



URBAN WATER UNIT

Maria João Rosa


Urban water unit

Hydraulics and Environment Dept.

LNEC – National Civil Engineering Laboratory

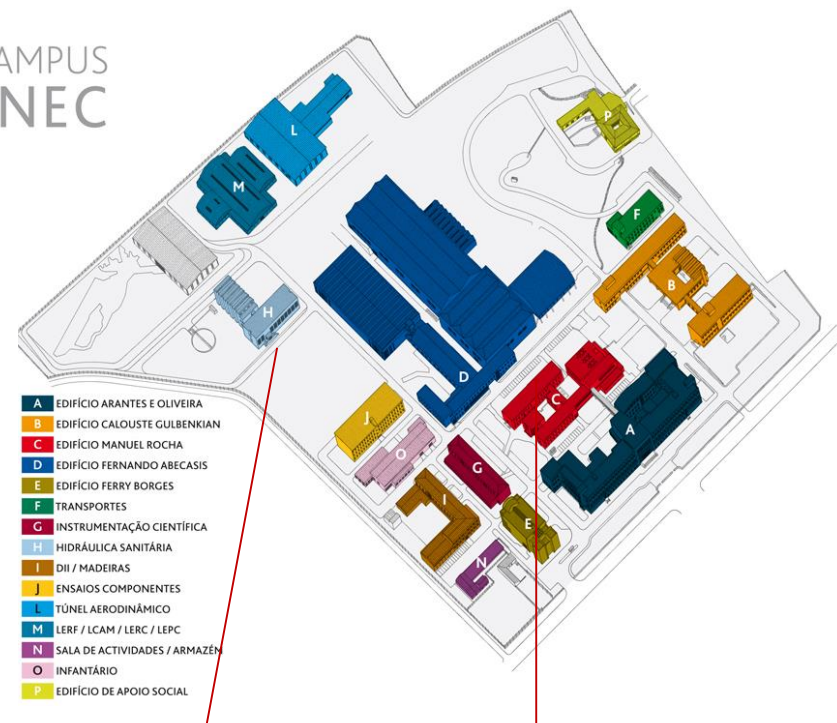
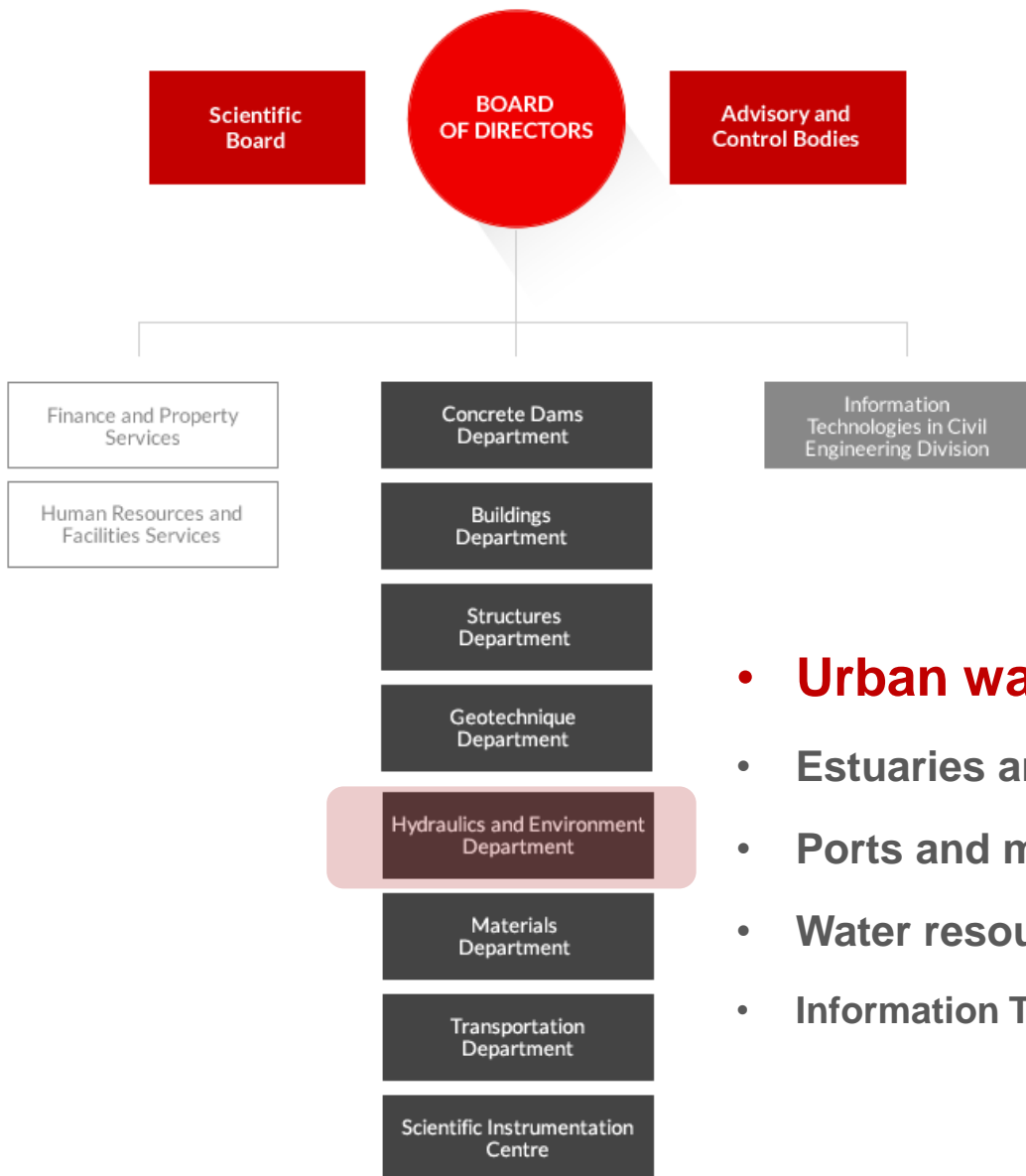
October 2018

LNEC in 1 minute...

- > National Civil Engineering Laboratory
 - > State owned R&D institution
 - > Founded in 1946
 - > 22 ha campus, in Lisbon, close to the airport
- 
- > Unique multidisciplinary perspective in civil engineering
 - > Innovative R&D, best practices in civil engineering, with a key role in advising the government, as an unbiased and independent body
 - > 28 M€ annual budget, 40% from the National Budget and other sources, 60% own revenue through Sci. & Tech. contracts
 - > 498 total staff (researchers, technicians, admin) + research fellows

LNEC in 1 minute...

CAMPUS
LNEC



We are here, at the
Congress Centre

- **Urban water unit**
- **Estuaries and coastal zone unit**
- **Ports and maritime structures unit**
- **Water resources and hydraulic structures unit**
- **Information Technol. in Water & Environ. Research Group**

Urban water unit | NES/DHA

- Problem-driven, leading-edge **R & D & innovation** on urban water systems and services - **water supply, wastewater and stormwater**
- **European and national funds** from competitive calls and **industry funds** from **collaborative projects**, an in-house developed model of project with researchers, IT providers and utilities
- **Advanced consultancy, regulation and standardization** of water services
- **Capacity building** (institutions and individuals) through collaborative projects, advanced courses and training programs for water professionals, PhD and Master students
- 23 total **staff**, 20 researchers: 12 PhD + 7 PhD students + 1 MSc research grantee
<http://www.lnec.pt/hidraulica-ambiente/en/core/urban-water-unit/team-7/>

<http://www.lnec.pt/hidraulica-ambiente/en/core/urban-water-unit/activity-2/>

R&D&I areas & ongoing/recent related projects

✓ Infrastructure asset management

water networks and WTPs/WWTPs; decision support tools based on a performance-cost-risk integrated approach <http://igpi.aware-p.org/>, www.trust-i.net (FP7), **iCITAGE**

✓ Water and energy

water losses and energy management in water supply systems <http://iperdas.org/>
ICT technol. www.i-widget.eu, big consumers (e.g. hotels <http://adapt-act.lnec.pt/>),
hydro-agriculture projects **agir**, energy efficiency in the urban water cycle **avaler+**

✓ Reliability, safety and resilience of urban water systems

assessment and control of undesirable inflows into sewers <http://iaflui.lnec.pt>
resilient cities, climate change adaptation www.resccue.eu (H2020)

✓ Water quality, treatment and reuse

natural waters, drinking water, wastewater, water reuse (urban and rural areas)
conventional, advanced and nature-based treatments (centralized/decentralized)
process development and prototype demonstration, performance assessment and
benchmarking of full-scale plants www.trust-i.net, www.life-aware.eu, www.life-hymemb.eu, www.life-impetus.eu, democon, www.marsol.eu/, <http://ieqta.lnec.pt/>



LABORATÓRIO NACIONAL
DE ENGENHARIA CIVIL



UQTA

Water Quality and Treatment Laboratory



LABORATÓRIO NACIONAL
DE ENGENHARIA CIVIL



UQTA

Water Quality and Treatment Laboratory

Lab Facilities



Chemistry Lab



Microbiology Lab

Water treatment testing facilities



Jar test



Adsorption/biofiltration systems (BAC)



Lab scale membrane units



Pilot scale membrane units

Equipment for water quality testing in distribution systems



Vis Spectrophotometer



Epifluorescence microscope



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UQTA

Water Quality and Treatment Laboratory

Lab Facilities



Relevant equipment for water analyses



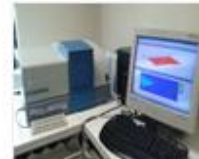
TOC analyser



HPLC-DAD



UV-Vis Spectrophotometer



Spectrofluorometer

Field devices



Refrigerated sampler



Chlorine analyser



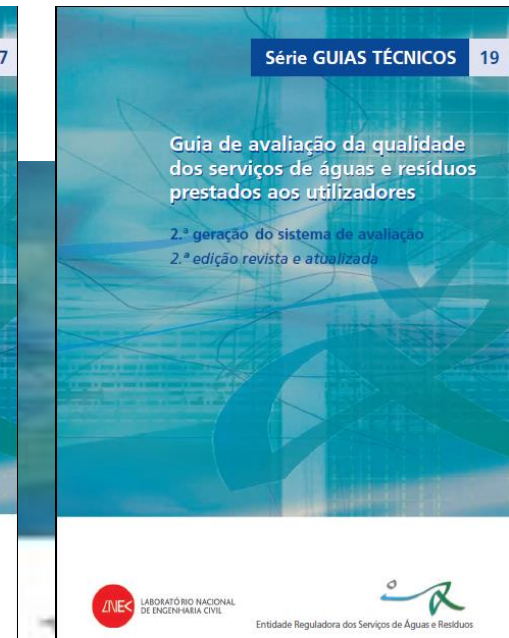
Udometer



Multiparametric analyser

Supporting the regulation of water services

- ERSAR guides for assessing the performance of water and wastewater services based on IWA PI systems for water services (HAlegre, JMBatista et al.) and wastewater services (RMatos et al.)
- Technical guides on infrastructure asset management, water losses, water treatment, water conservation and efficient water use...



Standardization

- **Chairing the National Technical Commission on Urban Water Systems** and many of its sub-commissions, and integrating many CEN and ISO working groups (ongoing)
 - **ISO TC224** Service activities relating to **drinking water supply** systems and **wastewater systems** - Quality criteria of the service and performance indicators
 - ISO 24500:2007 series
 - Water losses
 - **ISO TC282 Water reuse**
 - Irrigation - ISO 16075:2015 (parts 1, 2, 3), ISO 16075:2016 (part 4)
 - Water reuse in urban areas
 - Risk and performance evaluation of water reuse systems
 - Industrial water reuse
 - **CEN TC 164** (water supply)
 - **CEN TC 165** (wastewater engineering)
- **ISO TC251 Asset management** - ISO 55000:2014 series

Lecturing, training & capacity building

- Institutions, professionals, post-graduations
- Collaborative projects – iGPI, iperdas, iAflui, iEQTA ...
- Training programs for water professionals
- PhD and Master students
- Advanced courses

Advanced courses - examples

- Urban drainage (wastewater and stormwater) – modelling, design and operation
- Water supply systems – modelling, design and operation
- Water quality monitoring - parameters and methods
- Conventional and advanced water and wastewater treatment and water reclamation
- Strategies for controlling chemically resistant microorganisms and oxidation by-products
- Strategies for controlling cyanobacteria and cyanotoxins in drinking water
- Performance assessment and improvement of water and wastewater treatment plants
- ISO 24500 series - performance assessment of water and wastewater services
- ISO 55000 series – asset management
- Water reuse – treatment technologies, risk and performance, ISO standards



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 763562



LIS-Water: The new centre of excellence for water
Better water governance for a better world!

Some relevant projects

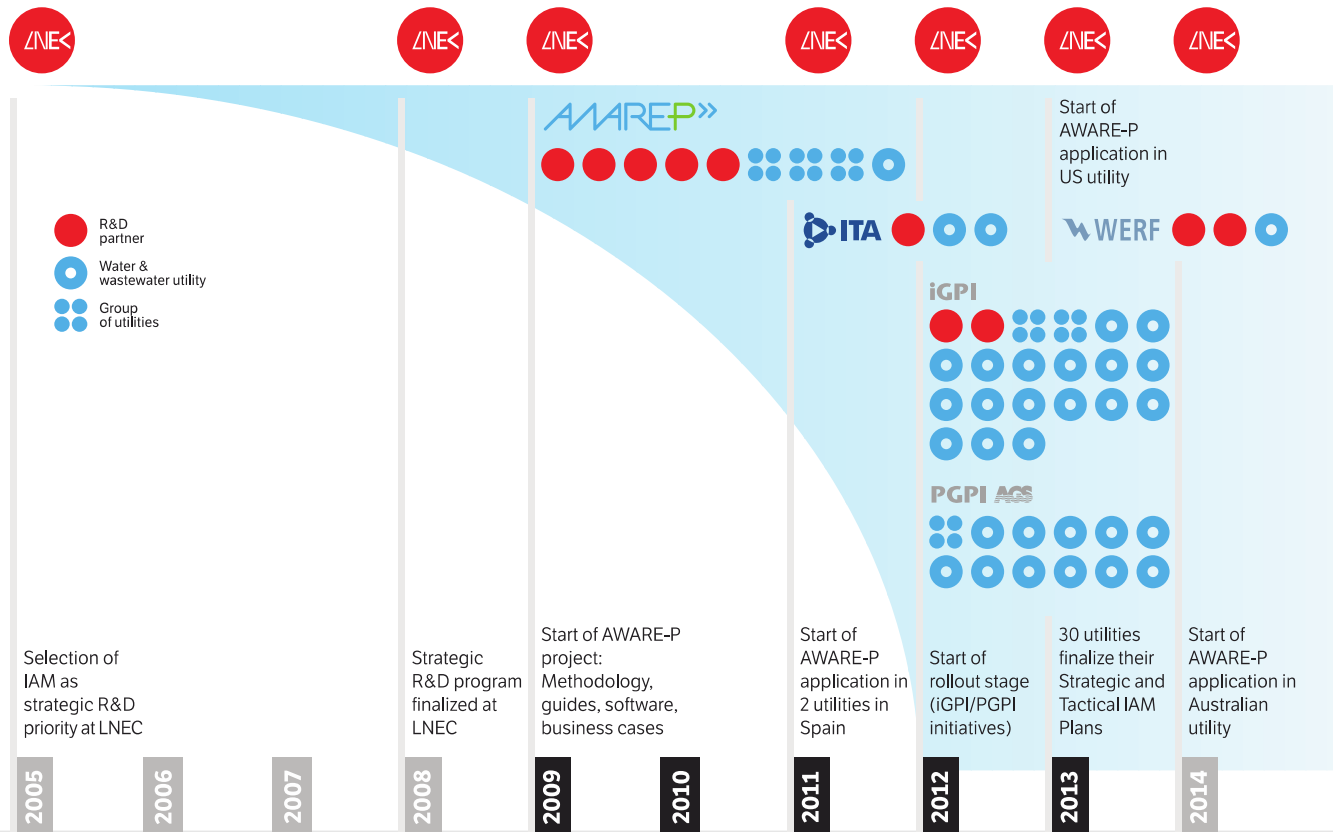
<http://www.lnec.pt/hidraulica-ambiente/en/core/urban-water-unit/activity-2/>

IAM. Infrastructure Asset Management

AWAREP»

from incipient to leading-edge IAM planning in Portugal

From R&D to the industry

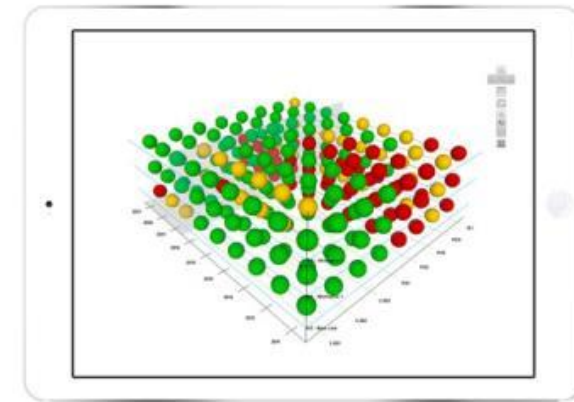
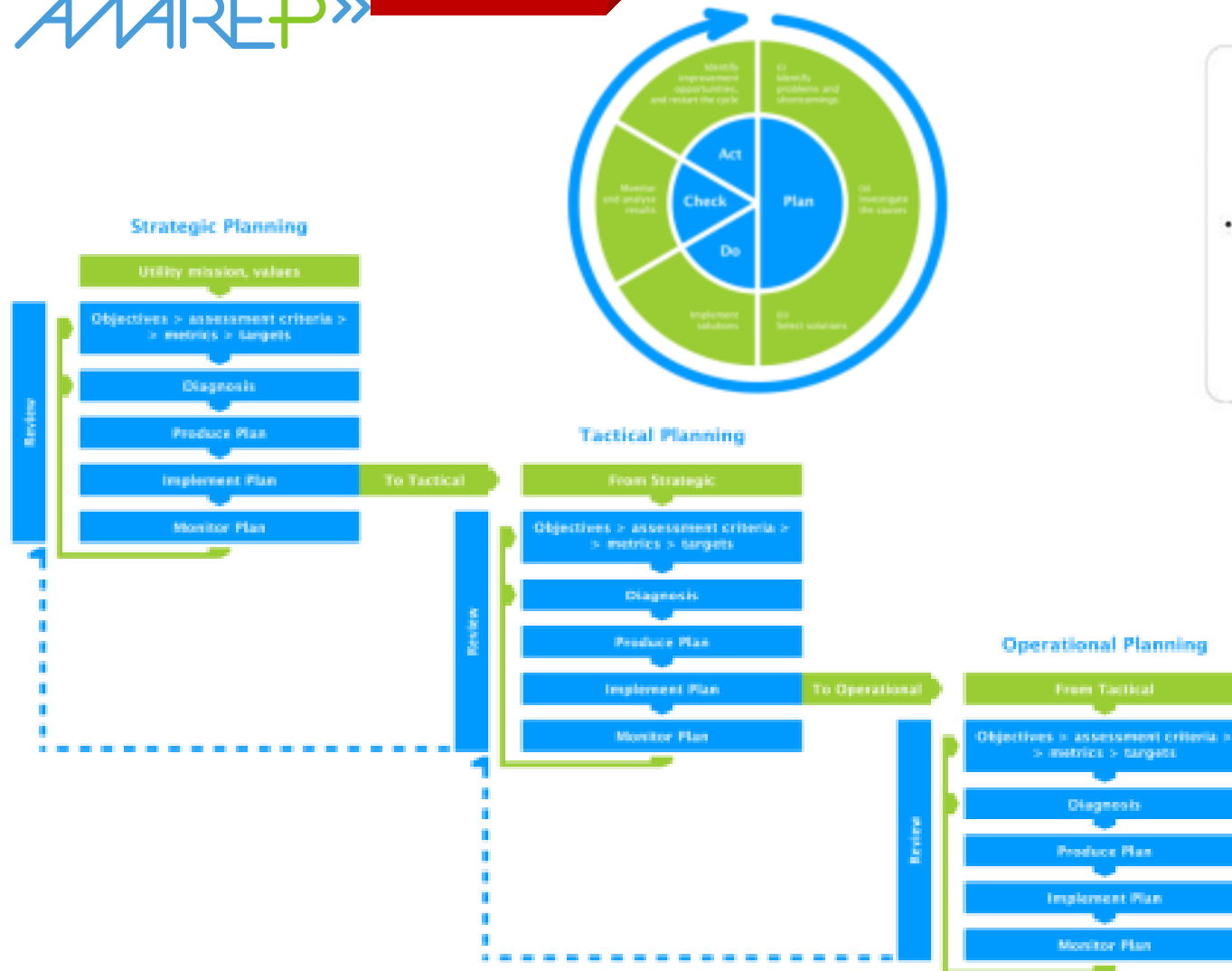


IAM. Infrastructure Asset Management

ANAREP»

Methodology

Software and tools



performance-cost-risk

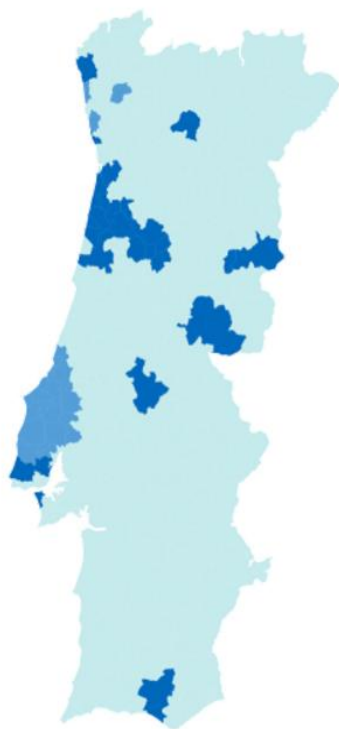
IAM materials

The collage displays a variety of materials related to the Initiative Nacional para a Gestão Patrimonial de Infraestruturas (iGPI):

- Documents:**
 - Plano Estratégico de Gestão Patrimonial de Infraestruturas 2013 – 20[xx]**: A strategic plan document.
 - Plano Tático de Gestão Patrimonial de Infraestruturas 2013 – 20[xx]**: A tactical plan document.
 - Documento de Análise**: A document for analysis, including a table for the degree of work completion.
 - ANEXO – Aspetos analisados**: A table detailing the aspects analyzed for the evaluation of the iGPI 2015.
 - Avaliação iGPI**: A document for the evaluation of the iGPI, showing a table for the degree of work completion.
 - Aperfeiçoamento dos planos de GPI**: A document for the improvement of the GPI plans, showing a table for the degree of work completion.
- Software Interfaces:**
 - iGPI Interface**: A web-based interface for the iGPI, showing a sidebar with navigation options like Quickstart, Data, Plan, Indicators, Infrastructure value index, Financial Analysis, System Profile, Network model, Failure Analysis, Component Importance, Unmet Demand, ADMINISTRATION, Results, and Users.
 - 3D Model**: A 3D visualization of a network structure, likely representing a water supply system.
 - Map**: A map showing the geographical context of the infrastructure network.
 - Tablet Interface**: A tablet displaying a software interface for the iGPI, showing a table for the degree of work completion.

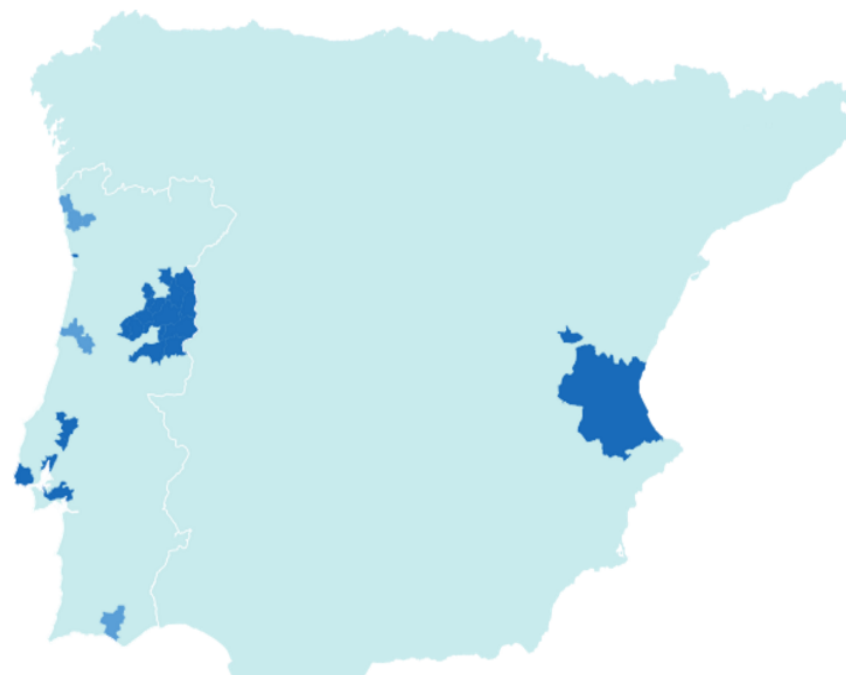
IAM water utilities

iGPI 2015



iGPI 2012

- **Modalidade 1**
 - Águas de Coimbra
 - Águas da Região de Aveiro
 - AQUAPOR - Águas do Planalto
 - CM Sabugal
 - EMAR Vila Real
 - INDAQUA
 - Infraquinta/Inframoura/Infralobo
 - INOVA - Cantanhede
 - SM Abrantes
 - SM Castelo Branco
 - SMAS Almada
 - SMAS Loures
 - SMAS Sintra
 - SMSB Viana do Castelo
- **Modalidade 2**
 - Acquawise
 - Águas do Oeste
 - AGERE
 - EAMb Esposende
 - INDAQUA (*)
 - SMAS Sintra (*)

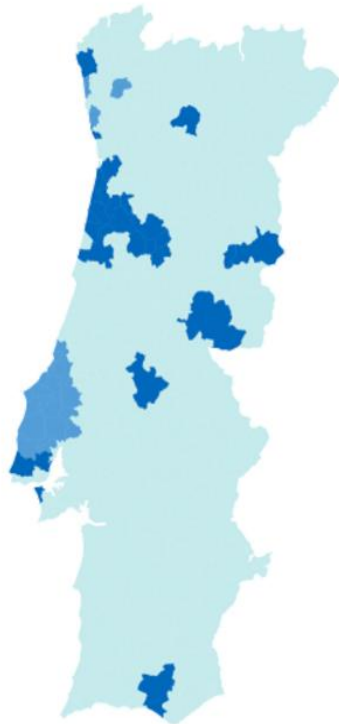
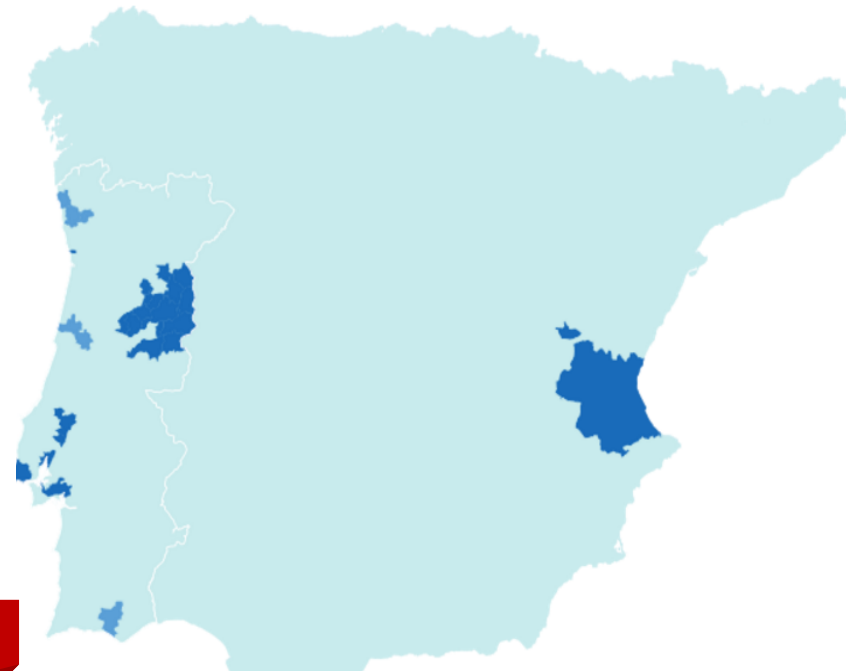


- **Perfil-base**
 - Águas do Porto
 - Águas de Santarém
 - Águas do Zêzere e Côa
 - Águas de Valencia
 - AQUALIA - Cartagua
 - CM Barreiro
 - CM Palmela
 - SMAS Vila Franca de Xira
 - SANEST
- **Perfil-aperfeiçoamento**
 - AGERE
 - Águas de Barcelos
 - Águas de Coimbra
 - Infralobo
 - Inframoura
 - Infraquinta
 - INOVA
 - SIMAS Oeiras e Amadora
 - SMSB Viana do Castelo

IAM water utilities

iGPI 2015

Direct results of the utilities
(IAM plans)



iGPI 2012

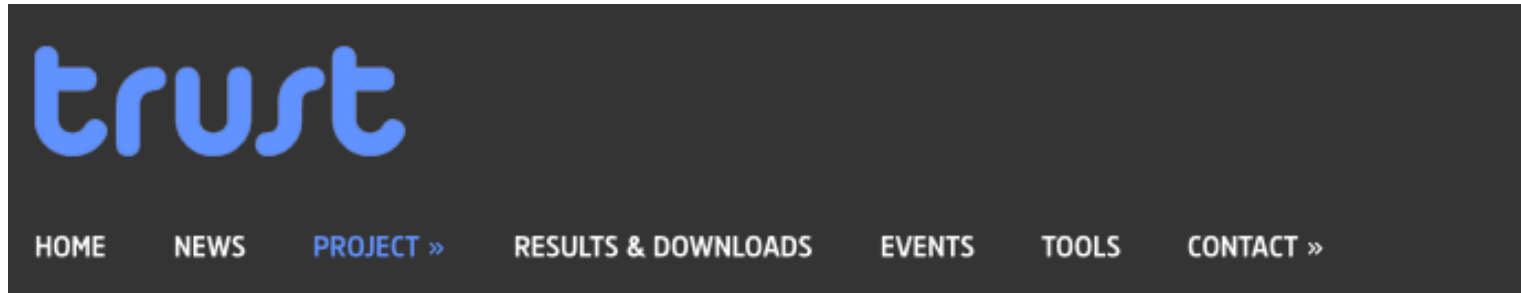
Training and capacity
building



TRUST FP7

Transitions to the urban water services of tomorrow

IWW (Germany) et al. | 2011-2015



WA5

FUTURE WATER POLICIES & INTEGRATED TOOLS

The objective of Work Area 5 is to develop general-use integrated approaches and planning support tools aimed at the transition from current status to the desired sustainable urban water cycle services of tomorrow. The integrated approaches, developed both at the regional/national level and at the utility level, will seek a balanced long-term asset management view between performance, risk and cost, and will take into account social and political acceptance. The life cycle assessment paradigm will be incorporated whenever appropriate and feasible. The proposed development work aims at empowering policy makers and water utilities.



LEADER

Helena Alegre

www.trust-i.net

iPerdas

Water loss & energy management



Modalidade 1

AGERE EM Braga
AGS – Paços de Ferreira
Águas de Alenquer
Águas de Barcelos
Águas de Coimbra
Águas de Covilhã
Águas do Sado
CM Barreiro
EMAR Vila Real
Infralobo
Inframoura
Infraquinta
INOVA Cantanhede
SM Castelo Branco
SMAS Almada
SIMAS Oeiras Amadora
SMSB Viana do Castelo

Modalidade 2

ACQUAWISE
AQUALOGUS
AQUASIS
CM Óbidos
CM Peniche
CM Reguengos de Monsaraz
Esposende Ambiente
Hubel Indústria da Água
INOVA Cantanhede *
Itron
Navia (MdeMaquina)
Pedro Almeida
SM Nazaré

iPerdas 2014



iPerdas 2016

Legenda

- Perfil Aperfeiçoamento
- Perfil Base - Distribuição
- Perfil Base - Adução



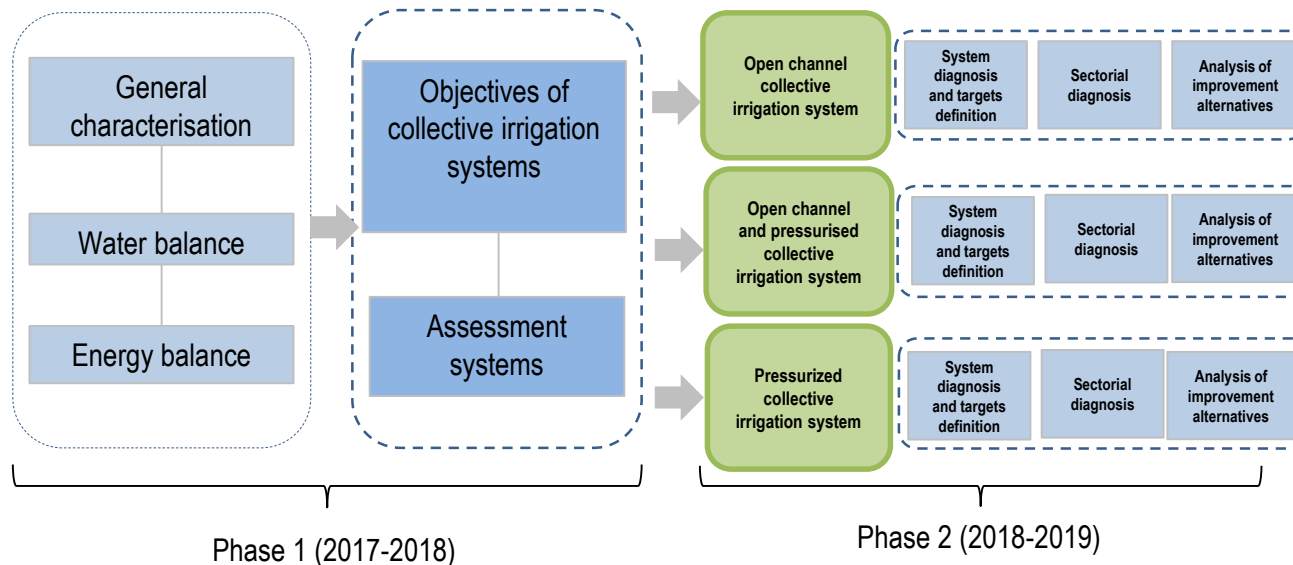
In Portugal...

- Water use efficiency in irrigation systems of 60-65% (DGADR, 2014)
- Energy consumption in irrigation systems increased from 200 kWh/ha to 1500 kWh/ha between 1960 and 2017 (SIR, 2017)
- Collective irrigation infrastructures in poor condition and labour-intensive (PDR 2020)

What's necessary?

- Adapt existing and well succeed methodologies from the urban water system to collective irrigation systems
- Develop tools to support diagnosis and decision-making about alternatives to improve efficiency
- Develop an assessment system to promote water and energy management in collective irrigation systems and the definition of public policies

AGIR | Efficiency assessment of water and energy in collective irrigation systems



Phase 3 – Technical guides (2019-2020)



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DE ENGENHARIA CIVIL



UNIVERSIDADE
DE ÉVORA



Instituto Nacional de
Investigação Agrária e
Veterinária, I.P.



Centro Operativo
e de Tecnologia de Regadio
Centro de Competências para o
Regadio Nacional



LABORATÓRIO NACIONAL
DE ENGENHARIA CIVIL

Maria João Rosa | NES/DHA

iWIDGET FP7

Improved water efficiency through ICT technologies for integrated supply-demand side management

UExeter (UK) et al



The screenshot shows the iWIDGET project website. The header features the iWIDGET logo in large, light blue letters, with the tagline "Smart meters, Smart water, Smart societies" to its right. Social media icons for Twitter and LinkedIn are present, along with a "Login Form" button. A navigation bar below the header contains links: Home, Project (highlighted in teal), Partners, News, eLearning, Publications, Contacts, and Aderir ao projeto. Below the navigation bar, a breadcrumb trail reads: "You are here: [Home](#) » [Project](#) » [Project Tasks](#) » [Work Package 4](#)". The main content area is titled "Work Package 4: Review and evaluation of the iWIDGET systems". Below this title, it states "Overall Work Package Lead Partner: LNEC" and "Contact: [Sergio T Coelho](#)". The section "Work Package 4 Objectives:" follows, with a sub-header "Working with WP3, the objective of WP4 is to:" and a list of three objectives: "assess the impact of case study local conditions on the generalization potential of the iWIDGET system (i.e. is it safe to draw conclusions from the case studies as to what might be achievable at the European scale)", "perform a technical evaluation of the iWIDGET system", and "perform an economic evaluation of iWIDGET business models and iWIDGET business case". The website URL "www.i-widget.eu" is displayed in the bottom right corner.

iWIDGET Smart meters
Smart water
Smart societies

[Home](#) [Project](#) [Partners](#) [News](#) [eLearning](#) [Publications](#) [Contacts](#) [Aderir ao projeto](#)

You are here: [Home](#) » [Project](#) » [Project Tasks](#) » [Work Package 4](#)

Work Package 4: Review and evaluation of the iWIDGET systems

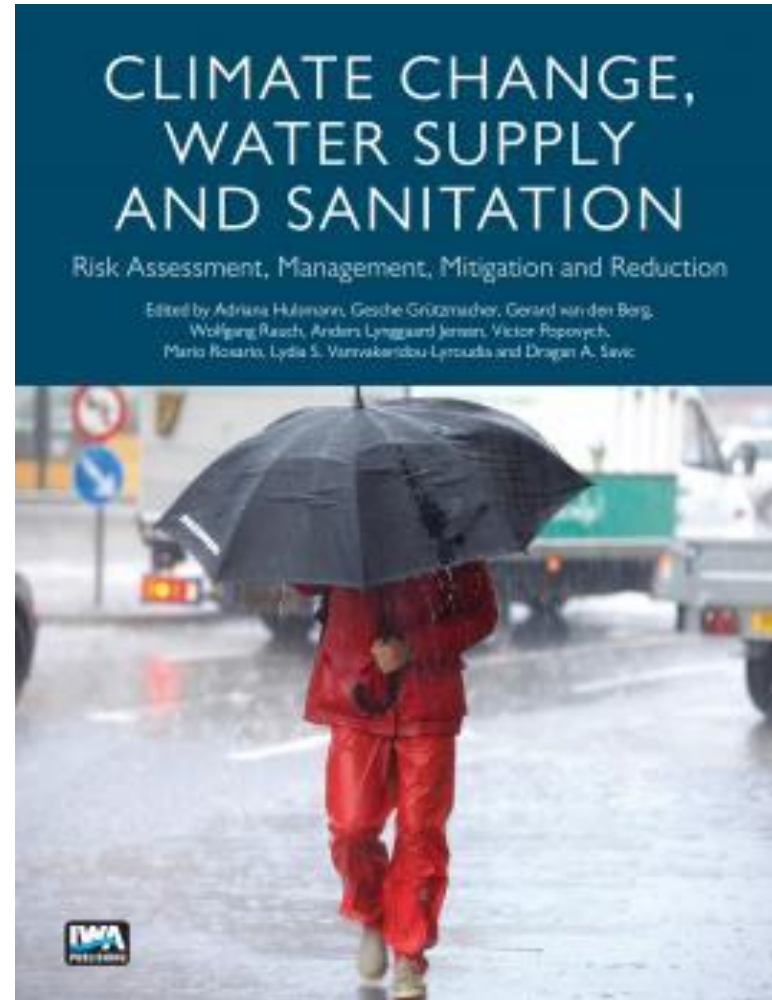
Overall Work Package Lead Partner: LNEC
Contact: [Sergio T Coelho](#)

Work Package 4 Objectives:

Working with WP3, the objective of WP4 is to:

- assess the impact of case study local conditions on the generalization potential of the iWIDGET system (i.e. is it safe to draw conclusions from the case studies as to what might be achievable at the European scale)
- perform a technical evaluation of the iWIDGET system
- perform an economic evaluation of iWIDGET business models and iWIDGET business case

www.i-widget.eu

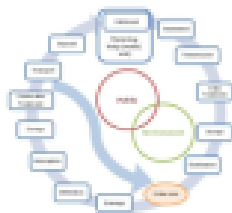


Water Cycle Safety Planning - Framework



Water cycle safety plan framework

Proposal



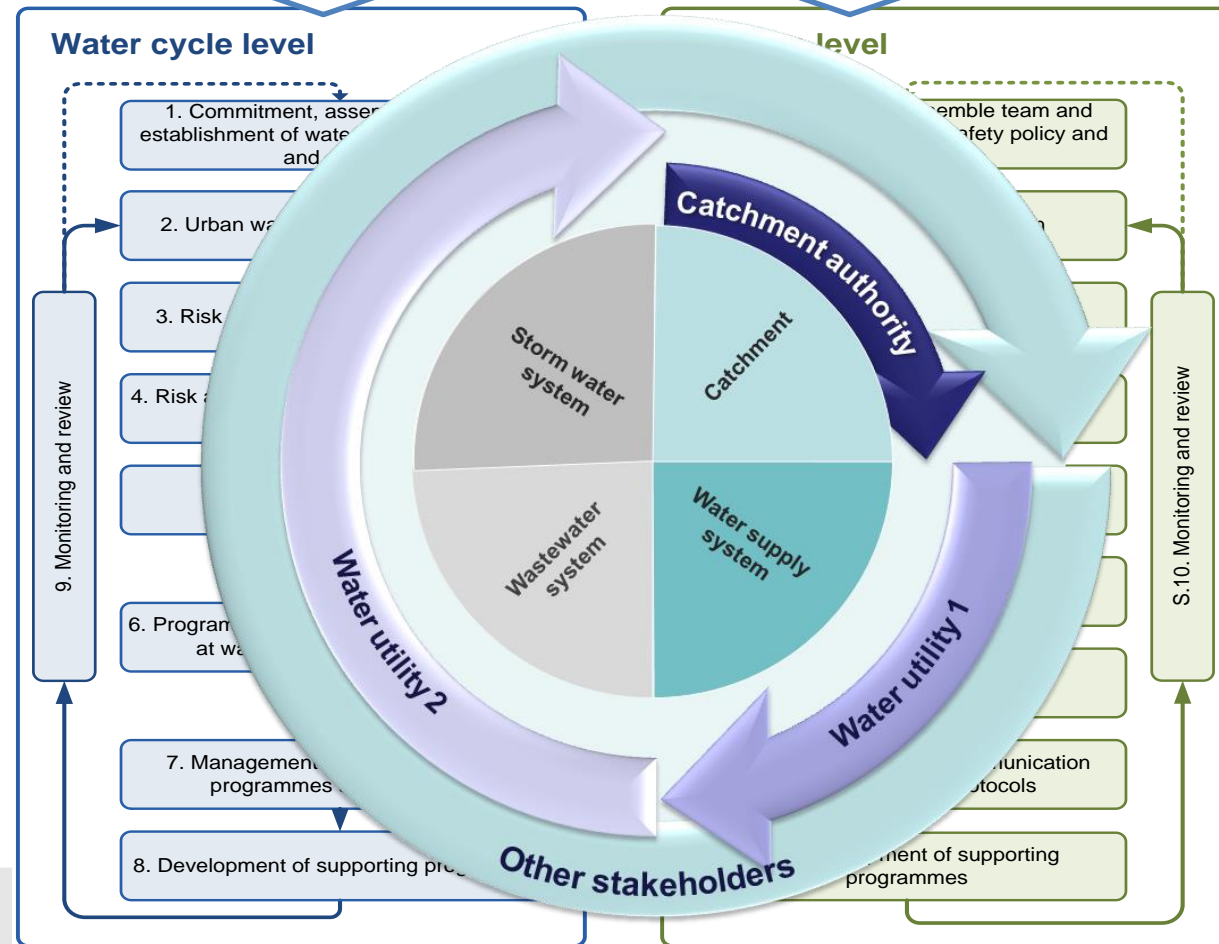
Water cycle safety plan framework



- Two levels of action
- Primary aims are protection of public health, of public safety and of environment

- Macro scale
- Systems' interactions

- Detailed analysis
- Subsystem level



Water Cycle Safety Planning Demonstration

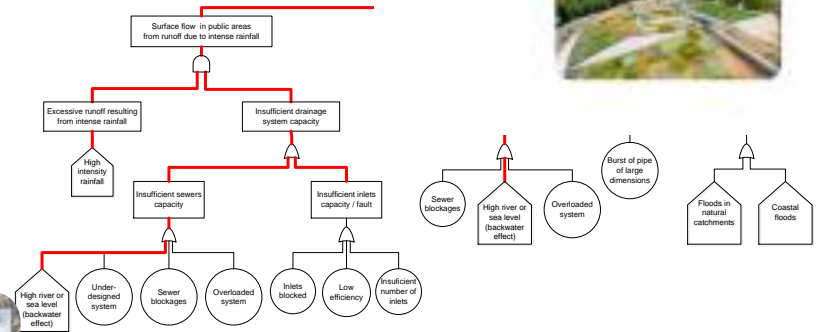
Risk assessment

Fault trees for each hazard identified

Relevant CC related events identified using GIS

20 CC relevant events identified

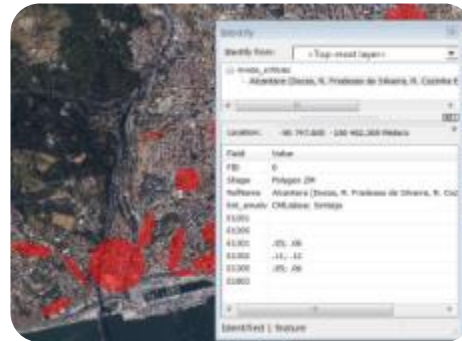
3 main risk sources – high intensity rainfall, high river or sea level and low rainfall



Demonstration of the WCSP, RIDB, RRDB, GIS applications for risk assessment in Lisbon



Working meetings



Risk events characterisation and location

Event ID	Event	Probability class	Consequence Class				
			Health and safety	Financial	Environmental	Socio-economic	Liability, reputation and image
11701.03	High velocity runoff in Luís de Camões street due to intense rainfall (RP > 10 years) and to insufficient sewers capacity resulting from high river or sea level, causing injuries to public, damages to property, disturbances in services and activities	4 based in records of 10 rainfall occurrences with return period 10 years: 1976, 1989, 1985, 1987, 1993, 1997, 1999, 2002, 2008	1 based in records	1 Dependent of the affected area	n.a.	5 Small affected area	1 Injuries not affected
11301.06	High depth flooding in public areas or private properties in Alcântara due to intense rainfall (RP > 100 years) and to insufficient sewers capacity resulting from high river or sea level, causing injuries to public, damages to property, disturbances in services and activities	3 based in records of 5 rainfall occurrences with return period 100 years: 1967, 1983, 1997	2 based on records	2 Dependent of the affected area	n.a.	4 Significant affected area	2 References on the media and complaints
11705	Discharge of organics in the water cycle or soil due to discharge of untreated WW from wastewater system caused by failure in Alcântara WWTP for insufficient treatment plant capacity during peak flow causing damages to the environment	5 based on rainfall records and WWTP capacity	1 based on records	1 Low impact	1 Rapid recovery	1 Low impact on the environment	1 Injuries not affected
	Never occurred	1	3 The occurrence Expected public health consequences	3 A low percentage of expected and expected	n.a.	5 Interruption of services and activities and clients affected	4 Adverse coverage by media in front page

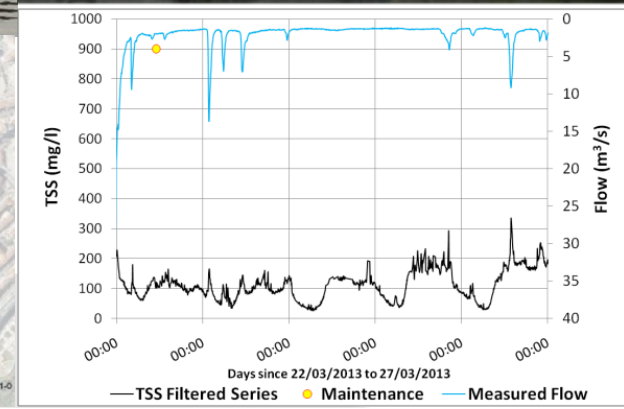
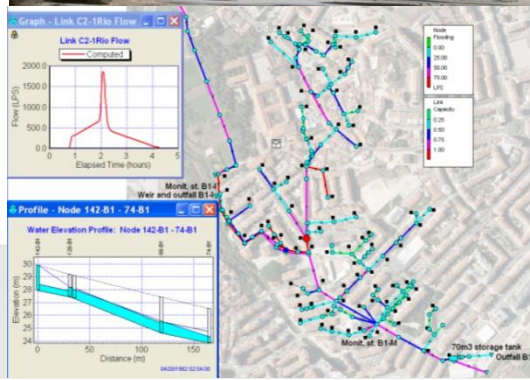
Risk reduction measures location

Communication among stakeholders using an interactive board



Urban flooding, stormwater management

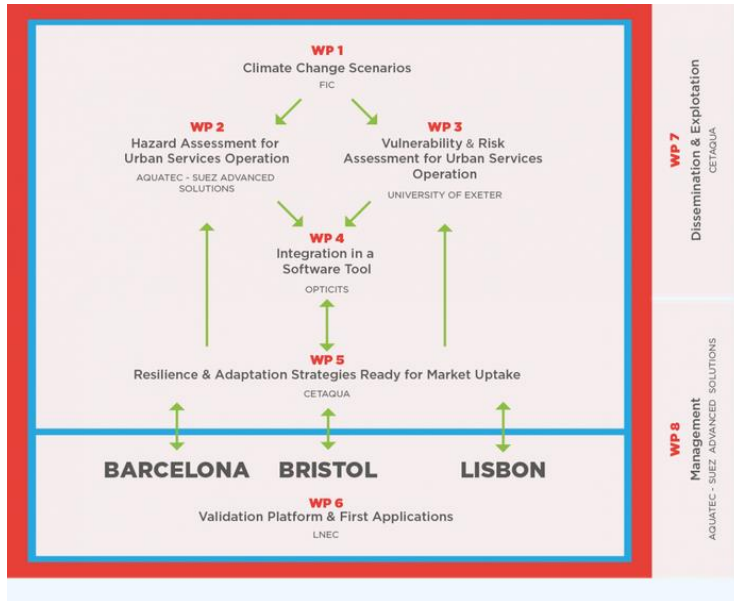
Multiuse SUDS (sustainable drainage solutions) as nature-based solutions for stormwater management and urban re-naturing (local, site, end-of-pipe solutions) / combination with ICT technologies



RESCCUE

RESILIENCE TO COPE WITH CLIMATE CHANGE IN URBAN AREAS.

8 M€ H2020 project, 18 partners, 2016-2020
Coordinator: Aquatec (Pere Malgrat)



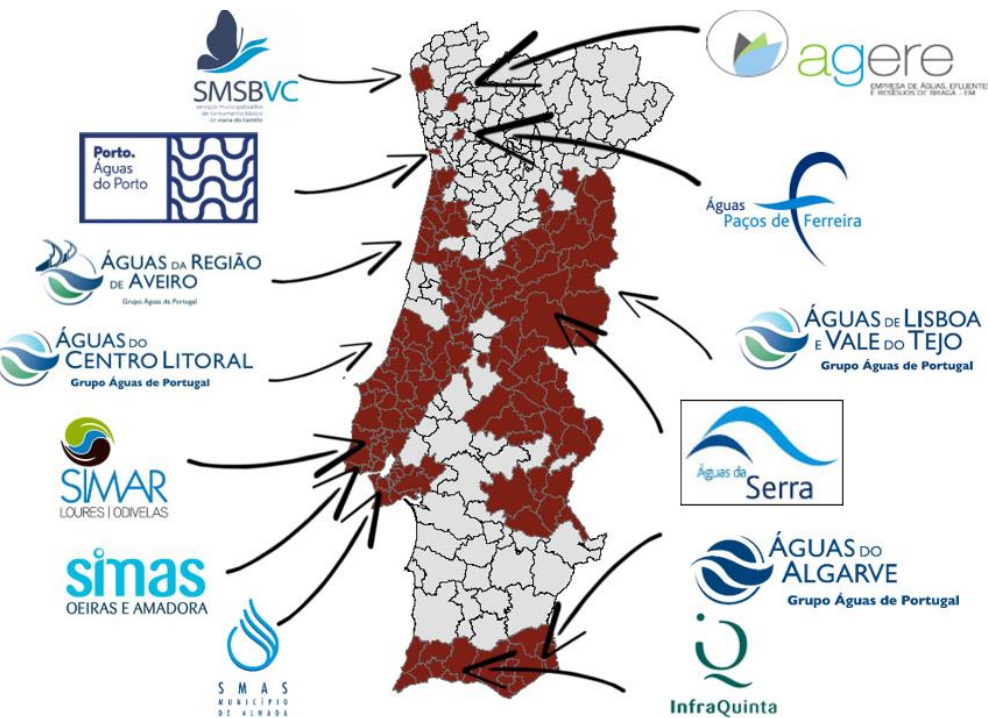
To help cities to become **more resilient** to physical, social and economic challenges by generating **models** and **tools** to bring this objective to practice and make them applicable to different types of cities, with different climate change pressures.

RESCCUE will also assist cities preparing their **resilience plans**.

www.resccue.eu



National Initiative for the Control of Undue Inflows 2016-2018



Objectives

Capacity building of the utility's team

Internalization of a **structured process** for the undue inflows

Development of a **Plan for the Control of Undue Inflows**



WACCLIM “Water and Wastewater Companies for Climate Mitigation”

- A contribution for improving the carbon balance of wastewater utilities...
- In Mexico, Peru and Thailand
- LNEC and ITA – UPValencia (Spain) for IWA
- 2014-2015



On behalf of:



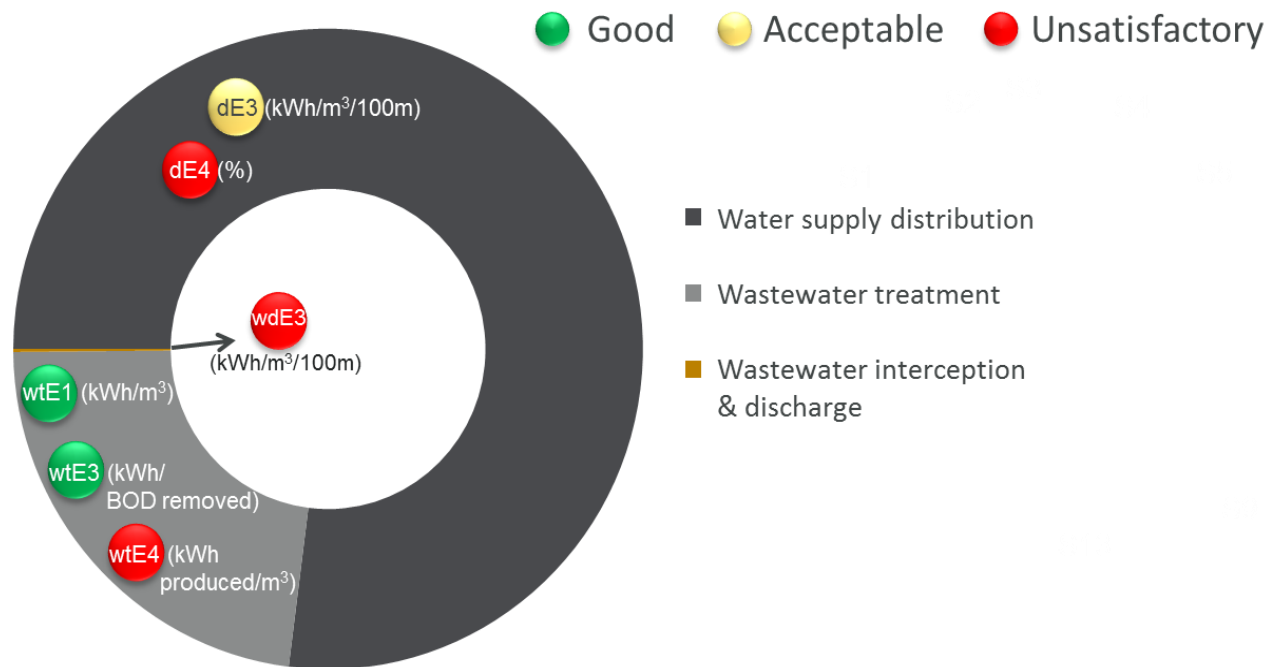
Federal Ministry
for the Environment, Nature Conservation,
Building and Nuclear Safety



of the Federal Republic of Germany

WACCLIM “Water and Wastewater Companies for Climate Mitigation”

- A contribution for improving the carbon balance of wastewater utilities...

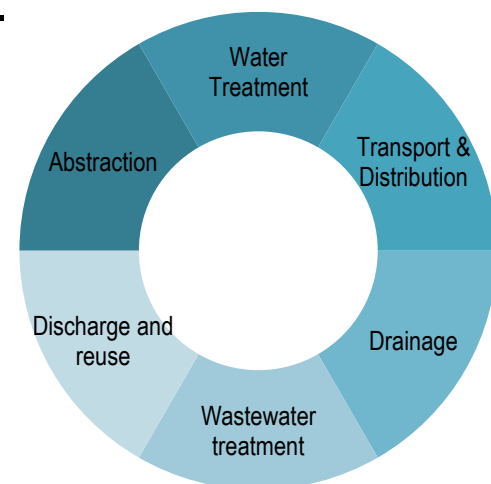


The challenges...

- High water losses in water supply systems
- High Undue Inflows in the sewer systems
- Low efficiency of pumping equipment
- Underutilization of treatment capacity
- Systems' Layout or network operation with low energy efficiency

What's necessary?

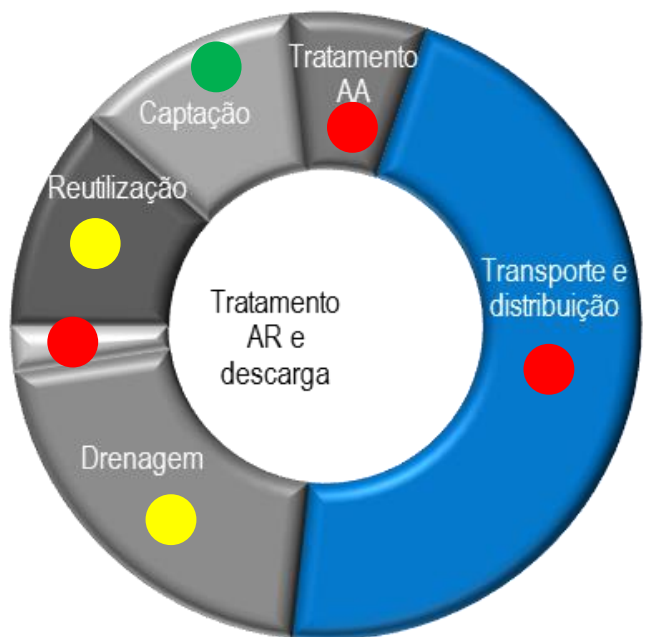
- Develop and assessment system covering all the stages of the urban water cycle
- Develop instruments for diagnosis, selection and economic analysis of alternatives and monitoring of the impact of actions.



2018-2021, **Coordinator:** LNEC, **Partner:** Lisbon University & multiple water utilities,
Funding: National Innovation support Fund

Energy efficiency assessment and sustainability of urban water services

- Rational for diagnosis



Energy consumption &
Performance per **stage** of the
**urban cycle, component, process
or equipment**

- Expected results

- *Baseline* of the water sector and identification of energy drivers in each stage
- Assessment system for diagnosis and decision support
- Action plan to improve energy efficiency in multiple utilities
- **Energy efficiency measures implemented and monitored**
- **Direct contribution to national energy efficiency targets**

Benchmarking water and wastewater treatment plants

PASt21

National initiative for performance assessment of WTPs and WWTPs



<http://past21.lnec.pt>

2009-2011



Benchmarking

energy
efficiency

GHGs

performance indicators

performance indices

process modelling

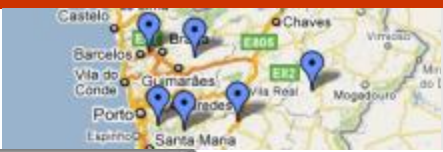
stormwater

water quality, water reuse

WTPs| WWTPs

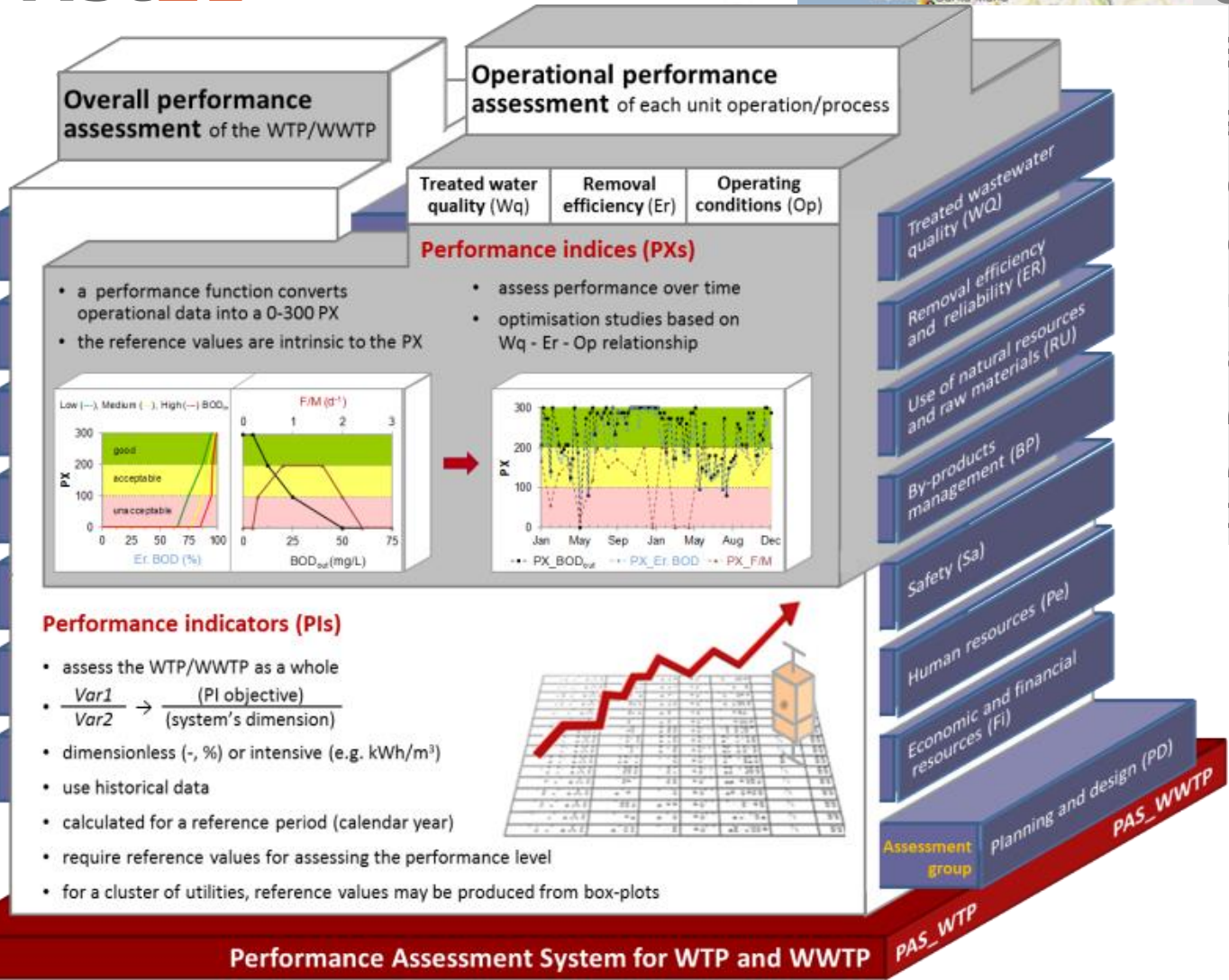
Capacity building

PASt21



Benchmarking
energy
efficiency

GHGs
performance indicators
performance indices
process modelling
stormwater
water quality, water reuse
WTPs| WWTPs
Capacity building



Performance Assessment System for WTP and WWTP



TEMA ETAR

Avaliação e melhoria do desempenho das operações e processos de tratamento de ETAR em termos de eficácia e fiabilidade, eficiência energética, gestão de lamas e valorização de recursos (água, energia, fósforo).



TEMA GPI

Capacitar as entidades para o desenvolvimento e implementação de planos de gestão patrimonial de infraestruturas de tratamento de águas residuais (ETAR).



TEMA Formação

Formação dos técnicos em tratamento de água residual, tratamento convencional e avançado e estratégias de abordagem aos novos desafios. Este tema contempla 8 módulos

ANEK

iEQTA. Initiative on energy, water quality and treatment | 2017-2019

Benchmarking WWTPs (ETAR)



Infrastructure asset manag. IAM (GPI)



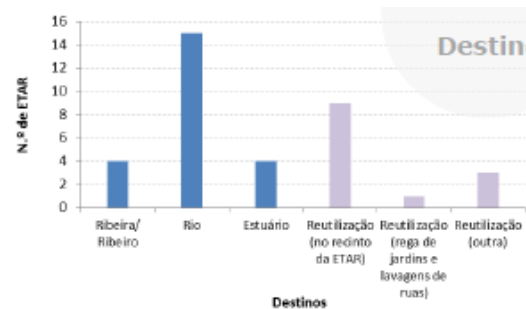
Tutorials (Formação)



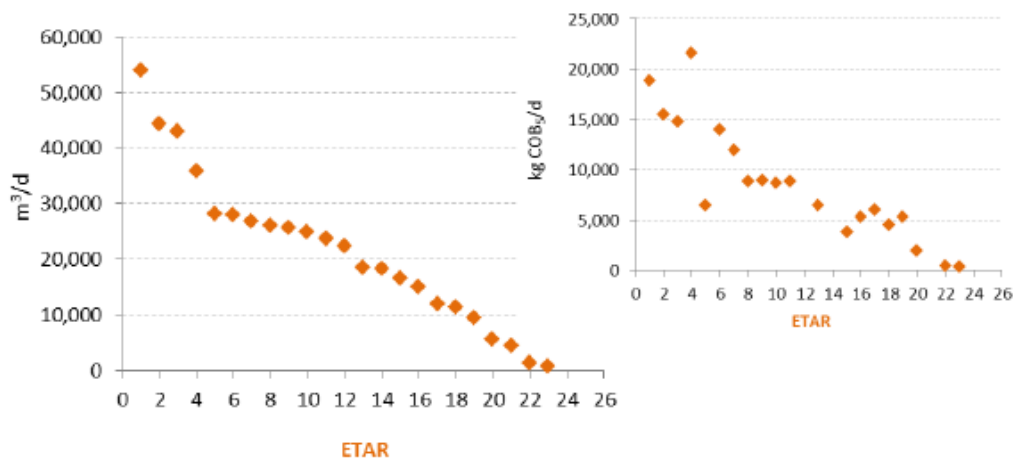
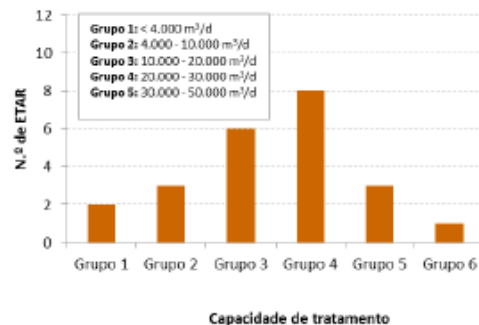


TEMA ETAR

Caracterização das ETAR



Capacidade de tratamento



Localização



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DE ENGENHARIA CIVIL



UQTA

Water Quality and Treatment Laboratory

Lab analyses and testing

Pilot prototyping



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DE ENGENHARIA CIVIL

Monitoring & characterization of cyanobacteria and cyanotoxins

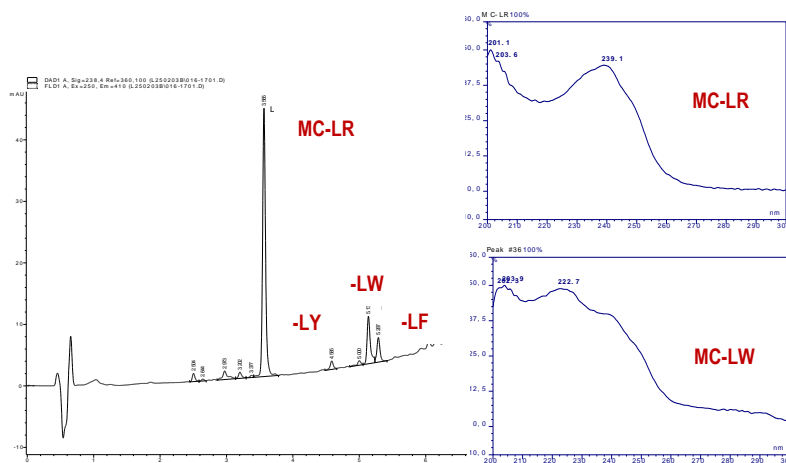
Cyanobacterial bloom



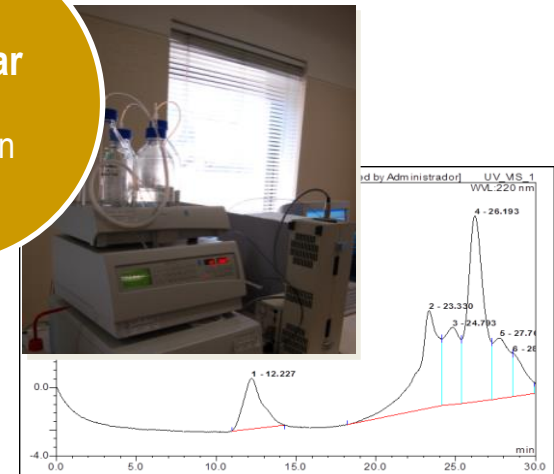
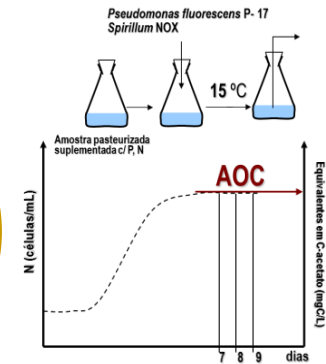
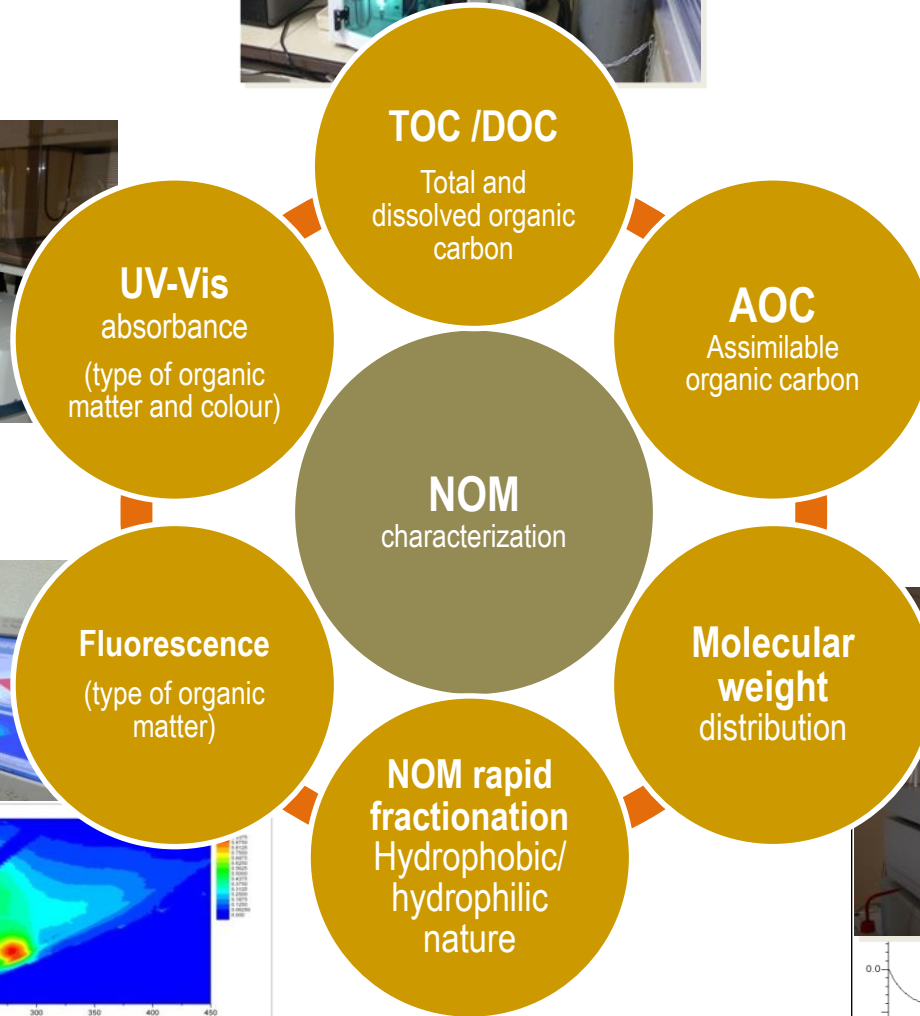
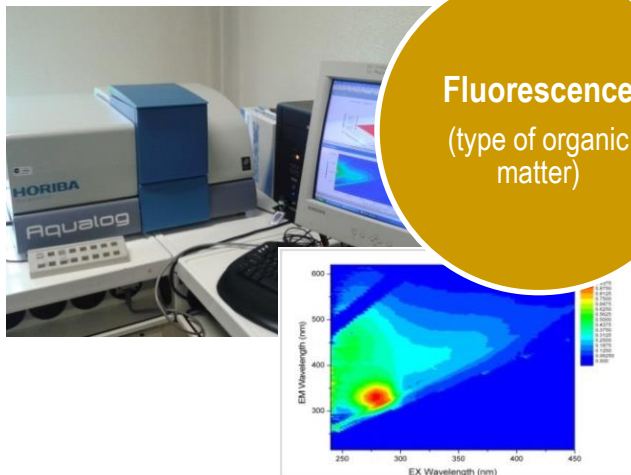
Water sample processing



Cyanotoxin identification and quantification



Monitoring & characterization of NOM - natural organic matter



WATER TREATMENT

Strategies for climate change adaptation



Assessment of current treatment works to handle climate change related pollutants and options to make current multi-barrier systems climate change proof – Summary of Prepared Research



Adapted operation of drinking water systems to cope with climate change



Resilient Water Supply

Feedback from validation and demonstration in partner cities WP5.2



Guidelines for improved operation of drinking water treatment plants and maintenance of water supply and sanitation networks

Ceramic Membranes

Emerging in Europe but not yet in Portugal:
+ chemical resistance
+ membrane lifetime
+ ability for heavy loads of particles

PAC/MF prototype

Benchmarking PAC/MF vs. conventional treatment



INNOVATION

When, where and how using PAC/MF?

Tailoring

+ PAC dosing for specific contaminants
+ PAC/MF for different water qualities and pretreatments

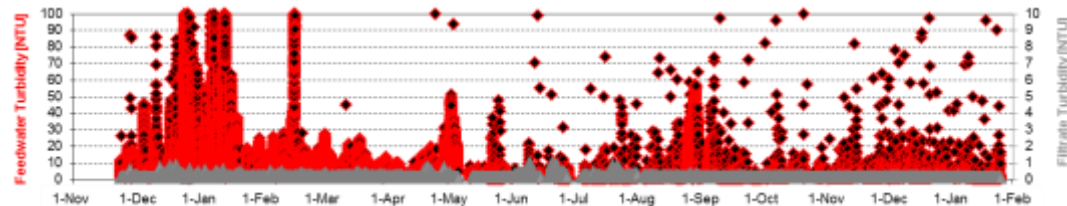
Social Indicators

Cost benefit analysis crossing technical, environmental, economic and social dimensions (stakeholders resistances and believes)

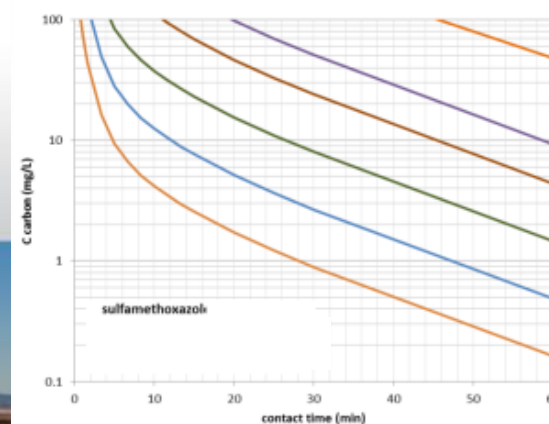


FP7 EU project, WP44.2.1

- PAC/UF and PAC/MF (ceramic UF and MF) for **unrestricted urban water reuse**
- LNEC, IWW (Germany)
SimTejo, Metawater (Japan)



- **Activated carbon** selection and optimization for PAC/NF or GAC for micropollutants (EDCs, pharmaceuticals, ...) control for **water reuse**
- Lab testing of a **new low-pressure NF membrane** (hollow-fiber)
- Design of **PAC/NF configuration** and operating conditions



- **Innovative hybrid MBR-(PAC-NF) systems to promote Water Reuse**

- **CETaqua (SP)**
Aigües de Barcelona
LNEC

HOME

CONTEXT

PROJECT

PARTICIPANTS

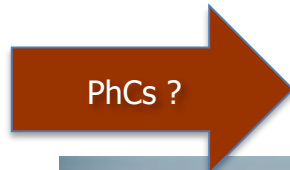
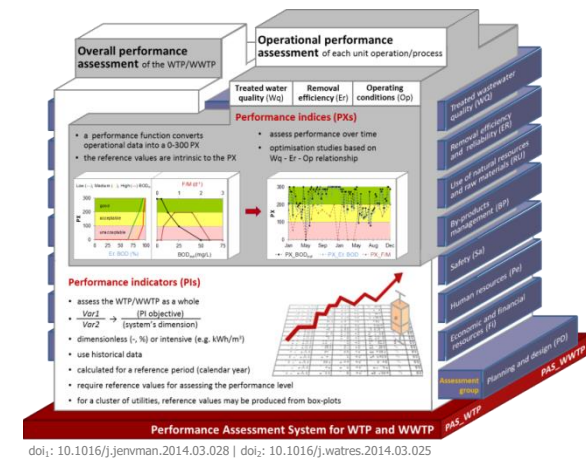
PUBLICATIONS AND EVENTS

ABOUT LIFE

NEWS

www.life-aware.eu

- ❑ Operational improvement of the current barriers using benchmarking tools (KPIs, indices)
- ❑ Chemical enhancement of clarification barriers by adding commercial vs new adsorbents from cork and carob-based (local) wastes and biopolymer coagulants



Accacia's bark
(tannin rich)



Beirolas WWTP

2 CAS WWTPs, 3 prototypes



Faro NW WWTP

PhCs ?

Tagus River

Ria Formosa
clam production

PhC analysis in 150 clam samples + 850 WW samples

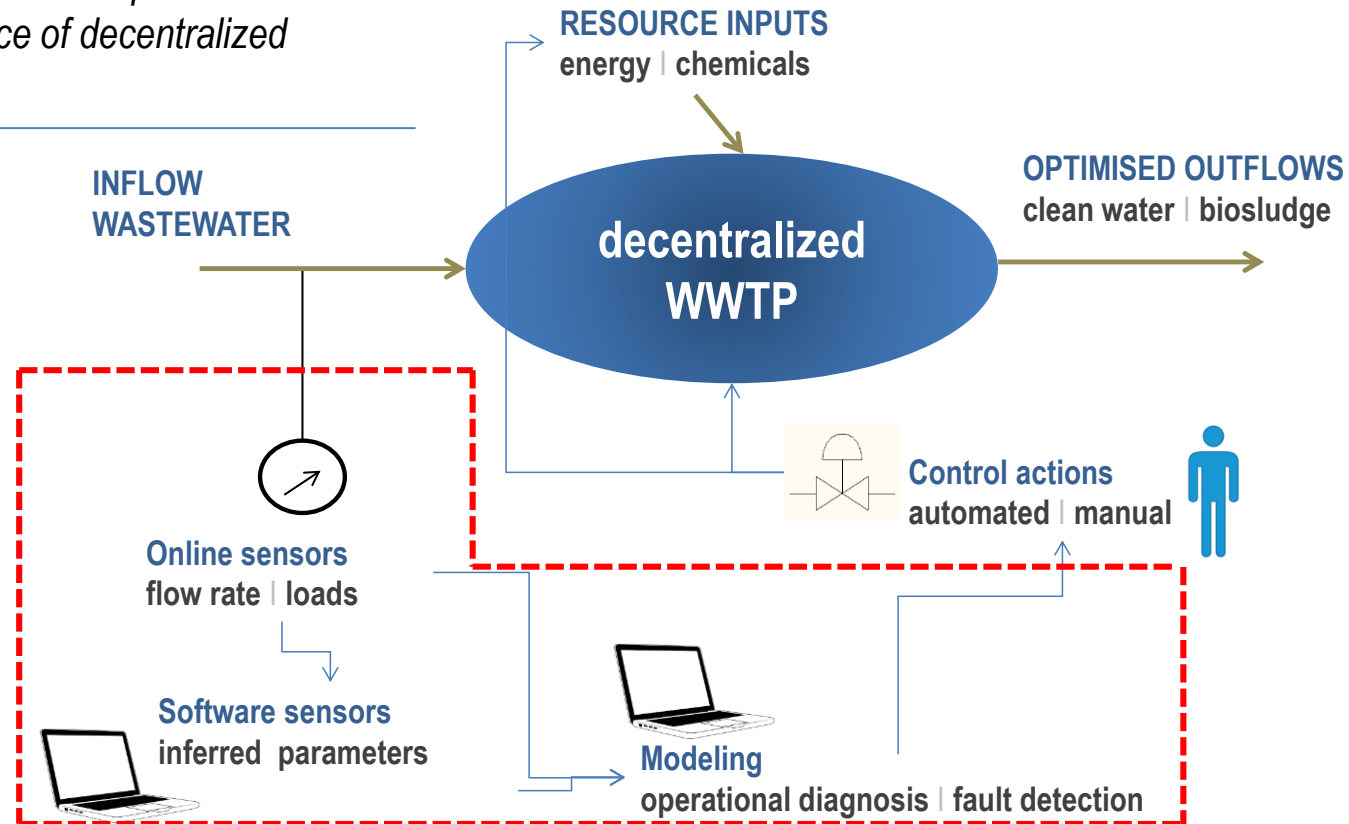
- PhC accumulation in clams
- Multidrug resistance bacteria

DEMOCON - DEcentralised MOnitoring and CONtrol [project PTDC/AAG-TEC/4124/2012]

1. Idea: Improved supervision and control provides conditions to increase the resilience of decentralized wastewater treatment plants

2. DEMOCON framework :

Based on the use of on-line data, partly processed through software sensors and integrated in a dynamic model structure. This model can be used in the definition of different control strategies.



3. DEMOCON project: 2013/15, case study WWTP (5000 p.e.) nearby Lisbon.

Thank you!

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