

Abstract

Water scarcity, climate variability and rapid urbanization are placing unprecedented pressure on urban water systems worldwide. While approximately 400 billion cubic metres of wastewater are treated globally each year, only around 11% is reused, largely due to regulatory barriers, monitoring challenges, public acceptance issues and concerns over environmental and health risks. Greywater, which constitutes roughly 65% of total household wastewater, and urban rainwater together represent vast untapped resources that could significantly ease the strain on conventional water supplies. Green4Grey aims to unlock this potential by advancing decentralized green infrastructure for the safe treatment and reuse of non-conventional water resources in urban settings.

Green4Grey will deliver an integrated, scalable and replicable framework that combines digital spatial planning, nature-based solutions, smart monitoring and social innovation. At its core is a spatially explicit City Information Model (CIM) that maps the quantity and quality of available non-conventional water sources – including rainwater, roof runoff, greywater and treated wastewater – alongside climate, population density and infrastructure data. This decision-support tool will enable urban stakeholders to identify optimal locations for decentralized systems and evaluate associated costs, benefits and environmental impacts.

Green4Grey will design, test and validate innovative decentralized treatment solutions, including nature-based and hybrid systems such as green roofs, constructed wetlands and subsurface flow systems, all adaptable to diverse climatic and urban conditions. A comprehensive risk assessment and mitigation framework will ensure compliance with EU, international and local standards, addressing both environmental and health dimensions and supporting safe reuse under variable operating scenarios. In parallel, an IoT-enabled dynamic monitoring and control system will integrate meteorological forecasts, real-time water quality and quantity data, predictive flow modelling and adaptive control functions. This will enable robust system operation, rapid response to changing environmental conditions and seamless interoperability between decentralized and centralized water infrastructures.

The project follows a dual approach: top-down development of transferable methodologies, best practices and planning tools, combined with bottom-up, multi-actor co-creation tailored to local needs and governance settings. Citizens, municipalities, water agencies and policy-makers are engaged throughout all project phases, from planning and co-design to monitoring and dissemination, fostering public trust and ensuring that solutions are locally relevant and widely accepted.

These innovations will be demonstrated across five pilots in Haifa (IL), Heraklion (GR), Prague (CZ), Valencia (ES), and Florianópolis (BR), representing a wide spectrum of climates, urban forms, socioeconomic contexts and regulatory environments. The consortium brings together partners from Greece, Spain, Czechia, Israel, Sweden, the Netherlands, and Brazil, to contribute complementary expertise in hydrology, environmental engineering, urban design, AI-driven monitoring, constructed wetland systems and performance-based architectural design.

By combining city-scale digital planning, performance-based design, distributed low-cost sensing, machine learning, predictive maintenance, innovative water quality monitoring and meaningful stakeholder engagement, Green4Grey will move decisively beyond the current state of the art in decentralized urban water management. The project will deliver actionable knowledge, validated technologies and decision-support tools that strengthen urban resilience, reduce reliance on conventional water supplies, inform policy frameworks, and accelerate the transition towards circular, climate-adaptive and inclusive cities.



► Project coordinator

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► Project partners

- UNIVERSITY OF VALENCIA - SPAIN
- CZECH TECHNICAL UNIVERSITY IN PRAGUE - CZECHIA
- TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY - ISRAEL
- HÖGSKOLAN KRISTIANSTAD - SWEDEN
- EINDHOVEN UNIVERSITY OF TECHNOLOGY - THE NETHERLANDS
- FEDERAL UNIVERSITY OF SANTA CATARINA - BRAZIL

► Funding organisations

GSRI (GREECE) / AEI (SPAIN) / TA CR (CZECHIA) / MOE (ISRAEL) / FORMAS (SWEDEN) / NWO (THE NETHERLANDS) / CONFAP (BRAZIL)

► Duration

3 years

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urban water circularity,
decentralized nature-based treatment,
City Information Model (CIM),
risk assessment framework,
IoT-enabled monitoring

KEYWORDS