LABORATÓRIO NACIONAL
DE ENGENHARIA CIVIL

URBAN WATER UNIT

Maria João Rosa
Urban water unit
Hydraulics and Environment Dept.
LNEC – National Civil Engineering Laboratory

September 2018

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

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Lab Facilities

UQTA
Water Quality and Treatment Laboratory

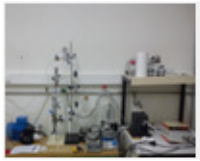
Chemistry Lab

Microbiology Lab

Water treatment testing facilities

Jar test

Adsorption/biofiltration systems (BAC)

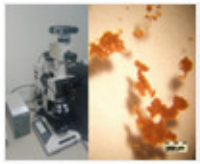


Lab scale membrane units

Pilot scale membrane units

Equipment for water quality testing in distribution systems

Vis Spectrophotometer



Epifluorescence microscope

http://www.lnec.pt/hidraulica-ambiente/en/core/urban-water-unit/infrastructures-5/

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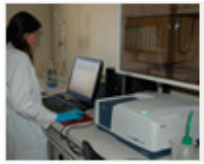
UQTA
Water Quality and Treatment Laboratory

Lab Facilities

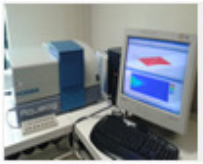
Relevant equipment for water analyses

TOC analyser

HPLC-DAD



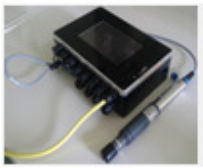
UV-Vis Spectrophotometer



Spectrofluorometer

Field devices

Refrigerated sampler



Chlorine analyser

Udometer

Multiparametric analyser

http://www.lnec.pt/hidraulica-ambiente/en/core/urban-water-unit/infrastructures-5/

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

LIS-Water
Lisbon International Centre for Water

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Cranfield University

UNIVERSITÉ PARIS 1 PANTHÉON SORBONNE
IAE PARIS
SORBONNE BUSINESS SCHOOL

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!

Intertwined areas

Think-tank and strategic advice
Policy makers

Education, training and capacity building
Water professionals

Research and Innovation

Community outreach and engagement
Society at large

Business and start-up support
Industry

1+4

Some relevant projects

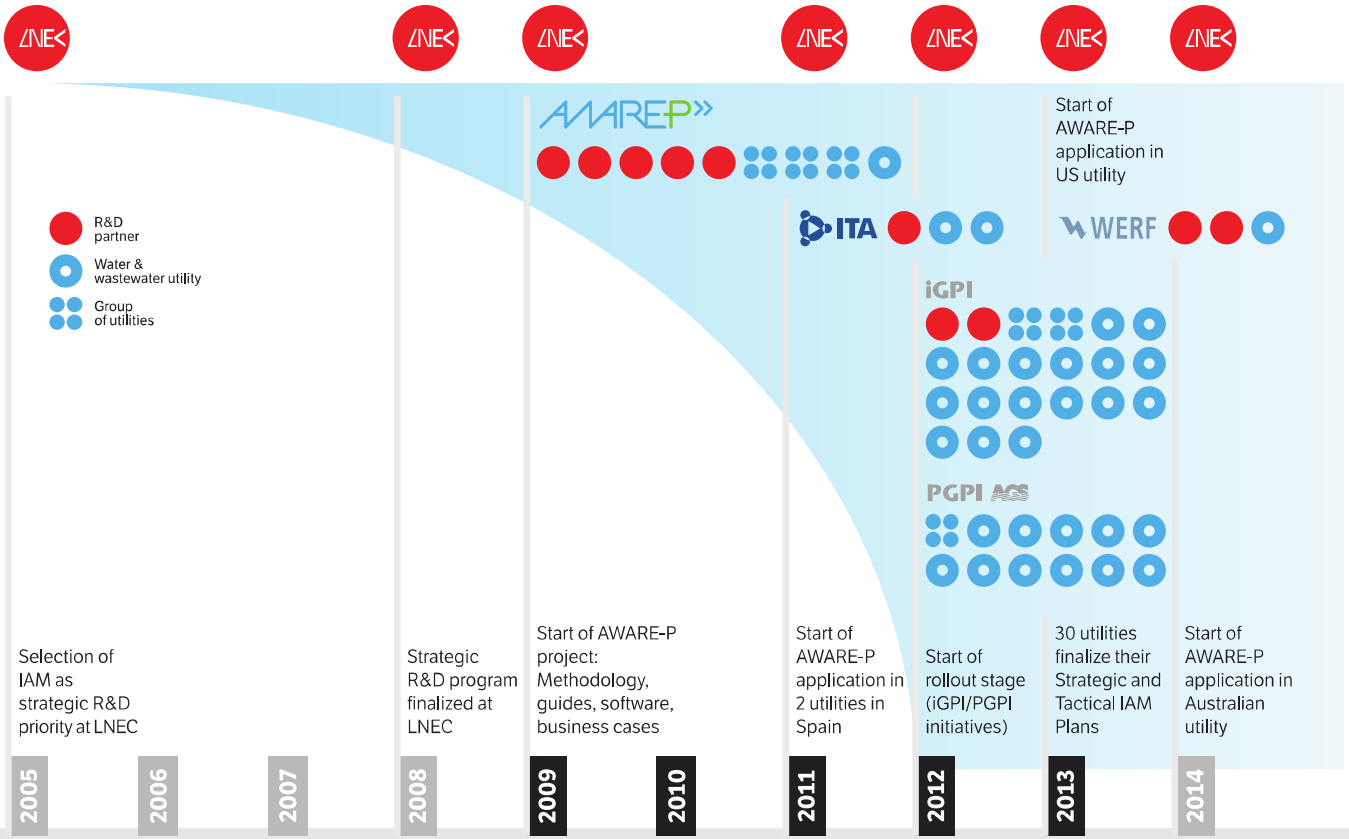
http://www.lnec.pt/hidraulica-ambiente/en/core/urban-water-unit/activity-2/

IAM - Infrastructure Asset Management

AWARE-P

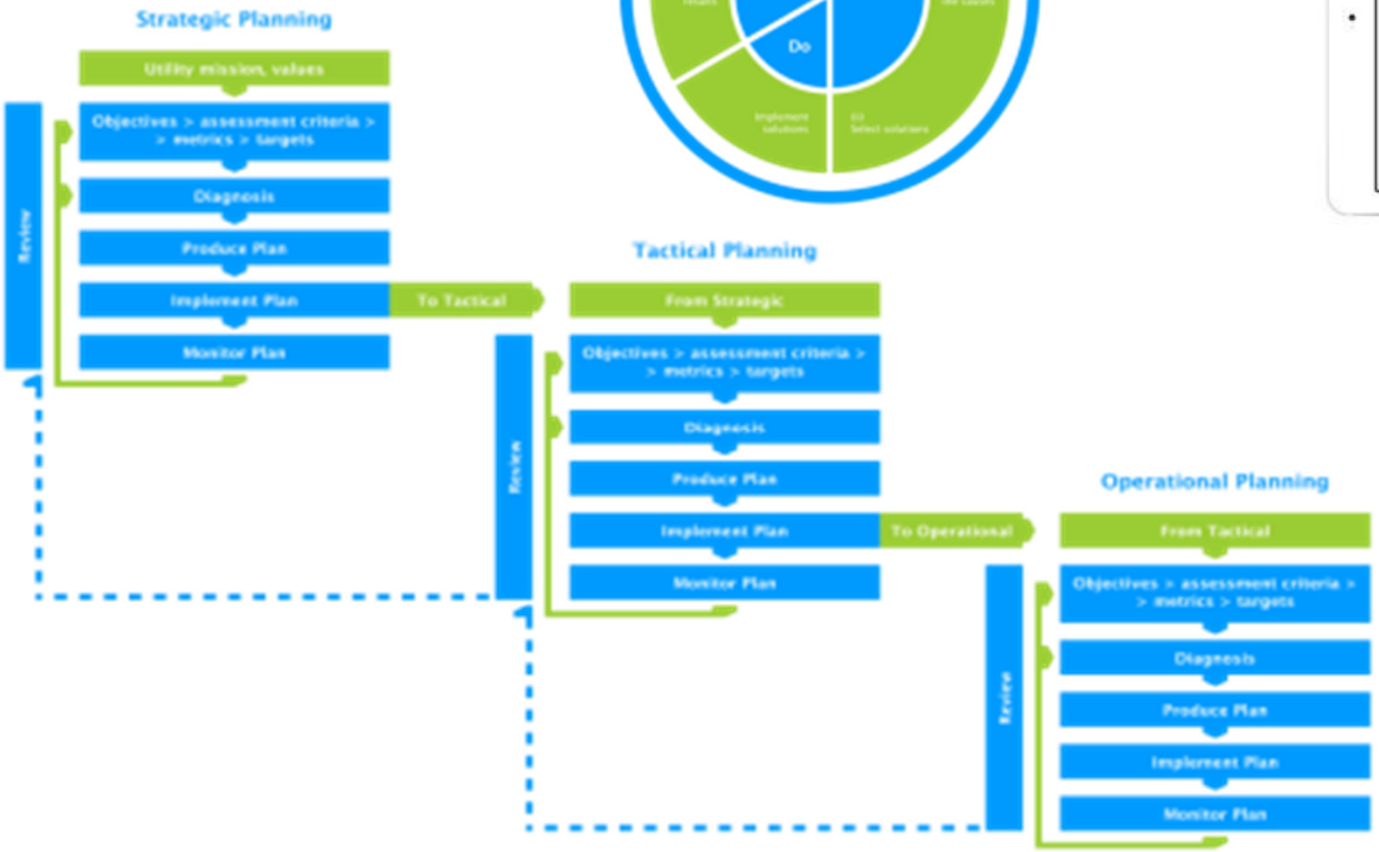
from incipient to leading-edge IAM planning in Portugal

From R&D to the industry

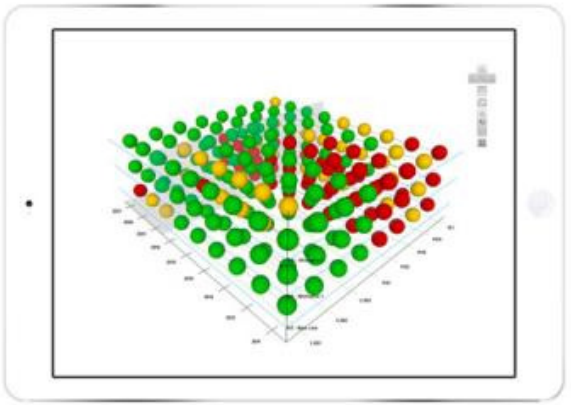


IAM - Infrastructure Asset Management

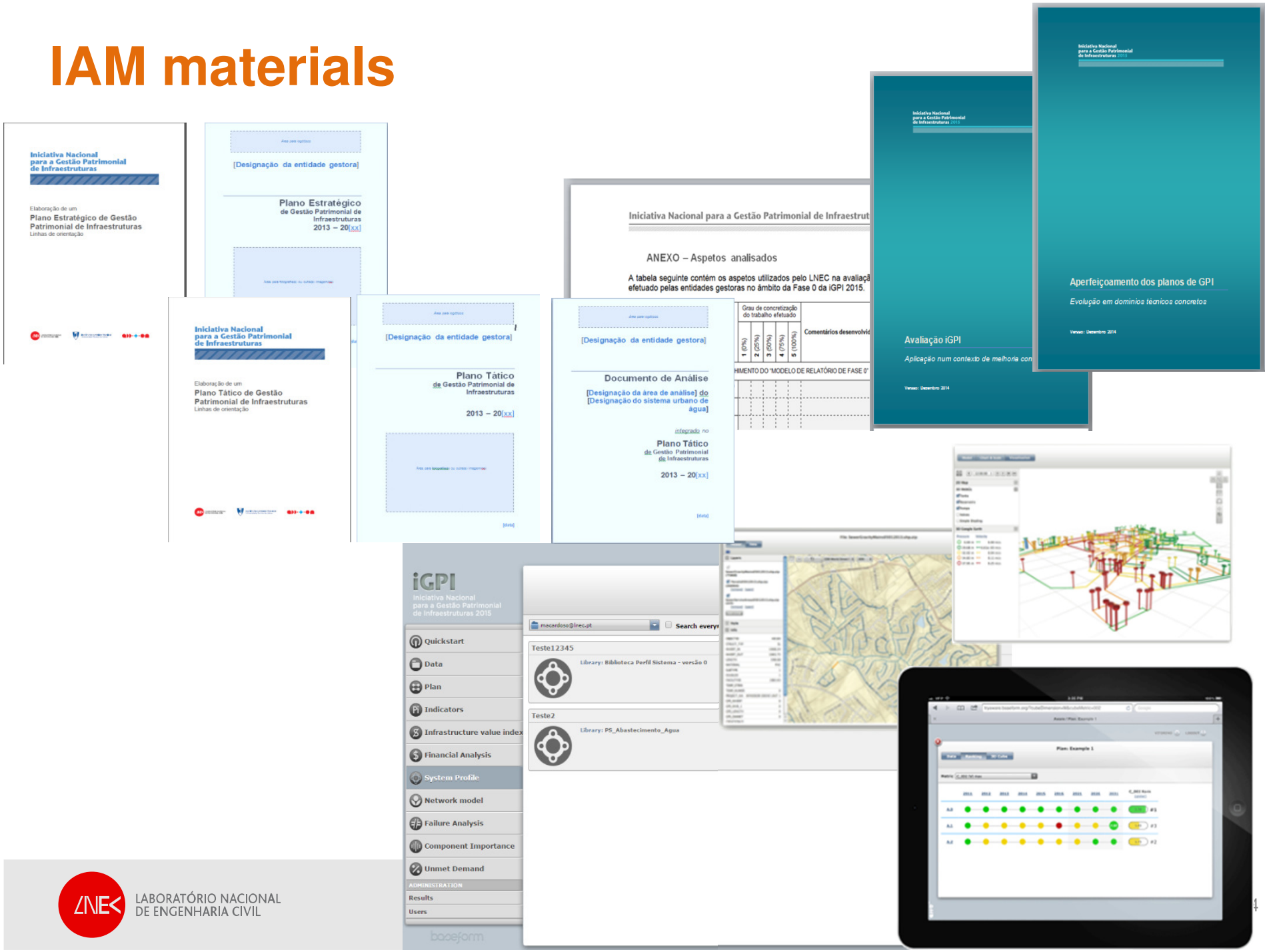
Methodology



Software and tools



IAM materials



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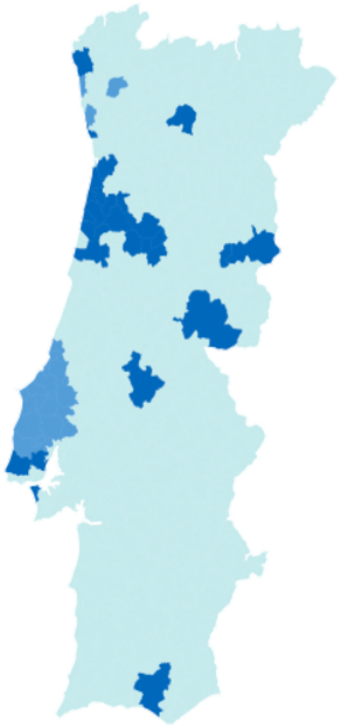
The water utilities

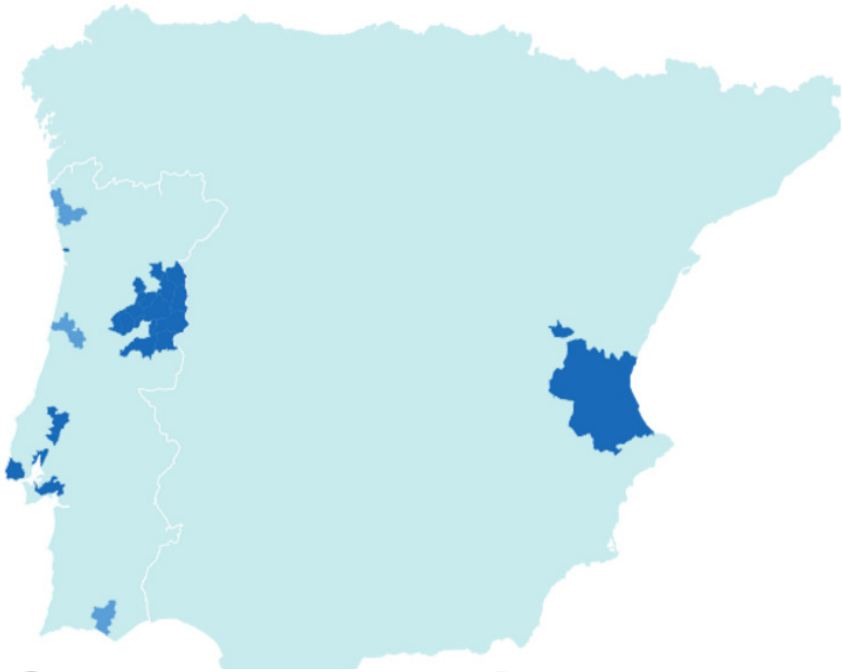


Modalidade 1
- Águas de Coimbra
- Águas da Região de Aveiro
- AQUAPOR - Águas do Planalto
- CM Sabugal
- EMAR Vila Real
- INDAQUA
- Infraquinta/Inframoura/Infralobo
- INOVA - Cantanhede
- SM Abrantes
- SM Castelo Branco
- SMAS Almada
- SMAS Loures
- SMAS Sintra
- SMSB Viana do Castelo

Modalidade 2
- Acquawise
- Águas do Oeste
- AGERE
- EAmb Esposende
- INDAQUA (*)
- SMAS Sintra (*)

iGPI 2012

iGPI 2015

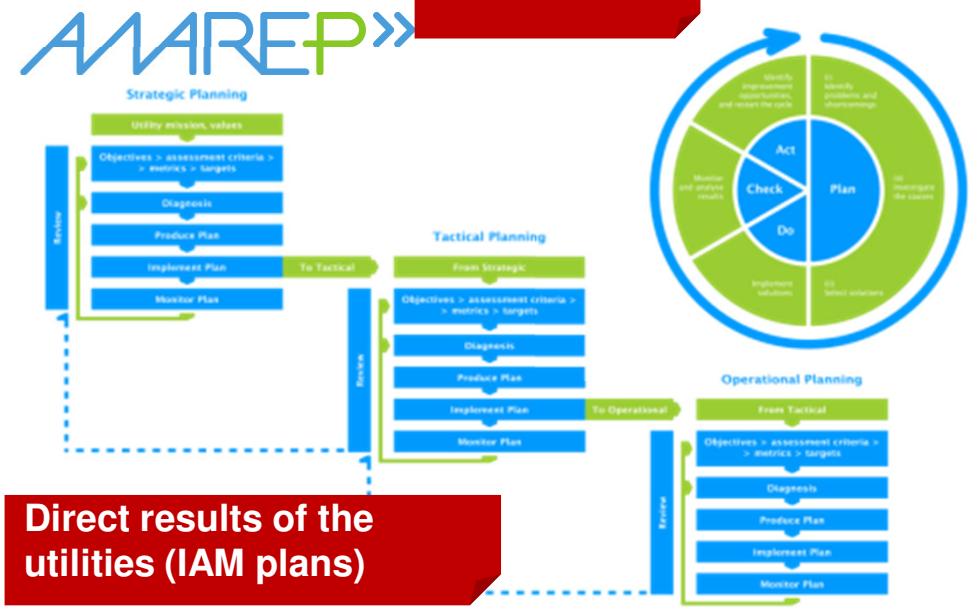


Perfil-base
- Águas do Porto
- Águas de Santarém
- Águas do Zêzere e Côa
- Aguas de Valencia
- AQUALIA - Cartagua
- CM Barreiro
- CM Palmela
- SMAS Vila Franca de Xira
- SANEST

Perfil-aperfeiçoamento
- AGERE
- Águas de Barcelos
- Águas de Coimbra
- Infralobo
- Inframoura
- Infraquinta
- INOVA
- SIMAS Oeiras e Amadora
- SMSB Viana do Castelo

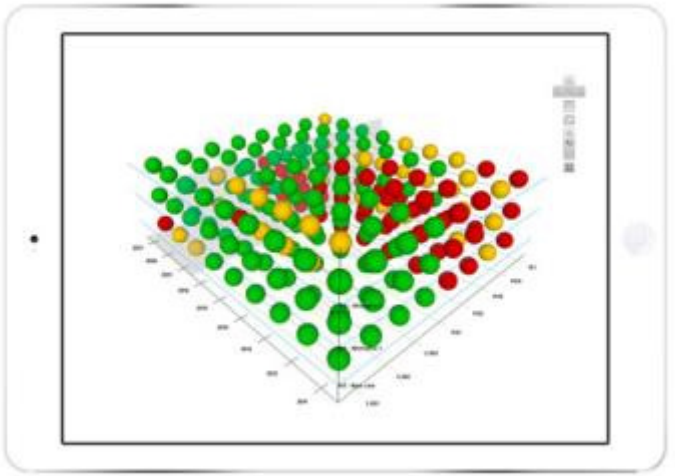
IAM - Infrastructure Asset Management

Methodology



Direct results of the utilities (IAM plans)

Software and tools



Training and capacity building

TRUST FP7

Transitions to the urban water services of tomorrow

IWW (Germany) et al

trust

HOME NEWS PROJECT » RESULTS & DOWNLOADS EVENTS TOOLS CONTACT »

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

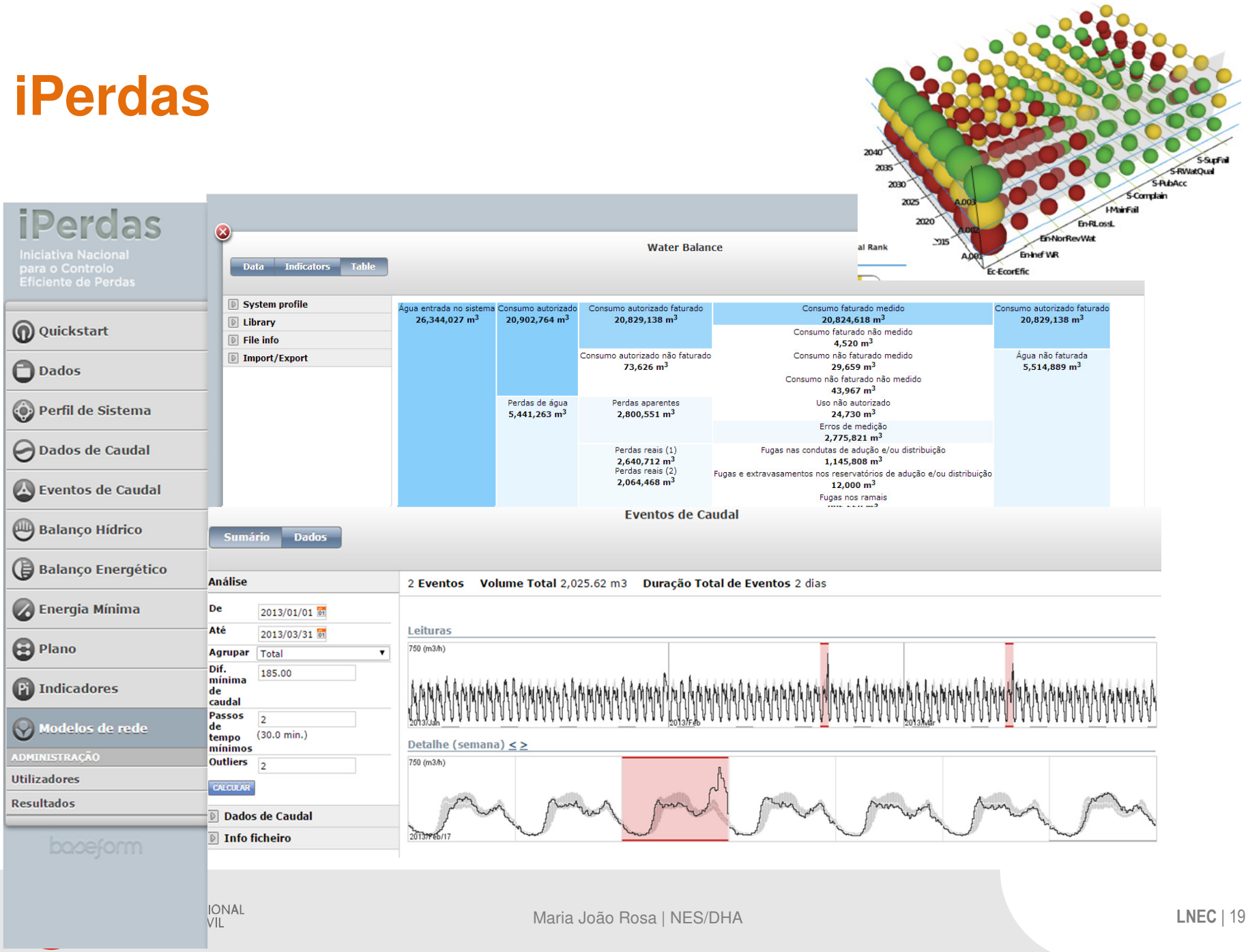
www.trust-i.net

iPerdas - Water loss and energy management collaborative project

iPerdas materials

- Software and instructions
- Supporting documents
- Quick start guides
- e-learning: metering course

iPerdas


iPerdas
Iniciativa Nacional para o Controlo Eficiente de Perdas
Quickstart
Dados
Perfil de Sistema
Dados de Caudal
Eventos de Caudal
Balanço Hídrico
Balanço Energético
Energia Mínima
Plano
Indicadores
Modelos de rede
ADMINISTRAÇÃO
Utilizadores
Resultados
baseform
Water Balance
Data
Indicators
Table
System profile
Library
File info
Import/Export
Água entrada no sistema 26,344,027 m3
Consumo autorizado 20,902,764 m3
Consumo autorizado faturado 20,829,138 m3
Consumo faturado medido 20,824,618 m3
Consumo faturado não medido 4,520 m3
Consumo autorizado não faturado 73,626 m3
Consumo não faturado medido 29,659 m3
Consumo não faturado não medido 43,967 m3
Perdas de água 5,441,263 m3
Perdas aparentes 2,800,551 m3
Uso não autorizado 24,730 m3
Erros de medição 2,775,821 m3
Perdas reais (1) 2,640,712 m3
Perdas reais (2) 2,064,468 m3
Fugas nas condutas de adução e/ou distribuição 1,145,808 m3
Fugas e extravasamentos nos reservatórios de adução e/ou distribuição 12,000 m3
Fugas nos ramais
Consumo autorizado faturado 20,829,138 m3
Água não faturada 5,514,889 m3
Eventos de Caudal
Sumário
Dados
Análise
De 2013/01/01
Até 2013/03/31
Agrupar Total
Dif. mínima de caudal 185.00
Passos de tempo mínimos 2 (30.0 min.)
Outliers 2
CALCULAR
Dados de Caudal
Info ficheiro
2 Eventos Volume Total 2,025.62 m3 Duração Total de Eventos 2 dias
Leituras
750 (m3/h)
2013/Jan
2013/Feb
2013/Mar
Detalhe (semana) < >
750 (m3/h)
2013/Feb/17
2040
2035
2030
2025
2020
A.003
A.002
A.001
S-SupFail
S-RWatQual
S-PubAcc
S-Complain
I-MainFail
En-RLossL
En-NonRevWat
En-Inef WR
Ec-EconEfic

The water utilities

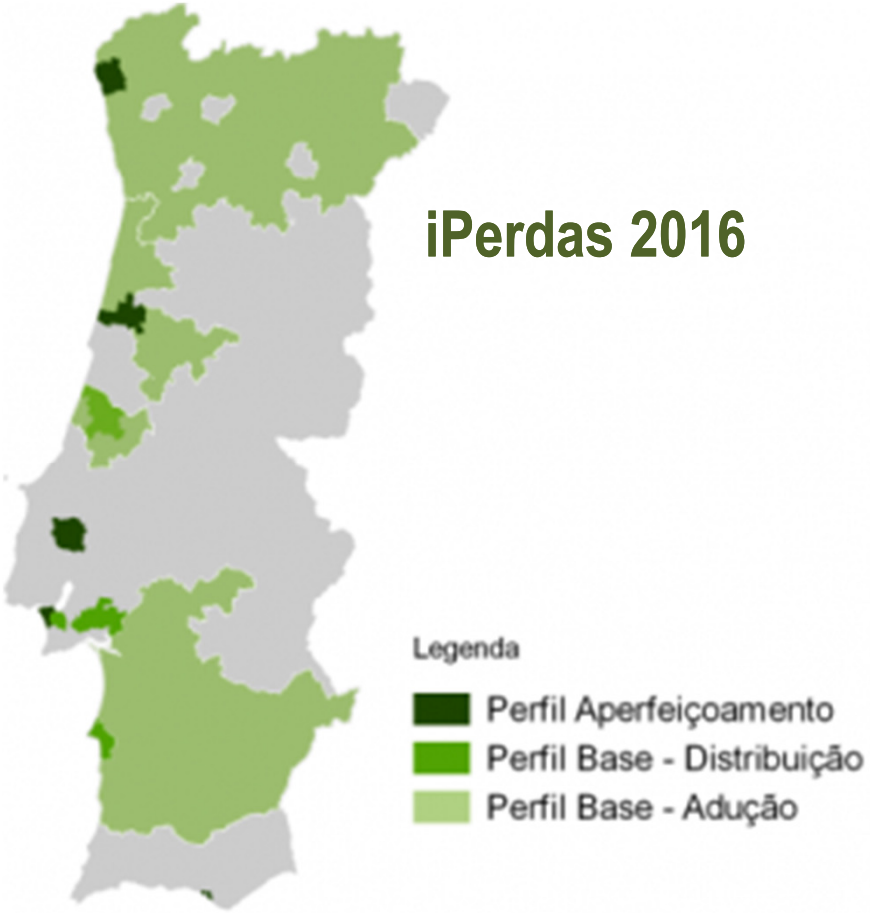
Modalidade 1

- 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

AGIR

Efficiency assessment of water and energy in collective irrigation systems

In Portugal…

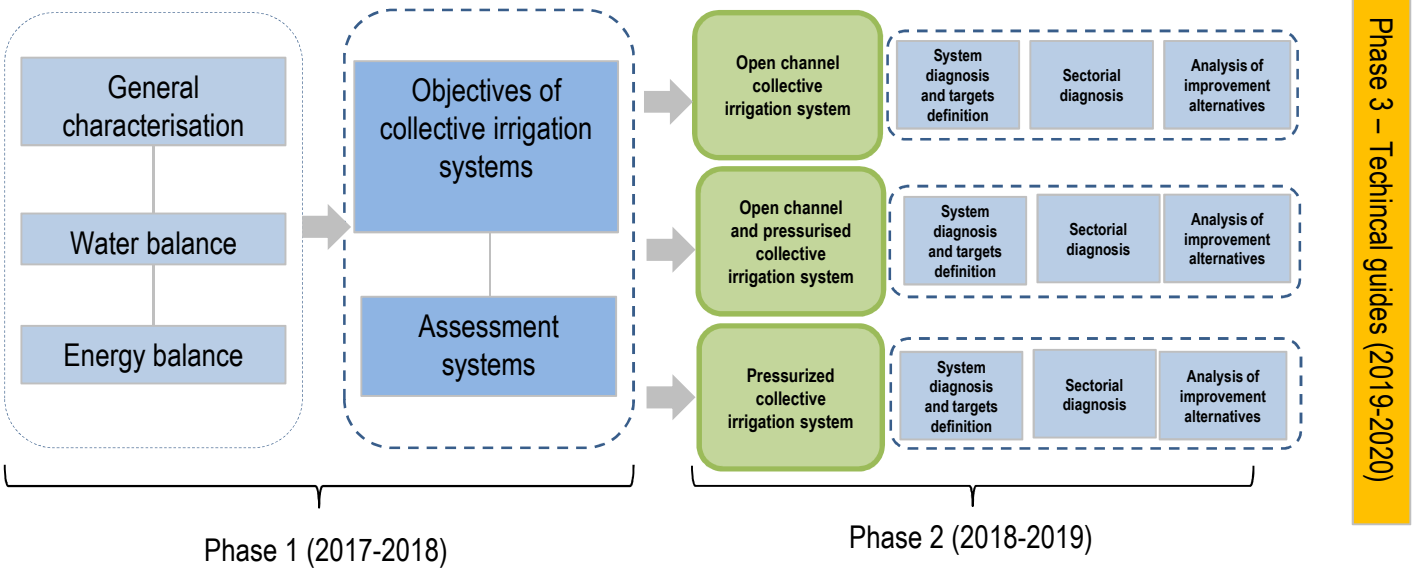
- Water use efficiency in irrigation systems of 60-65% (DGADR, 2014)
- Energy consumption in irrigation systems increased from 200 kWh/ha to 1500 kWh/ha between 1960 and 2017 (SIR, 2017)
- Collective irrigation infrastructures in poor condition and labour-intensive (PDR 2020)

What is necessary?

- 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
- Adapt existing and well succeed methodologies from the urban water system to collective irrigation systems

AGIR

Efficiency assessment of water and energy in collective irrigation systems



Federação Nacional de Regantes de Portugal
Fenareg

LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

UNIVERSIDADE DE ÉVORA

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

IPS Instituto Politécnico de Setúbal

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

A.B.O.R.O

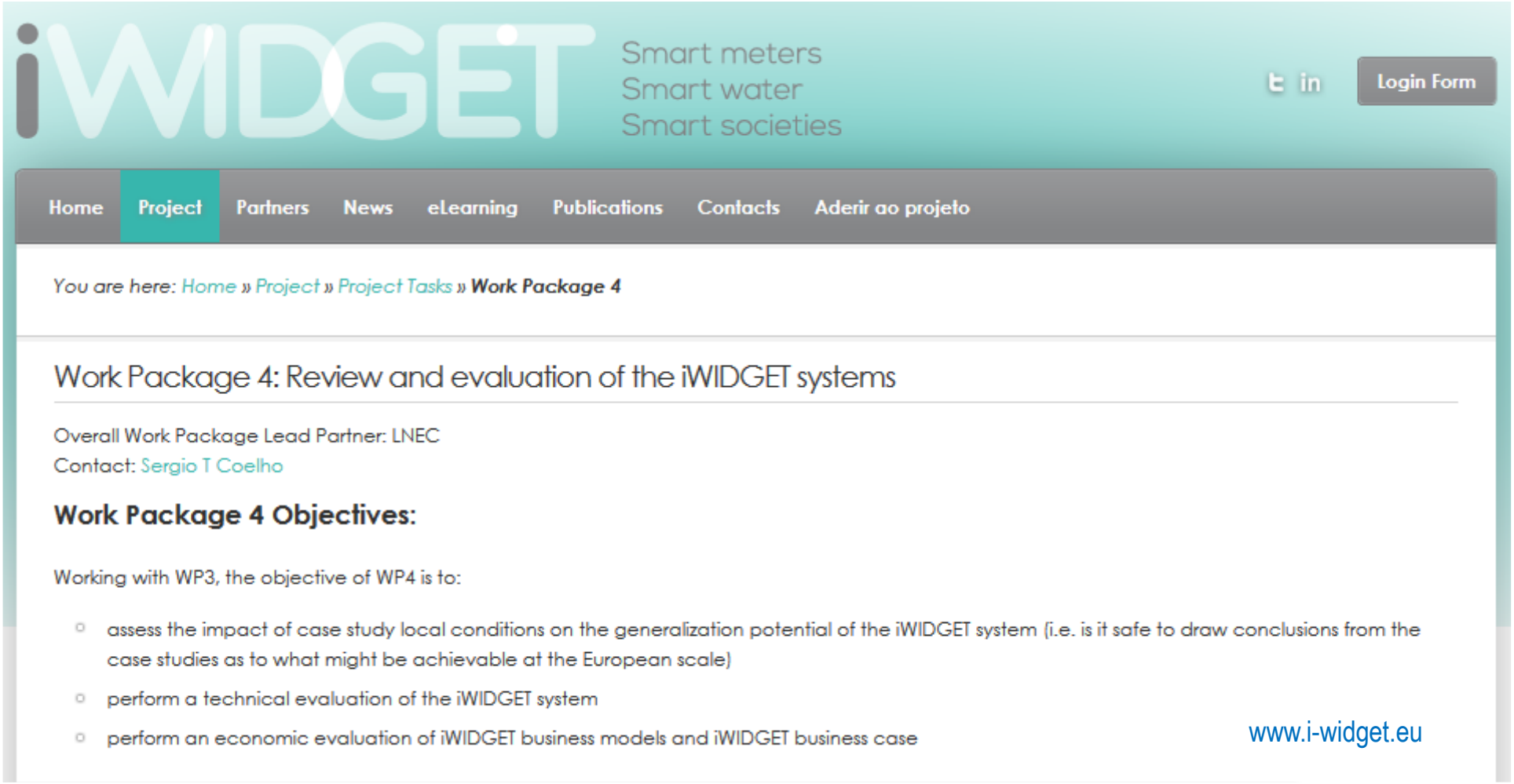
Associação de Regantes e Beneficiários do Vale do Sorraia

A. B. O. VIGIA

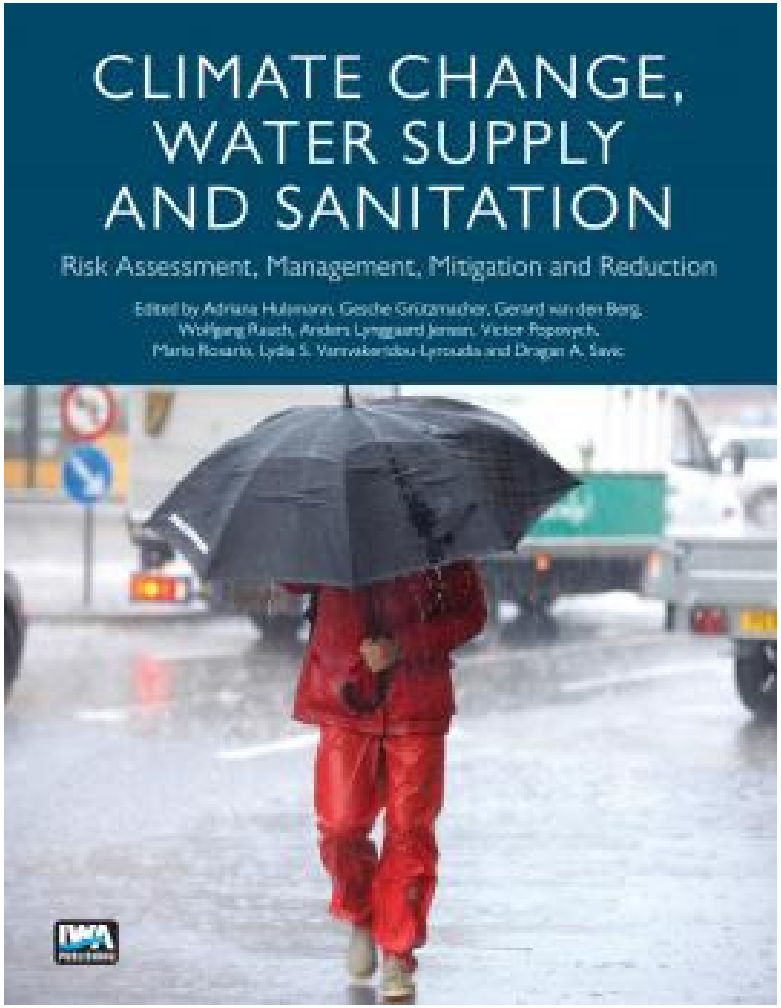
iWIDGET FP7

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

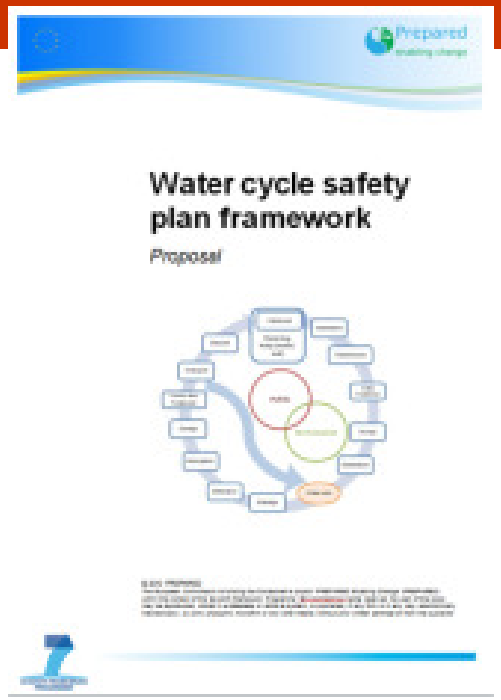
UExeter (UK) et al



Prepared (FP7 www.prepared-fp7.eu/)



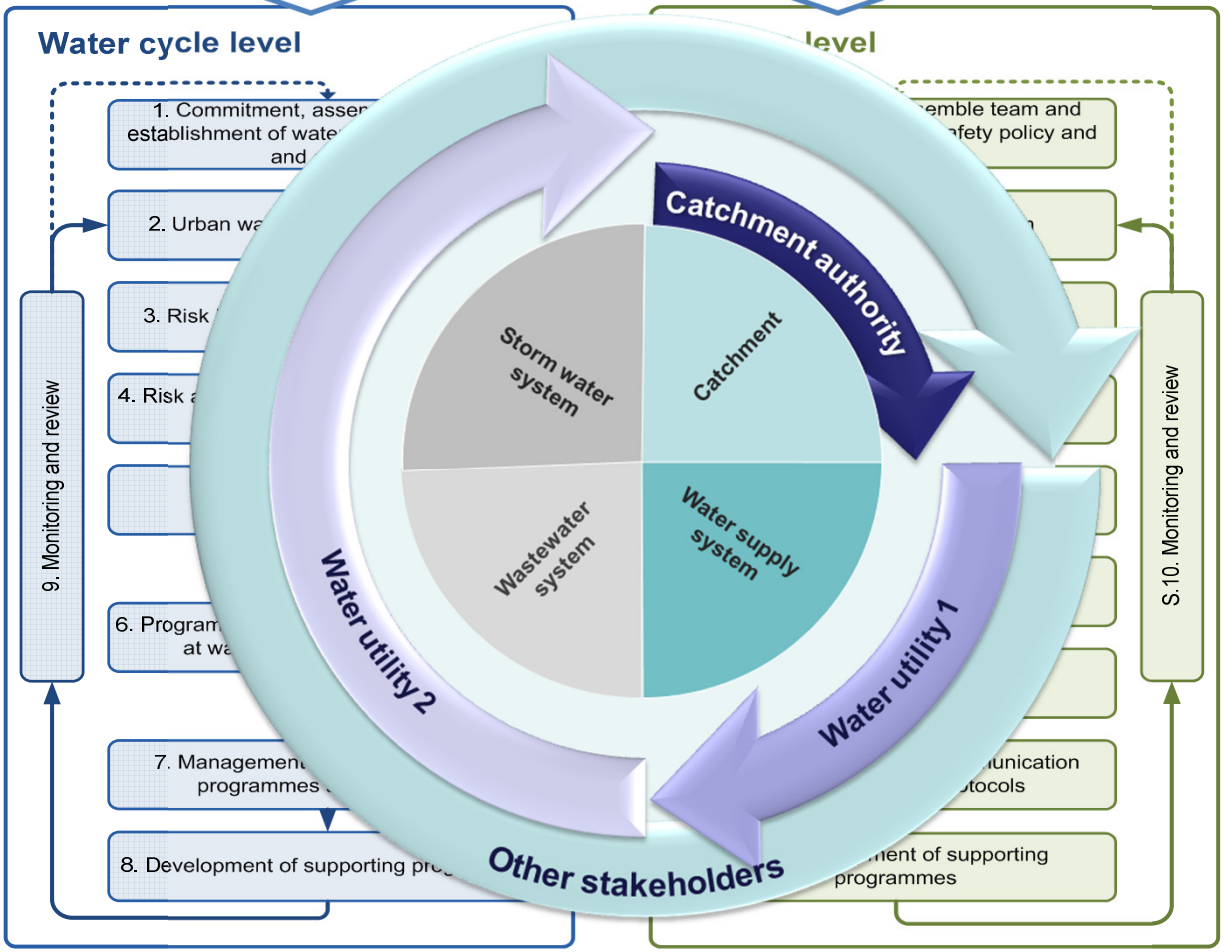
Water Cycle Safety Planning - Framework



- 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

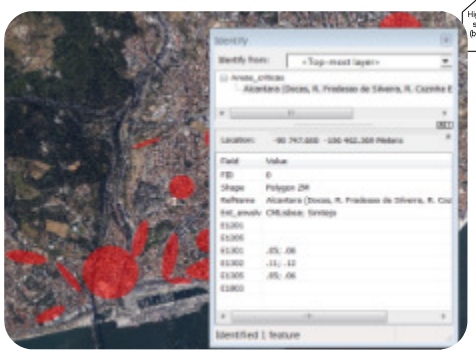
Relevant CC related events identified using GIS

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

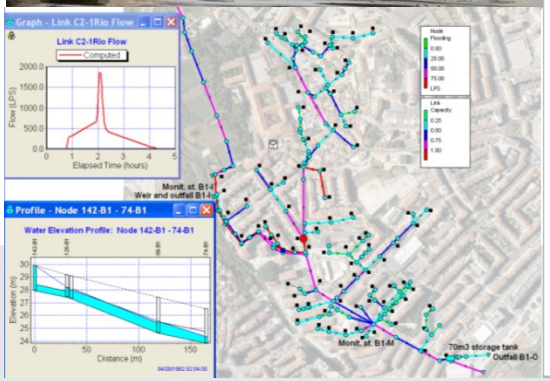
Event ID	Event	Probability class	Consequence Class				
			Health and safety	Financial	Environmental	Service continuity	Liability, complaints, reputation and image
E1201.03	High velocity runoff in Luís de Camões street due to intense rainfall (RP = 10 years) and to insufficient sewers capacity resulting 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, 1969, 1985, 1987, 1993, 1997, 1999, 2002, 2008	1 based in records	1 Dependent of the affected area	n.a.	3 Small affected area	1 Image not affected
E1301.06	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
E1705	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 percentage of untreated discharges	1 Image not affected
		1 Never occurred	3 The occurrence f ejected public health consequences	5 A low percentage of AQB test would be expected	n.a.	5 Interruption of supply relevant in duration and clients affected	4 Adverse coverage by media in front page

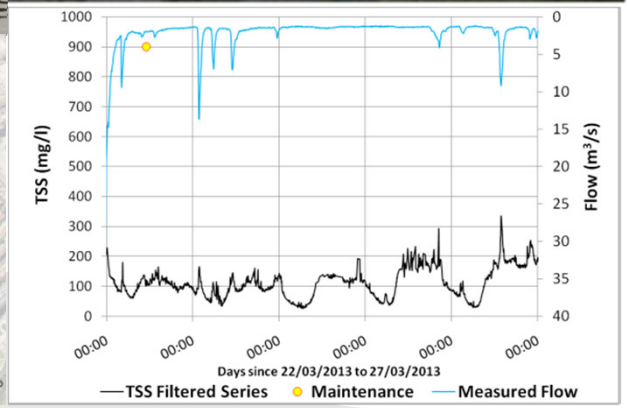
Risk reduction measures location

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





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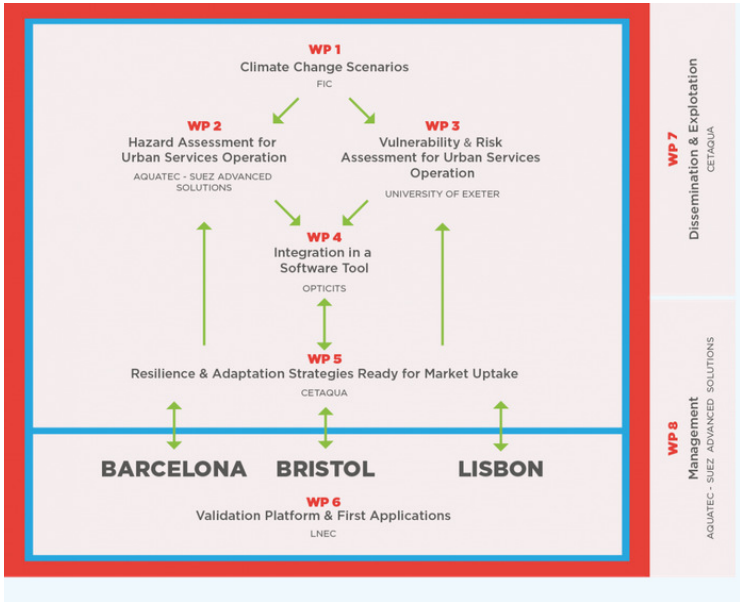
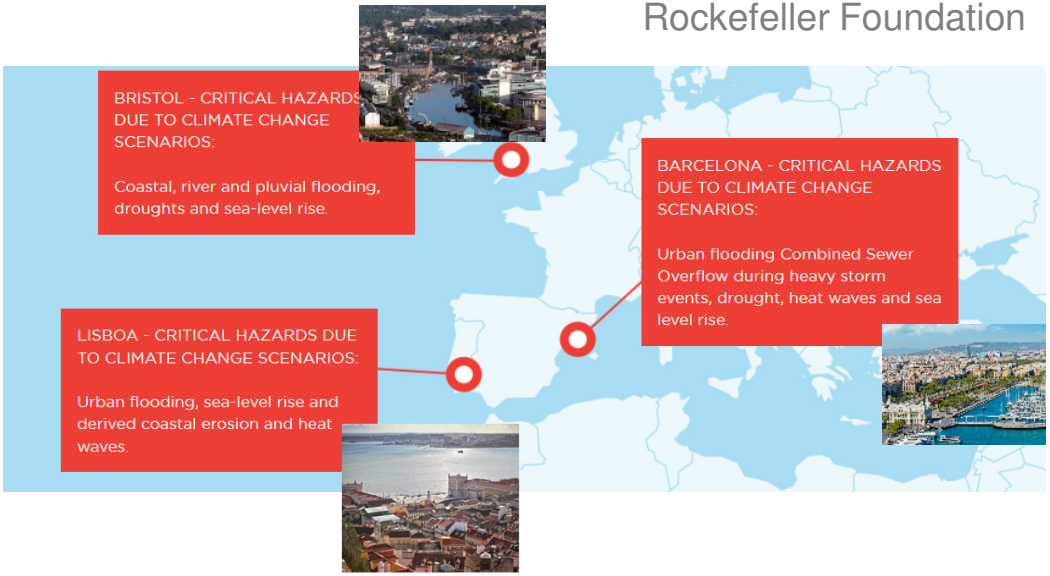
RESCCUE

RESILENCE TO COPE WITH CLIMATE CHANGE IN URBAN AREAS.

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



100 resilient cities,
Rockefeller Foundation



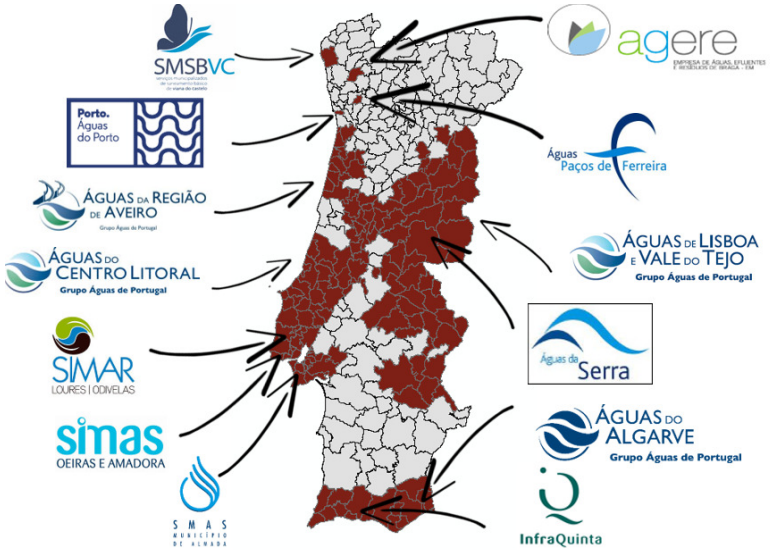
To help cities to become **more resilient** to physical, social and economic challenges by generating **models** and **tools** to bring this objective to practice and make them applicable to different types of cities, with different climate change pressures.

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

www.**resccue**.eu

National Initiative for the Control of Undue Inflows

iAFLUI



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

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of:

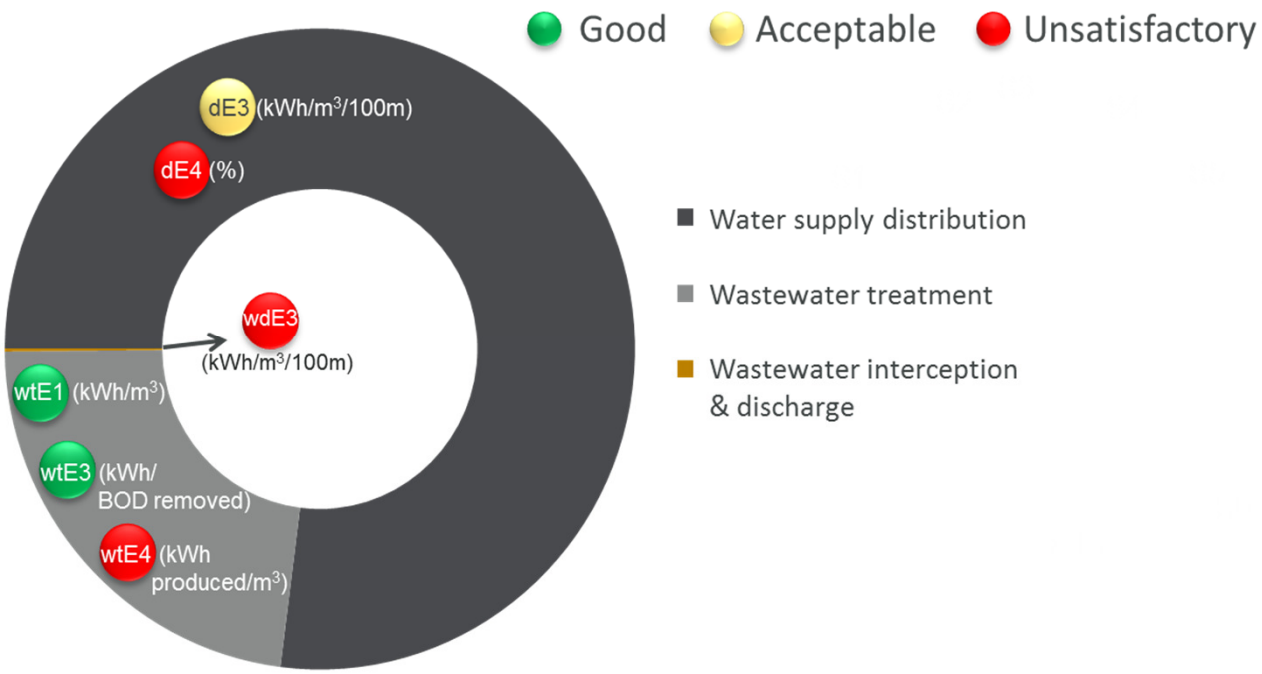
Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

of the Federal Republic of Germany

IWA the international water association

WACCLIM "Water and Wastewater Companies for Climate Mitigation"

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



Energy efficiency assessment and sustainability of urban water services

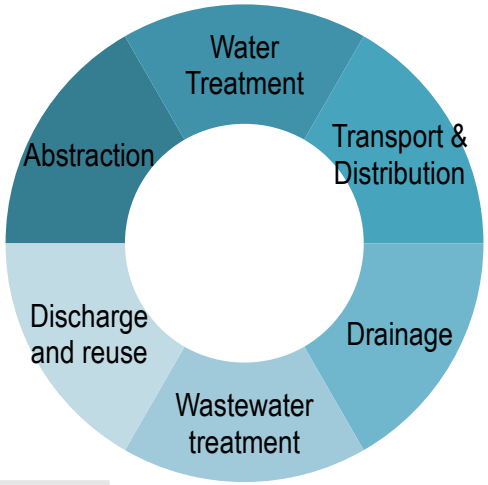
Avaler+

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 is 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.

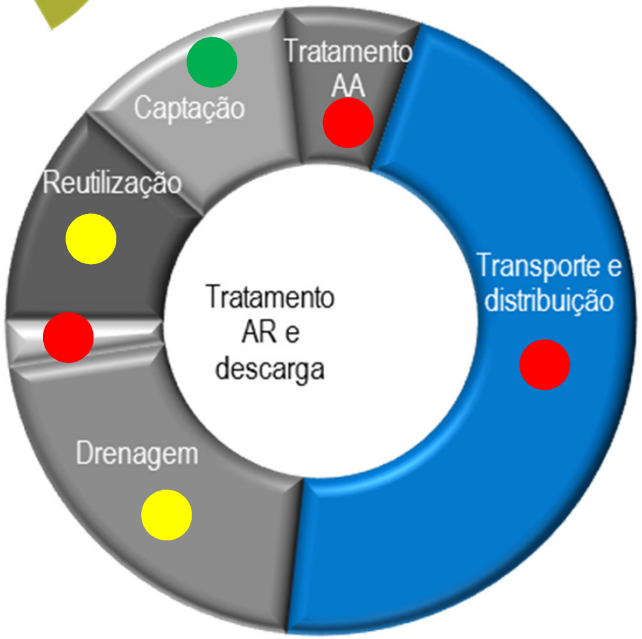


2018-2021, **Coordinator: LNEC**, Partner: Lisbon University & multiple water utilities, Funding: National Innovation support Fund

Energy efficiency assessment and sustainability of urban water services

Avaler+

- Rational for diagnosis



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

- 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

Benchmarking

energy efficiency

GHGs

performance indicators

performance indices

process modelling

stormwater

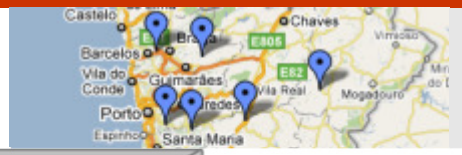
water quality, water reuse

WTPs| WWTPs

Capacity building

Benchmarking water and wastewater treatment plants

PASt21



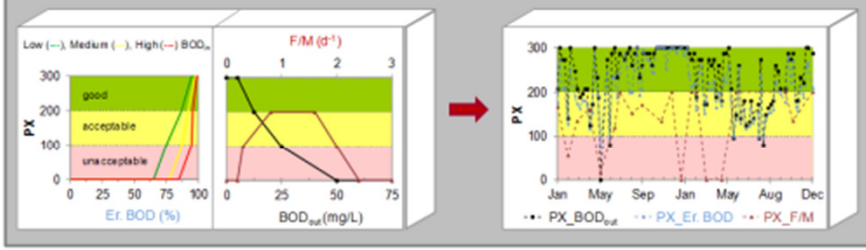
Overall performance assessment of the WTP/WWTP

Operational performance assessment of each unit operation/process

Treated water quality (Wq)	Removal efficiency (Er)	Operating conditions (Op)

Performance indices (PXs)

- a performance function converts operational data into a 0-300 PX
- the reference values are intrinsic to the PX
- assess performance over time
- optimisation studies based on Wq - Er - Op relationship



Performance indicators (PIs)

- assess the WTP/WWTP as a whole
- $\frac{Var1}{Var2} \rightarrow \frac{\text{(PI objective)}}{\text{(system's dimension)}}$
- dimensionless (-, %) or intensive (e.g. kWh/m³)
- use historical data
- calculated for a reference period (calendar year)
- require reference values for assessing the performance level
- for a cluster of utilities, reference values may be produced from box-plots

Treated wastewater quality (WQ)
Removal efficiency and reliability (ER)
Use of natural resources and raw materials (RU)
By-products management (BP)
Safety (Sa)
Human resources (Pe)
Economic and financial resources (Fi)
Assessment group
Planning and design (PD)
PAS_WWTP
PAS_WTP
Performance Assessment System for WTP and WWTP

Benchmarking

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

trust
www.trust-i.net

doi$_1$: 10.1016/j.jenvman.2014.03.028 | doi$_2$: 10.1016/j.watres.2014.03.025

iEQTA

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

iEQTA

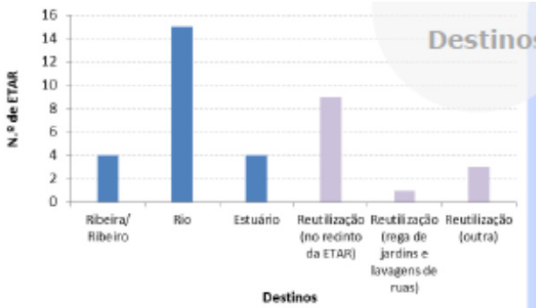
iEQTA – Initiative on energy, water quality and treatment

Benchmarking WWTPs (*ETAR*)	AGS, SMAS Município de Almada, LUSÁGUA, Águas de Barcelos, TRATAVE, Porto. Águas do Porto, efacec
Infrastructure asset manag. IAM (*GPI*)	AGS, SMAS Município de Almada, AQUAPOR, Águas de Santo André Grupo Águas de Portugal, vimagua
Tutorials (*Formação*)	AGS, SMAS Município de Almada, AQUAPOR, Hidurbe

TEMA ETAR
Caracterização das ETAR

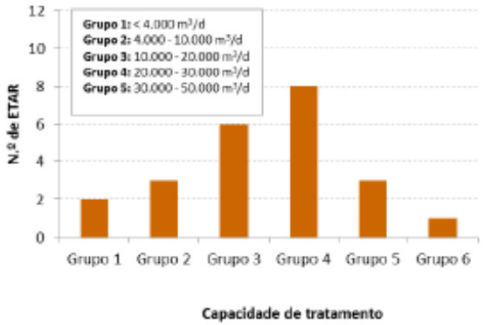
Licença de descarga

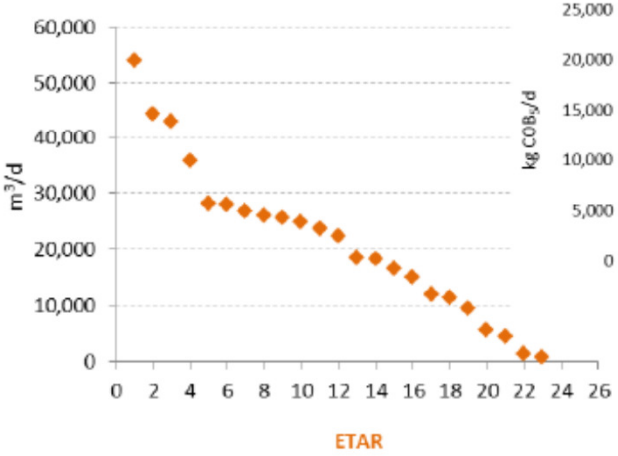
Destinos

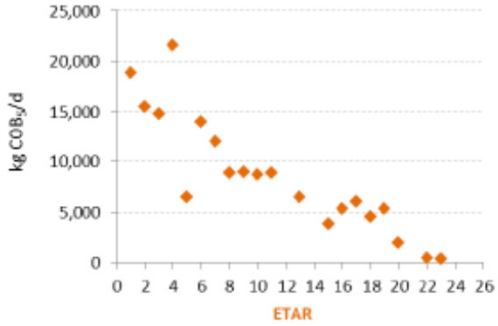


Localização

Capacidade de tratamento







LABORATÓRIO NACIONAL
DE ENGENHARIA CIVIL

UQTA
Water Quality and Treatment Laboratory

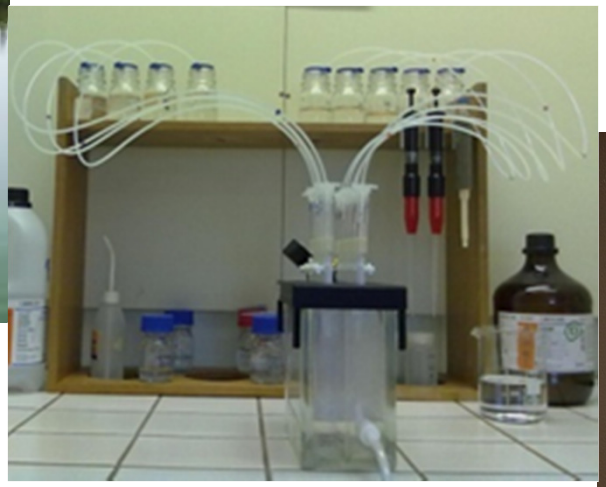
Lab analyses and testing

Pilot prototyping

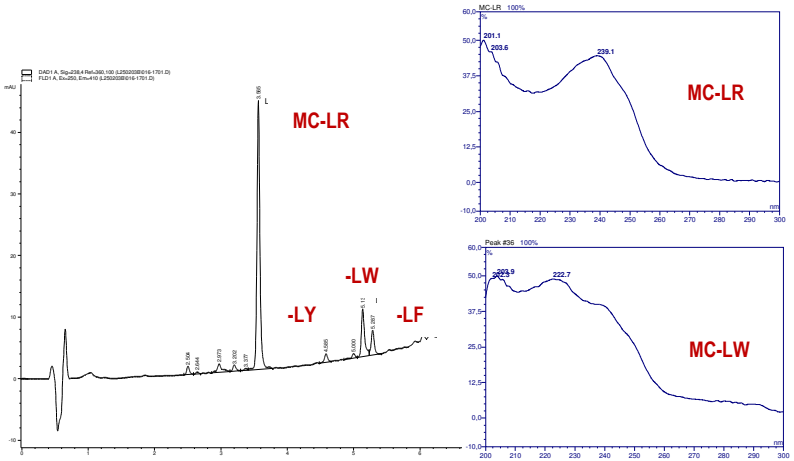
Monitoring & characterization of cyanobacteria and cyanotoxins

Cyanobacterial bloom

Water sample processing



Cyanotoxin identification and quantification



LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

UQTA
Water Quality and Treatment Laboratory

Monitoring & characterization of NOM - natural organic matter

TOC /DOC
Total and dissolved organic carbon

UV-Vis
absorbance
(type of organic matter and colour)

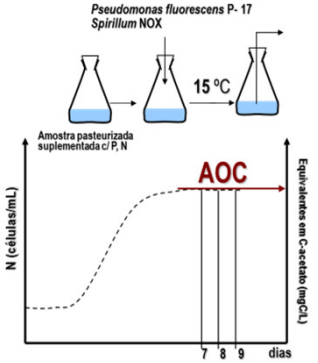
AOC
Assimilable organic carbon

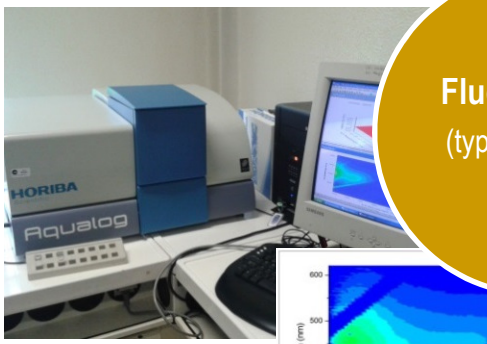
NOM
characterization

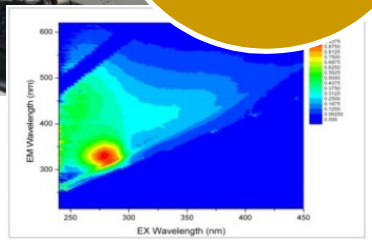
Fluorescence
(type of organic matter)

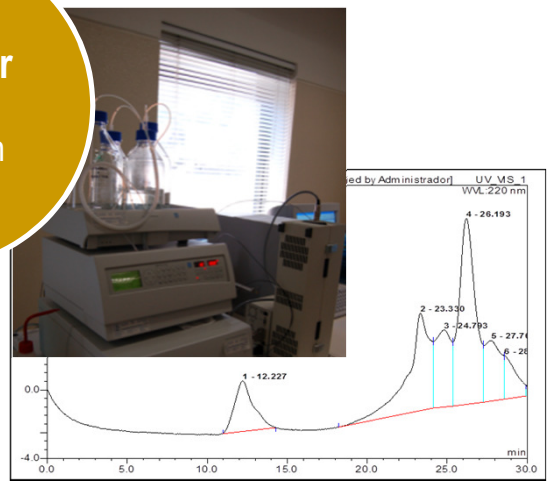
NOM rapid fractionation
Hydrophobic/ hydrophilic nature

Molecular weight
distribution









WATER TREATMENT
Strategies for climate change adaptation

Prepared enabling change

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

Prepared enabling change

Adapted operation of drinking water systems to cope with climate change

Prepared enabling change

Resilient Water Supply

Feedback from validation and demonstration in partner cities WP5.2

Prepared enabling change

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

Hymemb

Tailoring Hybrid Membrane Process for Sustainable Drinking Water Production

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 (stake-holders resistances and believes)

This research has received funding from European Union LIFE programme under grant agreement LIFE12 ENV/PT/001154, 2014-2016.

www.life-hymemb.eu

LNEC LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

ÁGUAS DO ALGARVE
Grupo Águas de Portugal

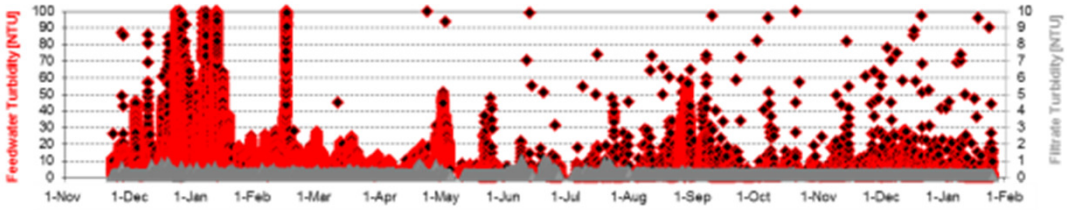
Advanced treatments for water reuse

www.trust-i.net

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)



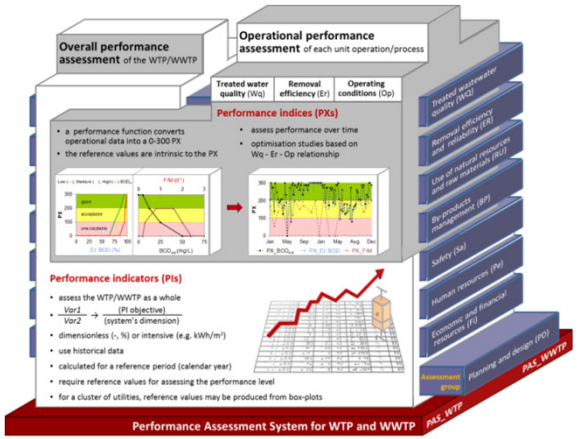
Advanced treatments for water reuse

- **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

www.life-aware.eu

LIFE IMPETUS

Improving current barriers for controlling pharmaceutical compounds in wastewater treatment plants



doi$_1$: 10.1016/j.jenvman.2014.03.028 | doi$_2$: 10.1016/j.watres.2014.03.025

- 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)

PhCs ?

2 CAS WWTPs, 3 prototypes

PhCs ?

Tagus River

Ria Formosa clam production

PhC analysis in 150 clam samples + 850 WW samples

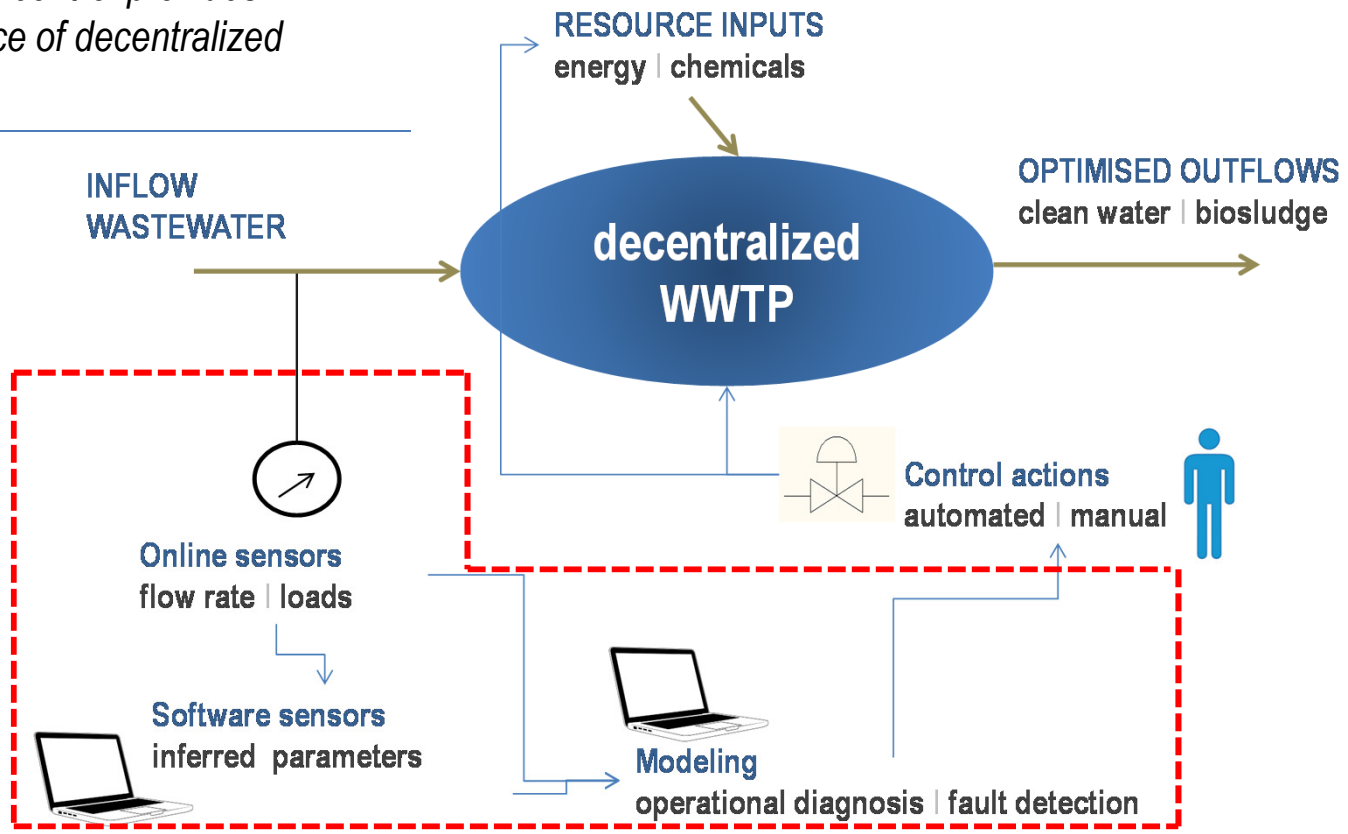
- PhC acummulation in clams
- Multidrug resistance bacteria

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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