure 3.11 Underground sanitation network that can be accessed*

*Figure 3.12 Urban and industrial wastewater treatment plant*

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*Figure 3.13 Water analyses laboratory*

**IFTS:**

IFTS's expertise is based on a long experience of separation techniques, state-of-the-art testing facilities and a team of scientists, engineers and technicians who are among the best in their fields of expertise.

The knowledge developed at IFTS applies to all industries. Thus, daily, the teams of the institute meet the needs of various industrial sectors such as aeronautics, agribusiness, chemistry, environment, mechanics, nuclear, pharmacy...

Based in Foulayronnes, between Bordeaux and Toulouse in southwestern France, IFTS has an international positioning and has two subsidiaries: one in the USA (Middlesex, NJ) and the other in China (Shanghai). The Chinese subsidiary has

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integrated a new building in 2014, where our local sales team is based as well as a testing laboratory for filters and cleanliness control.


*Figure 3.14 Laboratory for Liquid/Solid separation process studies - Feasibility – Optimization*

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*Figure 3.15 Laboratory for filter testing*


*Figure 3.16 Laboratory for Characterization and cleanliness*

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*Figure 3.17 Laboratory for Water analysis*


*Figure 3.18 Laboratory for studies and expertise in membrane separation*

Already inaugurated at the end of 2018, IFTS will make fully operational, in early 2019, its brand-new Roger Ben Aïm Test Centre, a research and experimental centre designed to evaluate the behaviour of pilots and industrial equipment on real waters with specific characteristics.

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Located in Lot-et-Garonne, in Agen (France), the Roger Ben Aïm Test Centre is located between two sites in the city: the drinking water production plant and the effluent treatment plant. This positioning gives him direct access to their water through a network of interconnected pipes. It is also close to the Garonne and the Canal des Deux-Mers between Atlantic and Mediterranean.

The Centre has ideal working conditions for its personnel who offer their services to private companies to test and prove objectively the performance of any technologies or innovations in order to treat water or sludge over a significant period of time (a few days , weeks or several months continuously ...)., in complete confidentiality to:

- Evaluate and qualify technologies and equipment for treatment and reuse of water or sludge management,
- Test and compare competing technologies at the pilot or semi-industrial scale, under controlled conditions,
- Organize equipment demonstrations in real conditions,
- Establish the equipment consumption budget in real conditions of use,
- Evaluate in-situ measuring instruments and online sensors,
- Test the endurance of equipment and sensors ...

The Test Centre is also intended to conduct research (researchers, doctoral students, academics...) by French and international teams, including tests on natural waters or at various stages of their treatment of clarification, purification or on sludge.

The building, on stilts to avoid the risk of flooding, has at the first level, a parking and experimentation area covering several underground water storage tanks. Upstairs, a large space of 360 m² is dedicated to experimentation of treatment devices, a mechanical workshop, offices and a meeting room. It is surmounted by a soon vegetated roof which will serve as ground for experiments of irrigation and air cooling by the plants.

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*Figure 3.19 Roger Ben Aim Test Centre*

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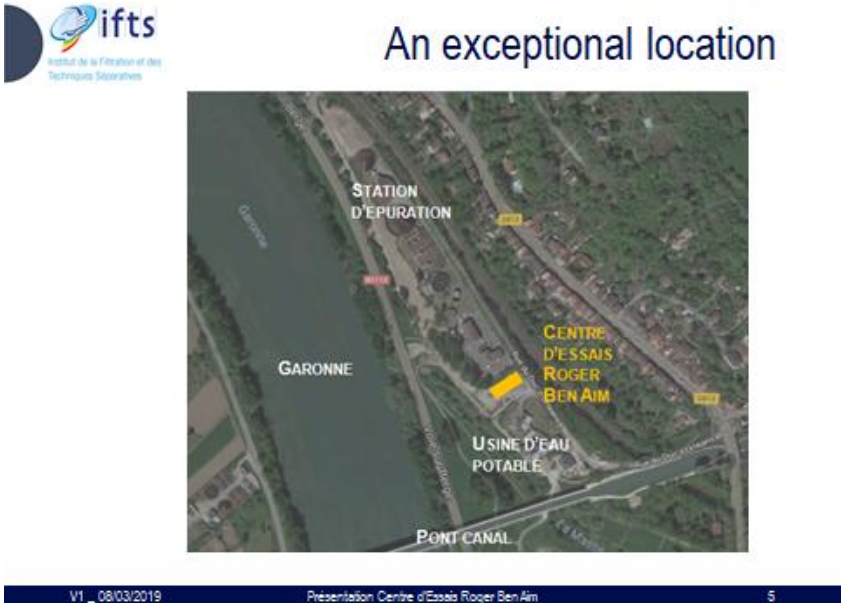


*Figure 3.20 Location of the Roger Ben Aim Test Centre*

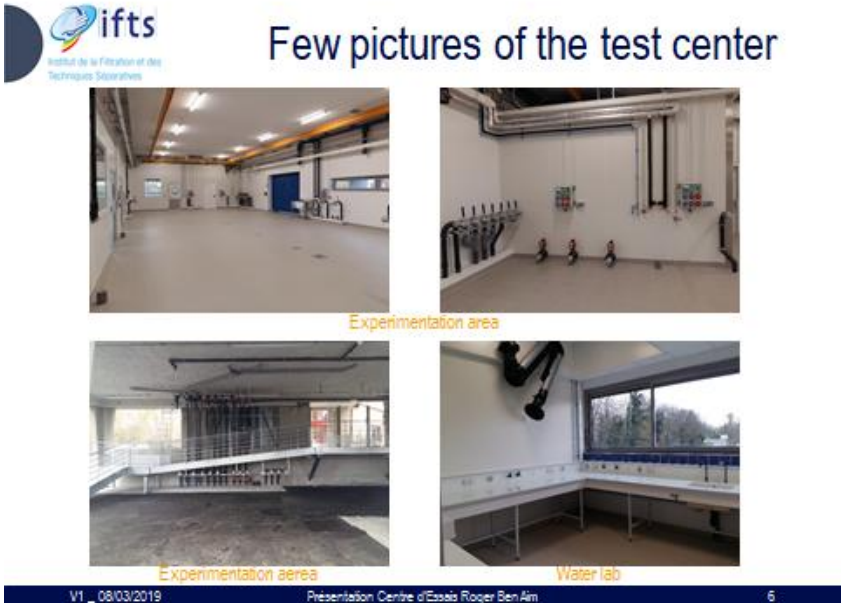


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*Figure 3.21 Facilities of the Roger Ben Aim Test Centre*

UNILIM's research themes in the field of water and the environment are as follows:

- Evaluation of the mobility of contaminants in complex environments:
- Natural environment (sediment, water bodies, soil)
- Methods for treating water or sludge
- Determination of the mechanisms controlling the mobility of contaminants
- Adsorption/desorption mechanisms; dissolution/precipitation; redox
- Interactions between solid / liquid / gas phases
- Interactions with organic matter
- Innovative sampling methods:
- Passive sampling
- Inorganic contaminants ◊ DGT
- Inorganic Contaminants ◊ POCIS, Chemcatcher
- Macrophytes

The contaminants studied are the major elements in the environment, the parameters of the quality of wastewater; organic and inorganic trace elements. The analytical tools available are:

- Sampling material for soils and sediments:
  - Drill, auger, sieves
- Water sampling material (surface and ground water) and flow measurements:
  - Automatic samplers (as ISCO), sampler for piezometer, piezometric probe, passive samplers, flowmeters
- Sample preparation:
  - Micro-wave mineralisator, lyophilizator, ASE for organic pollutant extraction in solid or biologic matrix, SPE automat, evaporator for small volumes

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- Solid characterization:
  - Optic microscopy and picture analyse, SEM, XR-diffraction (Carmalim platform of Limoges University), XRF, CHONS analyzer, zetameter
- Materials for metals and metalloids analyse:
  - Inducted coupled plasma mass spectrometry (ICP-MS), microwave plasma atomic emission spectrometer (MP-AES), atomic absorption (flame and furnace), polarography
- Analytical materials for organic compounds:
  - LC MS QTof - LC detector DAD/fluorescence - GC MS/MS QQQ – LC MS QQQ to obtain soon
- Analytical materials for water characterization:
  - TOC/TN meter, ionic chromatography, automatic titrator, global parameters (pH, conductivity, O2, ...), spectrophotometers (UV and fluo) and field material for water analysis
- Test laboratory:
  - Pilot units, columns, pumps, ...
- In vitro culture material, histology, molecular biology:
  - Electrophorese DGGE, PCR (non-quantitative)

## 3.7 Technical/information context

Currently, information is provided through targeted actions

- Participation in trade fairs
- Publication of news on different media (websites, activity reports, workshop meetings)

The information available is:

- The characteristics of LAVISO
- Technical platforms
- Services offered

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## 3.8 Advances in the creation of the community of users

### 3.8.1 Target group contacted

The following entities have been contacted

- Agence de l'Eau Adour Garonne
- Agence de l'Eau Loire Bretagne
- Office Français pour la Biodiversité
- Agence pour la valorisation de la recherche universitaire du Limousin
- Limoges Métropole
- Agglomeration du Niortais
- APESA
- Bordeaux Métropole
- BRGM
- CCI Nouvelle Aquitaine
- Communauté d'agglomération de La Rochelle
- Communauté d'agglomération du Bassin de Brive
- Communauté d'agglomération Grand Angoulème
- Communauté d'Agglomération le Grand Périgueux
- Communauté d'agglomération Pau Bearn Pyrénées
- CRITT Génie des Procédés et Technologies Environnementales (GPTE)
- DREAM
- EGIS
- Ester Technopole
- Grand Poitiers Communauté Urbaine
- Communauté d'agglomération du Grand Guéret
- IRSTEA EABX - Ecosystèmes aquatiques et changements globaux
- Association Scientifique et Technique pour l'Eau et l'Environnement
- Groupe de travail EPNAC l'Evaluation des Procédés Nouveaux d'Assainissement des petites et moyennes Collectivités

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- la mission d'assistance à la gestion de l'eau et de l'assainissement Dept Gironde
- Entités transfert de technologies
- Ministère de la transition Ecologique et Solidaire
- OPURE
- SOLTENA
- Régie Municipale des Eaux de Mont de Marsan
- SAUR
- Suez
- Veolia
- Service d'Assistance Technique en Epuration et Suivi des Eaux Charente
- Service d'Assistance Technique en Epuration et Suivi des Eaux Charente-Maritime
- Service d'Assistance Technique en Epuration et Suivi des Eaux Deux-Sèvres
- Service d'Assistance Technique en Epuration et Suivi des Eaux Landes
- Service d'Assistance Technique en Epuration et Suivi des Eaux Lot et Garonne
- Service d'Assistance Technique en Epuration et Suivi des Eaux Pyrénées Atlantique
- Service d'Assistance Technique en Epuration et Suivi des Eaux VIENNE
- Service d'Assistance Technique en Epuration et Suivi des Eaux Corrèze
- Service d'Assistance Technique en Epuration et Suivi des Eaux Creuse
- Service d'Assistance Technique en Epuration et Suivi des Eaux Dordogne
- Service d'Assistance Technique en Epuration et Suivi des Eaux Haute-Vienne
- Service Gestion des Eaux de l'Agglomération d'Agen
- Aqseptence
- Schneider

### 3.8.2 Methodology used for user's engagement

Methodology used for user's engagement is characterised by:

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- Workshops
- Events
- Meetings
- Visio conference
- Webinar

Type of methods: The methodsare based on conferences, workshop,co-designand co-construction.

### 3.8.3 Engaged stakeholders

City of Limoges: Local authority. Limoges wants to be involved in the Living Lab, promote it, and make some of its facilities available, including for prototype testing

The Nouvelle-Aquitaine region: The Nouvelle-Aquitaine region wants to get involved in the Living Lab, promote it, and make some of its infrastructures available for animation, workshops etc.

SOLTENA / Pôle Environnement Nouvelle-Aquitaine: SOLTENA wants to get involved in the Living Lab, promote it, and make some of its infrastructures available for animation, workshops etc

ASTEE Limousin, Poitou-Charentes: ASTEE Limousin, Poitou-Charentes extends its action to the northern part of the Nouvelle Aquitaine region in a low-density territory with a significant coastline. The water issues in this region are varied.

It brings together members from all disciplines who wish to be actively involved in promoting the association and contributing to the exchange of information and knowledge in all the fields covered by Astee. The board defines and organises a programme of activities with the support of structures, organisations or companies, thus enabling inter-professional exchanges to be intensified.

ASTEE Nouvelle-Aquitaine wants to get involved in the Living Lab, promote it, and make some of its infrastructures available for animation, workshops etc

These different stakeholders are very involved in the approach and are willing and motivated to knowledge exchange.

### 3.8.4 Protocols for communication with users

Protocols for communication with users:

- Mailing list
- Workshops
- Events
- Meetings
- Visio conference
- Webinar

## 3.9 Innovation management

Description of advances in the specific procedures focused on systematic processes to capture creative ideas.

These issues are chosen to answer to pregnant problems as pollution control, adaptation to climate change, energy saving.

A workshop has been organized on the 2nd of December 2021 with the topic concerning wastewater treatment in rural area.

Participants to this workshop were selected to represent different stakeholders of this topic: private and public companies involved in wastewater treatment, associations and companies working in aquatic system quality survey and management, organizations representing the agricultural community, master students. 18 persons participated; three groups were constituted in order that the different activity sectors be represented in each group.

The workshop was made up of four steps: one step to define the pregnant topics, identified as inducing catastrophic situation in wastewater management in rural area, and then a selection of major issues to consider was done. The second

stage, for each previously selected challenge, different ways that could enable to avoid or solve this critic situation should be proposed. Here again a selection of the 3 more relevant ways/procedure to avoid or solve the problem were selected.

During the third step, each team identified all the persons (first name, employer, position and picture) that should be involved in the procedure selected at step 2. The last stage was the writing of a storytelling, indicatingchronologically each action of the procedure to avoid or solve the problem.

The synthesis of the workshop is given in annex.

## 3.10 Services of the Living Lab

**Support for innovation**

The three main partners and their represented organizations offer to support entrepreneurs in the development of new technological processes and the marketing of innovative products and services.

At the beginning of the innovation process, we can propose the facilitation of discussions in a climate of innovation and development of water technologies in the New Aquitaine region. For this we set up co-creation workshops with CODEmaker and mobilize a co-design organization hosted at the University of Limoges. These workshops can include all the key stakeholders identified in the quadruple helix concept (academy, industry, government and public). An example of such workshop is the one proposed concerning wastewater management in rural area. It can correspond to innovation development at all TRL levels.

**Generate innovative research**

The Living Lab aims to respond to technological needs with the construction of research projects that will bring together expertise in the fields of environment and water technologies, including chemistry, biology, microbiology, science soil and process engineering. LaViso can propose trials on a pilot scale or process on

semi-industrial units with performance monitoring thanks to the expertise of the project partners.

LaViSo offers assistance in research funding for research and technology transfer projects, the construction of appropriate consortia and the implementation of technical studies hosted on test platforms.

**Technology transfer**

"Technology transfer and research-industry cooperation are powerful levers of innovation and for companies, a development accelerator. »CCI France LaViSo wants to sustainably strengthen the competitiveness of companies by providing innovative solutions of a high technological level that will lead quickly to the establishment of new products and services. With the presence of several networks in the consortium such as Water and Climate, the expertise available within each consortium member, the availability of platforms, LaViSO offers technical support covering all levels of preparation, ranging from the definition from concept to technology validation. The transfer can lead to a financial transaction, and materialize in different ways: patent acquisition, cooperation, provision of human resources, etc. This would concern high TRL levels.

**Training**

The partners are experts in many technologies and methodologies that will benefit from the innovation process, with the expertise to provide leading edge water treatment technology. It will also be possible to provide on-demand training for technical processes.

**Labeling. Normalization**

LaViSo makes an important contribution to the development of vocabulary standards, measures or tests that contribute to the clarification of technical and commercial exchanges, for example IFTS creates standardization commissions, researches and develops new procedures for essays and drafts the draft standards on which all agree.

**Intellectual property**

Thanks to the support services for innovation and transfer from the University of Limoges grouped together in AVRUL, the work done within the framework of the SVSO will ensure that intellectual property rights are taken into account throughout the entire period.

**Market Analysis and Marketing**

The consortium also aims to provide studies on market opportunities for technologies that will be evaluated, in particular through the external partners of the TWIST project, such as the CCIs in New Aquitaine. The partnership also has access to a wide range of support actors.

## 3.11 Activities carried out in the Living Lab

TWIST French Living Lab, specifically in OIEau - Office International De L'eau, has two new Pilots working, one to test Triton ™ filter floor from Johnson Screens regarding their efficiency and environmental impact and the other to test an innovative method to detect cavitation and other pumps faults with a Schneider Electric variable speed drive.

**Aqseptence Group SAS and OIEau inaugurate a new pilot**

Aqseptence Group trusted the Office International de l'Eau to support it in its R&D projects by entrusting it with the tests of the Triton ™ filter floor from Johnson Screens, a brand of the Aqseptence group.

This partnership is part of the ERDF - SUDOE project TWIST (Transnational Water Innovation Strategy) in which OIEau is a partner.

*Figure 3.22 Installation the new pilot*

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*Figure 3.23 The new pilot in place*

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*Figure 3.24 Inauguration of the new pilot*

In order to adapt to changing market needs and maintain its leadership, Aqseptence Group is constantly optimising its processes, including Johnson Screens' Triton™ filtering floor manufactured in France. The company has entrusted the performance qualification of this product to the OIEau, in order to guide it in its future innovations.

In 3 months, the OIEau teams created a pilot on a semi-industrial scale at their La Souterraine site, which allows them to test the efficiency of the Triton™ system in real-life situations and to optimise its environmental impact (water and energy consumption).

The results obtained will thus make it possible to demonstrate the strengths of the current product and to focus on the axes of new developments. Inaugurated on Monday 7 September, in the presence of teams from Aqseptence Group and

the International Office for Water, this pilot project is the first step in a long-term collaboration.

**Schneider Electric &OIEau: Innovative method to detect cavitation and other pumps faults**

Centrifugal pumps driven by asynchronous motor are widely used in industrial applications because of their low cost, high performance and robustness. However theses pumps can be damaged by wear and the performances of the machine can be altered.

*Figure 3.25 System for detecting pump cavitation*

This research work deals with fault detection and diagnosis of fault that may appear in a pump. Usually, a vibratory or noise monitoring can be established, but it's often really costly and can be cumbersome. A different approach based on the analysis and processing of the stators' current is proposed here in order to highlight theses faults. This method can detect a torque drop in the pump shaft, and coupled with a flow measure it can determine if a cavitation is occurring or not. This provisional maintenance gives the health state of a pump in real time and only requires acquiring the current and using RMS and spectral analysis.

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For 2 years, Schneider Electric and International Office for Water have work together on this subject.

For now, the methodology researches have been done and a first set of experiments has been led on an existing pedagogical platform at IOW (multi-stage centrifugal pump with an asynchronous motor, current, voltage, pressure and flowrate measurement).

The next objective is now to develop a new facility with additional features:

- Torque and speed measurement
- Test on a synchronous motor
- Use of a mono-stage centrifugal pump

With this new pumping loop, we will be able to test this new detection method on a different pumping structure (different pump, different motor), and to compare it with mechanical measurements.


*Figure 3.26 Part of the new pilot*

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*Figure 3.27 The new pilot of Schneider*

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*Figure 3.28 Members of Schneider visiting the new pilot*

# 4 Living Lab in Portugal: UL3

## 4.1 Introduction

Since the beginning of the TWIST project a large amount of work has been done by the Urban Lisbon Living Lab (UL3) team (Águas do Tejo Atlântico, S.A., Instituto Superior Técnico, and Instituto Superior de Agronomia) in order to create the right conditions to set-up and run the Portuguese Living Lab which is focused on water reuse and resources recovery.

From creating its concept and focus, to identify and engage relevant stakeholders and setting up conditions and infrastructures to carry out its projects and activities, UL3 is now a well-established Living Lab where specific R&D+I activities are taking place.

Setting-up and running a Living Lab requires not only to perform innovative experiments, but also ensuring that the projects developed are in accordance with the needs and expectations of the civil society, public administration, industry and universities. Thus, it was key to engage stakeholders such as NGO, SMEs, and end-users, which are often forgotten on the traditional innovation process.

Divulgation is also a key activity on a Living Lab, not only to make it known, but also to pro-actively look for new partnerships aiming to find innovative and efficient solutions to old and new problems and constraints.

Together with defining administrative issues such as structure, type of management approach and overall rules and regulations for the UL3, meetings, workshops and events have been held with a view to create a robust structure that is able to contribute to a more efficient and sustainable way of living and working that is inclusive and supported by innovation and technological development.

The following chapters synthetize what has been done so far by the UL3 team and what projects and respective activities have been carried out.

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## 4.2 Institutions involved in the constitution of the Living Lab

The Portuguese partners of the TWIST project are developing the Urban Lisbon Living Lab (UL3) under the topic of water reuse and resource recovery (water, nutrients and energy) from wastewater.

The partnership includes Instituto Superior Técnico (IST), Instituto Superior de Agronomia (ISA) and Águas do Tejo Atlântico, S.A. (AdTA). These institutions have their own research and have experience working together, having collaborated in several projects. They are experienced partners that can equally contribute to the development and support of the multiple projects embraced by UL3.

**Águas do Tejo Atlântico, S.A. (AdTA)** is a public company and is responsible for managing and operating the wastewater treatment system of Greater Lisbon and West[1], guaranteeing the quality, continuity and efficiency of the service. It exploits a system that includes 104 Water Resource Recovery Facilities (WRRF), 292 pumping stations and 922 km of main sewage system, and treats around 244 $Mm^3$/yr, serving a population of 2,4 million inhabitants (23 municipalities).

AdTA has as mission contributing to the pursuit of national objectives in wastewater collection and treatment within a framework of economic, financial, technical, social and environmental sustainability. AdTA is a strong and well recognised R&D+i agent within the industry – which includes its own R&D+i dedicated department. It has already in its profile several R&D activities in partnership with other institutions, companies and universities in a wide range of subjects, including novel treatment processes and implementation of management and simulation tools for optimizing wastewater treatment and collection. R&D activities include the participation in several national as well as in European projects and include international awards recognition, by International

[1]NUTS III

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Water Association (IWA) with a Global Honour Award for the project "AQUASAFE" developed in partnership with European SME, which is related to operational platform for decision support systems in Lisbon sewage system.

By partaking on TWIST, AdTA has the opportunity not only to share its knowledge, but also to improve in skills and human capital in relevant topics, such as, nutrients recovery, wastewater treatment and reuse and/or processes modelling and optimization. AdTA will put at disposal of TWIST project and Portuguese partners its infrastructure for N/P recovery and wastewater reuse.

Currently, AdTA hosts at its facilities and in partnership with other water industry related companies and academia, experimental projects, related with energy efficiency, operational management optimization, wastewater treatment for reuse, among others.

It is also common AdTA receive master and doctoral students to conduct their Master thesis in partnership with academia.

**Instituto Superior Técnico (IST)** is a Higher Education Institution, the largest school of Engineering, Science and Technology in Portugal. IST's mission is to contribute to the development of society by providing top quality higher education in the areas of Engineering, Science, Technology and Architecture, at undergraduate and postgraduate levels, as well as developing Research, Development and Innovation (RD&I) activities to allow it to provide teaching in line with the highest international standards. Its mission is therefore expressed in the three functions which characterize the concept of a modern university: to generate knowledge, to transfer skilled professionals and to transfer and apply knowledge and innovation.

IST consists of 9 departments and is involved in some of the most prestigious RD&I and technology transfer institutions in Portugal, with remarkable impact internationally in many scientific and technological domains. There are about 10,500 full-year equivalent under and post graduate students, and about 1,500 full time equivalent teaching and non-teaching staff.

The contribution of IST to apply knowledge and innovation is also described by the creation of 53 Spin-off companies since 2009, which further apply into society the research developed in this institution. IST also stimulates intellectual property protection as a means of fostering knowledge valorisation currently has a portfolio of more than 250 patents, being the Portuguese institution with the largest number of patents registered. Many of these patents result from research projects involving companies that have preferential rights for commercial exploitation. Licensing other intellectual property rights, such as computer programs copyright or technology products associated brands, among others, is also carried out by IST. Some of IST's start-ups have license agreements that enable exploitation of intellectual property rights of the school and associated research centres.

Research at IST is organised in 23 Centres and Institutes that pursue challenging research programmes with a strong social impact in the fields of Architecture, Engineering, Science and Technology. These Centres and Institutes address a multidisciplinary research in an international and multicultural atmosphere.

The **School of Agriculture, Instituto Superior de Agronomia (ISA)** is one of the faculties of the University of Lisbon. The core mission of ISA is Higher Education, Research & Development, and Technology Transfer in the scientific fields of Agriculture, Forestry and Natural Resources Engineering, Food Science and Engineering, Animal Production Engineering, Environmental Engineering, Biology, and Landscape Architecture. Within Higher Education, ISA is attended by 1500 undergraduate, master and PhD students. The 130 professors and 125 Researchers are PhD graduates with recognized scientific work published in international journals. Presently, ISA is involved in more than one hundred research & development projects, financed by EC and national funds. ISA is also involved in several projects concerning technology transfer with research institutes and private enterprises.

ISA hosts three nationally recognized scientific research centres: i) the Forest Research Centre (CEF) is a research unit devoted to the integrated research of forestry and related ecosystems, forestry products and forest related service, ii) the

Centre Linking Landscape, Environment, Agriculture and Food (LEAF) focused on the entire Agro-Food chain, combining basic and applied sciences, from the cell and microorganisms to the landscape, for the knowledge and promotion of effective solutions aiming at the conservation of natural resources and the production and food quality, iii) the Research Network on Biodiversity and Evolutionary Biology (Associated Laboratory), in partnership with CIBIO, University of Porto and iv) the Centre for Applied Ecology "Prof. Baeta Neves" (CEABN) an integrated research centre integrates a whose mission is to promote scientific research in applied ecology to forest and agricultural ecosystems, contributing to management and use.

## 4.3 Definition of the type of Living Lab

Taking into consideration the types of Living Labs described on GT2.1.1, the closest description of the one established by UL3 is an 'Intermediary Living Lab', in which different partners are invited to collaboratively innovate in a neutral arena. As said, the work developed is mostly focused on water reuse and resource recovery.

As the above-mentioned document states, there are many different types of Living Lab environments. In the case of UL3 the three institutions that form the Urban Lisbon Living Lab maintain their autonomy and each Living Lab projects are based in one of the existing facilities which are selected on a case-by-case approach. The location of the projects relies on its TRL level and on the topic to be addressed.

Depending on the need, all UL3 partners contribute to the development of the projects according to the type of tasks required.

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## 4.4 Objectives of the Living Lab

UL3 has as main objective the creation of an environment that is favourable to the development of R&D+i products and services focused on reuse and recovery of resources – water, energy and nutrients from urban wastewater. Open innovation is key, giving to users an active role on the creation process.

The defined specific objectives are in close relationship to the thematic areas in which it is focused:

- Reuse of recycled wastewater,
- Nutrient recovery, and
- Energy recovery and management.

## 4.5 Advances in the definition of the structure and internal regulation of the Living Lab

### 4.5.1 Type of entity

As mentioned, the three institutions that form the UL3 will maintain their autonomy and the Living Lab projects will be based in one of the existing facilities. The location of the projects will depend on its TRL level and the topic to be addressed. The remaining two institutions will collaborate on the project according to the type of tasks involved. *Ad-hoc* equipment and supporting infrastructures are likely to be created in order to conduct the project activities successfully.

For each project a mutual agreement memorandum or protocol is developed, which includes the definition of roles, tasks to perform, resource allocation and benefits associated with each organization.

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### 4.5.2 Management body

IST and ISA are responsible to coordinate the Living Lab activities, although AdTA also plays an active role on managing the Living Lab. These three institutions have a long track of collaboration that eases the relationship amongst all partners. Constant communication among all parties and a constant search for consensus guide all management decisions.

All parties are well informed on management issues and any partner can replace other in the event of one of the partners being temporarily unavailable. The three institutions that form the management body of UL3 share the same views, values and perspectives on the relevance of R&D+i.

### 4.5.3 Corporate image

A logo is an essential component of any organization, being the main visual piece of its identity, allowing anyone to easily identify the organization and its core activity.

Figure 4.1presents the UL3 logo. The blue and green colours highlight the importance on contributing to a bluer and greener economy. It can be perceived a drop of water representing the raw material of the living lab – wastewater, and its potential to become a valuable resource at the service natural resources and environmental protection. The round-bottom flask enclosed by a rhombus shape represents a space where experiments take place. The bubbles are both the process, the multiples spheres of the society that are involved in UL3, the experiments results and the transferability of the developed innovation to market.

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*Figure 4.1 UL3 logo*

UL3 will also have a dedicated space on the TWIST project webpage (https://twistproject.eu/) where information on the Living Lab and on its projects, activities and people involved will be presented.

## 4.6 Living Lab physical context

### 4.6.1 Infrastructures

UL3 has multiple infrastructures and facilities at its disposal, which will be used according each project needs and characteristics. Furthermore, if required, *ad-hoc* structures will be developed/built for specific projects. Each partner has their own facilities and infrastructures that are at the service of the living lab and will be used on a case-by-case necessity.

**AdTA** has made available to UL3 all its infrastructure which serves a total of 23 municipalities (see Figure 4.2). A total of 104 WRRF in both urban and rural areas, 292 pumping stations and 922 km of main sewage system. Depending on the location, population served and the receiving environment different treatment options are available from conventional to advanced technologies. Some WRRF are equipped with anaerobic digester and produce energy, others have the ability

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to use recycled water at the facility and others to be reused externally for street cleaning, irrigation and refrigeration of commercial surfaces.

Currently, the projects at AdTA facilities are located at Alcântara, Beirolas (Lisbon) and Guia (Cascais). The Alcântara WRRF at the heart of Lisbon, is the headquarters of AdTA having conference and meeting rooms where, for instance the workshop took place. Also, in Lisbon at Chelas WRRF an Innovation Centre will be implemented, which will function as an R&D+i hub of the company to the world.

All facilities are equipped with at least one meeting room and internet is available, an essential tool to guarantee an easy communication between all UL3 partners and engaged actors.

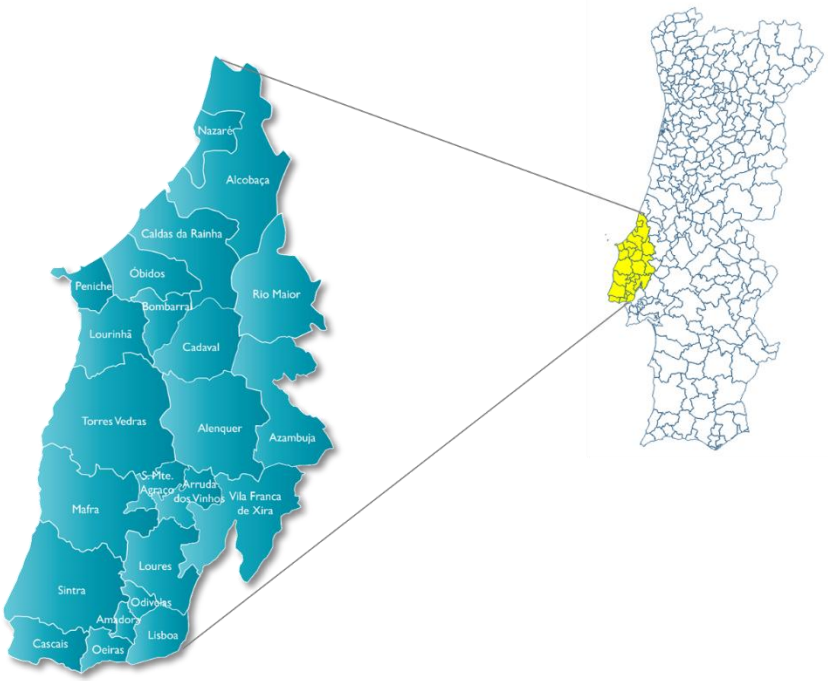


*Figure 4.2 Councils served by AdTA infrastructures*

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**IST** has multiple laboratories inside Campus where lower TRL experimental setups can be installed, and also perform water quality analysis.

The main laboratories involved in UL3 are the main Analysis Laboratory and the Environmental Laboratory. The main laboratory is a certified laboratory that performs physic-chemical and microbiology analysis to water samples.

The Environmental Laboratory is equipped with instruments to perform *in situ* analysis and also field analysis. The main equipment includes:

- spectrophotometer UV-VIS
- Oven up to 1000 °C
- Oven up to 200 °C
- Portable OD probes
- Portable pH probes
- Portable Electrical conductivity probes
- Refrigerator and freezing chambers
- Heating blankets
- Heat bath
- Cooled incubator

Figure 4.3 shows an overall view of the Environmental Laboratory. The laboratory can house bench scale and mesocosms experiments. Depending on the technology, pilot scale applications can also be installed in Campus.

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*Figure 4.3 General view of the Environmental Lab at IST.*

IST also has a Congress centre with a main room with a capacity for 200 people and 3 smaller rooms.

**The School of Agriculture (ISA)** has full responsibility over a university campus with 100 hectares, known as Tapada da Ajuda. This space is a multifunctional urban, agriculture, forest and botanical area within the city of Lisbon. Tapada da Ajuda is an open case regarding multiple and complex pressures. Currently, Tapada da Ajuda is a kind of a patchwork of urban zones (residential and offices) with an agricultural area that attains more than 32 hectares (namely vineyard, orange and olive orchards). In addition, Tapada da Ajuda comprises an expanding urban farming zone (approximately 1 hectare), a well-known classified botanic garden, forest areas and several biodiversity hotspots, among them a temporary river and a small lake. Therefore, the living lab of Tapada da Ajuda is a mesocosm of the real world and has all ingredients that can be required to test any

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environmental solution, from lab to full scale. An overview of Tapad da Ajuda is presented below (Figure 4.4)

*Figure 4.4 Aerial view of Tapada da Ajuda*

## 4.7 Technical/information context

UL3 counts with several platforms to disseminate information and knowledge. The preferential means of communication are emails and team meetings. The TWIST website is pivotal to disseminate information, both from the project itself and from the Living Labs. Social media, including LinkedIn are also key to publicize the project and its living labs. Each UL3 partner also makes use of their own website to promote the Living Lab, its projects, activities and results.

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To promote networking and disseminate R&D+I activities, **AdTA** organizes an innovation event – the innovation pathway every year which is a well-established and recognized event by the industry where the TWIST project and UL3 is promoted.

## 4.8 Advances in the creation of the community of users

### 4.8.1 Target group contacted

In the beginning of TWIST project, the target groups working with the UL3 were mostly research institutions (universities and research centres). With the development of the activities the target groups have expanded, and public and private companies together with NGOs have been engaged.

Looking for better involve all stakeholders on UL3 activities a national workshop was conducted aiming the promotion and reinforcement of co-creation partnerships amongst the different water sector agents with capacity to create new processes of R&D+I, including:

- companies involved in the water sector,
- technology and R&D+i institutes and private companies;
- middle schools for water education purposes,
- municipalities and other local and regional government institutions,
- non-profit organizations involved in the water sector and in sustainability issues;
- end-users.

### 4.8.2 Methodology used for user's engagement

Different actors require different methods and engagement approaches. UL3 partners have decided to apply fit-for-purpose methodologies aiming at extract the most and the best possible information and points of view from UL3 users. As such, the following methods have been applied:

- Conference calls,
- Interviews,
- Questionnaires,
- Workshops,
- Emails.

In addition, and whenever appropriate, formal and informal conversations have been held with different people and institutions where UL3 partners have shown availability to develop partnerships with institutions and companies not yet involved in the Living Lab activities.

### 4.8.3 Engaged stakeholders

In the beginning of TWIST project, the target groups working with the UL3 were mostly research institutions (universities and research centres). With the development of the activities the target groups have expanded and a total of 59 actors have been engaged (see Figure 4.5).

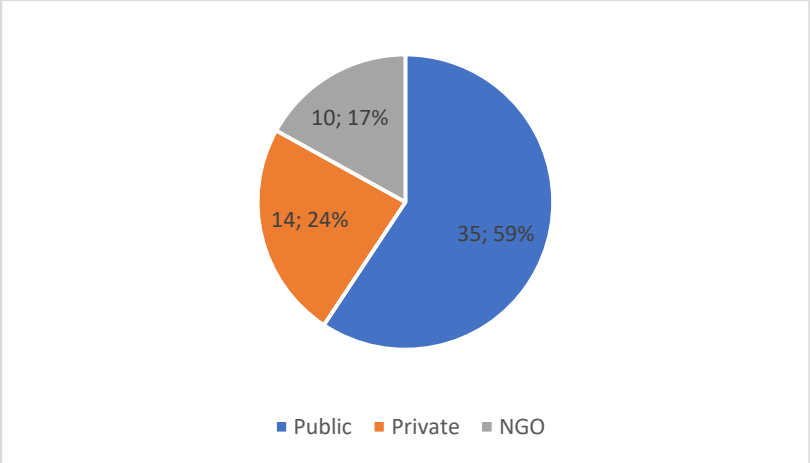


*Figure 4.5 Type of institutions, by sector, engaged in TWIST and UL3 activities*

These institutions have different typologies and roles within the water sector, as showed on the figure below.

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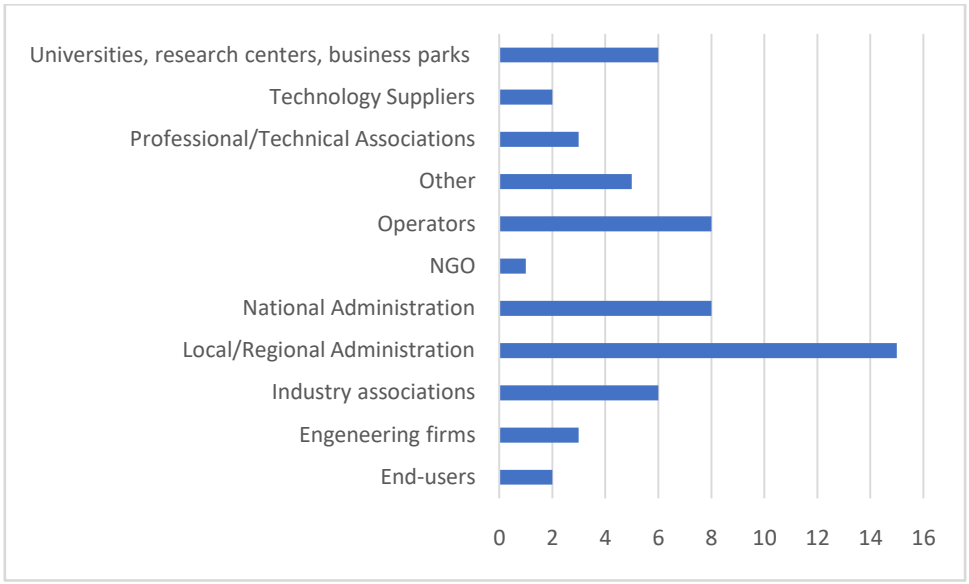


*Figure 4.6 Type of institutions engaged in TWIST and UL3 activities*

For the workshop developed under GT2, UL3 invited the institutions described on the table below.

*Table 4.1 Institutions engaged on UL3 workshop*

| Designation | Type |
|---|---|
| Faculty of Sciences and Technology of the New University of Lisbon | Academia |
| Francisco George Public Health Unit | Public Administration/Research Centre |
| National Laboratory of Civil Engineer | Public Administration/Research Centre |
| Altice | Telecommunication company |
| INOV-INESC | Private |
| Águas do Ribatejo | Utility |
| Águas do Norte | Utility |

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| | |
|---|---|
| SIMAS Oeiras e Amadora | Utility |
| Águas do TejoAtlântico | Utility |
| National Health Institute Dr. Ricardo Jorge | Public Administration/Research Centre |
| Instituto Superior Técnico | Academia |
| ISQ | Private |
| Comissão de Coordenação Regional de Lisboa e Vale do Tejo | Public Administration/Regional Development |
| National Laboratory of Energy and Geology | Public Administration/Research Centre |
| Algae for future | Private |
| iBET | Private |
| Lisboa E-Nova - energy and Environment Agency of Lisbon | Private |
| Instituto Superior de Agronomia | Academia |
| National Innovation Agency | Public Administration |
| Cerlinx Brewery | Private |
| Portuguese Water Partnership | NGO |
| Lisboa City Council | Public Administration |
| ADENE – Ñational Agency for Energy | Public Administration |
| Valorsul | Private Company - Urban Waste |
| Wada Solutions | Technology development |
| EAGB – Water and Electricity from Guinea-Bissau | Utility |
| Irrigation Association from Loures | End-users Association |

### 4.8.4 Protocols for communication with users

As for the methods for stakeholders' engagement, all communications with UL3 users vary and a fit-for-purpose approach has been taken, depending on issues such as urgency, the nature of the information to be discussed/disseminated and

the preferences showed by each specific user. The following methods have been adopted:

- meetings and conference calls;
- emails;
- presentations;
- reports.

## 4.9 Innovation management

Managing and stimulating innovation require different and specific procedures aiming to systematically capture creative ideas and promote innovation.

**AdTA** has tried to promote, stimulate and manage innovation using the following means:

- As part of the event 'Innovation Pathway', every year the company launches the 'challenge to innovation' to people inside and outside the company both national and international. This challenge aims capturing creative ideas that can contribute to tackle operational issues. The three best ideas are awarded with a monetary prize;
- Going to universities to stimulate student's knowledge, curiosity and creation of innovative ideas by challenging them to present to the company their ideas for projects;
- Receiving masters and doctoral students giving them access to AdTA facilities and infrastructure and supporting them on conducting their post-graduate work;
- Presence in conferences and seminars;
- The 'Ideas Factory', a tool that allows all AdTA workers to communicate any problem or necessities felt while conducting their daily activities.

**IST** and **ISA** promote innovation through the continuous participation in research projects and contracts with the industry. Many of these projects are

developed with the collaboration of master and PhD students. Previous to the formation of UL3, the three participating institutions already collaborated between themselves. The Living Lab not only enhanced the collaboration between them but also provided the framework to develop other projects involving stakeholders from the Quadruple Helix.

An example to engage the public in UL3 activities is provided by ISA **at**Tapada da Ajuda also. A digital platform will be customised in order to integrate all environmental data and to monitor a residential house performance regarding water and energy. Thus, moving forward, it is aimed that this platform is accessible to the public, so citizen awareness regarding environment and technological innovation will be raised.

## 4.10 Services of the Living Lab

In the beginning of TWIST project, the services offered by the UL3 included mostly research studies and testing of equipment under a specific research project. Some Academic training in the Urban Water Cycle also occurred.

Since then, UL3 has expanded its activity conducting R&D+I projects with some results having been achieved (see chapter 12). Additionally, graduate and post-graduate students have been received and supported in conducting their research studies to obtain a degree.

Several funded projects have also been initiated with different stakeholders – PMEs, major companies and research centres, with experiments occurring in real-life settings. Open days and events have been organised and/or participated in where UL3 was presented.

On-the-job training has also become a common activity promoted by UL3, where different workers from AdTA have been exposed to different types of projects and activities in view of expanding the skills of the company's human capital.

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## 4.11 Funding of the Living Lab

Although funding opportunities are available, most of the projects and R&D+I activities of UL3 have been self-funded, with the costs being shared among each project partner, or entirely assumed by the project promoter.

## 4.12 Interrelation with other Living Labs and innovation networks

So far, UL3 has only establish relationships with the Living Labs created within the TWIST project, *i.e.*, the Open Water Lab (OWL2) in Spain, and Laviso in France, where experiences have been shared and the developed technologies presented. In the near future is expected to engage with ENoLL.

## 4.13 Activities carried out in the Living Lab

As previously mentioned, each UL3 partner conducts different projects and activities under the UL3 umbrella.

**AdTA** is developing 4 different projects through UL3:

- Wastewater treatment and energy recovery by Microalgae-Based Process;
- Disinfection of urban wastewaters treated with peracetic acid;
- Development of treatment processes using photocatalytic surfaces;
- VIRA - Craft Beer made from Recycled Water.

**IST** is developing three different projects through UL3:

- Adaptation of green walls to treat greywater
- Assessing microbial contamination in green areas irrigated with treated wastewater - Project MAARTE
- Sludge dewatering

**ISA** is running 2 different projects at Tapada da Ajuda UL3 Living Lab

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- Smart Home of Tapada da Ajuda – SHoTA
- Urban farming TA – constructed wetland for water reuse

### 4.13.1 Wastewater treatment and energy recovery by microalgae-based process

The project wastewater treatment and energy recovery by microalgae-based process is being developed by AdTA together with the company A4F - Algae for future.

The proposed technology solution aims studying microalgae production as an alternative for secondary and tertiary treatments, coupling either conventional secondary, tertiary effluent or side stream treatment with microalgae production. This treatment enables the recovery of nitrogen through microalgae growth instead of emitting it to the atmosphere as N2 and N2O (a powerful greenhouse 298x more powerful than CO2). Additionally, the microalgae capture CO2 from the atmosphere.

The accumulation of microalgae biomass in the process will be studied and exploited for bioenergy. Thus, it promotes an environmentally friendlier technology and circular economy due to lower energy consumptions of the treatment process and an increase of biogas production.

This pilot was developed aiming to give answer to the following objectives:

- Study the efficiency of nutrients recovery from wastewater using technology with microalgae;
- Study the co-digestion potential of sludge with the microalgae biomass produced;
- Technical-economic viability of the technology scale-up.

Below is showed the phases in which the project is divided, and the stage that it is at the moment.

1. Pilot-scale testing for secondary and tertiary treatment in a semi-continuous mode (concluded);
2. Pilot-scale testing for secondary and tertiary treatment in a continuous mode (not started);
3. Pilot-scale testing for runoff from sludge treatment (not started);
4. Anaerobic co-digestion study with microalgae substrate and sludge (not started);
5. Technical-economic viability of the technology scale-up (not started).

Currently two pilot-scale raceway ponds have been installed at Beirolas WWTP operated by AdTA, for on-site wastewater treatment and associated microalgae biomass production. One pond is intended for secondary treatment and other for tertiary treatment, as represented on the figure below. The biomass produced will then fed the digester in view of increasing biogas production. Clean water is intended to be produced at the end of any of the processes, i.e., a water stream with lower values of organic matter, nitrogen, phosphorus, micronutrients and pathogens. This project is currently under development and all small-scale tests have been done.

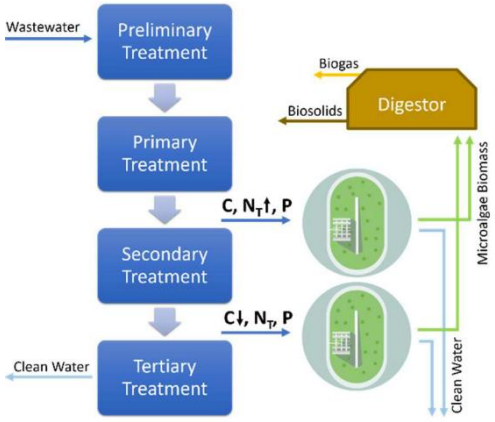


*Figure 4.7 Schematic representation of AdTA's WWTP integrating raceway reactors for microalgal biomass production (Badenes et al, 2019).*

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### 4.13.2 Disinfection of urban wastewaters treated with peracetic acid

The project disinfection of urban wastewaters treated with peracetic acid was developed by the Faculty of Sciences and Technology of the New University of Lisbon.

Disinfection is, in most cases, the last step of wastewater treatment before discharge to the receiving environment. This process is fundamental as it guarantees the quality of the discharge and minimises the risks to public health and the environment, in particular the risk of the proliferation of water-borne diseases through the partial destruction or inactivation of pathogenic micro-organisms present in wastewater.

Peracetic Acid is a relatively strong oxidizer, with a reduction potential (1.81 V) higher than chlorine (1.57 V) but lower than ozone (2.07 V). Its disinfection efficiency is therefore considered to be similar to that of ozone and chlorine, is effective in inactivating most pathogenic micro-organisms, and in removing total and faecal coliforms.

The project is developed in two phases, 1) evaluation of disinfection efficiency through the use of different concentrations of peracetic acid and different contact times; and 2) ecotoxicological tests.

The project includes the following activities:

- Tests with twelve different conditions for each effluent studied - different peracetic acid concentrations and contact times;
- Characterization of two secondary effluents from two different WRRF of AdTA - initial characterization and characterization after the addition of peracetic acid;

- Microbiological characterization of the treated effluent with peracetic acid, resulting from each condition tested - total coliforms, faecal coliforms, quantification of cultivable micro-organisms at 22°C and quantification of cultivable micro-organisms at 37°C;
- Ecotoxicological testing for the three most favourable conditions (best disinfection results), for each effluent;
- Preparation of a report.
- This project is currently under development and all small-scale tests have been done

At the time of this report, all work on a lab scale is concluded, being foreseen to start an industrial demonstration on 2021.

### 4.13.3 Development of treatment processes using photocatalytic surfaces

This project had as starting point the 'challenge to innovation' from the event 'Innovation Pathway 2018'. It was developed by iBET, a private non-profit research-intensive SME in the area of biotechnology and life sciences.

The main objective of the project is testing alternative wastewater disinfection systems: light-emitting diodes (LED) with different wavelengths, photocatalytic membranes and the combination of these processes. The work is developed as follows:

- Testing diodes that emit light at different wavelengths, without using photocatalytic surfaces;
- Testing the filtration efficiency in the absence of light using unmodified silicon carbide and photocatalytic membranes modified with titanium dioxide and silicon dioxide;
- Test the combined treatment process - different wavelengths combined with filtration using membranes with and without photocatalytic activity.

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All lab scale work is now concluded.

### 4.13.4 VIRA - Craft Beer made from Recycled Water

AdTA developed the project VIRA - Craft Beer made from Recycled Water with the objective to demonstrate that recycled water can be used safely in several urban opportunities, replacing the use of drinking water. With this commitment, along with craft beer producer Cerlinx Brewery, AdTA created its own local craft beer, with 100% recycled water and 100% safe.

This project was not developed with a commercial aim, but rather to test advanced treatment technologies and proof that a high-quality water can be produced from recycled wastewater and that it can be compatible with noble uses such as drinking water. It was a campaign to promote water reuse developed with the premise that if beer that is safe for consumption can be made from recycled water, this water can be used for irrigation and industrial purposes.

The recycled water used in this project was produced in Beirolas WRRF. This WRRF, located in Lisbon, was designed to serve a total population equivalent of 213 500, with a maximum flow of around 54 500 m3/day. The treatment process includes preliminary treatment (screening and grit removal), primary clarification, biological treatment, secondary clarification and sand filtration. Additionally, an advanced oxidation (ozone) and a reverse osmosis were implemented at a pilot scale in order to produce water with quality compatible with potable uses. The water produced was monitored with the most complete program for drinking water (Figure 4.8).

The beer production started with a sterilization of the water, followed by: mashing, combining milled grain with water; boiling the beer wort with hops; fermentation and clarification. It was produced two types of VIRA, a Belgian Blonde Ale and an American IPA, approximately 1 000 litres.

VIRA was presented at 'Innovation Pathway 2019', held in Alcântara WRRF (Lisbon) on September 26th of 2019, attended by more than 500 water and wastewater professionals.

Currently, all industrial small-scale work has been concluded.

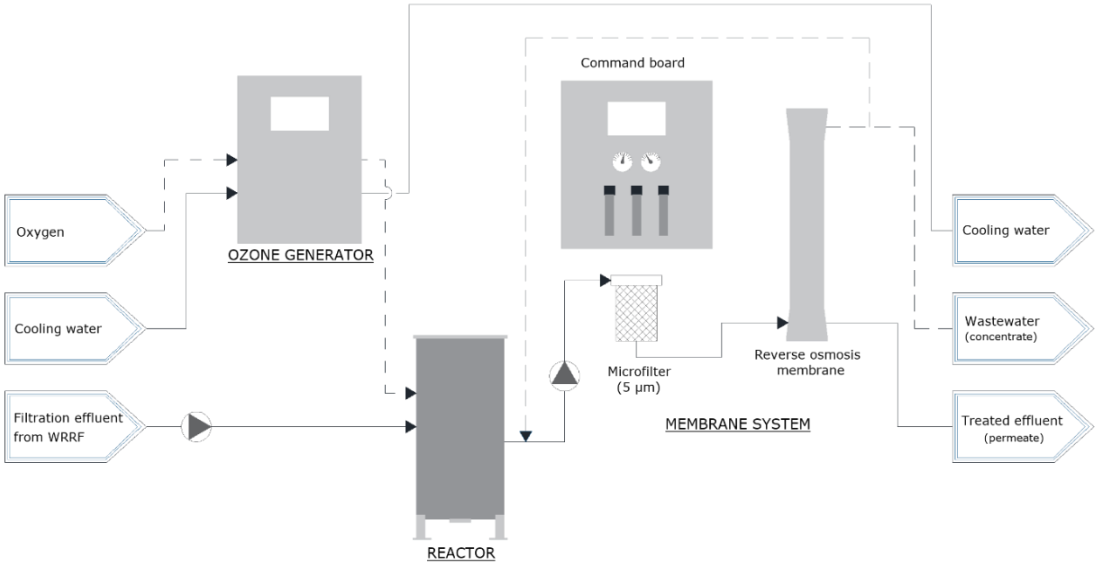


*Figure 4.8 Advanced treatment process diagram*

## 4.13.5 Adaptation of green walls to treat greywater

The Project is being developed together with the company Quizcamp. This company has developed a modular Green Wall already available in the market, Minigarden, where irrigation is performed with potable water. Figure 4.9presents an overview of a Minigarden Module.

*Figure 4.9 Minigarden module.*

The goal of the project is to combine the characteristics of the Green Wall with a vertical flow constructed wetland, to produce a hybrid green wall which has the capacity to treat greywater.

Greywater represents the wastewater streams without contributions from the toilet. Greywater accounts from around 70% of the total wastewater produced in a household, and given its lower pollution levels, it requires minimum treatment to produce treated wastewater with suitable quality for several non-potable uses.

The project activities include the adaptation of the modules structure and irrigation system to received greywater. Several filling media and plants are also being tested to determine the best treatment conditions.

Focus is being given to the application of Circular Economy concepts, by selecting residues from other industries. The materials tested so far include shredded cork, a mix of shredded cork and coconut fibres and residues from the textile industry. Figure 4.10shows a detail of the filling media being tested.

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*Figure 4.10 Detail of the filling media with crushed tiles and coconut fibre.*

The adaptation of the irrigation system is relevant to ensure an adequate distribution of the greywater over each module to prevent preferential pathways and increase the residence time inside the system. Figure 4.11 shows a detail of the adaptations being tested for the distribution system at the top of the module.

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*Figure 4.11 Adaptation of the irrigation system of the modular green wall Minigarden.*

### 4.13.6 Assessing microbial contamination in green areas irrigated with treated wastewater – Project MAARTE

Project MAARTE involves two partners from UL3, IST and AdTA, and also a third institution – Lisbon Municipality.

The goal of the project is twofold: develop a methodology to determine microbial contamination in green areas and to apply it to assess the effect of irrigation with reused water.

The method is being developed at the main Analysis Laboratory at IST and includes the collection of samples of vegetation within a specific area.

The municipality is currently preparing the request for a permit to irrigate a public park with treated wastewater from a nearby Wastewater Treatment Plant (WWTP), managed by AdTA. The park is located in the north area of Lisbon and contains sensible areas such as playgrounds (Figure 4.12**¡Error! No se encuentra el**

**origen de la referencia.**). The grass is currently irrigated with groundwater, and the WWTP is undergoing construction works to upgrade the treatment process in order to ensure a water quality compatible with irrigation of green areas.

*Figure 4.12 View of a public park in Lisbon to be irrigate with treated wastewater.*

The method is being used to characterize the current situation of the park and to assess the effect of irrigation with treated wastewater.

The effects of irrigation flow and solar exposure will also be assessed for grassed areas.

### 4.13.7 Sludge dewatering

The project involved two UL3 partners, IST and AdTA. Th project included the installation of an experimental facility at Frielas WWTP to simulate faecal sludge dewatering (Figure 4.13).

*Figure 4.13 Sludge drying experimental facility at Frielas WWTP.*

The goals of the project are to study the performance of drying beds in the treatment of faecal sludge in diverse climatic conditions. Focus is given to microbiologic contamination.

This study will support the installation of these systems in developing countries. The application of this technology will enable the increase of treatment levels of sewage and faecal sludge. This will benefit public health, promoting Circular Economy and value creation.

### 4.13.8 Smart Home of Tapada da Ajuda – SHoTA.

This project consists of a full scale nutrient resource recovery facility built in a detached house that is being revamped in order to lodge a family (3 persons) permanently. The aim is to evidence the feasibility of resource recovery process when using decentralised, on-site, small wastewater plants (proof of concept approach). Currently, the project is receiving attention from private companies and

being a family house in university campus, ISA students will have access to the house facilities and will be able to perform research work there.

The technical concept is based on a Urine Diverting Toilet (UDT). The flow separation is the most sustainable alternative for nutrient recovery. The separation of urine, called yellow waters, allows a more efficient recovery of phosphorus in the form of struvite, a compound that contains magnesium, phosphorus and nitrogen and can be used as fertilizer. The Advanced Phosphorus Recovery System (APRS) have an equalizer tank and a phosphorus recovery reactor that will be able to recover the phosphorus using a ratio of Mg2+:P O43- of 1.2:1. The system features a solid-liquid separation system consisting of a filter bag (Figure 4.14). A yearly generation of 1.2 kg of struvite and a monthly system energy cost of approximately 3.30 euros is expected.

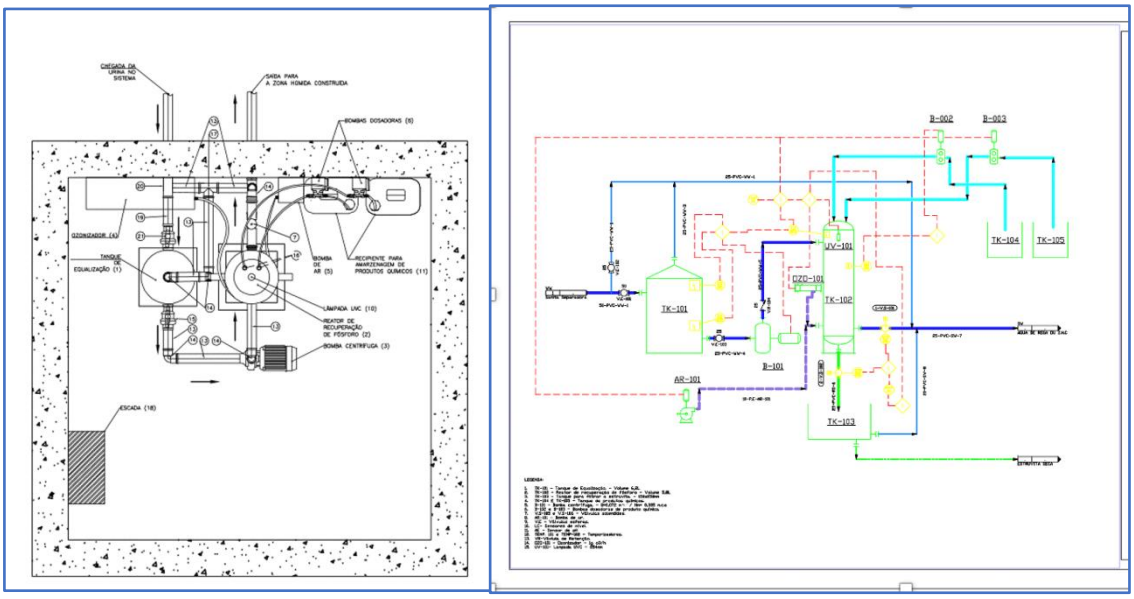


*Figure 4.14 Resource recovery plant lay-out and instrumentation at ShoTA (ISA)*

TWIST is co-funding the laboratory construction.

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### 4.13.9 Urban farming TA – constructed wetland for water reuse

At Tapada da Ajuda is already under civil works a constructed wetland for wastewater treatment and water reuse for agriculture irrigation, a project with the strong involvement of Lisbon Municipality. The Urban farming TA is a community urban farm drive, with 50 plots. This full scale solution aim is to provide an experimental lab for testing this type of nature based type processes, namely to municipalities that are aiming to promote urban farming. The wetland (7.00x3.00) will support a small scale plantation of bamboo.

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