



A CROSS-DISCIPLINARY COLLABORATION

This chapter describes the activities within the prototype realization processes where concept, requirements and drawings are realized into actual products.

This key step of the research brings together the necessary multidisciplinary expertise for the development and construction of the first 1:1 scale prototype of multifunctional urban service.

As shown in the table below, each partner holds a specific yet complementary role towards fulfilling the realization of a fully functioning innovative water station.

partner	role
HERA Group Innovation Central Direction Eng. Salvatore Molè, Innovation Central Director Eng. Enrico Piraccini, head of development, IC Direction Eng. Simone Allegra, project development, IC Direction Eng. Davide Cupioli, Innovation Central Direction Eng. Federico Lazzarini, Innovation Central Direction	Research commissioner, responsible for the project management, financier of prototype construction
Architecture Department University of Ferrara Prof. Gabriele Lelli PhDc Ilaria Fabbri	Scientific support, overview of the project, responsible for the design phase, innovation, trainings, usability tests
Marco Peroni Ingegneria	Structural supervision and calculation
Studio Sampieri	Electrical system design and supply
ARLAM s.r.l	Metal fabrication and responsible for the coordination of the different companies involved in the construction process
Ecoline s.r.l water technology	Design and construction of the water treatment system
Vetzeria La Nuova	Supplier of the screen-printed glass panels and related glazing bead
Pubbligraf s.a.s	Supplier of the back lit polycarbonate panels
TSA Technology	LED screen supplier
Novowood by Iperwood s.r.l	Wood Plastic Composite supplier
Realmore s.r.l	Responsible for the development of the application with augmented reality through which the functionalities of the prototype are disclosed to early users
Sicuromagna s.r.l	CE marking consultant

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Figure n. 256
The first prototype of PUNTOnet H₂O, installed at Hera Group Headquarter in Bologna. Photo by Fabio Mantovani, 2021.

Table n. 11
Partners and roles within the technical design and construction process

257 PRODUCT IMPLEMENTATION

In this phase of the project, all design specifications were carefully reviewed to ensure they were at a design-to level that allows the product to be developed, or, in case of single components (like buttons, water filters and chiller), it was checked whether they were in compliance with the project requirements. In this cross-disciplinary research group, the author, together with professor Gabriele Lelli, took charge of all design considerations and detail drawings, except for sheet metal design and fabrication drawings; moreover, an extensive study of user interface and the glazed envelope was carried out, with a thoughtful examination of samples of construction materials and technology solutions, such as LED backlighting diffusers and printed glass panels. Several different graphics were suggested for the totem glazed skin, with tentative visualizations and mock-ups: among the different solutions, ranging from ice cubes close up to details from David Hockney's paintings, the graphic displaying a macro picture of perturbed water, shaded in bluish tones, was the most appreciated within Hera Group stakeholders, and the one actually realized for the first prototype. Team members from University side also gave their scientific support during the creation of a Virtual Reality App, intended to describe the prototype goals and features to early testers.

258 MANUFACTURING PROCESS

Specialized workshops and factories based mainly in Emilia Romagna Region manufactured the first version of PUNTONet H2O in 90 days: it may seem quite a long time, but it should be considered the prototypical nature of the object and the simultaneous interactions between operators, technicians and specialists from many different fields; moreover, this period included production downtime and logistic issues due to the COVID outbreak. As production proceeds and components were assembled, the technical team methodically discussed progress and reviewed any non-conformance to specifications and provided dispositions whether the different parts could be accepted, reworked, or remade. The PhD Candidate was actively involved in this operations management and on-site inspections during the whole realization process; at the same time, the analysis and planning phase for the installation of the prototype in the selected demo site started.

DEMO SITE INSTALLATION

The first prototype was installed on the 23rd of December 2020 at Hera Group Headquarters in the city centre of Bologna, in Carlo Berti Pichat street, at the entrance of the main office building; the demonstration site is therefore a semi-private area, that only Hera Group's employees, authorised suppliers and consultants can access, with about 500 people every day passing through. Since January 2021, PUNTONet H₂O is freely accessible to everyone working for the local utility. All the pre-operational activities for the electrical and data connections, small civil works and the assembly itself of the street furniture were carried out under the author supervision, jointly with Hera Group team members. After the installation and water supply adjustments, the prototype was immediately connected to the internet to verify the functionality and stability of all components, also the ones being remotely monitored, such as environmental data.



Figure n. 257
The research team regularly inspected the first prototype work in progress at ARLAM factory in Forlì. Photo by Ilaria Fabbri, December 2020.

Figure n. 258
Installation and adjustments at Hera group Headquarter in Bologna. The maintenance door reveals the inner working of the station, with easy access to plumbing and filter and digital display. Photo by Ilaria Fabbri, 23rd December 2020.

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Figure n. 259
A selection of the graphic options for the glass panels back-print, including the appointed one.

Figure n. 260
Glass sampling with different widths, textures, transparency rates and surface treatments. Ph Ilaria Fabbri

DESIGN DETAILS

Envelope

PUNTONet H₂O has unique **back printed glass panels**, that lend a refined and highly variable aesthetic, able to adapt with colours and textures to any type of outdoor environment. This shiny, reflective, and semi-transparent surface has been chosen in order to give the prototype a **feeling of refreshment** and making it easy to see and recognize by citizens. During the day, the two sides of the totem will reflect light and become dynamic; when it gets dark, the backlighting system automatically turns on, transforming the piece of street furniture into an **iconic, easily visible beacon** throughout the city, for greater accessibility, safety and branding awareness.

Graphics panels are made from impact proof, monolithic glass panels, 10 mm in width, with a high resolution print on the inner side of the plate to prevent scratching on the front face. Glass panels can be recycled endlessly when replacement is required.

Led Screen

Like a contemporary **Litfaßsäule**, a mid-twentieth century street furniture in the shape of a column combining billposting and public fountain in the same object, PUNTONet H₂O also features a digital screen enhancing user engagement in healthy lifestyles through customised visuals. The provided 44" LED wall serves as **sustainability indicator**, and can display the number of disposable bottles or CO₂ emissions saved by the community, as well as real time data about water quality, to increase adoption and trust in municipal tap water. Digital signage can also be used for **branding purposes**: along with the promotion of public, messages or initiatives, sponsorship at either individual or corporate levels may help defray costs for the installation and the upkeep of the street furniture, to the extent that can also generate revenue.

Water dispenser

All components used in the wetted areas of the prototype are made from **stainless steel**. Easy to clean, hard, tough and corrosion resistant, stainless steel does not affect water taste and limits microorganisms from colonising. In addition, some of the stainless steel components, such as the bottle rest, the control panel and the dog bowl, have a **brushed finish** that reduces glare effects and masks the fingerprints, scuffs, scratches of daily use.

Chilled or ambient water is a personal preference, although the cold one is often in demand during hot summer months. For this reason, the station includes the two options; the third buttons, slightly apart from the other two, fills the stainless steel bowl fixed in the lower part of the totem with unfiltered ambient water, enabling dog walkers to let their pet drink. A **programmable amount of water** is dispensed after pressing the corresponding button: the first prototype delivers 500 ml, but users can stop water flow while the station is pouring by pressing the button again, if they desire less liquid. Selection buttons are raised from the surface, easy to find and with soft touch operations, made in stainless steel as the whole command panel, that is dual sided, with buttons on both sides: this design expedient enables operation by users with a preference for either left or right hand. Furthermore, thanks to the bottle rest, people can fill their bottle through a **one-hand operation**. Finally, to ensure tasty water of premium quality, a **certified hollow-fibre filtration** system is used in combination with a silver impregnated **carbon block filter**.

Figure n. 261

Close view of the control panel and the underlying bottle rest. The oblong opening allows an uninterrupted view of the surrounding.

Photo by Fabio Mantovani, July 2021.



Dog bowl

The design goals of a wide accessibility and user friendliness highlighted questions about mixing a bottle refill dispenser with a water outlet dedicated to pets; actually in Italy several local ordinances prevent dog owners to let their pet drink from the faucet for humans; PUNTONet H₂O tries to accommodate both, still preserving the cleanness and hygiene of the water access point through specific design solution.

The bowl sits away from the water supply for humans in a brushed stainless steel box, at the base of the stele, at **180 mm from the ground**; this value has been identified after measurements at pet relief areas, along with the comparison of detail drawings from several manufacturers of dog friendly fixtures (Urban Fountains+Furniture, Australia; Murdock Pet Fountains, USA; Most Dependable Fountains, USA; Willoughby Drinking Fountains, USA, just to name a few).

Fresh water at air temperature is dispensed by pressing the button labelled with a dog paw, in the stainless control panel. Excess water can be emptied by a simple tipping of a small foot pedal, and collected in a hidden internal drainage system; therefore, **no stagnate water** is left over.

Smart functions

PUNTONet H₂O seeks to **extend the range of activities that can take place in a public setting**, like a small hub for the community to meet, work outside or take a break; to do so, the station is equipped with public Wi-Fi and general power outlets, that enable users to recharge their devices but also e-bikes and mobility scooters.

The prototype also integrates a variety of IoT sensors (air quality sensors, sound level metre, security cameras, water flow and power meters etc.) arranged in a wireless network configured to obtain live user data and real time, high precision environmental monitoring.

The data collected by PUNTONet H₂O feed into a **digital dashboard** displaying the information (primarily water and power usage and air pollutants) in one interface; for the first prototype, the access to this pilot dashboard is limited to research team members, but it is planned to make it available to the whole local multi utility and public administration. In a wider perspective, the dashboard could become the front end of a large-scale Internet of Things (IoT) network of sensors, not only the ones embedded in the prototype developed with this research; in the future it could conveniently collect data from other smart sensing urban objects, providing a centralised view of multiple urban data sources, thus a more informed way to monitor and manage urban assets and facilities.

The research group developed a PUNTONet H₂O **dedicated App** with a twofold purpose: to simulate a greater engagement of early users, who can quickly discover the prototype functionality and get additional information about the initiative; and to submit a survey, in order to collect feedbacks and suggestions. Scanning the QR code attached on the totem with their mobile devices, people can automatically download PUNTONet H₂O dedicate App, read more about the prototype and express their opinion about it.



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Figure n. 262

Close view of the dog bowl. With a simple foot pedal, the stainless steel basin flips, leaving no stagnant water. Ph by Fabio Mantovani, July 2021

Figure n. 263, 264

Both sides of the totem are equipped with general power outlets for outdoor use, that enable users to recharge their device or small electric vehicles.

Ph by Fabio Mantovani, July 2021

Bench

Inclusive, distinctive, sustainable. The prototype features a very comfortable bench, crafted in the shape of a drop with rounded edges, and a cozy seat covered in dark slats of **Wood Plastic Composite (WPC)**.

Not requiring special maintenance, at the end of their life cycle WPC panels can be extruded again and recycled up to 20 times, with no need of adding any other components and no physical or mechanical alterations. WPC is not only **recyclable**, but its main components, wood and plastic, are sourced from recycling streams, too. Wood Plastic Composite slat has the **warm touch** of wood, but doesn't rot, and above all does not overheat as metal, which was used as part of the seating in previous design versions. Moreover, with its appreciable **thermal insulation properties** (Mussa and Salih, 2020), Wood Plastic Composite gives an additional help in the protection against extreme temperatures of the components and working system located inside the bench.

A **wireless charging station** is embedded into the seat: users are provided with an additional chance to charge their phone by simply placing it on the appointed surface.



Figure n. 265

The wireless charging station is seamlessly integrated in the surface of the bench, made of Wood Plastic Composite.

Photo by Fabio Mantovani, July 2021.

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component	material - size and other info
Internal chassis	Galvanized steel
Outer frame	Powder coated steel painted in Graphite Grey RAL 7024 and brushed stainless steel
Push buttons	6x easy press stainless steel buttons
Nozzle	Recessed outlet in brushed stainless steel
Bottle rest	140x300x30 mm, brushed stainless steel
Dog bowl	140x460x30 mm, brushed stainless steel, with foot pedal
Glass panels	Back-printed impact proof monolithic glass panels, 10 mm
Water pressure	250-350 kPa
Flow Rate	Depending on entering water pressure – average 2,4 l/minute
Dispensed water	Max 0,5 litres per pressure
Filter	ECOSILVER L - Silver impregnated 0.5 micron carbon block filter + ultrafiltration membrane hollow fiber
Minimum working temperature	3°C
Water supply connection	1/2" inch supply line with 1/2" inch male compression fitting
Drainage	32 mm PVC preferred (drainage can be customised based on location)
Water chiller	70 litres per hour. ECO 70 model, mm 400x260x530 (HxLxD); voltage: 230 V, 50 Hz
Electrical cabinet	Gewiss GW40108, 410x655x140 (LxHxD) – max power consumption < 3kW
Weight	approximately 500 kg
Lighting	Back lit polycarbonate panel, dimmer-controlled, white 6000 K LED. Power 8,8 W/meter
Environmental sensors	AirQino module. Outdoor temperature, humidity, air pollution (O3, NO2, CO, CO2, VOC, PM10, PM2,5), public nuisance monitoring
Surveillance cameras	2x AXIS F1035-E Sensor Unit fisheye lens with a 194° horizontal field of view
Wireless charger	1x Qinside Qi1001V3, 80mm (diameter) 15,5mm (height)
Wi-Fi	Router Cisco IR829 + ANT-5-4G2WL2G1-O ANT-2-WLAN-D-O
Monitor	Outdoor LED wall mm 500x1000x109 (LxHxD), max power consumption 0,35 kWh

Table n. 12

Technical information of the first prototype of PUNTONet H₂O

POTENTIAL RISKS AFTER INSTALLATION

The demo site where the first version of PUNTONet H₂O is installed, a semi-private area, partially covered by the projecting roof of the main office building at Hera Group Headquarter in Bologna, is definitely a **protected environment**, slightly different from urban locations where the prototype is intended to be placed and used.

Positively, the controlled conditions offered by the appointed pilot scheme may facilitate more focused testing stage, aiming to get input from real people, identify flaws and areas of concern before releasing the product to the public, without disturbing boundary conditions like complete exposure to extreme weather or improper use and vandalism. On the other side, not testing the prototype under normal-expected usage condition may reduce awareness about its actual robustness (rain and direct sunlight for instance), and may lead the research team to overlook suggestions from target audience not directly involved in the test (children, retired persons, dogs...).

In summation, in terms of efficacy of prototype development, the installation and test of the first version of PUNTONet H₂O at Hera Headquarter in Bologna may incur the following risks:

Health and safety

- Potential contamination of water outlet with personal bottle;
- Potential slip hazard at the base of the fountain;

No/low uptake of use

- Many employees attending the demo site supply their own drinks;
- Proximity of the bar inside the building office;
- Underutilization of certain features of the prototype, like the dog bowl, since pets are not allowed in the area;

Feedback reliability

- Limited target audience (Hera Group's employees, authorised suppliers and consultants) and consequent lack of on-site input from other categories (children, retired people, dogs, cyclists, joggers...etc);
- Too indulgent or non-completely objective testers, as involved somehow in the Company business;

Extreme weather

- Winter freeze;
- Overloaded refrigerator in hot weather;
- Steel parts overheating;
- Partial awareness of long-term effects of the rain exposure (a roof projection currently shelters the prototype).

Installation and test in such protected outdoor area is a crucial, preparatory stage before introducing the service in a real urban area, completely accessible to the general public; this last step will be achieved later on, after subsequent refinements of this first prototype.

EXPECTED MAINTENANCE

A critical step to promote adoption of public drinking fountains and user engagement – but it applies for any other kind of street furniture, too – is keeping the station clean and well maintained. Even if early testers of PUNTONet H₂O will be somehow involved with the key stakeholder itself (Hera Group's employees, suppliers and consultants), therefore aware of possible flaws and warmly motivated by their company to test the prototype, it is nevertheless extremely important to plan a proper maintenance scheduling and monitor daily usage and weather effects. The expected maintenance steps for this first version of the service are summarised as below.

Weekly duties

To work properly and look perfectly neat, the prototype would require approximately one inspection visit every seven days, to throw away any accumulated trash or debris and remove lime build up using a brush or scrub pad if necessary; during the procedure, the flow of water should be checked to make sure there is a constant stream.

Detail clean (every 6 months, pending location and use)

Over the span of six months, a general system sanitation is required. To do so, the totem access door will be opened, for a full internal chassis and external wipe. On the occasion of the detail clean, carbon block filters will be replaced, while the hollow fibre membrane providing for ultrafiltration will just undergone backwash to prevent fouling. Checking drainage and water supply pressure may also be required, plus any needed repair work. IoT sensors at the top of the station should be tested too on a regular basis from expert technicians.

The simple access to inner working thanks to the opening parts (totem's door and the upper part of the bench where the electrical cabinet and the chiller are located), curbs operational and environmental costs, while the modular construction, made in galvanized or painted steel with stainless steel parts, are designed to be re-coated, refurbished or replaced easily.

Recommended annual duties

Interventions of extraordinary maintenance will be scheduled according to the litres dispensed; however, annual updates of the maintenance plan, including any replacements or repairs, would be highly advisable (Phurisamban and Gleick, 2017), along with in-depth inventory of water system and electrical equipment.

The estimated annual cost of maintenance is about 4000 euros.

The entire cost of the prototype development here described– including sheet metal design, fabrication drawings, sensors and technology equipment, prototype production and installation – **is supported by Hera Group**, interest in developing this innovative piece of outdoor furnishings in line with the goals of circular economy and beyond their consolidated business. Successive iterations of the prototype and improved versions will be paid by Municipalities willing to test the service on their territories, while water management and maintenance will be again cared for by the local utility.

Test and measure in the built environment



PRODUCT VERIFICATION

According to the Systems Engineering Handbook from the National Aeronautics and Space Administration (2007), Product Verification is an essential step within the Product Realization process, and tries to answer the critical question “**Was the end product realized right?**”

Similarly, the next part of the doctoral study explains how the product verification is performed and which design insights derived from this activity.

PUNTOnet H₂O verification mainly used the method of inspection, demonstration and test; a field experts review was also organized, in order to verify the conformity of the prototype with specific design features.

Inspection

During the first months of 2021 I regularly visited the demo site for a visual examination of the prototype’s actual working within the test environment; field observations to understand users’ reaction without mediation and public interaction with the product were simultaneously conducted. On-site inspections disclosed some design and technical flaws that were promptly noted for future refinements work.

Field Experts review

This phase of the research had the valuable support of CERPA Italia Onlus (The European Centre for the promotion of Inclusion) and CRIBA Emilia Romagna Region (Regional Centre for the Information on Environmental Welbeing) about the system accessibility to different type of disabilities. Two involved experts, the architects Piera Nobili and Cinzia Araldi, visited the demo site with the research group, and several possible improvements to widen the accessibility of the system were identified.

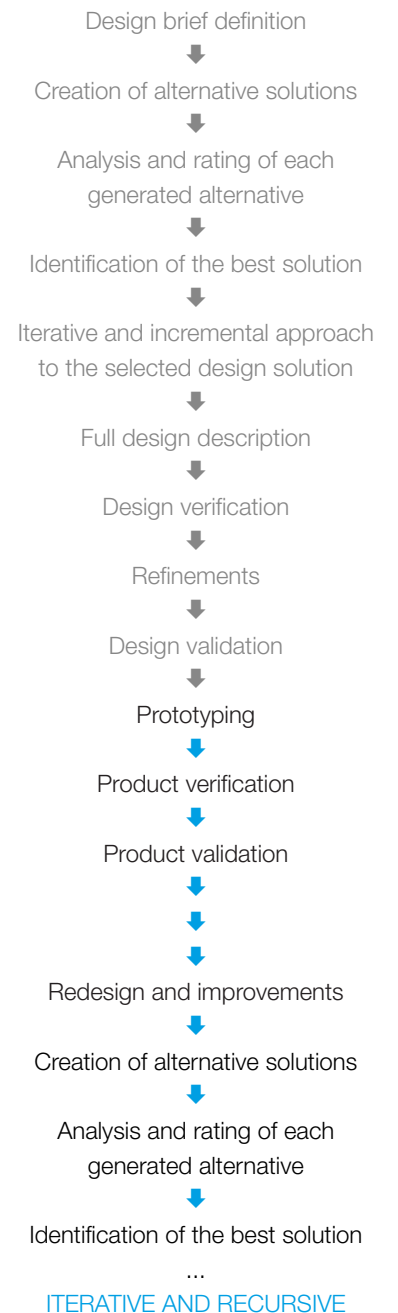
Test

As soon as the key stakeholder approved, I proceeded with user testing to obtain detailed data needed to verify performance and efficacy of developed piece of furniture. The data collected were in the form of:

- Scientific app-based survey, launched on January 7th 2021, concerning the perceived usability of the prototype and users’ general impressions, but also gathering data about personal drinking consumption habits;

- On-site usability tests, during which I acted as facilitator, in order to monitor for issues and, when they raised, I noted and investigated the actions and speech of participants;

- Semi structured interviews, started in March 2021, in which volunteers have been encouraged to provide useful critiques and suggestions to improve the solution. Non-users’ reasons have been investigated, too. This phase provided very useful insights for further development.



Flow diagram describing the adopted evaluation process and the research steps following the first prototype realization.

Figure n. 266

PUNTOnet H₂O in the background of the former industrial site in Bologna that actually hosts Hera Group Headquarter.

Photo by Fabio Mantovani, July 2021.

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Stimulation of users' commitment through text

The infographic stencilled onto the bench clearly discloses the imperfect nature of the prototype, saying "Hello! I'm just a prototype: help me to improve myself!". People are invited to be more indulgent in case of malfunctioning and flaws, and are supposed to be more willing to give feedback when they know there is scope of modification.

Gamification through augmented reality experience

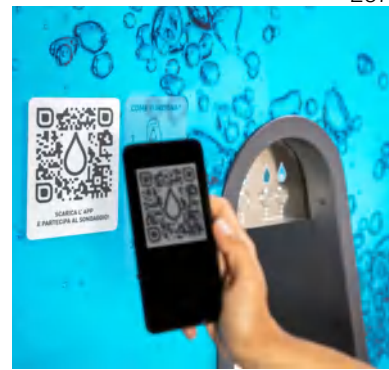
Learning from the "Deepest bin in the world" developed by the Swedish agency DDB, that proved how well this type of persuasion works (Alter, 2017), PUNTONet H₂O came with the launch of a pilot Augmented Reality App that can potentially increase citizens' attention in the proposed service and boost engagement. Just pointing their smartphone camera at the totem, users are enabled to see, on their screen, what the system can do. The dedicated app also displays a selection of the data collected by the sensors embedded in the totem, such as meteorological parameters, atmospheric pollutants and the quality of the dispensed water, and additional multimedia contents extending what is being projecting on the digital signage at that moment. During usability tests, people were invited to scan with their mobile devices the QR code applied on the totem, through which they could download PUNTONet H₂O dedicate App and fill in a scientific app-based survey that I crafted to collect information about testers' drinking habits, general perception of public drinking fountains and the prototype. PUNTONet H₂O can be used by anyone who is allowed to access the area, regardless he/she has download the dedicated app or not; however, the high number of first-time downloads represents an interesting cue about the number of prototype testers.

Usability and taste tests with moderator and rewards

The research group set up several "usability and taste tests" spaced evenly throughout the product verification process with the threefold purpose to involve sample users, to check the prototype's functionality, design, user experience and to detect any unexpected issue or potential new features.

As test facilitator, I asked people passing by (Hera Group employees, consultants or company suppliers) to take a sip from PUNTONet H₂O, download the dedicated app and express personal impressions about the prototype and its services. Voluntary testers received a 400 ml refillable bottle in return for their participation. We decided to adopt moderated testing to introduce the prototype's goals and functionality to participants, answer their queries and investigate the reasoning behind specific behaviour, that with just unmoderated observations would have remained undisclosed. Repeating that the piece of furniture that testers were using was not the final product but need refinements they can help finding, was also useful and increased engagement.

All these strategies contributed to the positive outcomes of the testing stage. All the comments and feedbacks from testing participants – including team mates, consulted experts, technicians and finally users – were accurately documented as essential assets for the research improvement.



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Figure n. 267

Scanning the QR code on the totem with their mobile devices, people can automatically download PUNTONet H₂O dedicate App, read more about the prototype and fill in a quick survey about it.

Ph by Fabio Mantovani, July 2021

Figure n. 268

The demo site before a round of usability test, with free refillable bottles as incentive for participation. Ph by Ilaria Fabbri, March 2021.

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FINDINGS

This part of the prototype development process is devoted to verifying the efficacy of the deployed pilot study and examining the results of the testing stage. In general terms, early testers of PUNTONet H₂O at Hera Group Headquarters showed a prevailing positive impression of the prototype as a whole, as assessed by the survey.

Survey response

Survey results show that the reliance on bottled water or refillable flask is almost equally distributed among sample users, with faint predominance of people buying plastic bottles when outside (54%). Contrasting this, 99% of participants indicate that they used public drinking fountains when engaged at least in one of the appointed outdoor activities, in agreement with the research hypothesis that citizens would be encouraged to drink tap water more frequently if they found an operating and appealing drinking fountain on their way. From the chart pies, it clear that nearly all testers agree that a widespread diffusion of PUNTONet H₂O would be helpful in curbing the consumption of plastics. The app-based survey also revealed key points on issues to focus on for further development of the proposed services.

Interviews

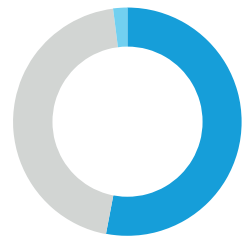
After I collected and preliminarily analysed the first results from the app-based survey, in order to get a sense of the emerging issues, I conducted semi-structured interviews with several voluntary testers to gain an in-depth look at their perception of the prototype. These interviews lasted between ten and fifteen minutes and were held in person nearby the demonstration site. It is worth remembering that only Hera Group's employees, authorised suppliers and consultants can access the area, therefore interviews are carried out within this sample group. Further versions of the prototype should be tested on a wider range of users, also including children, retired persons, dog walkers etc., so as to get the most relevant feedback and to uncover any relevant issue.

Some of the open-ended questions in these semi-structured interviews included:

- *What are the activities you like to do outside?*
- *What do you think about the street furniture and other urban elements in your neighbourhood?*
- *How clean and tasty do you think water from public fountains is?*
- *What do you like the most of the prototype? And what would you improve?*

During the interviews, I also turned some questions that users from previous rounds of test asked me: this strategy gave further insights about the key areas of concerns that users may have while approaching or using PUNTONet H₂O.

The feedback gathered from the testing session (survey results, on-site usability tests, semi-structured interviews but also comments from teammates, field experts and technicians) are structured in a Feedback Capture Grid; all the four quadrants received inputs, even though the "Ideas" that interviews sparked are slightly more in number than negative feedbacks and criticisms about the prototype.



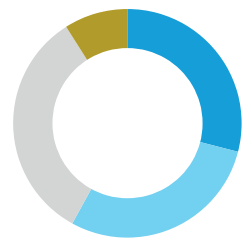
IF YOU WERE THIRSTY WHEN OUTSIDE, WHAT WOULD YOU BE MOST LIKELY TO DO?

- drink from my own refillable bottle 53%
- buy a bottle of water 45%
- keep thirst at bay 2%



HOW WOULD YOU RATE THE DESIGN OF THE PROTOTYPE (shape, colours, materials...)?

average evaluation = 3.70 / 5



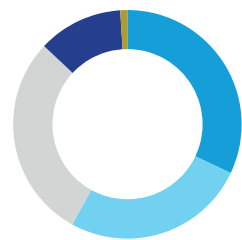
THINKING OF PUBLIC SPACES THAT YOU REGULARLY VISIT, ARE THERE PUBLIC DRINKING FOUNTAINS?

- yes, fully functioning 29%
- yes, but dismissed or poorly maintained 29%
- no, they aren't 33%
- I don't remember 9%



HOW WOULD YOU RATE YOUR EXPERIENCE WITH THE PROTOTYPE (dispenser and interface, seat comfort...)?

average evaluation = 4.10 / 5



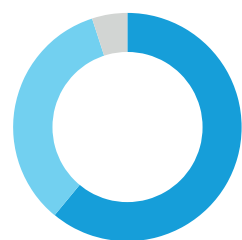
IN WHICH SITUATIONS, AMONG THE FOLLOWING, DID YOU USE A DRINKING FOUNTAIN?

- in a very hot day 32%
- during a bike trip 26%
- when out for a run 29%
- walking the dog 12%
- never 1%



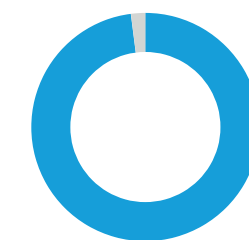
HOW WOULD YOU RATE THE PROTOTYPE WATER (taste, temperature, provided amount...)?

average evaluation = 4.15 / 5



ARE THE PROVIDED SERVICES USEFUL TO YOU (bottle refiller, electric charge, seat...)?

- very useful 61%
- of average usefulness 34%
- of little usefulness 5%
- not useful at all 0%



DO YOU THINK A WIDESPREAD DIFFUSION OF THIS PROTOTYPE WOULD HELP TO REDUCE THE CONSUMPTION OF SINGLE-USE PLASTIC BOTTLES?

- yes 98%
- no 2%

Figure n. 269
 Chart pies from the app-based survey. The total number of responses is 58.

LIKES

- I find it extremely useful.
- It is a brilliant idea!
- I really like wireless charging. Please add additional ones!
- I think there is a need for this kind of service in the urban environment, catering to sportpeople in parks and outdoor gym, but also to parents with little children, that are used to get dirty and thirsty when playing outside.
- There is a need for such pieces of furniture!

QUESTIONS

- What is it? It is not immediately clear.
- Does it provide sparkling water too?
- Does it work with solar energy?
- Where have I to place my water bottle exactly? It is not so evident to me.
- Why is it so high?
- What is this dotted grid? Is it a music speaker? I'd like it was!
- What kind of material did you used as seat?
- May I know how many refills I had from the prototype?

CRITICISM

- I don't like the dog bowl. I am not very fond of animals, honestly. You should move the area where the dog is supposed to drink to a greater distance from the bottle refiller outlet.
- I dislike the shape of the bench.
- Grooved surfacings, like the one used for the seat, get quickly dirty outdoors.
- The monitor resolution shall be increased.

IDEAS

- A covered shelter for rainy days.
- A drinking fountain. I would like to use the prototype even if I don't have my reusable bottle with me.
- A little trashcan would complete urban service equipment.
- You could add an automatic shoe brush.
- You'd better add touchless buttons.
- I would add a dog waste bag dispenser, to completely address pet's owner needs .

FINDINGS FROM PILOT STUDY

Next part of the research aims to integrate on site observations and feedback from users, stakeholders and experts into the prototype development process, thus devise new iterations of PUNTONet H₂O.

To maximize the amount of learning I got from testing the prototypical service, I crafted a list of the necessary design improvements and refinements, dividing them into four main areas:

1) Technology and interface

- Touchless buttons

Covid-19 pandemic generates the pressing need of minimizing contamination risks, and, consequently, prompts the adoption of several technical solutions minimizing the physical contact with whatever publicly-used feature. Conventional touch buttons shall be easily replaced with a touch-free sensor based interface.

- Extra lighting in close proximity to water outlet

Despite the wide back-lit surface of the totem, the oblong opening where the dispenser and bottle rest are located is not as visible as it should be when it gets dark. An additional LED light based on the sunset and sunrise schedule would provide a convenient night time illumination for greater accessibility.

- Log-in for payment options and personal rewards

The first prototype dispenses purified, ambient or chilled, water for free. In order to meet market and economic trends, and balance installation and maintenance costs, the key stakeholder gradually became acquainted with the necessity to include a pay-as-you go system for dispensing filtered water, however small this cost may be. Moreover, if the system could recognize users through a dedicated app as well as RFID tags, the utility would be able to trace usage pattern (such as number and volume of bottle refills) and provide incentives for those citizens adopting a particularly healthy and sustainable lifestyle.

- Implement remote monitoring

The centralised platform developed by Hera Group in the first version just collects data from security cameras and environmental sensors within PUNTONet H₂O, but it can achieve a greater intelligence and display usage data (power and water use), sustainability information like plastic bottles saved from landfill and report any irregular use or fault.

2) Design and equipment

- Highlight direction on bottle rest

The right spot where the bottle should be placed to let the water jet perfectly fill in, is not so evident, sometime causing water waste and splashes on the ground.

A slight hollow or a target for centration on the bottle shelf could help users in finding the perfect position.

Figure n. 13

Feedback Capture Grid that gathers on-site usability tests results, semi-structured interviews and comments from teammates, field experts and technicians about the first prototype of PUNTONet H₂O

- Add a “stoop and drink” fountain

Carrying a reusable water bottle all day can be a burden, especially during physical activity, and a few comments from interviews confirm this concern. An improved version of the prototype may therefore include a contemporary “stoop and drink” point; this water feature was somewhat neglected during the first phase of the design in favour of a bottle filler, that generally have a perception of being more hygienic (Hassard, 2012).

- Add sparkling water

Still or sparkling water is a personal preference, although the fast-paced diffusion of water kiosks in recent years (from 200 in 2010 to over 2000 units in Italy alone, according to Utilitalia 2018 report), is getting citizens used to find cooled carbonated water in public space at a fraction of the cost of bottled bubbly water. The provision of this additional choice emerged as one of the most desired improvement for the prototype, but involves design challenges in order to integrate large capacity CO2 tanks.

- Reconsider dog bowl location

Usability assessment reveals that some users dislike the proximity of the dog bowl to the bottle filler point, because of cross-contamination concerns. Moving pets dedicated spot elsewhere can give the opportunity to redesign drainage system and minimize splashes at the base of the totem.

3) Accessibility

- More inclusive seating

The bench pf PUNTONet H₂O seeks to provide a convenient resting place for all individuals and are especially dedicated to vulnerable population, who may have difficulty with standing or walking for extended periods. An armrest, for a convenient assistance in sitting and rising, and heel space carved out at the base for ease of getting up, have been suggested by accessibility experts to increase comfort in particular for senior citizens.

- Pay attention to visual displays and control accessibility

During on-site inspection, the experts in the field of accessibility and inclusion argued that individuals with vision impairments may have difficulty with control buttons that lacking tactile markings; furthermore, persons with cognitive challenges may find the graphics explaining the functioning, difficult or counter-intuitive. The system should therefore incorporate visual markings and tactile lettering.

4) Materials and components

- Improve perceived hygiene of bottle rest

Brushed stainless steel dispenser gets dirty when splashed with lime stain content, and even small deposits may detract from perception of cleanliness and hygiene of the whole system. To avoid water stagnation and reduce water stains, the stainless steel bottle rest should be given a small slope (about 0,5%).

- Glazed back-printed panels get damaged

Despite its pleasant and distinctive aesthetic when installed, monolithic glass panels reveal backsides, such as a very delicate printed surface, that get easily scratched during maintenance operations. The research team, jointly with glass manufacturers, shall evaluate different solutions, likewise stratified glass pane for a greater protection of the printed side.

- Better management of runoff and drainage

On-site observations disclose some flaws concerning excess water management, of both bottle filler and dog bowl; in particular, draining runoff from the lower bowl directly on the ground should be avoided in most urban locations, to prevent potential slip hazard and affect the system appeal. Directing all excess water into grey water pipes within sub surface pits will be considered.

Based on this list of flaws, observations and suggestions from prototype users, the product modification process begins.

14

FLAWS TO BE FIXED

- The right spot where to put the bottle for refill is not as evident as it should be.
- There is a need for extra lighting at water dispenser, for greater visibility in the dark.
- Some users are disappointed by the proximity of the dog bowl to bottle refiller.
- The draining system creates unsuitable splashes at the base of the totem, with consequent slip hazard.
- The water station is hardly accessible to individuals with visual impairment.
- The stainless steel bottle rest gets dirty when little amount of water is left over.
- The back print on glazed panels gets scratched easily during the simplest maintenance operations.

IMPROVEMENTS AND UPGRADES

- Touchless buttons are a keenly felt necessity after Covid-19 outbreak.
- A "stoop and drink" fountain would extend the system accessibility to users without their own vessel.
- A pay-as-you go system for dispensing filtered water should be considered to balance installation and maintenance costs.
- Sparkling water is a really sought-after option among modern-day consumers.
- Armrest and heel space would provide a convenient assistance in sitting and rising from the bench.
- Harness technology to achieve a full remote monitoring of the urban element.
- Implement the network of health-driven urban services prompted by PUNTONet H₂O.

Figure n. 14

Main insights from observations, usability tests and interviews at the demonstration site in Bologna.

Ongoing refinements and further development

"...Prototyping is like a spiral closing in along a single trajectory. Each prototype is a refinement of the previous one, and takes you one step closer to the final product. Iterative prototyping is a form of incremental refinement and validation, rather than a technique of exploration".
(Buxton, 2007, p. 388).

PRODUCT VALIDATION

While the Product Verification stage aims to identify which prototype's design areas or components do not meet the project criteria, requirements or specifications, including physical and functional interfaces, and therefore wants to prove whether "The product was done right", the Product Validation Process addresses the equally critical question: "**Was the right product realized?**" (NASA, 2007), and seeks to determine the effectiveness and suitability of the product when placed in a realistic environment. Of course, the ultimate goal of validation is to determine if the design itself is the right one for meeting stakeholder expectations; in particular, it is worth noting that, from this phases on, the research started receiving inputs from **new interested parties**, i.e. a handful of Municipalities willing to test the innovative service on their own territories; Hera Group, as key stakeholder, engaged with them to collect overarching constraints and intents. Therefore, the review and redesign of the first prototype is a crucial part for the overall viability of the project, scaling up and fully commercialise the proposed service into real urban environments.

Three independent but intertwined actions were performed in the next part of the research:

- 1) Find out technical solutions to fix glitches and flaws detected during on-site observations and testing;
- 2) Extend or reduce the provided services, according to market opportunity;
- 3) Investigate alternative design options to further develop the unit into new versions.

Product verification process called into question the **hierarchy of prototype's design elements** and, with it, the overall success of the proposed service in the expected environment, in relation to design features and technology equipment.

To evaluate different options, a **catalogue** of four distinct pieces of street furniture was devised, including the one just developed into full scale prototype; all of them fulfil the vital function of providing drinking water in public space, but they come in **four different sizes and shapes**, and increasing level of equipment, from the minor water outlet with stone basin and bell-shaped faucet, to the full equipped version, a rectangular stele with an indentation along its perimeter, measuring mm 350x150, suitable to accommodate on its side a reusable bottle for water refill, next to a longer and articulated bench of 5150 mm in length.

Again, the research group compared the four variants according to the same selection criteria previously used to pinpoint which solution translate into the first prototype. Among the eight indicators, the key stakeholder gave particular relevance to the **visual impact** of design option, its being iconic and original in shape; therefore, the double slab totem, with its oblong opening that allows to look through, ranked better than the rectangular stele of the XL version.

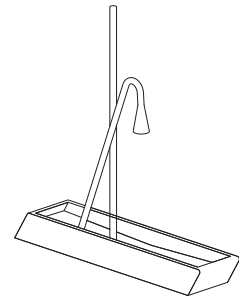
Figure n. 270
PUNTOnet H₂O smallest version, that consists of a rectangular stone basin and a steel bell-shaped faucet, providing nonfiltered ambient temperature water.
Visualization by Ilaria Fabbri



S

- wide accessibility ◆◆◆
- visual impact ◆◆
- self-stable geometry ◆◆◆◆◆
- extensible in service ◆
- water features ◆
- technical achievability ◆◆◆◆◆
- suitable advertising space ◆
- affordability ◆◆◆◆◆

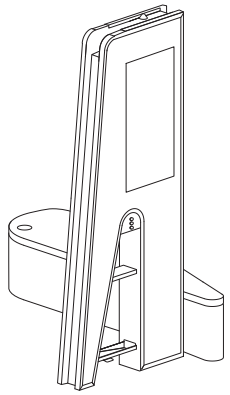
TOTAL: 26



M

- wide accessibility ◆◆◆◆
- visual impact ◆◆◆◆◆
- self-stable geometry ◆◆◆◆◆
- extensible in service ◆◆◆◆◆
- water features ◆◆◆◆◆
- technical achievability ◆◆◆◆◆
- suitable advertising space ◆◆◆◆◆
- affordability ◆◆

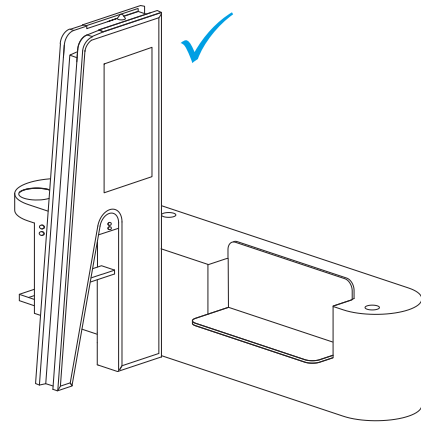
TOTAL: 34



L

- wide accessibility ◆◆◆◆◆
- visual impact ◆◆◆◆◆
- self-stable geometry ◆◆◆◆◆
- extensible in service ◆◆◆◆◆
- water features ◆◆◆◆◆
- technical achievability ◆◆◆◆◆
- suitable advertising space ◆◆◆◆◆
- affordability ◆◆

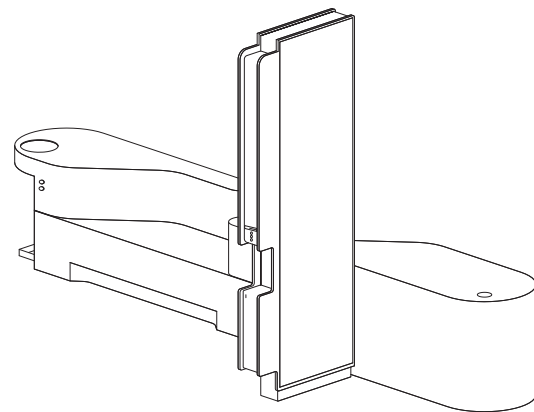
TOTAL: 38



XL

- wide accessibility ◆◆◆◆◆
- visual impact ◆◆◆◆◆
- self-stable geometry ◆◆◆◆◆
- extensible in service ◆◆◆◆◆
- water features ◆◆◆◆◆
- technical achievability ◆◆◆◆◆
- suitable advertising space ◆◆◆◆◆
- affordability ◆◆

TOTAL: 36
208



- | | |
|---|---|
| non filtered non refrigerated water | ✓ |
| filtered water | × |
| filtered chilled water | × |
| filtered chilled sparkling water | × |
| stoop and drink fountain | ✓ |
| bottle refiller | ✓ |
| dog bowl | × |
| public seating | × |
| environmental sensors/WiFi/ power outlets | × |
| digital screen | × |
| digital wall | × |
| workstation/desk | × |

15

- | | |
|---|---|
| non filtered non refrigerated water | ✓ |
| filtered water | ✓ |
| filtered chilled water | ✓ |
| filtered chilled sparkling water | × |
| stoop and drink fountain | × |
| bottle refiller | ✓ |
| dog bowl | ✓ |
| public seating | ✓ |
| environmental sensors/WiFi/ power outlets | ✓ |
| digital screen | ✓ |
| digital wall | × |
| workstation/desk | × |

- | | |
|---|---|
| non filtered non refrigerated water | ✓ |
| filtered water | ✓ |
| filtered chilled water | ✓ |
| filtered chilled sparkling water | ✓ |
| stoop and drink fountain | ✓ |
| bottle refiller | ✓ |
| dog bowl | ✓ |
| public seating | ✓ |
| environmental sensors/WiFi/ power outlets | ✓ |
| digital screen | ✓ |
| digital wall | × |
| workstation/desk | ✓ |

- | | |
|---|---|
| non filtered non refrigerated water | ✓ |
| filtered water | ✓ |
| filtered chilled water | ✓ |
| filtered chilled sparkling water | ✓ |
| stoop and drink fountain | ✓ |
| bottle refiller | ✓ |
| dog bowl | ✓ |
| public seating | ✓ |
| environmental sensors/WiFi/ power outlets | ✓ |
| digital screen | ✓ |
| digital wall | ✓ |
| workstation/desk | ✓ |



271



272

Table n. 15
Provisional catalogue of PUNTOnet H₂O street furniture family

Figure n. 271
Tentative impression of PUNTOnet H₂O large version in Venice Beach, Los Angeles.
Visualization by Ilaria Fabbri

Figure n. 272
PUNTOnet H₂O largest version, featuring a rectangular stele and a 5-metre-long bench, with two curvaceous backrests.
Visualization by Ilaria Fabbri



The subsequent phase of design exploration involved, as **variables**, different water types, IoT equipment and potential introduction of charges; a long bench covered in wood, with protruding seating and central armrest for greater accessibility and a higher top serving as standing workstation, was set as **fixed element**.

The purpose of the long bench is threefold:

- it contributes in making PUNTONet H₂O a multifunctional outdoor community hub with seats and “stoop and drink” outlet;
- it serves as counterweight, and gives balance and stability to the whole structure;
- it provides sufficient equipment room for the storage of electrical devices, filtering system and, above all, large capacity CO₂ tanks.

The simplest model just delivers unfiltered and unrefrigerated water for free, without vertical totem neither smart sensors; in more sophisticated versions, filtered, chilled and carbonated water complete the range of opportunities, with vertical elements that support environmental sensors and a led wall for public messages. Intermediate, tentative options consist of a stand-alone multipurpose bench, where water delivery of whatever type (free one or at a cost) is grouped in the smart front side, with a “water window” that accommodates reusable bottle while being refilled. The evaluation also includes the first prototype installed and tested in Bologna, but it is worth noting that, only in this case, filtered and refrigerated water are dispensed at no cost, and the sparkling option is not yet available.

During this second Design Solution Definition Process both an **iterative and incremental approach** are adopted: it was iterative because one version was refined in consecutive runs, but it was also an incremental work, because new features were added throughout a step-by-step evolution, and different sections of the product were developed at various times and rates.

The incremental progress embraced by the research group allowed to pinpoint the most promising design option and to highlight **which elements** a new, revised version of **the system cannot dispense with**:

- Iconic vertical totem, with a distinctive elongated opening;
- Articulated bench providing inclusive and flexible spaces to meet, work and relax;
- Advertising space, to increase community’s interest and engagement and help defray the cost of installation and maintenance;
- IoT equipment, to deliver real time data to public administrations and utilities and to assist with safety and maintenance management.
- Carbonated water, along with filtered and chilled type, in order to fully align PUNTONet H₂O range of choice to standard water kiosks’.

No similar product exists in the marketplace in Italy and abroad.

In regard to the last point, it is extremely important to highlight the **differences between the proposed service and “Water Houses”**, bottle filler stations originated in Italy around 2010 and quite common in France and Belgium, too, that usually dispense filtered still and carbonated water at a small fee. The following chart summarizes the key features of the two urban elements: the revised version of PUNTONet H₂O and standard water kiosks.

Figure n. 273
Impression of PUNTONet H₂O extended version, with a smart bench that accommodates “stoop and drink” fountain, dog bowl, device charging and a workstation desk.
Visualization by Ilaria Fabbri

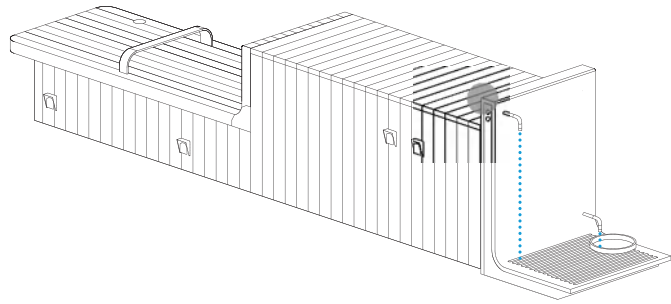
Table n. 16
Comparison table chart of different design solutions as the equipment, water type and payment terminal change.

ITERATIVE AND INCREMENTAL APPROACH FOR ALTERNATIVE DESIGN SOLUTION EVALUATION

- Free unrefrigerated unfiltered water
- Water at a fee (filtered, and eventually refrigerated and sparkling)
- Water selection interface
- Payment unit
- IoT sensors
- Led screen for public messages

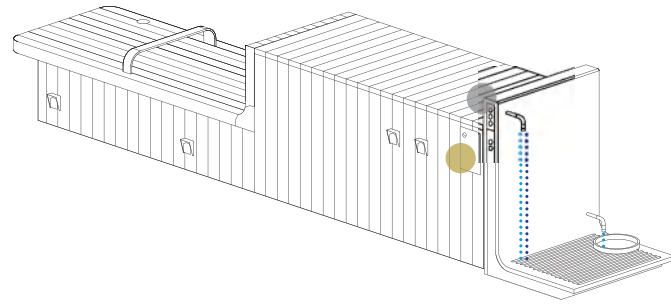
1. Free water only

Unrefrigerated unfiltered still water at no cost



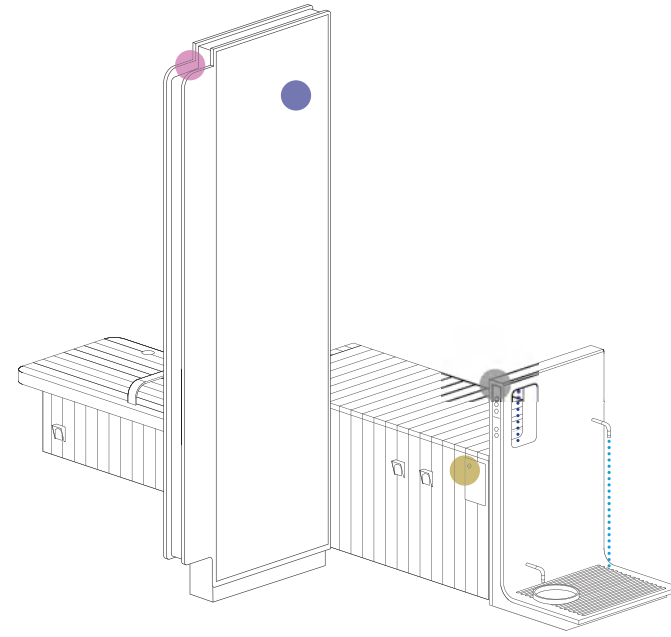
2. Free+pay

Free, unrefrigerated unfiltered water and filtered, refrigerated, or chilled water - at a cost - flows out the same outlet.



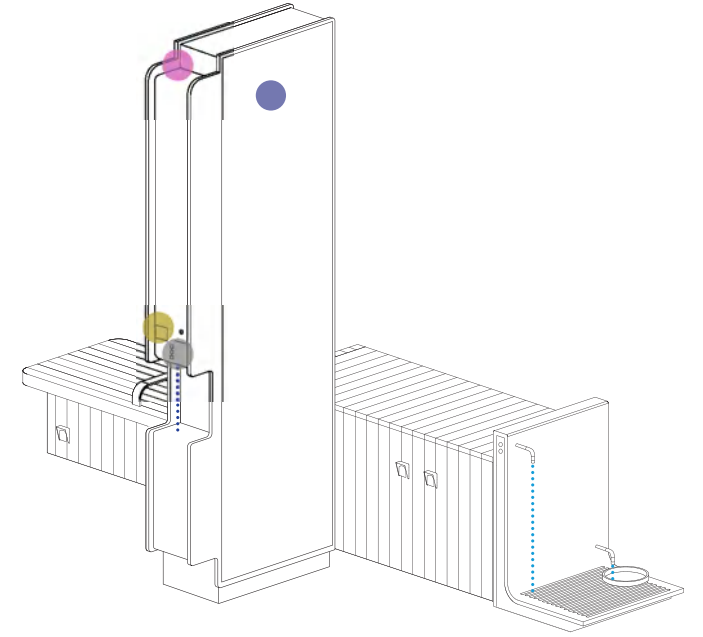
5. refill window + slim screen

A slim, rectangular totem placed side by side the bench hosts environmental sensors, Wi-Fi and a screen wall covering the whole surface of one of its side.



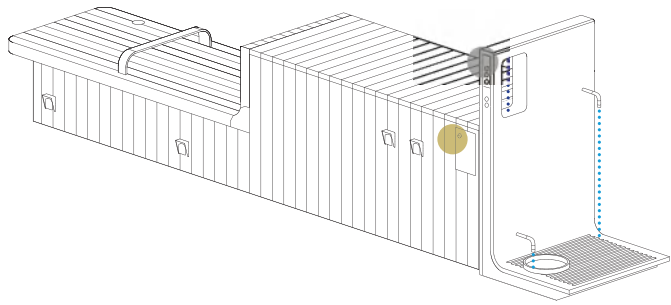
6. Free + thick screen

A rectangular steel with IoT equipment on the top and an indentation along its perimeter, accommodates filtered, refrigerated and chilled water dispensers, and the payment panel, too.



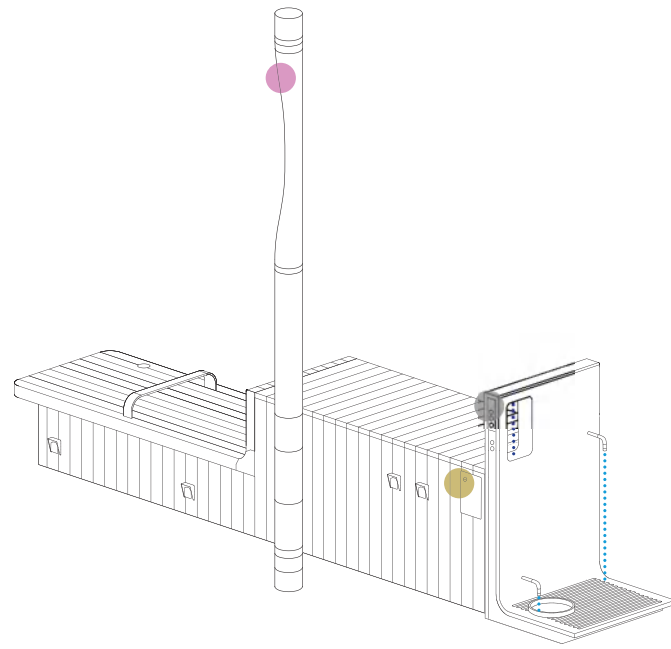
3. Refill window

Free, unrefrigerated unfiltered water is dispensed by downward spigot, while the water window can accommodate reusable bottles on both sides, for a refill with filtered, refrigerated still or carbonated water, at a small fee.



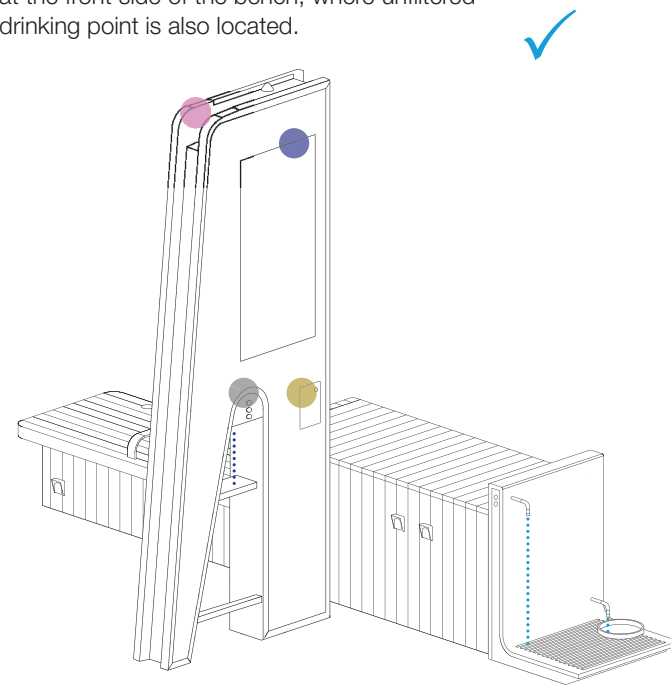
4. Refill window and pole

As compared to the previous version, the slim pole just allows the installation of IoT sensors and Wi-Fi router at appropriate height. Small light at the top it is like a beacon in the dark.



7. Free + totem

A revised version of the first prototyped vertical totem, with payment panel on the side, is placed next the bench; the dog bowl is moved at the front side of the bench, where unfiltered drinking point is also located.



8. First prototype

The service as built in the demo site in Bologna. No sparkling water nor payment method are provided.

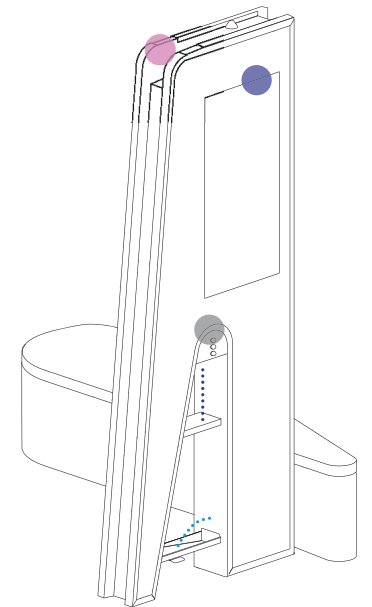


Table n. 17

Comparison chart between PUNTONet H₂O CO₂ and a standard "Water House", quite diffused in Italy, with more than 2000 units (Utilitalia, 2017), and abroad. Water house in Castel Bolognese, photo by Gabriele Lelli. Design visualization by Ilaria Fabbri



PUNTONet H₂O CO₂

Provided services	It combines several urban services into a single piece of urban furnishing (drinking fountain, bench, screen, lighting, device charging...). Most of them are free of charge.
Target users	The service is dedicated to pedestrians, dog walkers, bikers, runners, e-mobility commuters, tourists and thirsty wayfarers that are looking for a pleasant place to rest and have a cool drink.
Accessibility	Fully accessible for people with reduced mobility and visual impairments, and for dogs, which are not often accommodated or welcomed in city spaces.
Way of drinking	Thirsty users with or without their own reusable bottle. The bowl at the ground level fills for dogs who prefer to lap water up from a pool, and the spout is easy to use if they prefer to drink from flowing water.
Effect on personal water intake	It promotes daily hydration on the go. Its recognizable shape throughout the city may also serve as gentle reminder to increase water intake during the day.
Structure	Free standing, with no need of foundation nor excavation works; can be easily relocated if needed.
Design and shell	Iconic shapes, enjoyable and replaceable backlit covering, with endless opportunities of print; it provides a contemporary aesthetic and can be customized according to the location.
Urban placement	It can suit any kind of outdoor environment, up-market and historic locations included.
Dimensions and positioning	The piece of street furniture alone has limited dimensions, but a large clear floor space is required to accommodate different users around it.
Payment method	NFC reader for contactless payment via smartphone, smartwatch and credit card; payment app option will be implemented too.



STANDARD WATER KIOSK

Provided services	Monofunctional - narrow range of services: one or more bottle fillers that dispense filtered flat or carbonated water with small charge.
Target users	Water kiosks mainly target people who purposely reach them with their car, collect large amount of water, pack filled bottles in the boot and store them at home.
Accessibility	Limited accessibility for persons with disabilities and children; it does not cater for pets.
Way of drinking	The service only accommodates humans coming with their own vessel.
Effect on personal water intake	It supports large water stockpile at home.
Structure	Not self-standing, it requires foundation and anchor bolts of adequate embedment depth, which result in small civil works and local brakes of existing pavement.
Design and shell	Most of the time the design is purely utilitarian, inconspicuous, with limited possibilities of personalization.
Urban placement	Not suitable for all urban contexts. Rarely placed in prominent location, water kiosk is generally installed at the corner of car-friendly street scape, oriented towards motorized flow by necessity.
Dimensions and positioning	Bulky element that creates unsafe blind corners; conversely, the required unobstructed space is generally limited to the minimum maintenance clearance, as the service has only one operating/engaging side.
Payment method	Mainly coin/cash acceptor, and with connected burglary risks.



SECOND DESIGN RELEASE

In response to learnings from the first pilot scheme in Bologna and inputs from key stakeholder and Public Municipalities interested in testing the prototype in their own territories, PUNTONet H₂O evolved towards a new, improved design version.

The iterative and incremental development described in the previous section allowed to identify the best performing solution among the set of alternative concepts conceived in the second design cycle, drop less promising alternatives and proceed to the next level of resolution.

This iterative process gave the possibility to refine and revise the prototype relatively quickly, to **fix all areas of concerns** and **implementation** collected during the testing stage and detail features and functions addressing municipality expectations.

The design of the second version of the multifunctional water station has been successfully registered to the **European Union Intellectual Property Office** on November 29, 2021, with the patent number 008780043-0001. The certificate of design property appoints as inventors the following research members: from industry side (Hera Group) Eng. Enrico Piraccini, head of development, Innovation Central Direction, Eng. Simone Allegra, project development, Innovation Central Direction, M. Arch. Federico Lazzarini, Innovation Central Direction; from academic, side Prof. Gabriele Lelli, Next City Lab scientific coordinator, M. Arch. Roberta Bandini and PhDc Ilaria Fabbri.

The second release has been labelled as “PUNTONet H₂O CO₂”, to immediately refer to the supplement of sparkling option, but it should be noticed that the achieved implementations and improvements compared to the first version are far beyond this technical addition.

In general terms, performance objectives of PUNTONet H₂O CO₂ are the same of the first prototype's: a multipurpose piece of street furniture that dispenses drinking water and provides several urban services, designed to promote community wellbeing, express sustainability and enhance amenity in public spaces, parks, squares, and neighbourhood streetscapes.

To summarise the overarching features, the proposed urban object is:

- **Integrated system.** It collects urban data, it monitors and manages urban assets and facilities;
- **Landmark.** It is an iconic, easily visible beacon throughout the city, with distinctive and contemporary design, suitable for different locations;
- **Self-standing without foundation.** Except for small civil works for water and electrical supply, no cuts or damages on the existing paving will result from the positioning. This feature tangibly simplifies urban placement and holds down installation costs;
- **Modularly extensible** in terms of services and equipment;
- **Completely accessible.** It can accommodate a wide array of users with different needs and abilities, children, elderly, pets;
- **In line with the goals of circular economy.** Not only is it primarily made of recycled and recyclable materials, durable and weather resistant, but the very first ambition of this object to reduce plastic waste in a local precinct and encourage sustainable behaviours.

Figure n. 274

Urban placement study of PUNTONet H₂O CO₂ along a busy sidewalk and bike lane in a retail district, an easily accessible area where people gather and pass by.

Placing a reliable source of fresh water, a comfortable bench and a set of attractive public amenities nearby grocery shops and open air market may encourage people to stay outside longer, which can also boost retailers' revenues as a consequence.

Businesses may also gain extra visibility thanks to the led advertising screen installed on the smart water station.

Visualization by Ilaria Fabbri, siting in Höfe am Brühl quarter in Leipzig, Germany.

FAVOURABLE URBAN PLACEMENT AND EXACT LOCATION

The second design release is larger, more articulated in shape, and provides additional services: **longer stays** and wider range of activity are therefore expected at PUNTONet H₂O CO₂. For this reason, among the most favourable places already mentioned and motivated in the section “WELL-PLACED AND CONNECTED TO THE NEIGHBOURHOOD”, referring to the six design criteria I identified for a contemporary element dispensing water, **views** should be even more carefully considered.

Squares, or snug and verdant spot, that would **facilitate relaxation** and allow different level of engagement and conversation, are particularly worthwhile settings, more advisable than busy sidewalks.

It is also an imperative duty to verify that **traffic circulation or emergency access** nearby the prototype would never be affected by its installation or maintenance operations. North facing and **shaded areas** are desirable choices to prevent hot fixtures and water, chiller overload and user discomfort. However, the proximity of **trees** and hanging limbs onto the area should be carefully evaluated, since they can drop leaves and clog drainage, which can cause uncared-for appearance.

This second, extended version is bigger in size than the first prototype, thus requires a larger clear floor space to be properly maintained and used by pedestrians of all ages, dog walkers, cyclists, electric mobility drivers at the same time, an **unobstructed hard standing area** measuring at least cm 462x641.

In case of slopes or irregular ground floor of the appointed location, levelling metal feet will conveniently plumb the totem and the bench, and perfectly level the street element as a whole. As far as thickness, load bearing capacity and flooring features of the basement are concerned, the reader can refer to the paragraph “URBAN LOCATION AND GROUND SURFACE” within the chapter specifically dedicated to “Prototype design”.

The appointed layout ensures there is a sufficient room around the unit for **pedestrian circulation** and access. **Cyclists** are also taken into account: bikers dismounting and stopping the motion of the bike to refill their bottle or recharge the vehicle could be a barrier for other potential users. The additional space on the opposite side of the totem's provides users, and in particular cyclists, with useful manoeuvring space for balancing and avoiding eventual obstacles.

In terms of accessibility for **people using wheelchair**, this second design release features main operable parts, (touchless buttons, fountain and dog bowl push buttons, payment panel, bottle shelf and drinking tap) oriented for a comfortable **lateral approach**.

A remarkable difference with the first prototype is the need for an unobstructed working space for the maintenance and replacement of **two carbon dioxide tanks** of 20 kilograms each – seized in relation to expected use. Gas cylinders are located in a full-front drawer under the bench, that slides out and occupies a floor area of 168 x 90 cm in plan. For a greater flexibility of the system, the totem can be fixed either on the right or left of the bench, secured with its vertical side to inner **specular structure**, and so does the front drawer containing the CO₂ cylinders, which, however, should always be on the totem's side.

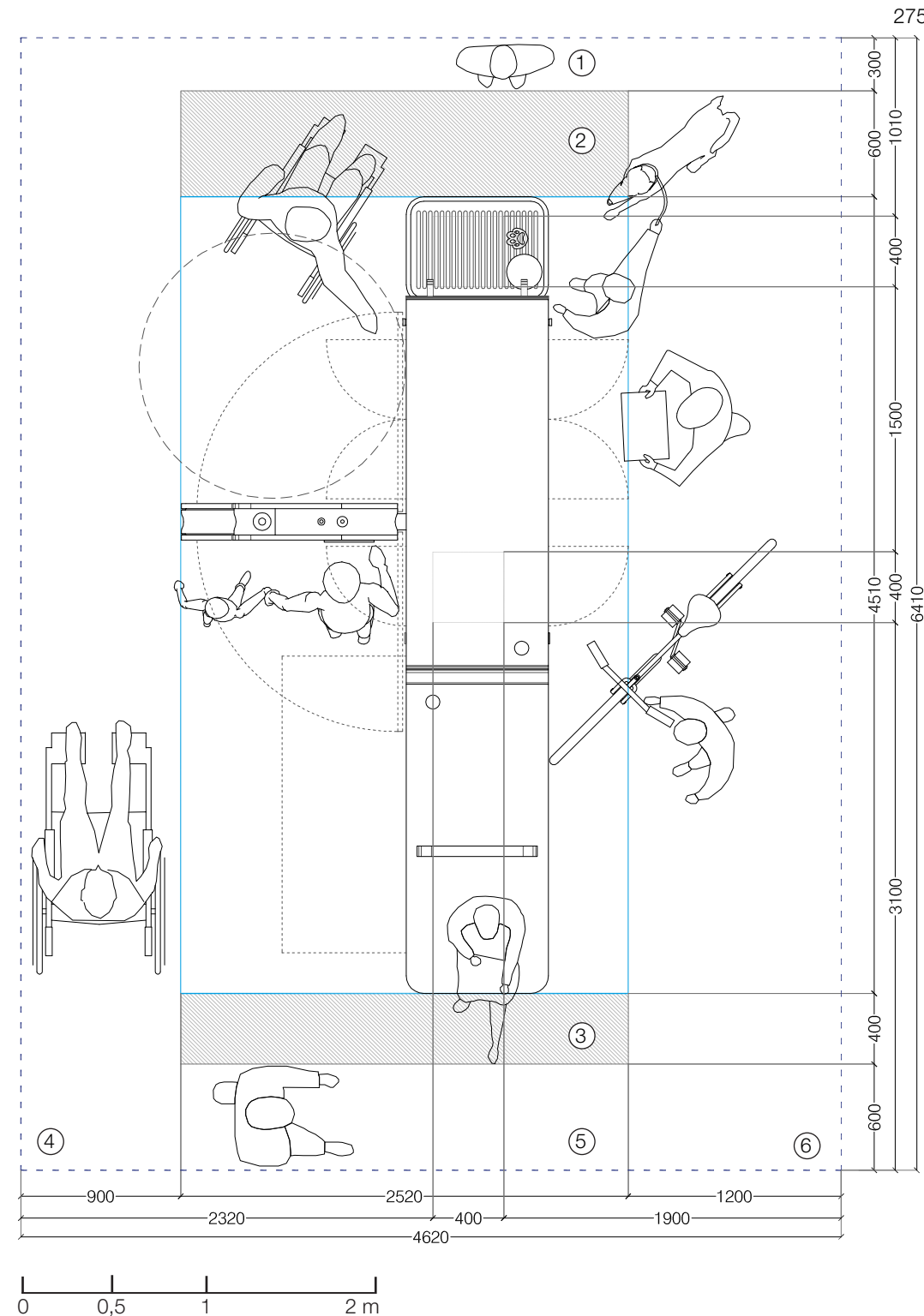


Figure n. 275

Accommodation model depicting the dimensions and positioning of the clear floor space required by different users (manual chair and scooter users, dog owners, maintaining technicians,...).

- 1- Minimum width for standing person
- 2- Clear floor area for "stoop and drink" fountain users
- 3- Clear way dedicated to people sitting at the bench
- 4- Minimum clear width for single wheelchair passage (900 mm)
- 5- Minimum space for one person passing (600 mm)
- 6- General maintenance clearance to accommodate tools, test equipment, procedures, and other job aids during an in-place repair, and additional space to allow bikers dismounting and stopping the motion

- - - minimum recommended size for the location, to properly use and maintain the element
- dimensions of the piece of street furniture, including maintenance doors
- location of water and power supply in relation to the outline of the element

PROVIDED SERVICES AND FUNCTIONS

As compared to the first prototype, PUNTOnet H₂O CO₂ further extends the range of activities that can be held in the public domain and provides more opportunities to meet, work, exercise or simply spend more time outdoors.

Each station integrates different services and street elements that can be profitably used in combination:

- non filtered non refrigerated water, at no cost, from a “stoop and drink fountain”;
- dog bowl for watering pets, for free;
- bottle refill that dispenses filtered water, available in chilled or at room temperature, in still or sparkling variants, at a fee;
- digital screen for branding purposes and public message display;
- public seating that can accommodate up to 4 people, with an armrest for a convenient assistance in sitting and rising, and heel space at the base for ease of getting up;
- elevated surface for an outdoor standing desk, so that people can enjoy sunlight and fresh air while reading or working with their laptop;
- air quality sensors and sound level meter;
- two flush-mounted surveillance cameras, aligned with the vertical surface of totem;
- acoustic speakers;
- public Wi-Fi;
- general power outlets, that enable users to recharge their digital devices but also e-bikes and mobility scooters;
- recessed flush-fit wireless charger for iPhone & Android devices.
- ambient lighting through the back-lit panels covering the totem on both sides for greater accessibility and safety during the night.

A thorough search of the relevant design literature and urban furnishings marketplace yielded that no similar products actually exist in Italy and abroad.

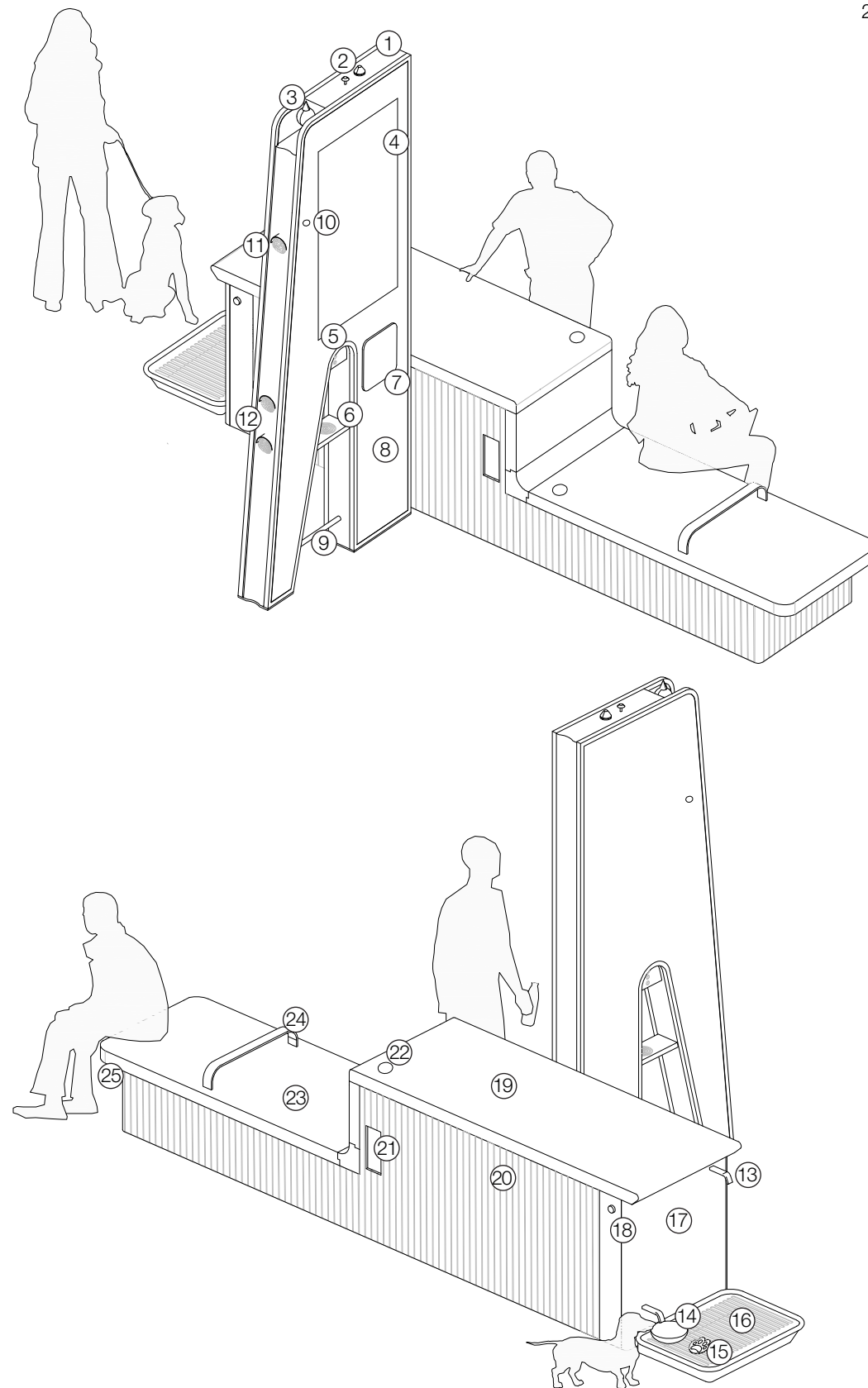
SERVICE CONNECTION

The multifunctional station requires the same connections of the initial prototype; first of all, the **potable water source**, provided through any existing subsurface pit, or built anew, that the long bench will cover and protect. Secondly, water station shall be drained into **storm water**, by a 30/40 mm PVC pipe to a specific pit, conveniently located underneath the fountain basin.

Finally, to power the chiller, sensors and digital devices an **electrical grid connection** with data networking is required, coming from the same underground pit of municipal water supply.

The appropriate dimension for both pits is about cm 40x40.

Public administrations willing to test the proposed service are expected to undertake the site arrangement and the service connection – portable water and electrical supply, and drainage storm water pit, based on the urban layout displayed hereafter, in order to fit seamlessly into any environment.



- 276
- 1- Public Wi-Fi
 - 2- Air quality sensors
 - 3- Sound level meter
 - 4- LCD screen 55" for advertisement, public messages and initiatives inspiring engagement in healthy lifestyles and environmental stewardship
 - 5- Filtered water dispenser in stainless steel, equipped with three touch-free buttons in a vertical row
 - 6- Brushed stainless steel bottle rest, with concentric target that highlights the right position for the bottle
 - 7- Stainless steel panel with different payment options
 - 8- Printed back-lit polycarbonate panel
 - 9- Painted steel tubular for structural connection
 - 10- Surveillance camera (on both side)
 - 11- Air vent holes
 - 12- Acoustic speakers
- 277
- 13- Public drinking fountain (for free)
 - 14- Dog bowl
 - 15- Paw-shaped foot pedal which overturns the bowl to the drain
 - 16- Drainage grid in painted steel
 - 17- Fountain backdrop in painted steel wrapping the end cap of the bench
 - 18- Push button that activates the dog bowl, with tactile pictograms (the counterpart on the other side turns on the tap)
 - 19- Standing desk in Okoume Marine Plywood
 - 20- Cladding in Okoume Marine Plywood with vertical furrows every 45 mm
 - 21- Two outdoor power outlets for device charging, with flat painted covers (on both sides of the bench)
 - 22- Flush-fit wireless charger for iPhone and Android devices
 - 23- Okoume Marine Plywood public seat, with rounded borders
 - 24- Curved armrest in painted steel
 - 25- Protruding wooden surface

Figure n. 276, 277
Second design release, axonometric view, from the side of "free" drinking fountain and the bench side.

DESIGN DETAILS OF THE IMPROVED URBAN AMENITY

As the first prototype and most of the subsequent tentative solutions, the revised version of PUNTONet H₂O is still composed of **two distinct pieces of street furniture** connected each other: a **totem and a bench**; the structure of both of them is essentially made of steel profiles painted in RAL 7024 graphite grey in all visible parts, with a 5mm-thick **metal plate** at the base, with appropriate openings to allow water and electrical connection, and supported by leveling feet, adjustable within a range of 50 mm.

To **reduce transportation costs** and facilitate assembly, the steel structure is split into two parts that are put together on site, with no need of special techniques.

The second version of the totem is higher and larger than the first one – 2950 mm, with a base of 1210 mm that tapers to 917 mm at the top, to better locate inner machinery and sensors, and **standing out in the streetscape even more**.

Several considerations have been made after the prototype test in Bologna about the **totem envelope**. Despite its pleasant and distinctive aesthetic when installed, and its recognized durability in harsh outdoor environment, monolithic glass panels reveal backsides, such as a very delicate printed surface, that get easily scratched during simple maintenance operations (both sides can be opened and reveal the inner workings). The skin of PUNTONet H₂O CO₂ is made from impact proof, UV resistant polycarbonate sheeting of 28 mm in width, frame included. The graphics are back printed to prevent scratching on the front face and back-lit to glow in the dark. Such panels are lighter, more easily replaceable than monolithic glass, and can be recycled as well.

The smaller sides of the totem are less than 210 mm in width, and are covered with a painted metal sheet, modeled in curved shapes to **make the totem appear thinner**.

The upper part of the totem elongated opening is filled with a **stainless steel element**, with a brush-polished finish, slightly recessed, that houses the **water outlet** and three touch-free buttons in a vertical row.

This revised version of the urban object introduces **touchless input** in the water dispenser to meet a keenly felt necessity in public equipment after COVID-19 outbreak. Users will simply place their hand approximately 1-3 cm from the surface of any of the three anti-bacterial stainless steel buttons to activate the built-in sensor and fill their own reusable bottles with either freshly carbonated water, chilled or ambient filtered still water. Tactile pictograms will be integrated on the vertical surface of the water dispenser.

An extra protection of downward water jet compared to the first version of PUNTONet H₂O has been studied: the water source is hidden in a larger metal cylinder, to prevent contact with any bottle rim or foreign objects, and safeguard hygiene.

Two small **LED spots** based on the sunset and sunrise schedule provide a convenient night time illumination for greater accessibility of the water dispenser. The need of additional lighting in close proximity of the nozzle also emerged from the testing stage in Bologna.

The **brushed stainless steel bottle rest**, located at 830 mm from the ground floor, allows single handed operation, which is made simpler and more intuitive thanks to a

target for centration: the concentric circles cut out from the metal surface help users in finding the perfect position where to place their vessel to let the water jet perfectly fill in. To avoid water stagnation and reduce water stains, that were noted during on-site observations and badly affected hygiene perception, the bottle rest has been given a **small slope** (about 0,5%).

The first prototype installed in the city of Bologna dispenses purified, ambient or chilled, water for free. In order to meet market and economic trends, and balance future installation and maintenance costs, the key stakeholder gradually became acquainted with the necessity to include a **pay-as-you go system** for dispensing filtered water, however small this cost may be. Moreover, if the system could recognize users through a dedicated app as well as RFID tags, the utility would be able to trace usage pattern (such as number and volume of bottle refills) and provide incentives for those citizens adopting a particularly healthy and sustainable lifestyle.

With the second release of the prototype, filtered water, be it ambient or chilled, shall be purchased with credit cards or coins, and user interface is improved accordingly, also including tech tools to assist the visually impaired. The **payment panel** is designed in the shape of a square with sides of 320 mm and rounded edges, a 10 mm-thick stainless steel metal plate with brushed finish, where the flush mount payment system is located. Further electronic implementations will allow consumers to use their smartphone for wirelessly transferring water preferences and funds to the station RFID/NFC reader – or to the microchip embedded in the smart bottle band – and to get the desired type of water.

According to the results of usability tests and surveys, some early users were disappointed because of the proximity of the dog bowl to the bottle rest: the second version of the urban service took this criticism into great account and the location of the water spout for animals have been reconsidered.

Pets area have been moved at one edge of the bench; at its place, a thin metal tubular, painted in graphite gray, provides **additional stability** at the base.

Next to the totem, and connected to it, a **long smart bench** contributes in making PUNTONet H₂O CO₂ a **flexible outdoor hub** where to rest and hydrate; at the same time, it gives stability to the structure with its weight, and provides enough equipment room for electrical and water system, CO₂ tanks included.

The drop-shaped bench of the first prototype evolved into an **extended public seat**, with rounded borders and **protruding head** that creates an appropriate **heel space** for ease of getting up. The 1750 mm-long flat surface can accommodate up to 4 people, and it is crafted in a way to give them **different possibilities to sit** up front, in the back and to the side. It features a comfortable sitting height of 465 mm from the ground.

As William Whyte rightly state in his book “City: Rediscovering the Center” (1989), ledges and benches deep enough to be **“sittable” on both sides** are not so common; some of them just tent people to do so, but are too shallow to let them sit down comfortably. The minimum-depth ledge I came across, that was meant to be used on

both sides, was 760 mm deep. If a sitting surface is at least that deep and is accessible on both sides, the length of each side counts as seating. A depth of 800 mm would also allow to store side by side under the bench two CO₂ tanks of 20 kg each. The benefit of the additional space is **social comfort** (Project for Public spaces, 2008). In this way, PUNTONet H₂O CO₂ will provide more room for groups and individuals to arrange as they wish, relax, and interact.

An armrest may help people with physical limitations getting into or out of a seated position; the lack of this feature in the first prototype was promptly noted by CRIBA experts during demo site visits and reported in the previous chapter “Test and measure in the built environment”. The new design includes a **painted steel arm**, fastened with hidden clips almost in the middle of the bench: it creates **two seating areas**, one measuring 800x775 mm and the other one of 800x915 in order to accommodate persons of larger stature or carrying bags.

The elevated surface of the bench is conceived as a **versatile outdoor standing desk**, so that people can enjoy sunlight and fresh air while reading or working with their laptop; both the seat and the reading stand are equipped with recessed flush-fit wireless charger for iPhone and Android devices, while two couples of outdoor power outlets with flat painted cover are available on both sides, for device charging and electric mobility station.

This resourceful urban element seeks to be attract pedestrians also by means of the **warm touch of the surface**: the seat, the desk and its sides are covered in **okoume marine plywood**. Top wooden covering (seating, rounded connection, vertical back rest and standing desk) would be made of okoume boards of considerable thickness – 750 mm and flat surface. Thinner wooden elements of about 30 mm could be used for vertical cladding, where it is advisable to cut out vertical grooves every 45 mm, to ensure a perfect ventilation of inner machinery.

Some portions of the vertical covering can be opened as maintenance doors, as depicted in the drawings I crafted.

The forward edge of the smart bench does not feature a wooden cladding, but a painted steel backdrop, curved at its far ends, that wraps the end cap of the element for 900 mm in height. Here is one of the most significant addition to PUNTONet H₂O if compared to the first prototype, the **“stoop and drink” fountain**.

With the inclusion of a **simpler water source**, dispensing for free two downward water arcs at different heights of unfiltered room-temperature water, PUNTONet H₂O extends its accessibility and can now hydrate thirsty people without their own vessels, previously excluded from the first design solution.

Two **raised stainless steel buttons** with **tactile pictograms** are devised at each side of the fountain: the icons of a drop and a paw engraved on their large surface of 4 cm diameter indicate which faucet they activate (respectively, the drinking fountain and the lower spigot for dog bowl).

They have soft touch operations and **time-flow setting**, that would prevent **water wastage** and at the same time allow a **free-hand operation**, thus facilitating individuals

holding canes or crutches, or with balance limitations, carrying bags or simply with long hair, needing to hold them back while drinking.

Humans’ spigot is no higher than 900 mm from the ground, in order to comfortably accommodate people with **different heights, bending abilities, or using wheelchair** and approaching at the side of the fountain.

The **two faucets** are simply designed, with curved lines and **recessed nozzle** to prevent direct contact with the water outlet, bearing in mind from literature review that fountains dispensing water from a hidden spout below and not above are less likely to be contaminated. Like the other wetted parts of the system, the two faucets are conceived in stainless steel with brushed finish, too.

As anticipated above when describing the revised totem, the **dog bowl** has been redesigned and relocated based on cross-contamination concerns that emerged in usability tests and interviews carried out at demonstration site in Bologna. In this second design release, the trough for animals sits away from the filtered water station, in a stainless steel bowl, which is filled with fresh water each press of the appointed push button. No stagnate water is left over: the tilting bowl can be emptied in the drainage grid when the diligent owner lowers the paw-shaped foot pedal. This is another design improvement if compared to the first prototype, where the dog bowl could be spilled directly on the ground, with consequent splashes at the base of the totem.

PUNTONet H₂O CO₂ also better manages **runoff** and **drainage**: excess water both from the free drinking fountain and the dog bowl is directed into a drain grid in painted steel, which should be exactly located on the sub-surface pit connected to storm water. Here would be drained also excess water splashing onto the bottle rest in the totem while refilling.

The proposed **open drain design** minimizes wetted areas on the ground and potential slip hazard that could result. A **splash reducing mesh cover** can be incorporated underneath the grate, to improve user experience at the “stoop and drink” fountain and to protect the drainage system from rubbish and debris.

In terms of **water supply**, the system now encompasses all the features of the most equipped standard-catalogue water stations (Halsey Taylor Endura, for instance), three-part objects with a bottle filler, an ADA-accessible normal arced drinking fountain, and a ground-level dog bowl (Ivanov, 2015), but in an original multipurpose urban element. The most comfortable for talking relaxing, eating, and sunbathing.

In the design intention, PUNTONet H₂O CO₂, as a whole and in light of urban placement studies and last refinements, is an **inviting and engaging outdoor space** for people to rest, work outside, or simply watch day-to-day life unfold in the neighbourhood.

An iconic and **lively gathering point supporting healthy habits** where friends and strangers can interact, relaxing, drinking water and eventually sunbathing.

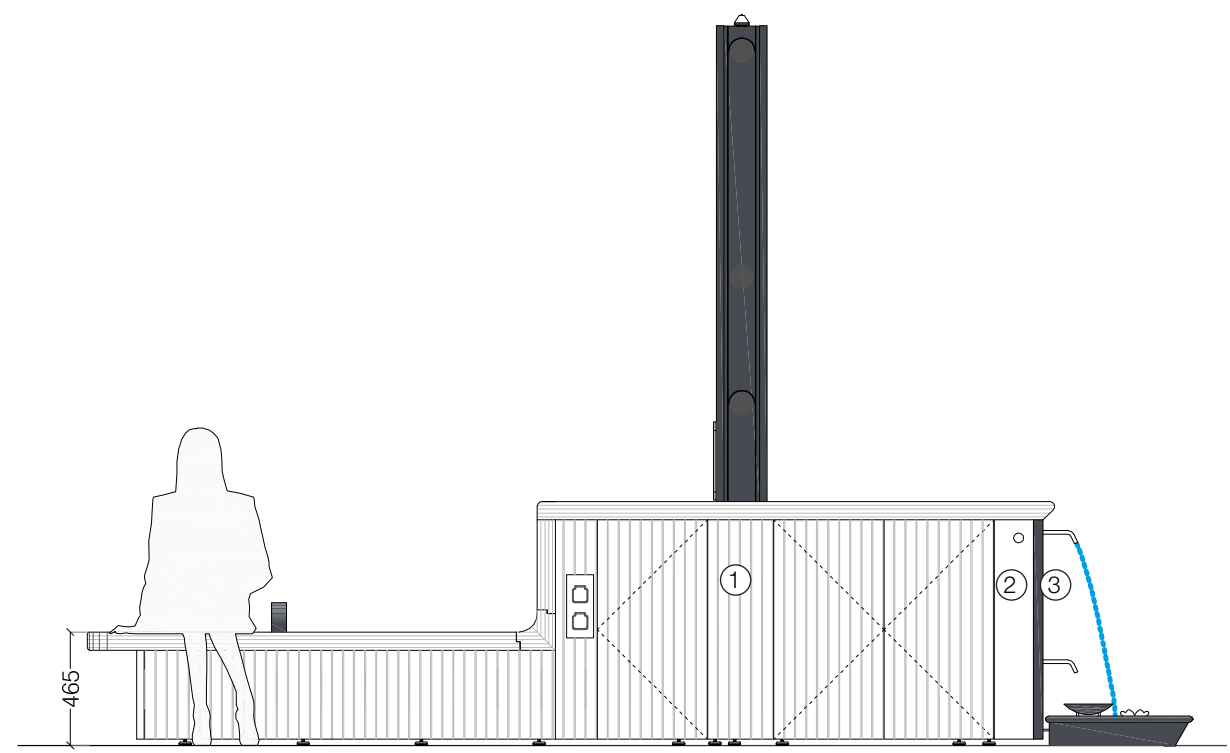


Figure n. 278

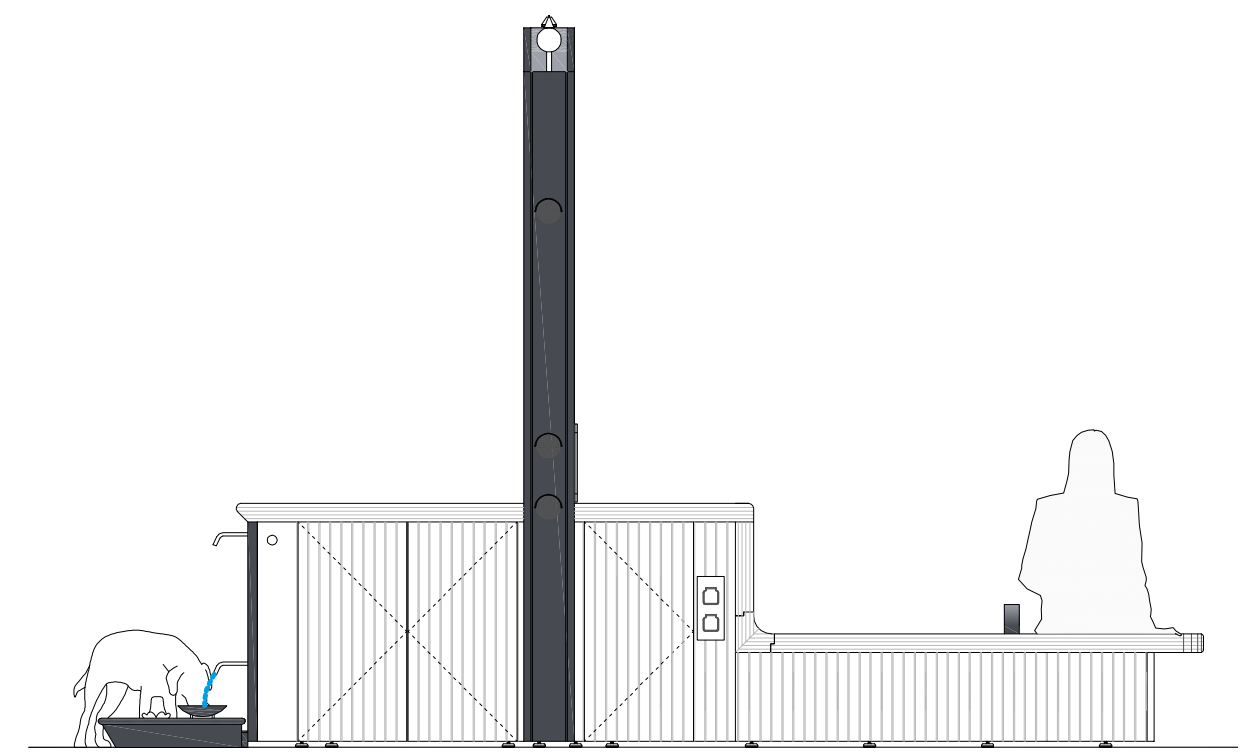
Daylight postcard of PUNTOnet H2O CO2 sited along the boardwalk in Gran Canaria.

Firstly, the drinking fountain would enhance personal hydration for children and older individuals, at greater risk of suffering from heat waves; secondly, the urban element would mark landscape focal points where people could have a rest and cool down in stunning locations.

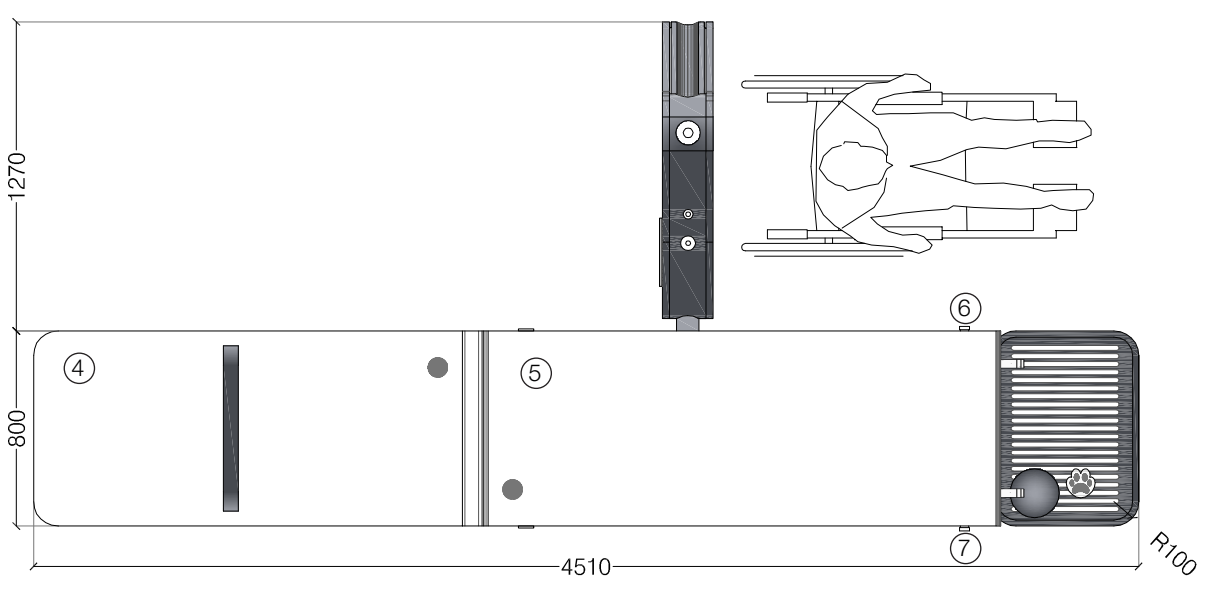
Visualization by Ilaria Fabbri



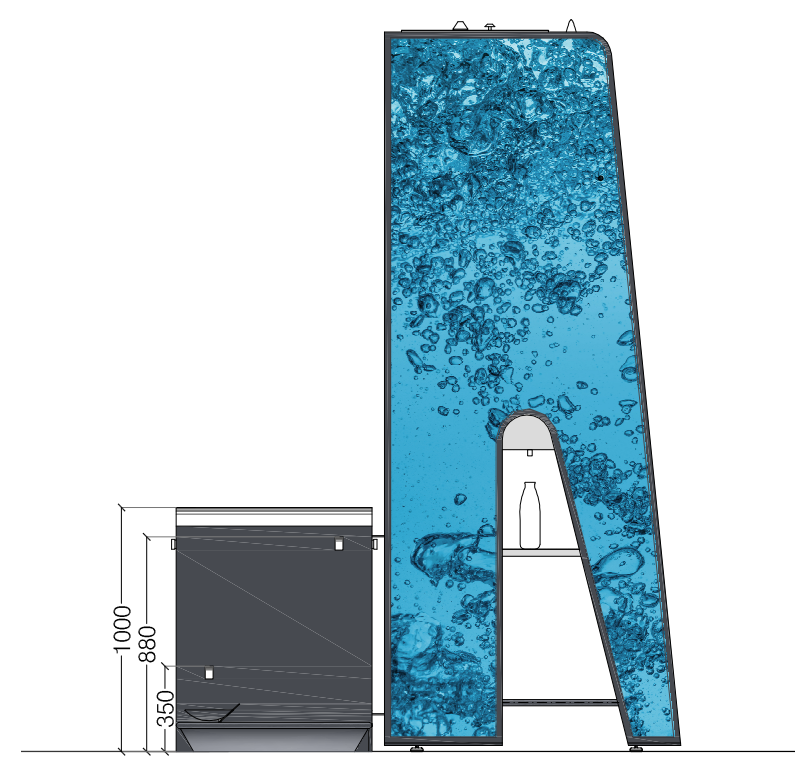
side view - bench side



side view - totem side



top view

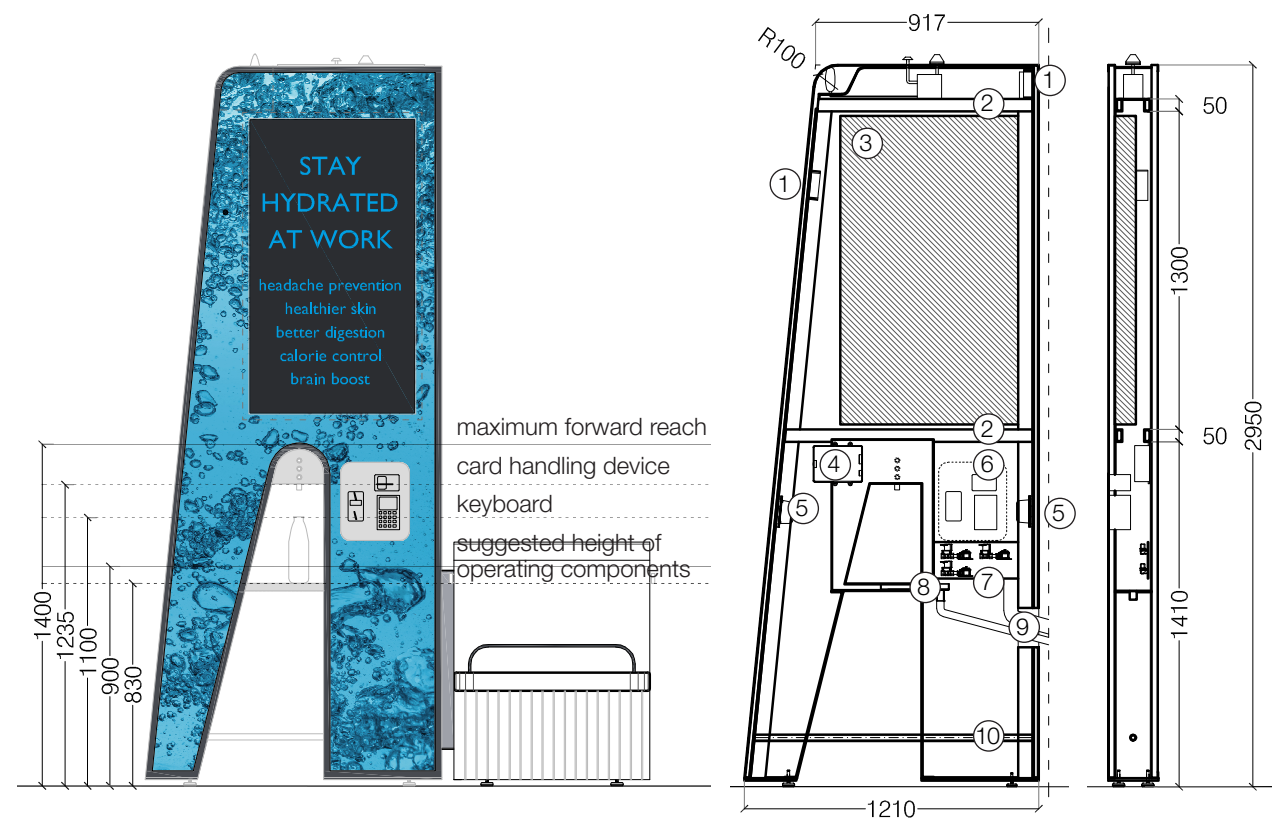


front view - drinking fountain side

Figure n. 279

Orthogonal projection drawings (top view, side views and front view) of the second design release of PUNTOnet H₂O

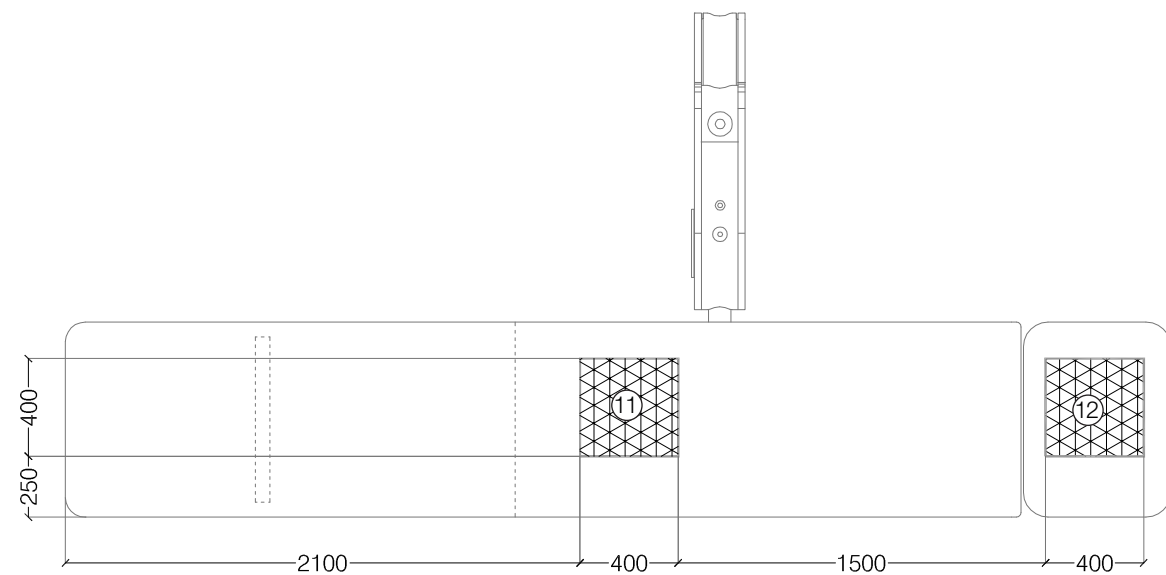
- 1- Okoume Marine Plywood 30 mm in width, vertical grooves every 45 mm, and rectangular slits for ventilation every 180 mm
- 2- Okoume marine plywood, 30 mm in width, plain surface
- 3- Fountain backdrop in painted steel
- 4- Seating in okoume marine plywood, 75 mm in width and plain surface
- 5- Standing desk in okoume marine plywood, 75 mm in width and plain surface
- 6- Stainless steel push button for the drinking fountain
- 7- Stainless steel push button for the dog bowl



front view - bench side

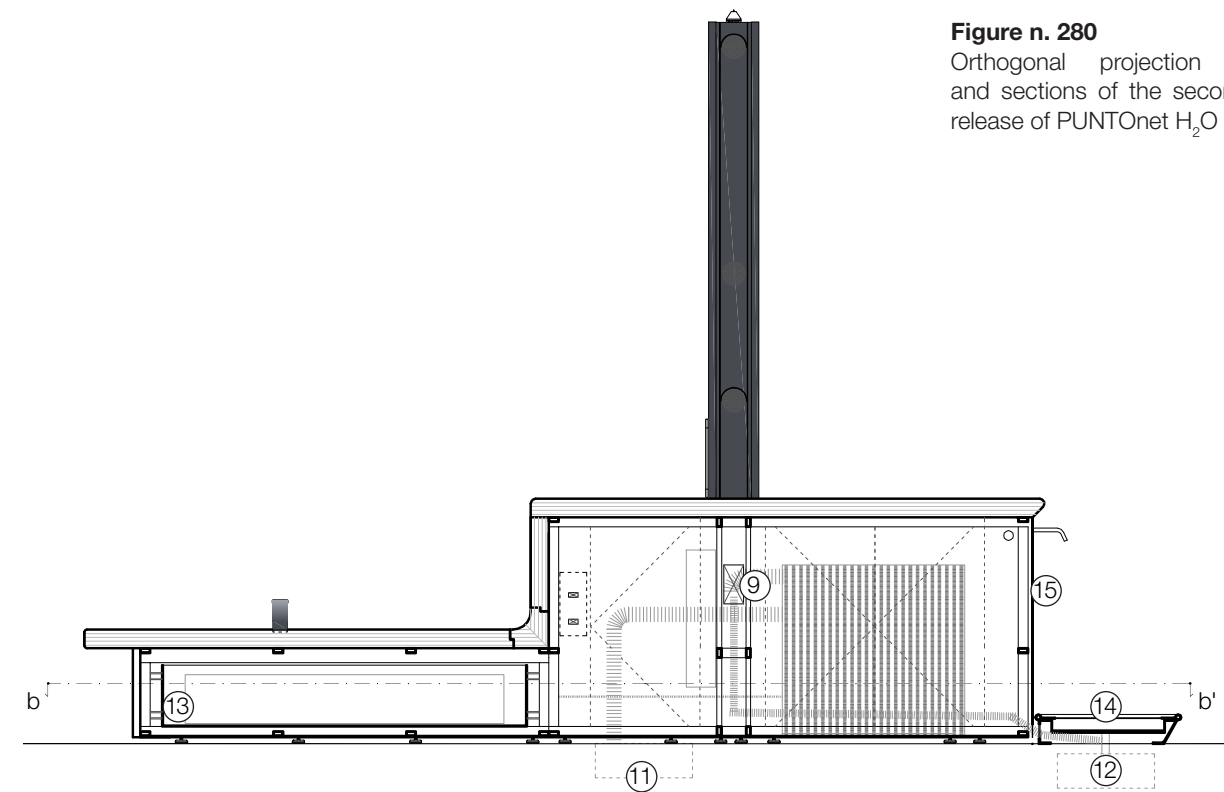
totem, sections

- | | |
|---------------------------------|----------------------|
| 1- Air vent | 6- Payment terminal |
| 2- Steel profile, mm 50x25x3 | 7- Electrovalves |
| 3- LCD screen, 55" | 8- Extractable basin |
| 4- Water dispenser control unit | 9- Pipes eyelet |
| 5- Acoustic speaker | 10- 25mm tubular |



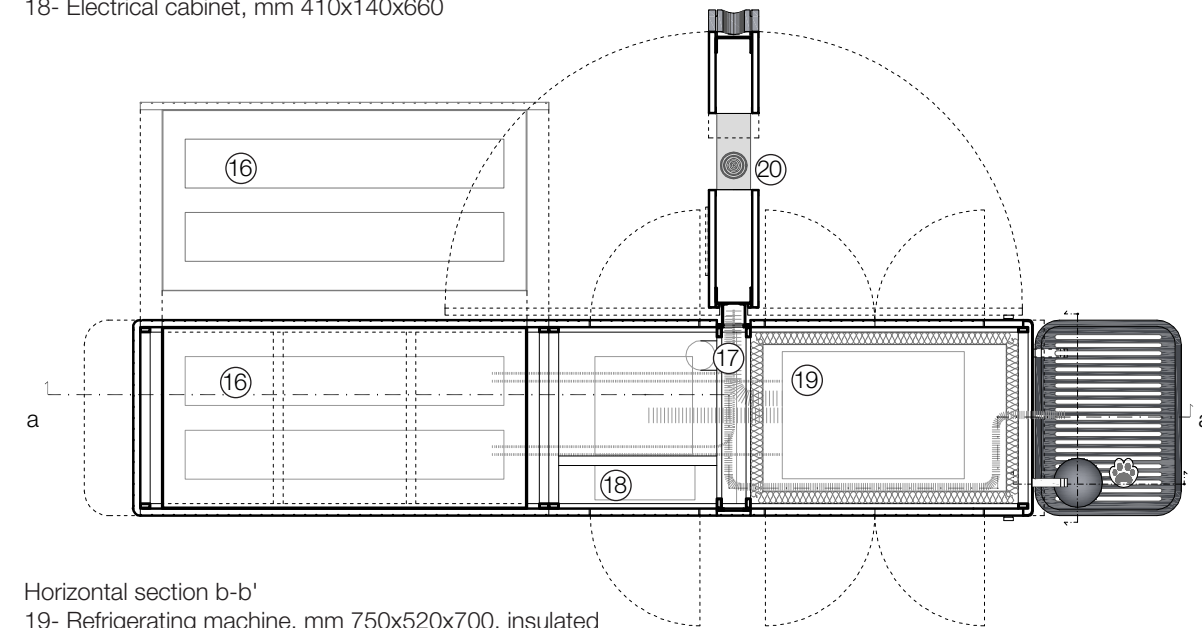
Plan of underground utility vaults

- 11- 40x40 cm access point for municipal water and electricity
- 12- 40x40 subsurface pit for drainage to storm water pipes



Vertical section a-a'

- 13- Drawer slides, for gas cylinder maintenance
- 14- Drainage grid, collecting both free and filtered water
- 15- Folded painted steel plate (3 mm in width) wrapping the end cap of the bench
- 16- Two CO2 tanks, 20 kg each, Ø 200 mm
- 17- Water filtration Ø 120 mm, 560 mm height
- 18- Electrical cabinet, mm 410x140x660



Horizontal section b-b'

- 19- Refrigerating machine, mm 750x520x700, insulated
- 20- Target for better centration of personal bottle with water jet

Figure n. 280
Orthogonal projection drawings and sections of the second design release of PUNTOnet H₂O

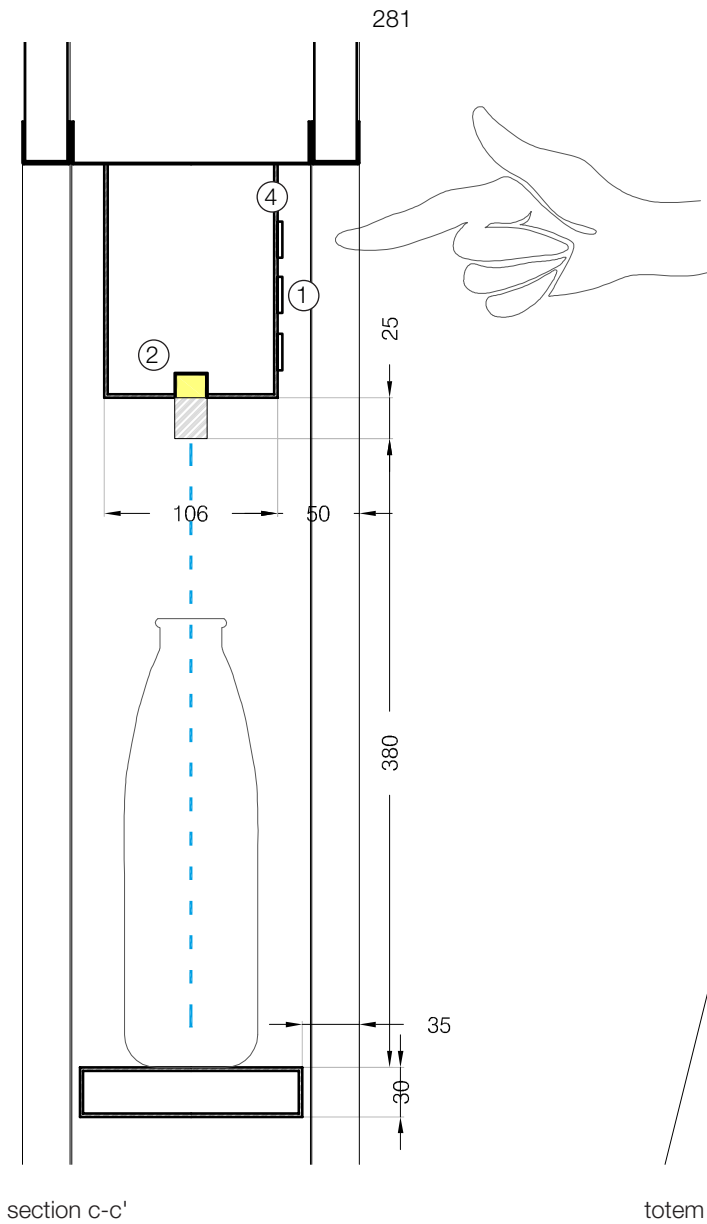


Figure n. 281
section c-c'
1- Touch-free operating buttons (filtered still room temperature; filtered still refrigerated; filtered sparkling refrigerated), combined with tactile pictograms.
2- LED spots on both sides of the nozzle.
4- Recessed stainless steel panel, with brushed finish.

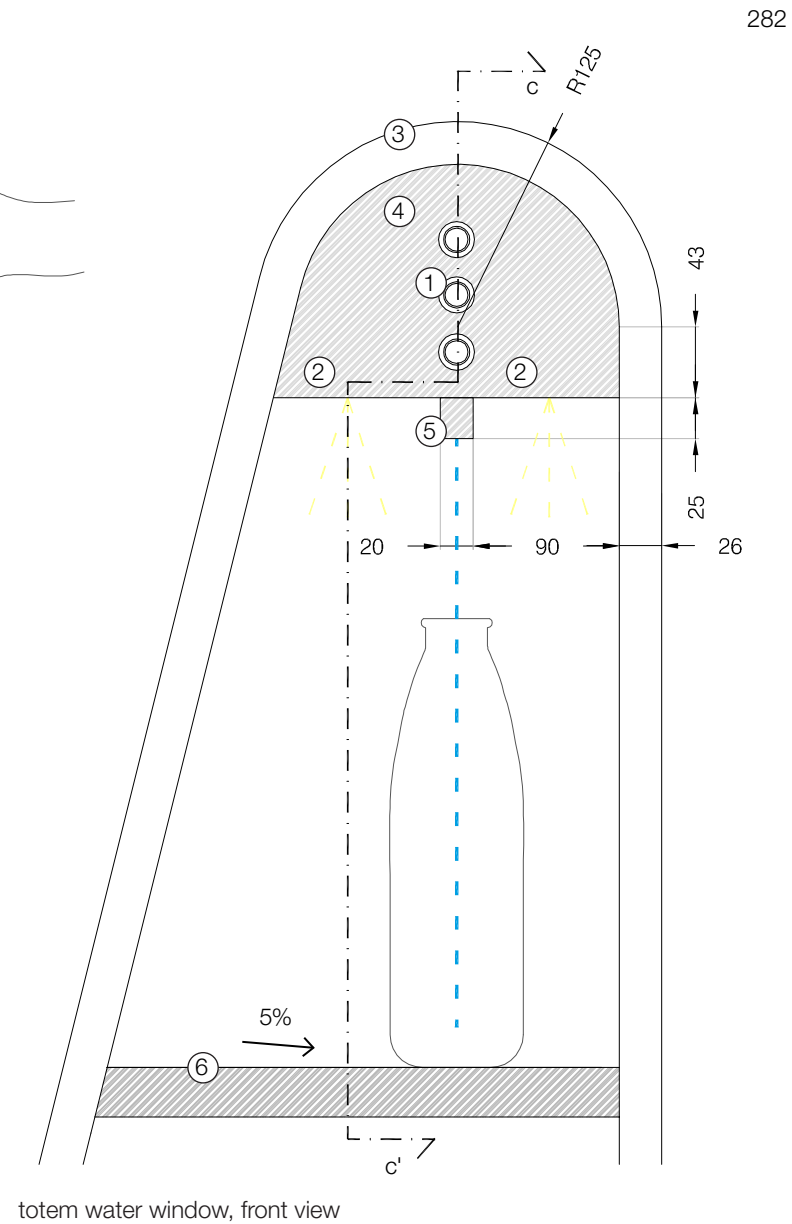


Figure n. 282
Water dispenser
1- Touch-free operating buttons (filtered still room temperature; filtered still refrigerated; filtered sparkling refrigerated), combined with tactile pictograms.
2- LED spots on both sides of the nozzle.
3- Perimetral steel frame of the totem, painted in RAL 7024 graphite gray.
4- Recessed stainless steel panel, with brushed finish.
5- Protected nozzle preventing bottle rim from coming in contact with the water outlet.
6- Brushed stainless steel bottle rest, located at 830 mm from the ground floor, with concentric circles cut out from the metal surface indicating the right position for the bottle to be filled. The bottle rest has a small slope to avoid stagnation and reduce water stains.

TOWARDS THE PUBLIC TEST: AREAS FOR FUTURE DEVELOPMENT

This revised and improved version of PUNTOnet H₂O aims to generate totally **new forms of public use** in newly conceived public space, by reason of its design and variety of different urban services, well-matching but still rarely seen in combination in a single piece of street furniture. Reliable source of drinking water, connected and charging spot, ambient lighting, sustainability indicator and billposting, comfortable bench, environmental supervisor at neighbourhood scale: this original urban amenity can potentially become a **flexible gathering point**, where to meet, work and have a rest in the outdoors, colonizing squares and parks.

As single object, it helps structure the character for distinct local precinct; as a network of urban elements, sharing common, recognizable features, the intervention has the potential to express a unique identity of a whole city that strive to live healthily. PUNTOnet H₂O CO₂ is specifically meant for public test in a real-world urban environment, completely accessible to the general public; besides the new, revised design, described in the previous section, two other features will be improved or developed from the very beginning before the launch of the new prototypes: remote monitoring and digital network with other urban services.

IMPLEMENT REMOTE MONITORING

The first prototype does not take full advantage of PUNTOnet H₂O potential as sensing interface collecting data from the urban environment, and, if compared to the expected technological equipment, the first realized object only monitors air, sound and water quality; subsequent versions should achieve a greater intelligence, much to the benefit of the city and the station itself.

With additional, relatively cheap sensors, water stations could be **remotely controlled** and operated: for instance, power and water meter could easily detect irregular (high/low) usage which may require investigation. A **digital dashboard** will display the information in one interface, and will provide usage figures, scheduled reporting (daily, weekly, monthly), sustainability information and alerts for several data sets:

USERS

- number of users
- length of stay
- anti-social behaviour detection

UTILITY

- total power usage by device
- power outage alert
- litres dispensed, with leak or irregular use detection
- fault reporting notifications

ENVIRONMENT

- air quality
- dispensed water quality
- urban sound level meter
- ambient light sensor

Remote monitoring system would firstly increase the **security of the water station**, as enables automatic shutdown in any case of suspected water issue, and more generally a **tailored, cost-effective maintenance** would be possible, including filter replacement and cleaning scheduling. **Urban safety** through unobtrusive surveillance cameras, and **ambient lighting**, with custom changes in time settings, brightness and colour adjustments, would also be enhanced.

Remote management would allow smooth LCD screen content changes, too. Interestingly, besides advertisement alone, LED projection could be used as **sustainability indicator**, to give public visibility to environmental and water quality (which can also help in rebuilding public trust in tap water), and to the district performance in saving disposable bottles from landfill, avoiding CO₂ emissions and other parameters based on service usage monitoring. The outdoor digital projection, making environmental efforts of each community visible to all, might encourage **virtuous competition** between neighbourhoods.

In wider terms, a more accurate and informed decision making, safety and maintenance of public spaces and its infrastructure would derive from such a network of these pieces of street furniture throughout a territory.

IMPLEMENT NETWORK WITH OTHER URBAN SERVICES THROUGHOUT THE CITY
In the research chapter dedicated to the “Design concept”, and more precisely in the section called “ENGAGING AND REWARDING”, I envisioned an **intangible system of urban services**, digitally interconnected one another and rewarding citizens’ effort in caring for the environment and their own health.

The experimental augmented-reality app already developed by Hera Group in late 2021 along with the first prototype can be conveniently extended in functionality, and some recommendations are noted hereafter.

Firstly, in out-of-home context, users might be noticed via smartphone when a drinking **water source is nearby**, including both PUNTONet H₂O stations and simpler water outlets. In this way, not only can people find units’ locations more easily, especially if non-residents, but they would be reminded and gently nudged to drink plain water more regularly during the day, with physical and mental benefits at all ages. This prospect is more interesting than the one offered by a common interactive map locator, which supposes that citizens are already looking for an appointed service; this suggestion, instead, deals with the possibility to send push messages in the downloaded app whenever the phone of passer-by approaches the smart urban service and can be achieved with **beacon technology**, that is generally much cheaper and effective than comparable QR-, NFC- and Wi-Fi-based system, thanks to the interactivity and direct connectivity of beacon notifications and push messages.

Secondly, if the service could recognize consumers and record their activity, people would be enabled, in turn, to get **additional information and incentives** like:

- Statistics on volume and type of water refills at the station;
- Achievement of personal goal of daily hydration;
- Individual sustainability performance (such as single use bottles saved from landfill and CO₂ emissions reduced);
- Obtain rewards in relation to their virtuous behaviour.

The last item is perhaps the most innovative of all those on this list.

The proposed **rewarding scheme** could conveniently go beyond the use of the contemporary outdoor water station, and involve other utilities from the service provider’s asset: electricity, waste management, gas, public water etc. In this way, for instance, a steady use of drinking fountain – and, consequently, individual decrease of plastic pollution – could be rewarded with waste tariff discount; conversely, a wiser use of water at household level could result in free access to sparkling water at PUNTONet H₂O CO₂, or citizens’ commitment in curbing unnecessary energy consumption may give back premium rates for electric bike sharing service.

The proposed initiative could also be extended outside utility market and involve into the “healthy rewarding network” local businesses and shop keepers with proved sustainable ethics, in which, for example, regular drinkers of PUNTONet H₂O stations may receive promotional purchase on fresh products at eligible local groceries, a win-win situation for all concerned.

Forthcoming public tests of the second version of the prototype represent an optimal circumstance to set up the involvement of local trade association in the project, engage with interested businesses and craft this conceived network of health-driven services providing rewards for those citizens that embrace particularly healthy and sustainable lifestyles.



Figure n. 283
Tentative visualization of a Smart Hub at the border of Ferrara historic centre, along the bike lane in Darsena street, experimenting the fruitful combination of smart drinking fountain, public seating and a steel frame shelter with transparent roof made of special coloured photovoltaic glass, dedicated to electrical mobility (with a design patent as well) : all of these services promote public health and active living in different but compatible ways.
The Smart Hub is one of the new urban objects being elaborated for a handful of public spaces in Ferrara within the project “AIR BREAK”, aimed at reducing air pollution and improving life quality through innovative services supported by technology. AIR BREAK project is among the winners of the European program of Urban Innovative Actions (UIA).

Design inventors: Enrico Piraccini, Simone Allegra, Gabriele Lelli, Roberta Bandini, Ilaria Fabbri
Air Break Project coordination: Municipality of Ferrara
Project partners: Università degli Studi di Ferrara (Next City Lab, Gabriele Lelli and Ilaria Fabbri), Sipro Ferrara, Politecnico di Milano, Fondazione Bruno Kessler, Dedagroup Public Services Srl, LabService Analytica e Hera spa (Patrizia Mangifesta, Gabriele Mengozzi, Davide Cupioli, Simone Allegra, Enrico Piraccini).
Visualization: Federico Gasperoni



Figure n. 284
Pilot urban dashboard for a 10 000-inhabitant town, Castel Bolognese, promoted by HERA Group in 2018, that collects data from different sources and brings together dataset coming from the local utility. This experimental platform, not common for such small towns, also allows city managers to monitor how innovative urban services (as waste containers, bike sharing and smart bus shelter) are performing and used.



Figure n. 285

Urban placement study of the multifunctional urban service in a prominent location within an office district in Tokyo; facilities such as water refilling stations, benches, device charging and standing desk are particularly advisable in such outdoor spaces to provide reasons for taking a walk within the workplace, and seating in landscaped, well-equipped areas can also offer sensory stimulation and lunchtime distraction from workplace stress.

Visualization by Ilaria Fabbri



In this final chapter I discuss the main contribution of the research, I indicate its beneficiaries and how this work could further benefit communities in the desirable circumstance of an effective distribution across the territory of the proposed service. I also outline the most important lessons I learned during doctoral studies and major outcomes that resulted.

Finally, I conclude with some areas for future research, and a tentative schedule of upcoming activities towards the test with the general public in different urban contexts.

SUMMARY OF THE RESEARCH

This doctoral work arises from previous research activities within university-industry agreements, conducted in the **field of public utilities**, and in particular dealing with the design of innovative physical interfaces of urban services and their most effective urban placement.

Among all streetscape elements, this research focuses on drinking fountain, probably the most useful and health-related urban convenience, but still excluded from the current transformation of urban furnishings, chronically underfunded, often carelessly sited, and largely ignored both by design practice and scientific literature.

As extensively highlighted in the first part of the study, outdoor drinking fountains represent a **valuable public health opportunity**, as they help people stay hydrated on the go, especially lowering the risk of heat stroke in hot weather, they indirectly reduce waste from plastic bottles and offer a healthy alternative to the consumption of pop high-calorie beverages. Moreover, strategically located drinking fountains could encourage people exercise better and stay outside longer.

To show off their full potential, public water points should be reinvented according to modern-day social and design trends, leverage technology, and provide positive contribution in terms of appeal and accessibility of public space amenities. More interestingly, new design iterations not only can lend minor and often disrespected urban elements a **contemporary and fresh image**, but can also highlight unexpected but **desirable combination between different amenities**, for positive reinforcing effects on the range and quality of activities that can be held outdoors.

The positive collaboration between industry (Hera Group Multi utility) and academia (Next City Lab, University of Ferrara, namely professor Gabriele Lelli and PhD Candidate Ilaria Fabbri) made it possible to **translate smart healthy city concepts** into practical, functional and **tangible experiment**. Innovative street furniture products combining drinking water and other urban services have been designed, patented and prototyped during the doctoral course.

In the design intent, PUNTOnet H₂O is an iconic, multifunctional piece of street furniture like no similar product in Italian marketplace and abroad. The developed prototypes aim to **extend water access** in public open spaces and **promote healthier and more sustainable lifestyles** at different levels: it provides a flexible, wired-up spot where to meet, work and have a rest; it also includes environmental IoT sensors to capture data on urban air quality, soundscape and microclimate, and security cameras, for a safer and more informed community. An innovative “*health supervisor*” at neighbourhood scale.

Figure n. 286

The first prototype of PUNTOnet H₂O in the former industrial site in Bologna, Hera Group Headquarter. Photo by Fabio Mantovani, July 2021.

CONTRIBUTION AND BENEFICIARIES

The first beneficiaries of the research results are the **citizens** themselves, in terms of **individual and collective wellbeing**: PUNTONet H₂O is conceived to increase opportunity for daily water intake rather than other sugary beverages – that resulted in healthier community, more focused and productive students and employees – but also encourages to gather, to exercise and spend more time outdoors. Local residents will be provided with a wider array of urban services (managed by the public administration and others), through innovative, engaging, IT-enabled physical entities that add value to everyday places.

The **natural environment** would indirectly benefit from a wide diffusion of PUNTONet H₂O, since its use can help reduce plastic waste and transport pollution from disposable water bottles; the service would also reinforce Municipality's **environmental credibility** and contribute in meeting European targets of Single-Use Plastics Directive.

The proposed piece of street furniture, if properly distributed throughout neighbourhoods, is highly beneficial to **local government**, that would more effectively manage their territories thanks to the IoT network and multi-source data displayed on the digital platform.

Local Health Authority Service (ASL) is also likely to support the diffusion of a reliable source of water in the urban environment: this measure indirectly leads to healthcare costs reduction (for an expected drop in consumption of sugary drinks, and with it, decreased obesity rates and dental decay, along with fewer heat-related hospitalisation). Moreover, PUNTONet H₂O can be a valuable supporter of National Sanitary Service's campaign of health prevention, encouraging physical activity and inspiring engagement in healthy lifestyles through messages and rewards.

Associations for frail and disabled people aim to improve the quality of life of the most vulnerable citizens, so would look favourably at the extension of accessible water points in the city, able to reduce risks of dehydration and heat stress. Also the presence of the bench would support seniors in walking more.

The project can also bring competitive advantages to **local utilities** operating in environmental, energy and water services; as a matter of fact, the Italian multi utility services provider Hera Group involved Professor Gabriele Lelli and I with a University-Industry research aimed at developing innovative prototypes of multifunctional urban elements dispensing potable water.

Within the scope of rapid technological advances in utility teams, the rehabilitation of drinking fountains' image represents a promising area for the research and development section, an opportunity to extend company's consolidated business towards unexplored sectors related to health promotion, with expected revenues and positive assets.

Identifying innovative solutions to submit to public Administrations, in line with the goals of circular economy, able to reduce plastic waste and encourage sustainable and healthy behaviour among citizens is therefore much to the advantage of local utilities. An innovative, IT-enabled urban object would definitely improve the delivery of water service in public space, and allow a better management and maintenance of the

utility infrastructure, thanks to real-time monitoring. Finally, instilling public confidence – and respect – in tap water may indirectly result in a stronger citizens' commitment in reducing household water wastage.

Longer stays in public realm may result from more comfortable and attractive set of amenities: increased duration and frequency of outdoor activities boost physical retailers' revenues; **local businesses** may also gain extra visibility thanks to the led advertising screen installed on the smart water station.

Obviously, the installation of this urban piece of street furniture is not expected to improve spaces alone.

From one side, an **accurate urban placement** is crucial to make the prototype best serve its purpose; a suitable location is, in general, a safe and walk-worthy environment, that includes proper sidewalks, bike lanes, lively ground floors, where interesting roads intersect and potential users – especially vulnerable population – live, work and play. From the other side, in the project intention, the contemporary drinking fountain should have **synergistic interactions with other urban services** and facilities (e.g. public restrooms, infrastructure supporting sustainable mobility, sitting and resting features, outdoor exercise stations...).

The suggested combination between water outlets and other urban elements is intended both as **physical blending**, more design challenging than mere juxtaposition of different items of street furniture, and **intangible connection**. Harnessing technology, the proposed network of urban services might reward citizens' most virtuous behavior (achievement of recommended daily water intake and physical activity level, reducing reliance on plastic bottles, increasing sustainable mobility...) and further engage them in healthy lifestyle.

LESSONS LEARNT AND MAIN OUTCOMES

The main lessons I learned throughout my PhD studies can be grouped in three categories, addressing innovation between urban services, collaboration and public space design, and are briefly summarized below.

Innovation within urban services

- I appreciated that **experiential learning** and user research are vital for developing innovative public amenity. The use of smart technologies alone is not sufficient to improve traditional urban services.
- There is a lack of **professional figures** able to define strategic actions improving urban health through a wide view and multi-sectoral approach: urban facility management, digital skills and competencies both in urban and product design.
- Digital divide can represent a **stark barrier to contemporary urban services**, so stakeholder, utilities, public administration and designers must come together to address this issue and strive for a greater inclusion.
- I got acquainted with data **privacy** and **ethics issues** that are inherent to new generation of IoT-enabled street furniture.

beneficiary of research study	interest
Citizens	Personal health improvements; Economic savings (less personal healthcare costs and drink expenditure when outside); Functioning and appealing urban amenities supporting outdoor activities; Gifts and rewards for sustainable lifestyle; Healthier environment with reduced plastic waste and transport pollution.
Schools and Universities	Improvement in pupils' cognitive performance and attention.
Public and private companies	Well-hydrated and more productive employees; Corporate sponsorship possibilities.
Local government	Real-time data collection for more informed and effective city management; Single-use plastics reduction; Citizens' greater engagement and care of everyday places.
Local Health Authority Service	Healthcare costs reduction (decreased obesity rates and dental treatment, fewer hospitalisations for heat stress); Support in health prevention.
Associations for frail and disabled people	Greater water access for vulnerable populations; Reinforcement of age-friendly urban features, like public seatings.
Multi utilities	Market extension opportunities towards unexplored sectors with positive health implications; Propose for Public Administrations' consideration innovative solutions of urban services in line with circular economy; More efficient and informed management of utility infrastructure thanks to IoT sensors network; Plastic waste management reduction on the long run; Increased household diligence in reducing water wastage may result from rediscovered trust in local tap water.
Local businesses and retailers	Citizens' expected longer stays and strolls in public space may increase revenues; Extra visibility through sponsorship.
Animal rights advocates	Keep pets cool and hydrated, especially in hot days; Encourage dog walkers.

Table n. 18

A framework of main stakeholder/beneficiaries of the proposed service, and the corresponding interest in a further development. Personal rielaboration based on Ivanov's "Framing Usefulness" (2015).

Collaboration

- I recognized that innovative projects are **extremely costly** and require the collaboration between different, **highly skilled competencies**.
- **Cross sectoral approach** (research, private companies and public administration) is crucial when dealing with urban objects with health implication.
- Suitable arrangement and installation of prototypes on city land (from municipal water operations to civil works and maintenance) cannot dispense with a strong **public-private partnership**.
- When it comes to design patents and innovation, there is a need for legal **intellectual property** agreements.

Public space design

- I became more aware that innovative products take **time** to be designed, tested and launched into the marketplace, especially if envisioned to be completely accessible to the whole community.
- I experienced the **humbling side of testing stage**. Users might be confused or disappointed by unpredictable aspects.
- General public tends to assimilate new ideas and design trends through time: on first impression people are rarely very drawn to **original aesthetics**.

The most important insights concerning processes, outputs and outcomes of the project are:

- A collection of an extensive number of national and international researches dealing with drinking water provision and public health in the built environment;
- The uncovering of the common low accessibility of public fountains in most contemporary local precincts and the correlation between overconsumption of sugar-sweetened beverages and distrust in tap water;
- Raised awareness on some public administrations about the potentiality of an experimental, sensing urban object that dispenses drinking water and encourages people to stay outside longer;
- Design and technical investigation on the most desirable combinations of water provision and other urban amenities, along with urban placement studies for such aggregate of street elements;
- An innovative multifunctional product has been prototyped, and it is ready to be up scaled citywide in Italy and abroad;
- The study highlights viable opportunities of market extension for local utilities and private companies towards unexplored sectors with positive health and environmental implications.

FUTURE RESEARCH

To date, the second design release of the prototype – the one called PUNTONet H₂O CO₂ and described in the previous chapter – has been drawn in detail and the tendering process for the realization is underway; the contractor shall be responsible for engineering drawings, technology sourcing, manufacturing of at least five units, installation, handover and aftercare service. This revised version is specifically meant for public test in real-world urban environments, completely accessible to the general public.

New prototypes are scheduled for launch in summer 2022 both in Ferrara and Cesena.

URBAN PLACEMENT STUDIES

A list of potential demo sites for next pilot schemes is being mapped and validated within focus groups including the involved Municipalities, Hera and research partners (Prof. Gabriele Lelli and PhD Candidate Ilaria Fabbri).

The City of Cesena has planned to install **5 prototypes** in just as many neighbourhoods, very different from one another; one more prototype is supposed to be installed in Ferrara city Centre, within the scope of a EU funded project dealing with urban strategies aimed at reducing air pollution and improving life quality among local residents and commuters. Urban placement considerations expressed in previous chapters (especially “Design concept”) will be taken into account to finalise the exact location of PUNTONet H₂O stations in the selected areas, and also based on demographic data, in order to favour those districts with the highest concentration of seniors and children. In particular, the main goal of the **discovery phase** is to get a sense of prevailing **end-users** in each demo site, drinking habits, general needs and daily journeys of people from the different communities, but also to determine whether selected areas are already equipped with functioning water fountains, how clean they are, and what kind of street furniture is already there. Suitable target areas for this preliminary field observation would be parks, school entrances, retail venues, bus stops, that should be fairly representative of the city as a whole. Discovery Phase will be compiled to inform the development process of the new version of PUNTONet H₂O and tailor each demo site to better serve the community.

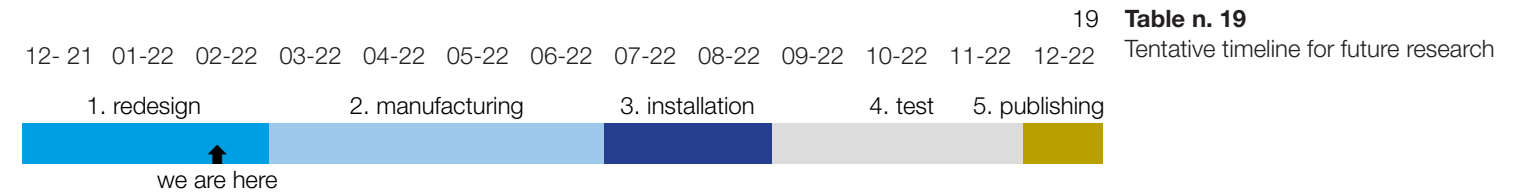
The position of the existing **water mains** and **electrical shafts** should also be considered in siting PUNTONet H₂O, as nearby access to such elements will dramatically reduce potential cost and timescales of prototypes installation.

TESTING STAGE

Again, PUNTONet H₂O will be verified through the methods of **inspection, demonstration and test**; a field experts review will be conveniently set up, in order to verify the conformity of the prototype with specific design features. The testing stage involving end users will be conducted with:

1) **Field observation**, without mediation, of users’ engagement with the prototype.

The study technique will be systematically carried out during working days and weekends, both on summer months and autumn/early winter. How do PUNTONet H₂O influence what people drink, day in and day out? How long people stay outside at the station? How do they use it?



1. Redesign and tender procedure (December 2020 - February 2022)

- Redesign PUNTONet H₂O based on pilot study at Hera Headquarter, user feedbacks and pilot Municipalities requirements (R);
- Announce the call for tenders to manufacture the revised version of PUNTONet H₂O (H);
- Construction drawings (C);
- Start Discovery phase to understand characteristics and end-users of each of the expected demo sites through inspections and qualitative research (R);

Legend of Actors:
H: Hera Group Innovation Central Direction

R: Research partners (Professor Gabriele Lelli, PhD Candidate Ilaria Fabbri)

M: Municipalities involved in pilot schemes

C: Contractor who have won the tendering process

S: Other stakeholders, local business and retailers

2. Manufacturing process (March 2022 - June 2022)

- Assemble the first new prototype (C);
- Run internal testing (C with supervision from H and R)
- Finalise the exact locations of PUNTONet H₂O in selected neighbourhoods through urban placement studies (M, H, R)
- Demo sites arrangement (M)

3. Installation and launch (July – August 2022)

- Install the new version of PUNTONet H₂O in the identified locations (C)
- Arrange a kickoff event to explain citizens the prototype’s goal and functionality (M, H, R)
- Create a Community Broadcast chat for a greater involvement of citizens in the initiative (R)
- Craft an app-based survey (R)
- Start collecting data from sensors (H, R)
- Start observations of users and non-users of PUNTONet H₂O in different neighbourhoods (R)

4. Test and measure (September - November 2022)

Engage with stakeholders to involve local business and services into the health-related network set up by the prototypes (M, H, S, P)

Analyse user data from surveys (R)

Run on-site semi structured interviews (R)

Conduct field expert reviews to detect flaws and test the system (H, R)

5. Knowledge Exchange and outcomes extension (from December 2022)

- Submit a final survey to prototype users (R)
- Reward participants in return for their participation (H, M, S)
- Hold workshops with project partners to upscale the initiative to other territories (M, H, S, P)
- Attend conferences and write journal articles to promote the project (R)

2) Revised version of an app-based survey.

An improved and **extended survey** will be distributed to people living in the target areas, asking among other questions, how often they used the smart fountain, if they used to drink tap water before the installation of this piece of urban furniture, if they reduced the consumption of pop high-calorie beverages and the use plastic bottles and whether they feel the prototype encourage physical activity in the area. Special attention is to be paid to those types of **users not yet tested** during the first on-site demonstration at Hera Headquarter in Bologna, because excluded from authorized staff, but particularly relevant for this research (like children, dog walkers, bikers and retired persons).

3) Feedbacks collection from an informal chat.

At the experimentation kick off the research team intends to launch a **Community Broadcast chat with WhatsApp** opened to volunteers among the sample group of citizens testing PUNTONet H₂O for a greater involvement in the initiative and feedback collection. Through the chat, people are given the possibility to informally share questions and report issues with photographs and videos directly to the research members; conversely, researchers will be able to spread information about the prototype itself and the trend of the testing stage.

It is worth noting that, in a **previous Pilot Scheme** carried out elsewhere by the same research group, the same strategy of a Community Broadcast chat, that I personally moderated for **one-year-long trial**, appeared particularly successful in bringing a positive sense of recognition to those who participate in the experimentation (Fabbri et al., 2020).

KNOWLEDGE EXCHANGE AND UPSCALE

Within a recursive, iterative process, the testing stage could require again a redesign of PUNTONet H₂O CO₂, according to its performance in public space and feedback from the community.

This step will provide for essential insights to extend the scheme at city level, and more steadily set up the replicability of the project in other locations with customized solutions for each urban context.

POTENTIAL RISKS OF PUBLIC TEST

The provision of the proposed multifunctional piece of urban furnishings in the public domain may incur the following risks:

Health and safety

- Potential contamination of water supply/outlet;
- Potential slip hazard at the base of the fountain and around the drainage grid.

No/low uptake of use

- Underutilization of certain features of the prototype which can lead to neglected appearance;
- Many sportspeople could keep on supply their own drinks instead of using the

proposed amenity;

- Potential public unawareness of PUNTONet H₂O services may result in no/low uptake of use.

Improper use (despite surveillance cameras)

- Water wastage;
- Use of drinking areas for personal cleaning and washing;
- Application of gardening-hose outlets for irrigations to water spigots;
- Vandalism to fountain structure and setting.

Extreme weather

- Winter Freeze: without adequate frost protection, the prototype should be turned off;
- Steel parts overheating;
- Refrigerator overload in torrid days.

Finally, to increase the accessibility of water sources across the pilot Municipalities, potential **refurbishments of existing drinking fountains**, concomitant to the distribution of the proposed prototype, should be considered, including any repair of old pipe connections to remove associated lead pollution threat.

FINAL CONSIDERATIONS

The overall viability of the project here presented highly depends on **scaling up the pilot scheme**: it is hoped that more public administrations would consider passing laws and detailed policies addressing the provision of drinking water in out-of-home context through fully functioning, appealing and innovative urban fixtures.

Adequate spacing and correct locations are the first steps to promoting the use of this kind of urban service among local residents and tourists. Therefore, precise planning standards should be set up, in a similar way that cities are promoting sustainable mobility through the installation of charging points for electric cars and bikes.

I strongly believe that street furniture can (still) play a central role in animating and enriching contemporary, hyper connected public places, as long as carefully designed and located, with special attention to sensory experience, inclusion and engagement.

Despite their comparative tiny size within the built environment, small urban things matter, and highly affect the image of a city. Current smartization of urban elements is a favourable yet daunting opportunity and should be carefully driven, **both by research and design practice**, towards real usefulness, beauty and enjoyment.

The ultimate purposes of this study are to offer a **well-founded research background** supporting the public health advantages of reinventing drinking fountains, and an **active contribution**, through an applied, practice-based activity, to devise, shape and craft some of the possible solutions to bring attractiveness and well-being to community outdoor daily life.



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CONCLUSION AND FUTURE WORK

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Figure n. 288
Turquoise, elongated fountain at
Oerliker Park West in Zürich.
Design by Studio Vulkan.
Ph Ilaria Fabbri 2013.

