Case study factsheet

Lisbon, Portugal

Last update on 2024-05-29

Project B-WaterSmart

Lisboa, Portugal , **Portugal**

Description

Lisbon has a smart management strategy for all key areas of urban development. The city aims at providing high quality of life for a growing population and economy, whilst tackling climate change challenges based on a green-blue problem-solving infrastructure. As such, the key actions targeted by the Lisbon Living Lab (Lisbon LL) are improving the city's water-smartness while increasing green areas by promoting water reuse in water demand/supply management for non-potable uses, water-energy-phosphorus efficiency, and housing more adapted to climate-change. Expected impacts are (i) reducing the use of freshwater and drinking water for non-potable uses, (ii) improving water-energy nexus, and (iii) supporting safe water reuse.

Within the Lisbon LL, the innovations deployed towards water circularity include six digital tools, and a technological solution for the direct potable reuse in beverage industry:

- The **Water-Energy-Phosphorus Balance Planning Module** (tool #25) is a matchmaking environment conceived and designed entirely for B-WaterSmart, where water sources and demand points are combined to enable the design of supply solutions to a set of potential users of reclaimed water. The supply and demand alternative combinations are assessed and matched through a range of user-selected metrics (e.g., volume availability, cost, energy content, carbon footprint, nutrient content) over a targeted period. The alternative combinations produced are further made available to Tools #24, #27 and #17.
- The **Risk Assessment for Urban Water Reuse** (tool #27) is a user-friendly risk assessment framework for water reuse in non-potable uses based on the relevant ISO standards (ISO 20426:2018, ISO 16075-1:2020 and ISO 16075-2:2020) and the Regulation (EU) 2020/741 on minimum requirements for water reuse. It evaluates human health and environmental (groundwater and surface water) risks incurred by the supply/demand combinations developed in Tool #25. Each alternative tested for human risk and for environmental risk undergoes a sequence of steps and receives a risk grade. Depending on the targeted risk level, the alternative will either be rejected (and potentially returned to tool #25 for redesign) or approved and forwarded to Tool #17.
- The **Reclaimed Water Quality Model in the Distribution Network** (tool #24) is a complete hydraulic and water quality extended-period simulation model for pressure flow networks. By modelling the (bulk and wall) decay of residual chlorine, the key barrier for water microbial stability, it aims primarily at mapping and quantifying risk in reclaimed water distribution networks.
- The **Environment for Decision Support and Selection of Alternative Courses of Action** (tool #17) is an intuitive numerical and visual decisional environment that enables non-experts to easily comprehend the decisional problem involved in prioritizing and to make decisions based on factual evidence/data. It is tailored to the decisional problem laid out by tool #25, which produces candidate supply/demand combinations (further qualified by Tools #24 and #27).
- The **Climate Readiness Certification (CRC)** Tool (#33) can be applied to residential and small service/commercial buildings, as well as to "neighbourhoods" considering both buildings and outdoor areas within the frontier established for the certification object. Each certificate has four classifications, from F (worst) to A+ (the best): one global classification, and one sub-classification for each evaluated dimension, Water Efficiency, Water-Energy Nexus, and Climate Adaptation.
- The **Urban Water Cycle Observatory** (tool #20) is a data repository for the utilities and instrument for engaging the stakeholders and the society. It includes two complementary tools: (a) a public access tool, with open data information of the water and wastewater city

dimensions (top-down approach) and (b) a private access tool, for individual entities integrate and analyse, via a set of analytics, the water consumption data of their facilities (bottom-up approach).
- **Protocol for safe potable reuse in the beverage industry** (technology #1) to produce knowledge, both on the water quality requirements and on the reclamation technologies (ultrafiltration, ozonation, reverse osmosis and biologically active activated carbon filter), based on a pilot demo of different reclamation schemes. The aim is to provide scientific evidence of the secure use of reclaimed water for potable use in the beverage industry and to increase the social acceptance to this alternative water source.

Facts of the applied technologies

UF+O3+BAC+RO pilot (Technology #1):

- Capacity: 1.25 m^3/h
- Water recovery rate: 70%
- Energy consumption (O3+RO): 0.7 kWh/m^3
- Energy self-sufficiency: ~60% with photovoltaic energy production

Key performance indicators

Water quality effectiveness KPIs (Technology #1):

- Compliance with drinking water quality standards according to the EU (DIRECTIVE (EU) 2020/2184, of December 16) and national legislation (Decree-Law No. 152/2017, of December 7, and Decree-Law No. 69/2023, of August 21)
- Removal of pathogen indicators to absent
- Removal of PFAS to below LOQ
- Removal of disinfection by-product to below LOQ
- Removal of pharmaceutical compounds to below LOQ

No prior situation existed as this is a new product (reclaimed water for craft beer production).

Best practices

A reclamation protocol for water reuse in craft beer production (B-WaterSmart public Deliverable 2.8) for technology #1.

Synergistic benefits

A set of 4 complementary digital tools was designed to support the decision-making process for a smarter water allocation and safe water reuse – a selection of alternative sources of action tool (tool #17) fed by a fit-for-purpose water demand/supply matchmaking tool (tool #25) and a health and environmental risk assessment tool (tool #27), and by a reclaimed water quality distribution modelling tool, a key instrument for risk management (tool #24).

Tooll #27 may support legislation and regulation improvement, namely on clarity and standardization of risk assessment for urban non-potable reuse, through a guided framework for the hazard exposure scenarios' configuration and the risk analysis for water reuse.

Key lessons

The impact of the Lisbon LL solutions developed is granted by the tools as a coherent set of accelerators/facilitators of the transformation of Lisbon into a water smarter city, quantitatively measured by the BWS assessment framework (tool #34). The tools contributed to the transition process feasibility as follows:

- Technical feasibility – by demonstrating direct potable reuse at pilot scale (technology #1); by prioritizing strategic and tactical planning options on water management (tools #17 & #25); by mapping and managing risk in reclaimed water distribution networks (tool #24); by guiding risk managers and stakeholders responsible for non-potable water uses (tool #27); by promoting water efficiency in buildings (tool #33).
- Economic feasibility – by providing information for cost-benefit analysis of reclaimed water use, including P and energy (tools #17 & #25) and direct potable reuse (Technology #1).
- Social acceptability – by building the trust on water reclamation and reuse, associated to a pleasant social activity (beer drink events – if water reclamation can be safe and reliable enough for the water to be used in beer production, it must be easier to safely treat it for lower water quality non-potable uses (technology #1); by increasing the citizens' awareness about the local context regarding the water use in the city and informing individual entities about their water consumption (tool #20); by providing an easy to understand and communicate risk assessment method (tool #27).

Lessons learned from technology operation

- The practical implementation of new directives on drinking water and urban wastewater treatment will likely be hampered by the current limitations (LOQ, cost, time) of the commercial offer on micropollutant analysis.
- Undue salt intrusions to the drainage system have an impact on the RO-based water reclamation process and must therefore be controlled.

Legislation and policy recommendations

In the context of the Lisbon LL, particularly for water reuse, relevant legislation includes:

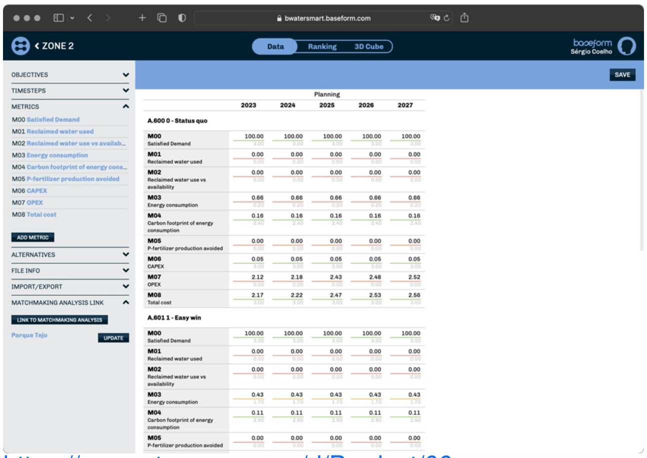
- European Regulation Reg. (EU) 741/2020 on minimum requirements for water reuse in agricultural irrigation
- Urban waste-water treatment Directive recast (under approval)
- Directive (EU) 2020/2184 on the quality of water intended for human consumption (recast)
- Portuguese Decree-Law 119/2019 on water reuse

Applied technologies

- **Activated carbon treatment coupled to an AOP**
- **Reverse Osmosis**
- **UV/Ozone**

Applied products

Environment for decision support and alternative course selection



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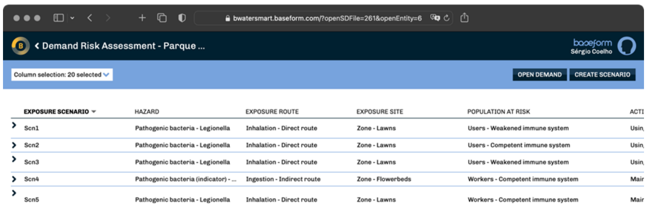
Risk Assessment for urban water reuse module



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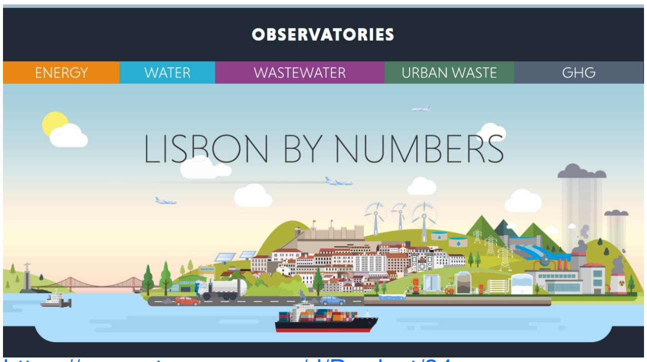
Urban Water Cycle Observatory



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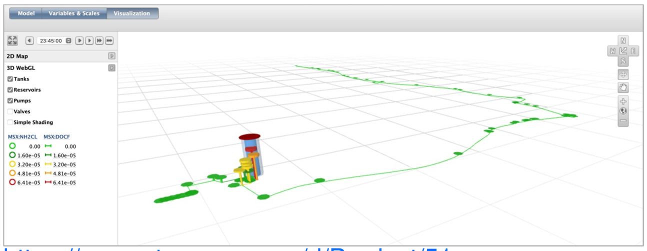
Reclaimed water distribution network water quality model



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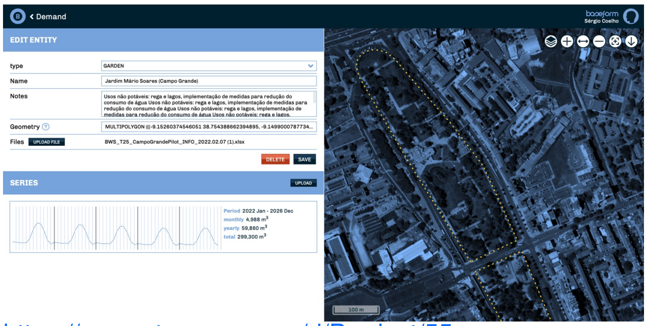
Water-energy-phosphorous balance planning module



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Climate Ready Certificates

https://mp.watereurope.eu/d/Product/31

Publications and references

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- Costa J., Ferreira F., Viegas R.M.C. (2022) Modelling chlorine decay in reclaimed water distribution systems. Águas e Resíduos iV.11.
- Costa J., Mesquita E., Ferreira F., Figueiredo D., Rosa M.J., Viegas R.M.C. (2023) Modeling Chlorine Decay in Reclaimed Water Distribution Systems—A Lisbon Area Case Study. Sustainability 15(23), 16211.
- Figueiredo D., Viegas R.M.C.; Charrua S., Mesquita E., Campinas M., Costa C., Lourinho R., Rosa M.J. (2023) Produção de água para reutilização na indústria alimentar - demonstração de tratamento avançado à escala piloto ENEG, Gondomar, 27-30 November (conference paper)
- Ribeiro R., Rosa M.J. (2022). Avaliação do risco para a saúde humana associado à reutilização de água: construção de cenários de exposição. 20.º ENASB, Cascais, 24-26 November 2022, 5 p. (communication in a conference)
- Viegas R.M.C., Costa J., Mesquita E., Ferreira F., Rosa M.J. (2023) Mechanistic modelling of chlorine decay in reclaimed water containing ammonia. 13th IWA International Conference on Water Reclamation and Reuse, Chennai, India, 15-19 January (communication in a conference)

Scales

Operational scales of this case study related to the application of tools and technologyies

- Local scale
- City scale
- Metropolitan scale

Challenges

Challenges that are addressed through the application of tools and/or technologies to the case study

- High drinking water demand due to dense or growing resident population and economy
- Untapped efficiency potential of water resources
- Dependent on distant freshwater resources
- Other

Related tags

Water reuse | Circular Economy | Alternative water sources | Water demand | Better-informed society | micropollutant removal | climate change adaptation | water-energy efficiency | water security and resilience | risk assessment | advanced water reclamation | awareness

Contact data

Contact person

Pedro Teixeira (pedro.teixeira@cm-lisboa.pt, CML); Maria Joao Rosa (mjrosa@lnec.pt, LNEC); Rita Ribeiro (rribeiro@lnec.pt)

Involved organisations

1. adene Agência para a Energia

   Agência Nacional de Energia (ADENE)

2. Águas do Tejo Atlântico Grupo Águas de Portugal

   Águas do Tejo Atlântico, S.A. (AdTA)

3.

BASEFORM

4.

Câmara Municipal de Lisboa (CML)

5.

Instituto de Ciências Sociais da Universidade de Lisboa (ICS)

6.

Laboratório Nacional de Engenharia Civil E.P. (LNEC)

7.

Lisboa E-Nova

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