

DISASTER-READY WATER STORAGE SYSTEM FOR CITIES

ElectroCap Project Proposal

Website link : <https://orbis.applikuapp.com/>



ADVISORS AND MENTOR

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MEET THE TEAM



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PROBLEM DEFINITION

CAUSES



Increasing risk of war



Imminent seismic activity



Potencial droughts caused by climate change



Compromise of major reservoirs



High-risk pathigenic contamination for public health

PROBLEM

In an emergency situation, access to drinkable water is **crucial** in the first 72h

SOLUTION BENEFICIARIES

A DISASTER-READY WATER STORAGE SYSTEM ENABLES USERS TO MAINTAIN ACCESS TO SAFE WATER WHEN THE PUBLIC NETWORK FAILS

High-risk population groups:

- **Elderly** individuals
- People with **reduced mobility**
- Residents in **high-density** urban areas
- Tourists and temporary workers

Everyone benefits from the panic free and equal distribution of water

Water network failure

Panic and hoarding of essential goods

Uneven allocation of resources



OUR SOLUTION



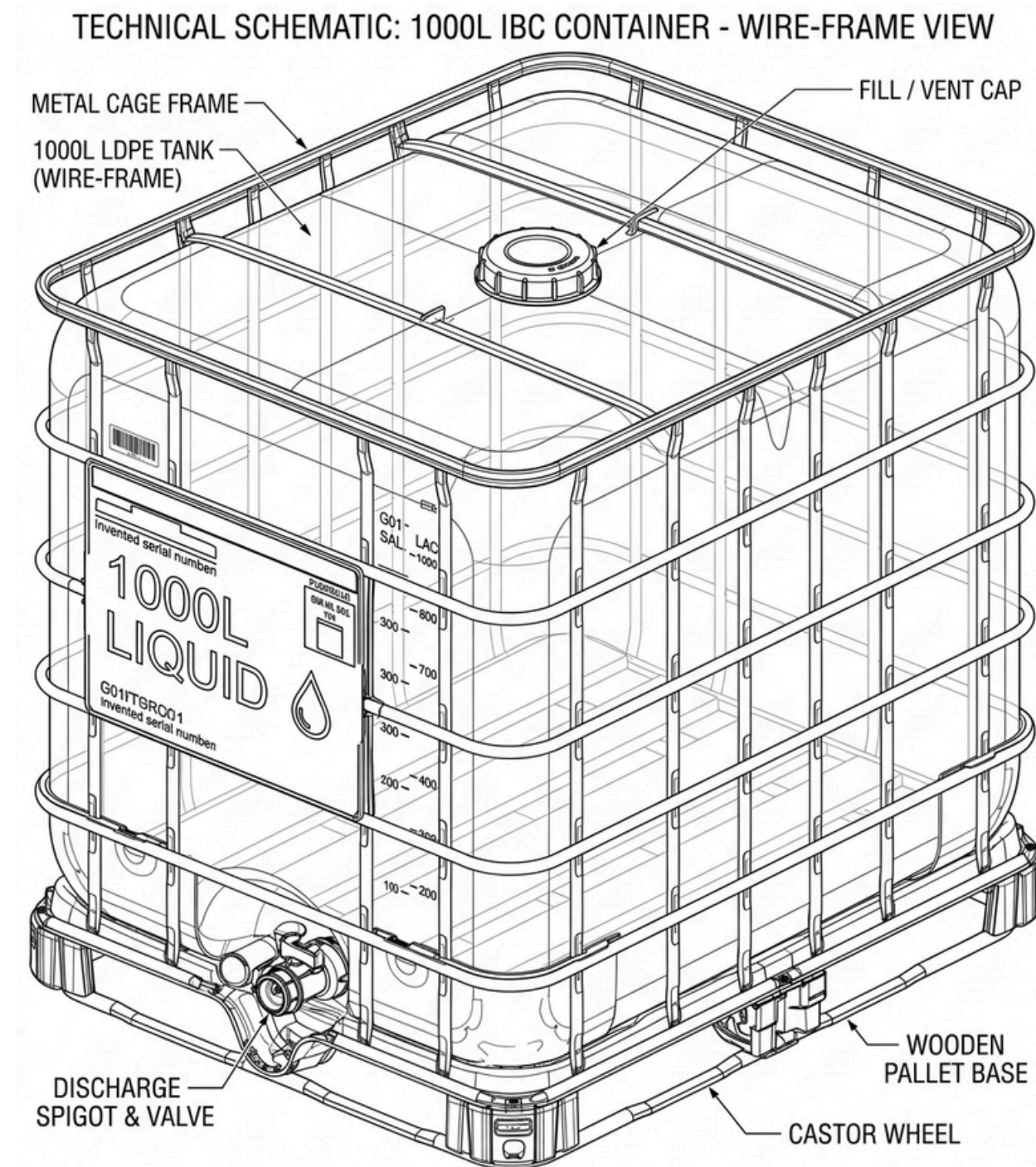
SOLUTION

Modular and automated **point-to-point storage** and **distribution network** for drinking water in **urban** areas

Permanently **monitored** through a web portal with variable permissions and access levels

Can be activated as an **exceptional** measure or for **general access** during a catastrophe

Can be used by **individuals** or public aid **institutions**



STAGES OF IMPLEMENTATION

NORMALITY

1. Strategic installation of modules
2. Integration into the municipal water network
3. Monitoring:
 - a. water level
 - b. water quality
4. Define maintenance protocols
5. Inter-module communication and with the database under normal conditions
6. Real-time website for normal conditions

CATASTROPHE

1. Immediate availability in critical time
2. Monitor water level
3. Control access and limits
4. Ensure system resilience, even in case of power and telecommunications failure
5. Modularity and transport to the most affected areas

PREVIOUS WORK & COMPETITORS

Japan – Seismic Resilience & Decentralization:

Decentralized storage networks operate by distributing data across multiple small reservoirs located near users, rather than depending on a single central system. Seismic-resistant infrastructure is designed so that tanks and pipelines can withstand earthquakes, ensuring that essential systems remain operational even during significant seismic events.

<https://thedocs.worldbank.org/en/doc/448651518134789157-0090022018/original/resilientwssjapancasesstudywebdrmhubtokyo.pdf>

UNITED KINGDOM – HUMANITARIAN MOBILITY (FASTANK)

Rapid-deploy modular tanks designed for quick assembly, allowing a single person to set them up in minutes without the need for tools.

<https://fastank.com/emergency-water-storage/>

China – Redundancy Engineering (Center Enamel)

Bolted steel tanks with enamel coating, highly resistant to corrosion and seismic shocks, that can be quickly assembled to replace sabotaged or compromised water treatment plants.

https://www.centerepoxytanks.com/bolted-steel-water-tanks-for-emergency-water-tanks_a14922.html

PREVIOUS WORK & COMPETITORS

Kärcher Futuretech – Mobile Water Supply

Offers mobile water treatment systems for disaster relief and remote operations. Provides complete solutions including raw water tanks, drinking water storage, and distribution stations. Designed for rapid deployment and independent operation from municipal grids.

<https://www.karcher-futuretech.com/en/products/mobile-water-supply.html>

PURIBEC – CONTAINERIZED WATER TREATMENT PLANT

Containerized water treatment plants integrating pumping, filtration, and storage within one or multiple ISO containers. Suitable for emergency response, remote communities, and industrial applications.

<https://puribec.com/en/commercial/our-expertise/containerized-water-treatment-plant/>

Applied Membranes (AMI) – Disaster & Mobile Water Systems

Markets containerized and trailer-mounted emergency water systems capable of treating fresh, brackish, or seawater into potable water. Portable, air-transportable options available, including solar-powered configurations.

<https://www.appliedmembranes.com/pages/disaster-mobile-water>

PREVIOUS WORK & COMPETITORS

Husky Portable Containment – Pillow Tanks

Portable potable-water bladder tanks used for temporary drinking water storage in disaster and humanitarian contexts. Serves as storage component for deployable purification systems.

<https://www.huskyportable.com/bladder-pillow-tanks>

READY CONTAINMENT – BLADDER TANKS

Provides potable and non-potable water pillow tanks for disaster relief, temporary storage, and container-conversion bladder solutions. Designed for rapid deployment and flexible capacity needs.

<https://fastank.com/emergency-water-storage/>

Aqua Control (Ireland) – Mobile / Off-Grid Purification

Compact mobile water purification systems for humanitarian and emergency use. Can operate via mains power, generator, or fully off-grid solar. Designed for rapid rollout by land, sea, or air.

<https://www.aquacontrol.ie/mobile/>

PREVIOUS WORK & COMPETITORS

Solar Water Solutions – Containerized Solar RO

Containerized solar-powered reverse osmosis units for fresh or brackish water treatment. Example deployment shows self-reliant system (0.5 m³/h capacity, 0.75 kW power demand) suitable for disaster response.

<https://solarwatersolutions.com/news/portable-reliable-water-for-disaster-relief-and-emergency-response/>

ROYAL EIJKELKAMP – OFF-GRID WATER

Mobile drinkable-water systems for disaster relief and remote operations. Plug-and-play systems with capacities up to 3 m³/h (WaterMiracle) and 20 m³/h (HydroNext).

<https://www.royaleijkelkamp.com/eco-innovation/water-works/solutions/off-grid-water/>

Watergen – Atmospheric Water Generators

Produces drinking water directly from atmospheric humidity. Does not require connection to a water source, but depends on temperature, humidity, and electrical power.

<https://www.royaleijkelkamp.com/eco-innovation/water-works/solutions/off-grid-water/>

SOLUTION REQUIREMENTS

Functional Requirements

- Store & dispense drinking water on-demand
- Automated refill from municipal water network
- Remote activation in emergency or normal mode
- Controlled, rationed water dispensing per entity
- Real-time status visible on web monitoring portal

Non-Functional Requirements

- 24/7 availability if needed including during catastrophe
- Failure detection & alert response in critical time
- Scalable modular architecture (add nodes as needed)
- Resilient to power & telecom outages (UPS + fallback comms)
- Secure, tamper-resistant access control

Technical Requirements

- Sensors: water level, pH, chlorine, turbidity
- Low-power microcontroller (Arduino / Raspberry Pi)
- Battery UPS charged via solar or grid
- Comm stack: 4G (normal) + LoRaWAN / satellite / UHF radio (fallback)
- Authenticated door; manual override on total electronics failure

User Requirements

- Accessible to all: elderly, reduced mobility, tourists
- Self-service capable in disaster scenarios
- Different access levels to the website per user / entity type
- Protocols defined for hospitals, nursing homes & schools

Business & Budget

- Cost per unit (IBC + sensors + electronics)
- Installation, maintenance & telecom costs
- Target: publicly fundable (municipal/EU grants)
- Cost per 1000 inhabitants

Regulatory & Environmental

- Municipal permits for installation on public/private land
- Compliance with DGS water quality standards
- GDPR-compliant user authentication data handling
- 3.5 L/person/day World Health Organization minimum (disaster mode)

Maintenance Requirements

- Scheduled water refresh cycle for potability
- Remote diagnostics and fault alerting via web portal
- Modular tank replacement without full shutdown
- Trained municipal technician protocols

Assumptions & Dependencies

- Access to municipal water network for refilling
- Partnerships with Lisbon City Council, DGS, Civil Protection
- LoRaWAN / satellite fallback comm. available
- IBC containers available at scale & low cost and resistant to adverse conditions

TECHNICAL CHALLENGES



Ensuring Drinkable Water

How to avoid still water issues while being cost and resource efficient



Ensuring Equitable Distribution

How to monitor water taken per “entity”, what to consider an “entity”



Communication between containers

How to guarantee that containers can communicate with each other through a safe network that does not fail in a time of crisis



Quick Response Time

We need to get up and running as quickly as possible!!

TECHNICAL CHALLENGES



Container's location

Where should we place the container for better accessibility at all times and places



Account for all needed water

How do we take into account not registered or foreign people in order to ensure everyone has water available



Container's Infrastructure

How to guarantee the prevails catastrophe conditions



Ensure power accessibility

For the solution to work we need to make sure we have energy available during the crisis

TESTING AND VALIDATION METRICS

Hardware & Sensors

- pH sensor accuracy vs. LAIST lab reference
- Chlorine & turbidity cross-validation against certified reagent tests (LAIST lab reference)
- Water level sensor precision across full 0-1000L range
- Leak test: PVC piping & valves under sustained pressure
- IBC cage structural integrity under simulated seismic load
(meeting already scheduled with LAIST for further clarity)

Electronics & Communications

- Failover time & reliability: 4G → LoRaWAN / Satellite when connectivity drops
- Battery UPS autonomy without grid power
- Solar charging sufficiency under low-light conditions
- Sensor data latency to web portal under each communication protocol
- Manual override: authenticated door opens on total electronics failure

Software & Firmware

- Access control: quotas correctly enforced per user / entity type correctly applied at scale
- Local dispensing work
- Automated alert triggers on water quality threshold breach
- Portal uptime under simulated high-traffic emergency load
- Full network recovery after simulated node failure

System-Level (end-to-end)

- Portal readings match physical sensor values (end-to-end accuracy)
- Potability shelf-life
- Water potability compliance after max time between refills

DIVISION OF LABOR



Electronics & Comms

Ensure **continuous monitoring** and **connectivity** between modules



Finance

Management of **expenses** and **revenues**



Geography / Statistics

Geographical distribution, **demographic** analysis, and **module location** planning.



External Relations

Management of **institutional contacts** and **partnerships**.



Software Engineering

Ensure **remote monitoring** of the infrastructure.

ELETRONICS & COMMS

HARDWARE

IBC containers (Intermediate Bulk Containers), 1000L capacity, equipped with:

- Low-cost, low-power reprogrammable microcontroller (such as Raspberry Pi, Arduino, among others)
- Monitoring sensors for factors such as: water level, pH, dissolved chlorine, turbidity and implementation of UV sterilization for quality assurance
- PVC piping
- Authenticated rapid-access door, overrideable in case of total electronic failure
- Automated valves and siphons
- Activated carbon filters at the dispensing terminal
- LED panel for local monitoring and debugging

TELECOMMUNICATIONS

Mobile network during periods of normal operation

+

Redundancy protocol ensuring the resilience of monitoring systems (LoRaWAN, Satellite, UHF/VHF Radio)

Team Leader: Carolina João

Team Members: MatildeSilva; Margarida Sebastião

FINANCE

Budget : Disaster-Ready Water Storage System for Cities

Projeto integrador de curso 2025/2026

Carolina João
Francisco Caravana
Margarida Sebastião
Matilde Silva
Tiago Carvalho
Tomás Ribeiro

Budget forecast for the project as a whole

Prototype Cost



Team Leader: Matilde Silva

Team Members: Tiago Carvalho

GEOGRAPHY/ STATISTICS

CONSTRAINTS

- Municipal **permits**
- **Legal** framework
- Pedestrian **access**
- Vehicle **access**
- Connection to the **water network**
- Connection to the **electrical grid**

POTENTIAL LOCATIONS

- Public **parks**
- **Interstitial areas**
- **Garages**
- **Metro** stations
- **Hospitals**
- **Schools**
- **Commercial** areas

STATISTICS

- Minimum **deployment time**
- **Volume** of drinking **water** per capita, per day
- **Refill frequency** to ensure water potability

EXTERNAL REALTIONS (PARTNERS)

Water Quality Control

LAIST (IST) - already a partner

- Chemical parameters to monitor
- Sensor definition
- Refill frequency
- Integration with the public network
- Quality standards



Bureaucracy and Licensing

Lisbon City Council

- Installation of tanks in public/private spaces
- Access to water and electricity networks
- Costs and regulatory framework



Technological Infrastructure and Communication

INESC-ID

- Information management
- Portal and database hosting



Instituto de Telecomunicações e Operadoras

- Connectivity
- Resilient communication protocols



Institutional Protocols

Directorate-General of Health

- Definition and guidance of hospital protocols
- Nursing homes (ERPI)
- Schools



Team Leader: Francisco Caravana

Team Members: Margarida Sebastião & Carolina João

SOFTWARE ENGINEERING

FIRMWARE

- Low-level **programming** and **automation** of the components used within the modules
- **Local/offline access control** method for the modules in case of deployment
- Controlled and rationed **dispensing** of water levels

SOFTWARE

Landing page + Team blog

Public presentation of the mission, objectives, and progress of the project.

Monitoring Portal

Interface and database to track the location, status, and data collected by the installed modules.

ROADMAP

25 Feb - 3 Mar

- Launch of the team website and blog – **Software Engineering**
- Revised project proposal
- Interview planning – **External Relations**

3 Mar - 17 Mar

- Solution Requirements List
 - Functional Requirements
 - Non-Functional Requirements
 - Business Requirements and Constraints – **Finance**
 - Technical Requirements – **Electronics**
 - User Requirements – **External Relations**
 - Regulatory and Environmental Requirements – **Geography/Statistics**
 - Maintenance Requirements
 - Assumptions & Dependencies

ROADMAP

17 Mar - 24 Mar

- Bill of Materials for the Prototype – **Electronics**
- Cost Management – **Budget**
- Research by the **Geography & Statistics**

24 Mar - 31 Mar

- Provisional version of the interim presentation

31 Mar - 07 Apr

- Final version of the intermediate presentation
- Obtain materials for building the prototype

07 Apr - 19 May

- Development of the first version of the prototype:
 - Demo version of the monitoring portal – **Software Engineering**
 - Demo version of the storage module – **Electronics**
 - Demo version of access monitoring – **Electronics & Software Engineering**
 - Use of the prototype under normal and exceptional conditions

ROADMAP

19 May - 26 May

- Conclusão do protótipo – **Eletronics & Firmware/Software**

26 May - 2 Jun

- Finalize the team portal website and blog – **Firmware/Software**
- Demonstrate the monitoring portal in operation with the prototype network of modules – **Eletronics & Firmware/Software**
- Explanatory video showing the project's operation through the prototype
- Pitch Deck
- EletroCap EletroDay Poster