EUROPEAN URBAN INITIATIVE

COOLING HAVENS

Monitoring a cooling pilot: Lessons learnt

EUI02-098

Budapest District XVIII – Havanna utca 64–75

Budapest Site Visit · 9 September 2026

Katerina Kolioukou

Work Package 7 Leader: PP3 – National Technical University of Athens (NTUA)

Co-funded by the European Union

The water layer of Cooling Havens

EUROPEAN URBAN INITIATIVE

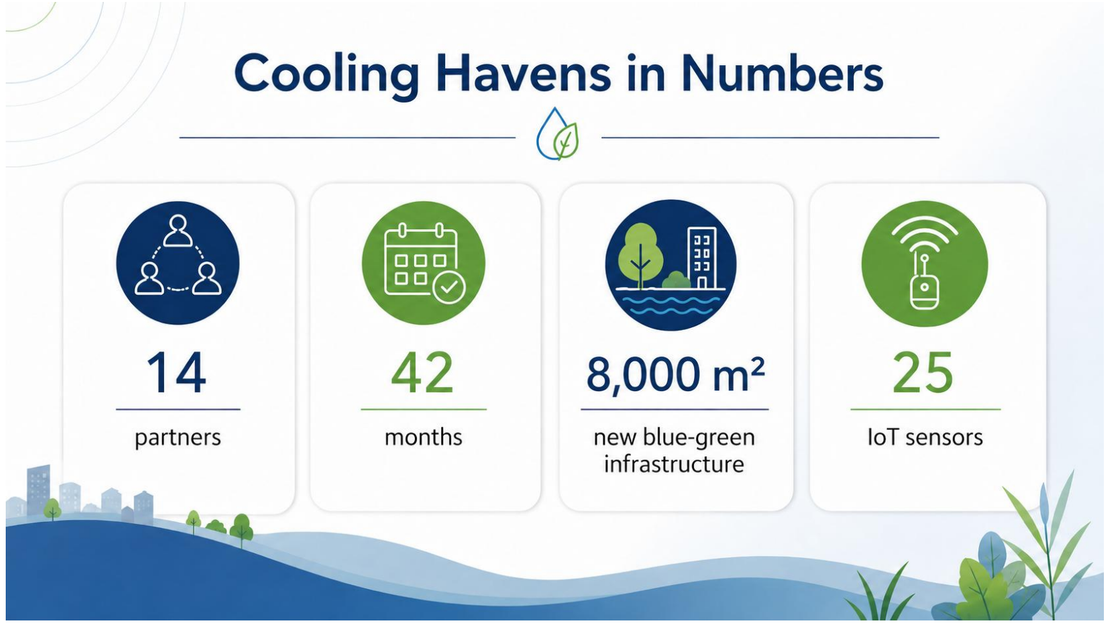
Our role

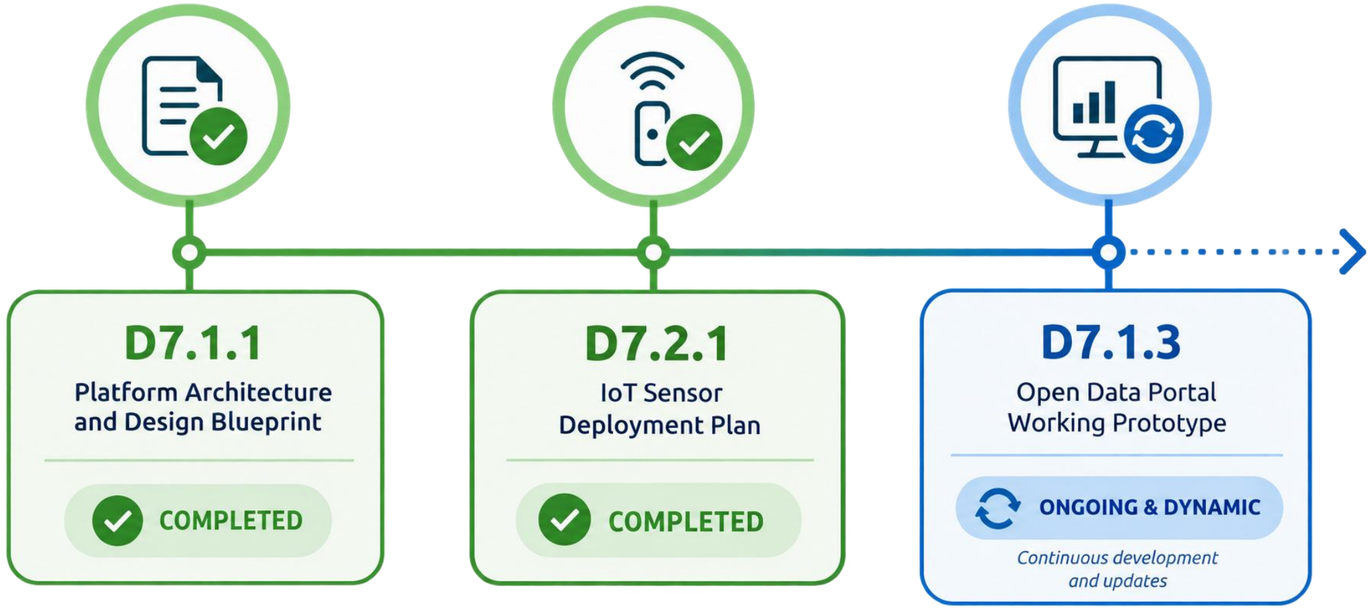
NTUA leads WP7 – Open Data Public Lab, providing the monitoring and digital framework for Cooling Havens.

Across a 42-month, 14-partner project, WP7 supports 8.000 m² of new blue-green infrastructure with 25 IoT sensors.

D7.1.1 Platform Architecture and D7.2.1 IoT Sensor Deployment Plan are completed, while D7.1.3 Open Data Portal Working Prototype is ongoing and dynamically evolving.

Together, they connect sensors → Digital Twin → Open Data Portal → KPIs to support data-driven decision-making.





Co-funded by the European Union

Two dense neighborhoods, the same problem

EUROPEAN URBAN INITIATIVE

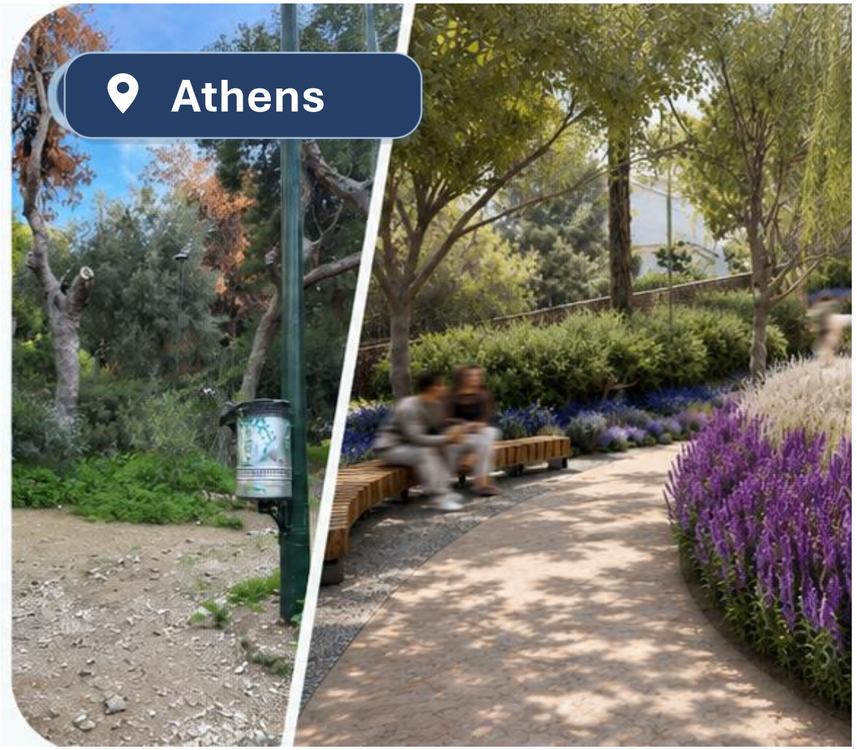


Athens and Budapest both face neighborhood-scale climate stress

Extreme summer heat

Concentrated in built-up blocks

Creates the need for a greener and cooler public space.



Nature-Based Solutions

can solve this problem.

Lower temperatures

More shade and greenery

More comfortable and livable neighborhoods

Climate-resilient and healthier cities

Co-funded by the European Union

The monitoring chain

Every intervention becomes a fully monitored system: field smart sensors feed gateways, which stream real-time data to the cloud, where data are validated, presented and translated into useful KPIs through our Digital Twin

Nature–Based Solutions

Raingardens, bioswales, etc.

IoT Sensors

Six domains, placed suitably

Gateways

Secure telemetry links, store-and-forward

Digital Twin and Portal

Maps, dashboard, data engine

KPIs and management

Cooling, retention and evidence for management

Co-funded by the European Union

Six monitoring domains

EUROPEAN URBAN INITIATIVE

Sensors and their placement are based on every site’s topology, plans and needs

Meteorology & microclimate

Rainfall, air temp & humidity, solar, wind

Soil

Volumetric moisture and temperature in the area

Hydrology: storage & overflow

Water level, flow, pump status and overflow

Water quality

Temperature, pH, conductivity, turbidity

Air quality & heat comfort

PM2.5/PM10, NO_2, O_3

Public space use

Anonymous footfall & occupancy

Co-funded by the European Union

Every sensor answers a question

PARKO I.N. AGIOU NIKOLAOU · NEAPOLI, EXARCHEIA

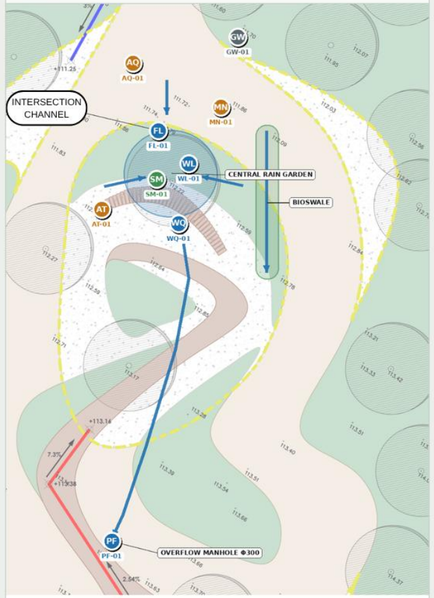
COOLING HAVENS (EUI02-098) · IOT SENSOR DEPLOYMENT PLAN · INTERVENTION AREA ≈ 1,036 M²

IoT Sensor Deployment Plan

Base: general layout & drainage plan (A05), faded — sensor + water-flow overlay

Rev. mockup · not to scale

Plan Sensor deployment over the park layout



Each node sits on the element it monitors. Blue arrows trace the water path — surface runoff converging into the central rain garden, then the overflow route to the outfall where PF-01 sits. Base drawing A05 (ECOSCAPES /) shown faded; overlay not to scale.

SENSOR LEGEND

CLIMATE & AIR

- **WS** Weather station
- **WN** Wind
- **RG** Rainfall
- **SR** Solar radiation
- **AP** Atm. pressure
- **AT** Air temp & RH
- **AQ** Air quality

WATER

- **WL** Water level
- **FL** Flow / velocity
- **PF** Pipe flow
- **WQ** Water quality

SOIL

- **SM** Soil moisture & temp

INTERVENTION ELEMENTS (NBS) & WATER PATH

- Central rain garden (113 m²)
- Small rain gardens ×3 (seating nooks)
- Bioswale (linear, 25 m)
- Collection channel + grate
- Perforated drains Φ110 / Φ200 / Φ300
- Surface & overflow water direction

WHY EACH NODE SITS WHERE IT DOES

RETAIN	**WL-01** → ponding in the rain garden	SLOW	**FL-01** → runoff at the channel
INFILTRATE	**SM-01** → soil water in the bed	CLEAN	**WQ-01** → outflow quality
COOL	**WS-01**+AT/AQ → microclimate & air	OVERFLOW	**PF-01** → discharge at the outfall

SENSOR SCHEDULE

ID	SENSOR	PARAMETERS	LOCATION (NBS ELEMENT)	PURPOSE — WHY HERE
WS-01	Weather station	Temp, RH, rain, press., solar, wind	WS-01 met pole · whole-site	Baseline microclimate of the site
WN-01	Wind sensor	Wind speed, direction, gusts	WS-01 met pole	Ventilation & comfort context
RG-01	Rainfall sensor	Rain intensity, cumulative	WS-01 met pole	Rain input driving the NbS
SR-01	Solar radiation	Solar irradiance	WS-01 met pole	Shading / solar load
AP-01	Atm. pressure	Atmospheric pressure	WS-01 met pole	Weather reference
AT-01	Air temp & humidity	Ambient temperature, RH	Seating / canopy	Local comfort at rest areas
AQ-01	Air-quality sensor	PM2.5, PM10, CO_2, NO_2, VOCs	Whole-site · planting	Air-quality co-benefit of greening
SM-01	Soil moisture & temp	Soil moisture (vol.), soil temp	Central rain garden	Infiltration & soil-water in the rain garden
WL-01	Water-level sensor	Water depth, overflow level	Central rain garden basin	Water retained / ponding in storms
FL-01	Flow / velocity	Flow velocity, runoff	Collection channel at stairs	Runoff entering the system
PF-01	Pipe flow meter	Pipe discharge, runoff volume	Φ300 overflow manhole	Overflow leaving the system
WQ-01	Water-quality sensor	pH, EC, turbidity, DO, temp	Rain-garden outflow	Water treated by the planting

Nodes: 13 · weather station WS-01 (met pole) = WS·WN·RG·SR·AP on one 4 m pole

Base drawing: ECOSCAPES / — A05 · Sensor overlay: deployment mockup, not to scale

Question-led setup

The platform links each sensor to a clear monitoring question

From data to KPIs

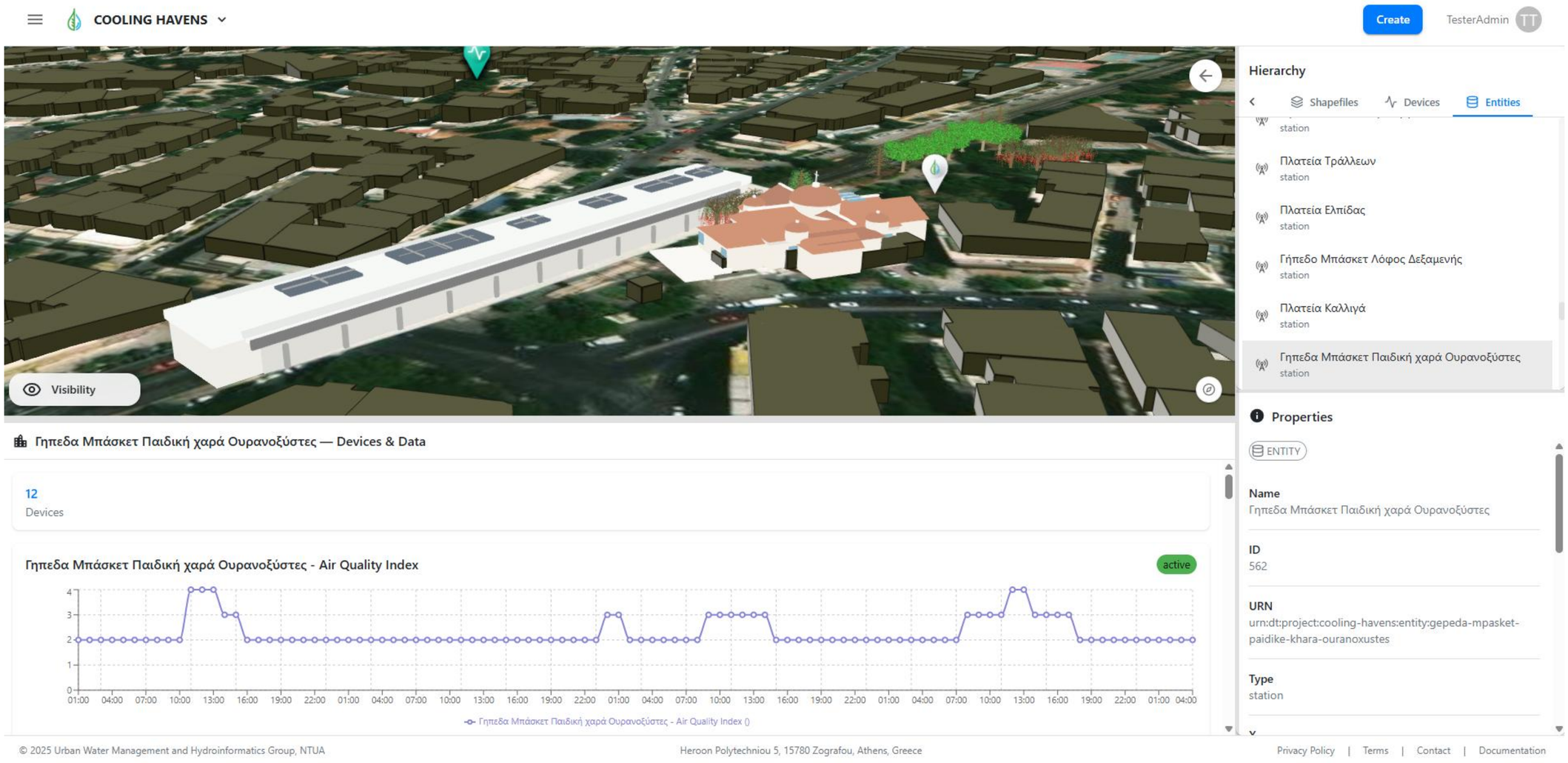
Raw measurements are turned into indicators for cooling, water and use

Useful for operators

The same view can support daily management and later replication.

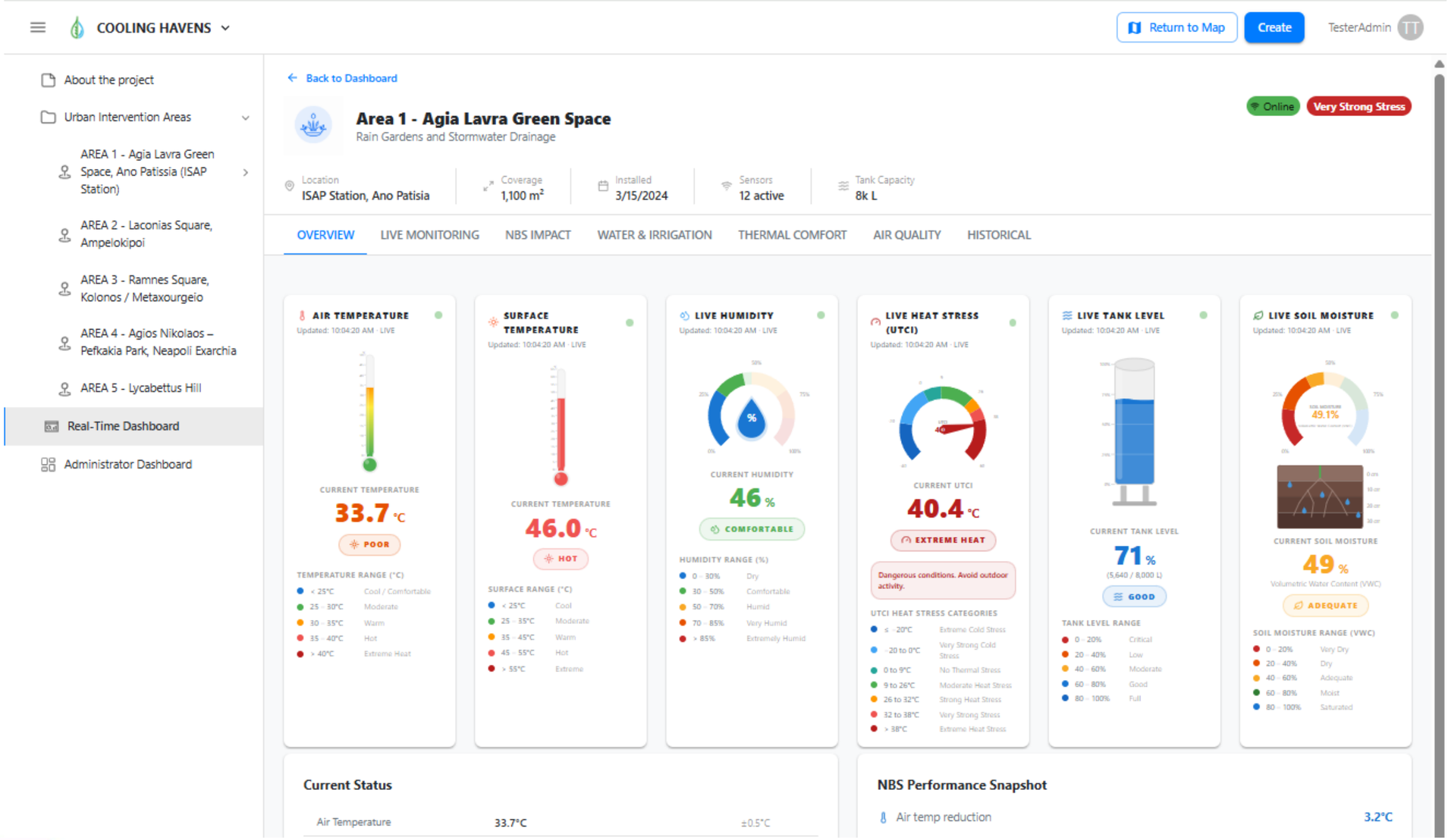
Co-funded by the European Union

The Cooling Havens Digital Twin



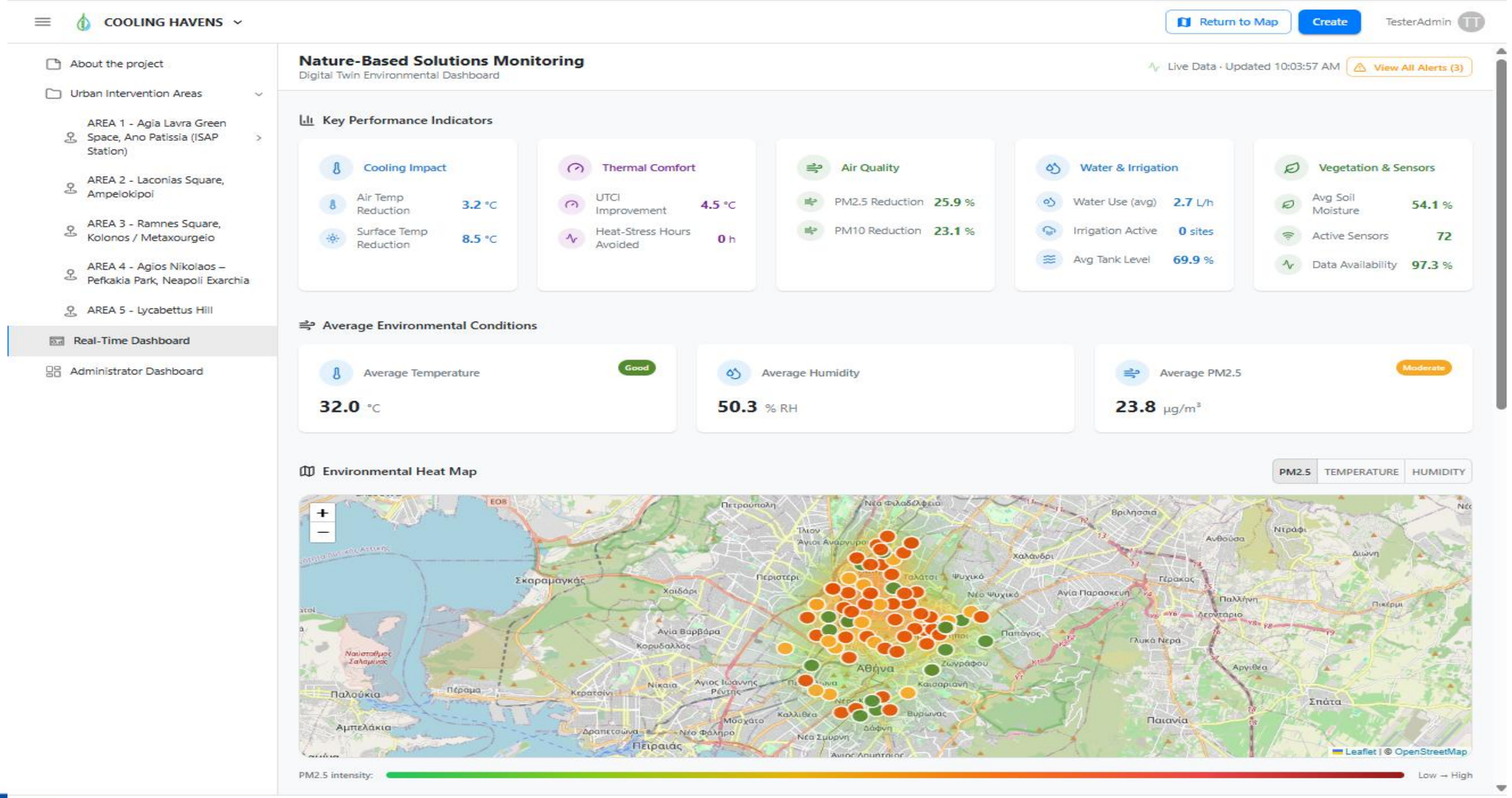
Co-funded by the European Union

The Cooling Havens Digital Twin



Co-funded by the European Union

The Cooling Havens Digital Twin



Three things that worked

EUROPEAN URBAN INITIATIVE

Careful placement of sensors

Sensor placement is tailored to each intervention’s functions and monitoring questions

Design for monitorability

Readable measurements and results, KPIs that actually mean something

Open, interoperable architecture

Modular Digital Twin platform that can be scaled and handed over

Co-funded by the European Union

Three things that surprised us

EUROPEAN URBAN INITIATIVE

Everything is indicative until built

Coordinates, mounts and routes shift with final geometry utilities

Maintenance is vital

Outdoor sensors and NBS interventions are sensitive and should be protected

Pre-intervention data

Baseline data are often difficult to find

Co-funded by the European Union

Our recommendations for Havanna Pilot

EUROPEAN URBAN INITIATIVE

Havanna questions first

Which zones overheat?
When is the space used?
How can planting survival be protected?

Place sensors by function

Compare thermal conditions across shaded seating, sport areas, pedestrian routes and exposed paved surfaces, while avoiding locations that could bias measurements

Maintenance from day one

Define calibration, cleaning, winterisation, spare-parts availability and response procedures before procurement

Management-focused portal

Focus on actionable indicators that support District XVIII in irrigation management, thermal comfort assessment and future replication

For Havanna, the key question is not ‘Which sensors should we buy?’ but ‘What decisions should the Digital Twin help us make?

Co-funded by the European Union

Transfer conditions for Havanna

EUROPEAN URBAN INITIATIVE

TRANSFER

Core approach and technical logic (sensor → validated data → KPIs → management action)

ADAPT

Sensor locations and configurations to Havanna's local context (shaded seating, sport areas, pedestrian routes and planting zones)

AVOID

Over-instrumentation and site-specific bias (e.g. too many sensors, focusing only on active cooling without water-quality and maintenance considerations)

PREPARE

Data ownership, maintenance roles, calibration routines, procurement specifications and response procedures

Transfer the core solutions**, adapt** to local conditions **and scale** across urban context

From Athens' experience to local impact in Havanna

Co-funded by the European Union

A Digital Twin Framework Budapest can adapt and scale

EUROPEAN URBAN INITIATIVE

WORKING DT PROTOTYPE

The Cooling Havens Digital Twin and Open Portal logic is being developed and demonstrated for Athens

SENSOR-TO-KPI KNOW-HOW

We translate field data into indicators for comfort, water performance, public use and maintenance

OPEN SCALABLE ARCHITECTURE

The approach is modular, interoperable and suitable for extension to new sites or municipalities under follow up agreements and contracts

MINIMUM VIABLE DT

NTUA is open to discuss further collaboration opportunities (for design and deployment of a Budapest DT)

Co-funded by the European Union

A possible roadmap for Budapest DT

EUROPEAN URBAN INITIATIVE

1 Define priority questions

Shade, comfort, sport use, planting survival, replication evidence

2 Start with minimum monitoring set

Install only the sensors needed to answer those questions

3 Develop and configure a Havanna Digital Twin

Connect sensors, time-series and geospatial data in one decision space

4 Use KPIs to decide scaling

Expand only when the pilot demonstrates value for district XVIII

NEXT STEP

NTUA is **available to explore adapting** the Cooling Havens **Digital Twin framework to Budapest's needs** through **potential follow-up projects** supported by the **Cooling Havens partnership**

Co-funded by the European Union

Let's continue the discussion!

URBAN WATER
MANAGEMENT AND
HYDROINFORMATICS
GROUP

https://www.uwmh.civil.ntua.gr

Co-funded by
the European Union

COOLING HAVENS

EUROPEAN URBAN INITIATIVE

Contact us

info@coolinghavens.eu

Follow us

www.coolinghavens.eu

showcase/coolinghavens

Coolinghavens

@Cooling_Havens

cooling_havens/

Cooling_Havens

Co-funded by the European Union