



LAYMAN'S REPORT
LIFE CERSUDS

LIFE15 CCA/ES/000091

LIFE
CER
SUDS

/ENG

PROJECT INFORMATION

Project reference: LIFE15 CCA/ES/000091
Duration: October 2016 – September 2019
Total budget: 1,817,972 €
LIFE Program contribution: 986,947 €

PROJECT FUNDING

This Project is financed by the LIFE Program 2014-2020 of the European Union for the Environment and Climate Action



With the collaboration of Generalitat Valencia through IVACE



LIFE CERSUDS consortium

Project coordinator



Instituto de Tecnología Cerámica (ITC-AICE)
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Project partners



UPV
www.upv.es



TRENCADIS de SEMPRE
www.trencadisdesempre.com



AYUNTAMIENTO DE BENICÀSSIM
www.benicassim.es



CCB
www.centroceramico.it



CHM
<http://chm.es>



CTCV
www.ctcv.pt

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Index

1.

What is the life programme of the European Union?

page 4

2.

What is the main purpose of LIFE CERSUDS?

page 5

3.

What have we done at LIFE CERSUDS

page 5

4.

Why and how have we developed the LIFE CERSUDS system?

page 9

5.

LIFE CERSUDS RESULTS

page 12

1. WHAT IS THE LIFE PROGRAMME OF THE EUROPEAN UNION?

LIFE is the EU's funding instrument for environment and climate action. The general objective of LIFE is to contribute to the implementation, updating and development of EU environmental and climate policy and legislation by co-financing projects with European added value.



2. WHAT IS THE MAIN PURPOSE OF LIFE CERSUDS?

The main purpose of the LIFE CERSUDS project has been the promotion of the use of green infrastructure in urban planning and the improvement of the capacity of cities to adapt to climate change.

LIFE CERSUDS is aligned with the principles of Circular Economy, as it has provided an innovative use for high quality ceramic material that was in stock and out of the market, and therefore had a low commercial value, in order to create a new Sustainable Urban Drainage System (SUDS), this time using ceramics as the main element for the construction of a permeable pavement. Thus, we have achieved a totally new system, with a nice aesthetic effect, useful for citizens and with a low environmental impact.

The **main objectives** of the project have been:

- To increase the permeable surfaces in cities, reducing flooding in case of torrential rains.
- To make the best use of the water stored during the rain period, reusing it in periods of drought.
- To reduce runoff volumes and peak water flows which end up in the collector network and, consequently, in the treatment plant or in the receiving medium.
- To integrate rainwater treatment within the urban landscape.
- To reduce the effects of diffuse pollution by protecting the quality of the water and thus avoid problems in the treatment plants.
- To reduce CO₂ emissions linked with the manufacturing of the pavement by using stocks of ceramic material with low commercial value.
- To avoid the formation of puddles, thus increasing safety and comfort when walking the streets in rainy weather while offering an aesthetic, high quality finish.
- To develop and promote cities on both a social and economic scale thanks to the installation of LIFE CERSUDS.
- To build and install a SUDS demonstrator in a city, more specifically in Sant Vicent street, in the municipality of Benicàssim (Castellón-Spain). This area is usually affected by floods due to cold front phenomena taking place at certain points in the year. The demonstrator which was built here was intended to show that this sustainable

drainage ceramic system allows for a better management of rainwater and is valid for the rehabilitation of light traffic areas.

- To provide a new commercial use and increase industrial profit by reducing the stock of ceramic material with low commercial value which is stored in companies.
- To promote greater awareness among public administrations, citizens and professionals in the world of construction, public works, architecture, etc., through training activities and dissemination

of the development of the LIFE CERSUDS project.

- To develop accurate technical documentation for further replication in other cities of permeable pavements based on the demonstrator's principles.



3. ¿WHAT HAVE WE DONE AT LIFE CERSUDS?

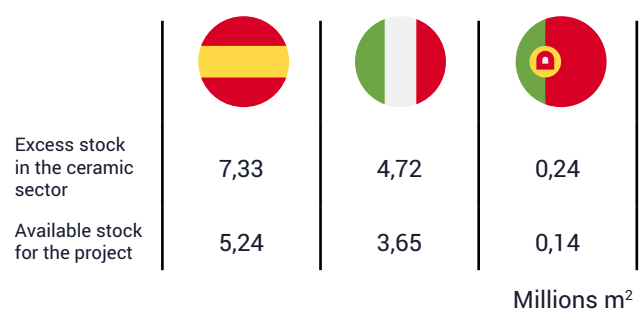
The 3-year LIFECERSUDS project started in October 2016 and ended in September 2019. Prior to the action of constructing the demonstrator, it was necessary to carry out a series of actions, such as, for example:

To characterize and quantify ceramic tiles with low commercial value.

A study of the ceramic stock available in Spain, Italy and Portugal was carried out, which can be downloaded at www.lifecersuds.eu/es/documentos.

This study was carried out through a series of interviews held with the most representative

companies of the ceramic sectors in these countries, thus making it possible to assess the quantity, quality, location and prices of the material with low commercial value of the Italian, Spanish and Portuguese ceramic companies.



To gather information together with other stakeholders

One of the first actions involved the creation of a Regional Working Group (RWG-LC), made up of several public administrations, entities and organizations involved in water management policies, where interests, synergies and appropriate strategies for the proper development of the project were defined. The members and representatives of member entities of the Regional Working Group have contributed their experience in the field of regulations, water quality, distribution and collection networks, as well as their accumulated experience in the development of LIFE projects with evident links with this project.

The members of the Regional Working Group LIFE CERSUDS (RWG-LC) are:

Conselleria d'Habitatge, Obres Públiques i Vertebració del Territori.
www.habitatge.gva.es

Confederación Hidrográfica del Júcar.
www.chj.es

Entidad Pública de Saneamiento de Aguas residuales de la Comunidad Valenciana.
www.epsar.gva.es

Federación Valenciana de Municipios y Provincias.
www.fvmp.es

Ayuntamiento de Benaguasil.
www.benaguasil.com

Universitat Politècnica de València.
www.iiama.upv.es

Ayuntamiento de Benicàssim.
www.benicassim.es

Diputación de Castellón.
www.dipcas.es

Ayuntamiento de Castellón.
www.castello.es

ASCER (Asociación Española de Fabricantes de Azulejos y Pavimentos Cerámicos).
www.ascer.es

COFINDUSTRIA CERAMICA.
www.confindustriaceramica.it

APICER.
www.apicer.pt

Sociedad de Fomento Agrícola Castellonense S.A (Facsa).
www.facsa.com

Planifica Ingenieros y Arquitectos, Coop.V. Planifica.
www.planifica.org

Instituto de Tecnología Cerámica, ITC-AICE.
www.itc.uji.es

Consorzio Universitario per la gestione del Centro di Ricerca e Sperimentazione per l'industria Ceramica - Centro Ceramico,CCB.
www.centroceramico.it

CHM obras e infraestructuras, S.A.
<http://chm.es>

Centro Tecnológico da Cerâmica e do Vidro, CTCV
www.ctcv.pt

Trencadís de Sempre, S.L.
www.trencadisdesempre.com



Second meeting of the RWG-LC 17th of January of 2017
Castelló, Spain



Third meeting of the RWG-LC 4th of May of 2017
València, España

Definition of the Demonstrator

It became necessary to define the hydraulic, environmental and social objectives that we were looking for as a consortium in LIFE CERSUDS, in addition to verifying the feasibility and regulatory adequacy of the solutions that we decided to adopt.

It was also necessary to analyze the processes of installation and subsequent monitoring of the results and, of course, to include the works to be carried out in the execution project.

Definition of the ceramic permeable system

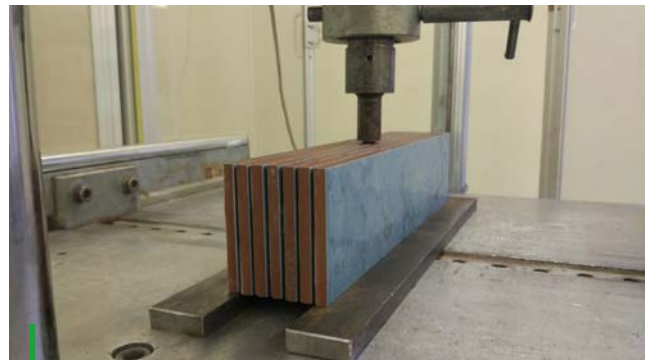
Due to its novel and disruptive character, defining how our permeable ceramic system was going to be, accurately expressing its requirements and obtaining its specifications has been key to simple, further replication in other cities in Spain, Italy, Portugal and also in the rest of the EU. In addition, we have been able to gather a complete guide of the formal possibilities of the pavement. These documents are very important, since they will serve as a basis for drafting public tenders for the urbanization of spaces in the surroundings of cities, making them more friendly and respectful of the environment, and protecting citizens by mitigating the negative effects of climate emergencies.

Demonstrator Development

This phase includes the manufacturing of the permeable ceramic product and the execution of the project, as well as the installation of the measurement systems. The demonstrator has allowed the monitoring of the results both in the realization phase and in its commissioning during the following months. In addition, it has been used as a space for disseminating information to technical personnel, members of public administrations, citizens and, in short, to those who are responsible for making decisions concerning the urban space.



Render of the demonstrator



Permeable ceramic cobble test



Permeable ceramic cobble installation

Replicability

The objective of this action was to demonstrate the feasibility of replicating the system in other areas of Spain, as well as in Italy and Portugal. In fact, the system will be incorporated into the demonstrator of the Lugo+Biodynamic project, in the remodeling project of the surroundings of Anselm Clavé Square, in Sabadell, with a possible replication in Aveiro (Portugal) and Fiorano (Italy), two countries whose respective ceramic clusters stand out and where similar climatic problems to those taking place in the Spanish space where the LIFE CERSUDS system is installed are common.

Control and monitoring actions

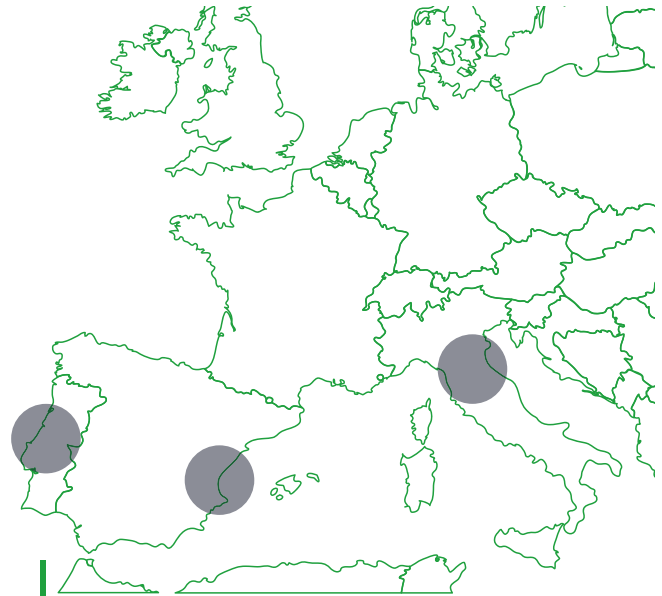
The impacts produced as a consequence of the implementation of the project and its communication, its socio-economic repercussion and its influence on the indicators proposed by the LIFE program have been all measured.

Communication and dissemination of results

A communication plan has been developed, both internally -for the members of the consortium- and externally, which has encompassed all actions aimed at effectively transmitting the benefits of sustainable urban drainage systems, in particular the LIFE CERSUDS project, to citizens, decision-makers and planners. The main communication channel through which the information has been collected and transmitted is the project website: www.lifecersuds.eu where information is available through videos, documents, press releases, training material, etc., on both the development of the project and its results. There is a clear commitment -reflected in the AfterLife Communication Plan- that the website will be kept up to date to keep users informed of all project activities and impacts.

Project management

It has brought together all the tasks aimed at ensuring the correct execution of the project.



Potential replicability areas: Portugal, Spain and Italy



Control and monitoring actions



CONAMA 2018.
National Environment Congress

4. WHY AND HOW HAVE WE DEVELOPED THE LIFE CERSUDS SYSTEM?

What are Sustainable Urban Drainage Systems (SUDS)?

SUDS are urban drainage infrastructures that reproduce the natural hydrological cycle prior to urbanization. They improve runoff quality, reducing pollution and favoring the creation and maintenance of spaces for the development of flora and fauna. These systems provide cities with new means and techniques to take a sustainable approach to rainwater management, integrating runoff management into the urban landscape and drawing inspiration from the natural behavior of space before it is urbanized. SUDS, which are increasingly being applied around the world, return water to the ground, allowing it to become part of the city daily life and help improve the urban landscape.

Within the different SUDS systems, permeable drainage pavements are easy to install in urban public spaces and are very effective. They allow water to penetrate to a lower granular layer where it is stored, filtering slowly towards the substrate. They provide a soil suitable for both vehicle and pedestrian traffic, and can be formed by impermeable elements separated from each other, so that water infiltrates between the voids, or directly through permeable materials, such as stabilized gravel, asphalt or pervious concrete.

Permeable pavements are one of the most complete SUDS techniques, because they allow for water retention in the drainage base and even transport or storage for reuse. In addition, they can offer a number of water treatment processes, such as biodegradation and sedimentation, and thus an increase in runoff quality. Its installation within urban areas is an interesting option when it comes to generating or

maintaining natural ecosystems requiring a certain level of humidity.

What is the LIFE CERSUDS demonstrator?

We have built a Sustainable Urban Drainage System by developing a permeable ceramic pavement based on the use of ceramic tiles of low commercial value. The demonstrator, with an area of approximately 3,000 m², has been built in a consolidated urban environment of light and pedestrian traffic located in the stretch of Sant Vicent street, in the municipality of Benicàssim.

Building the demonstrator in this space allows for a very appropriate observation, monitoring and evaluation aimed at proving that this permeable ceramic pavement can be an ideal solution for urban planning as well as a reference for interventions in consolidated environments. This is particularly true if these interventions are linked to the creation of Urban Green Infrastructures, since torrential rains or cold front phenomena are quite common from the end of August to the end of October.

On the other hand, the street selected for the development of the demonstrator is the road connecting the city with the coast, specifically with the "Torre de Sant Vicent", a tower built in the sixteenth century and located at the southern end of the Bernat Artola promenade.

Aerial view of Benicàssim



LIFE CERSUDS demonstrator project

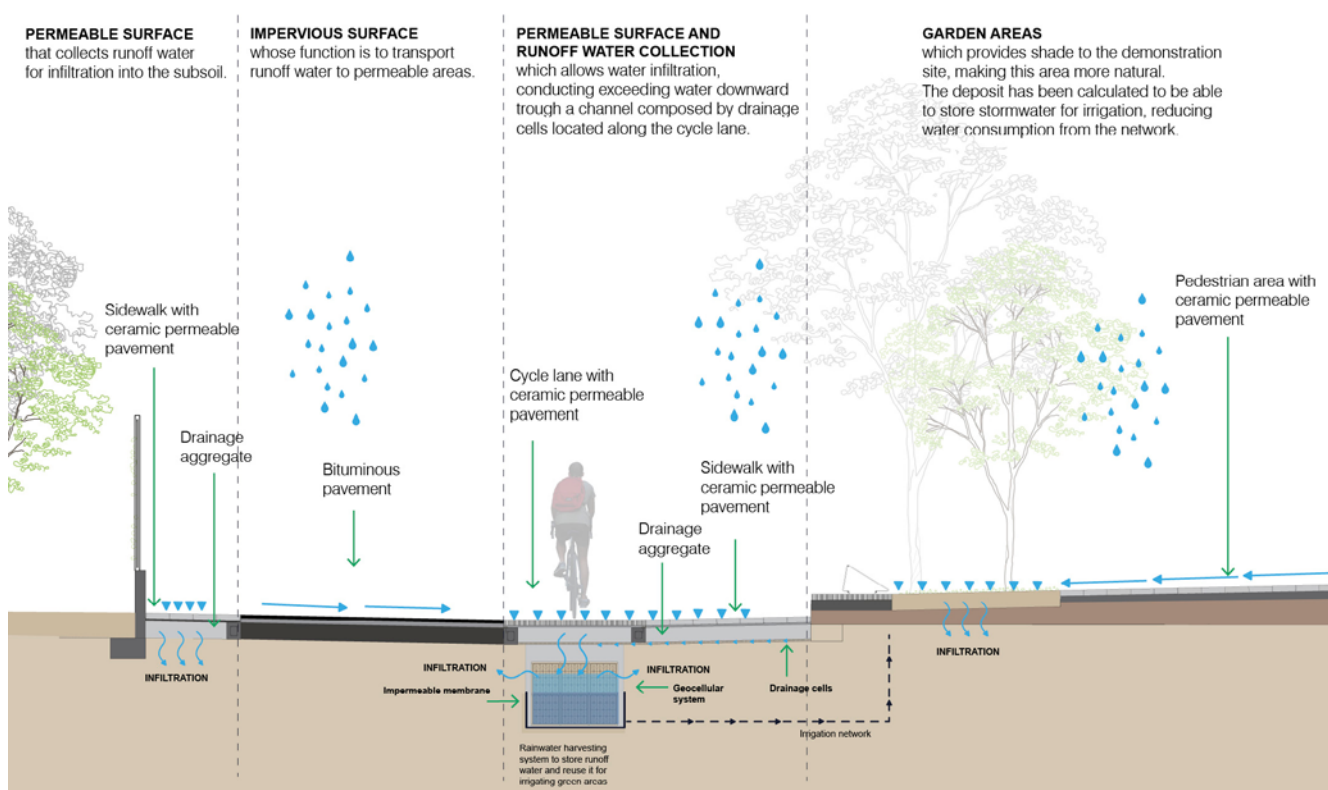
The demonstrator project has been developed by the F-VA firm “Fernandez-Vivancos Architect” with the participation of Eduardo de Miguel, architect, (www.fernandez-vivancos.com). The hydraulic design of the system has been developed by Sara Perales Momparler, from Green Blue Management (www.greenbluemanagement.com)

The demonstrator is located in a section of Torre Sant Vicent Street, between Mosén Elies Street and Tramontana Street, in the municipality of Benicàssim, and the road section has kept its usual setup, consisting of a central one-way traffic lane, together with a bicycle lane and two lateral pedestrian sidewalks.

The project has also addressed the improvement of public space access conditions by adapting this section to a single platform solution with a transversal slope of 2% towards the bicycle lane, thus obtaining a street section resolved at a single level which, added to its longitudinal slope of 1.5%, enables accessible access routes to public facilities along the

route itself. Also, as an additional improvement in the conditions of use, the character of the area as a resting space located in front of the Municipal Sports Pavilion has been improved, becoming an improved resting location on the route from the center to the beach.

Regarding the Urban Sustainable Drainage System (SUDS) itself, we have gone from the previous solution -consisting of a sealed surface featuring the collection of urban runoff by means of punctual gutters connected to a rain collector- to a new solution consisting of a permeable pavement made up of ceramic paving stones of low commercial value arranged on drainage bases which percolate the water to the ground, driving the excess water to a tank/channel located under the bicycle lane which allows for the recovery of this water to be used for watering of the landscaped areas and which also acts as a collector, delaying and reducing the contribution to the network during precipitation peaks.



Political decision making:

How and why the municipal government of Benicàssim decided to commit to LIFE CERSUDS.

According to the statements of Susana Marqués, Mayor of Benicàssim:



“I am convinced that the future of our cities is necessarily about being more environmentally responsible. We said “yes” to carrying out the LIFE CERSUDS project in our municipality because we wanted it to be a pioneer in this field. Benicàssim has a high potential and has always been committed to entrepreneurship and innovation: the fact of being able to host this project to locate the demonstrator has become an extraordinary opportunity arising from a problem. And it is that our municipality, because of its geographical location, suffers episodes of strong rains in some moments along the year. This project has resulted in significant resource savings and a more sustainable vision of water management, as well as in a new use for out-of-stock ceramic material that would not otherwise have been used.

Thanks to institutional support and absolute municipal technical commitment, we have been able to implement this initiative, which has given us the opportunity to share experiences and knowledge with academic institutions and organizations of international prestige. From the beginning, we knew that being the headquarters of this European project

could be a great projection for the municipality, as it has finally been the case.

I would like to point out that, from the very beginning, the implementation of LIFE CERSUDS was designed under a fundamental premise: CITIZEN INFORMATION, in order to involve citizens and make them a part of the project. Therefore, from day one, we informed people and neighbors so that they could perceive the great opportunity that the development of this project offers to our city. Obviously, and as it is common in any type of urban remodeling, works cause discomfort in the daily life of the city, but we tried to minimize the inconvenience as much as possible, focusing our efforts on designing alternative itineraries that resolved mobility issues in the surroundings of the area where the works were taking place, so as not to create rejection among neighbors and visitors.

In short, we are very proud of Benicàssim and very pleased to have been part of this initiative, which has given us the opportunity to turn a problem into a great success for our municipality.”

5. LIFE CERSUDS RESULTS

Hydraulic results

According to data recorded in the period September 2018 - August 2019, it is estimated that 1,060 m³ (slightly over one million liters) rained on the demonstrator area in a total of 28 events, with more than 1 mm of accumulated rainfall (with a total of 322 mm of accumulated rainfall in the period), and that the system has managed 86% of this volume. Only 149 m³ have left the system downstream in a total of 5 events, more than three quarters of which correspond to the torrential episode of 18 October 2018. On that day, 48.8 mm fell in Benicàssim, a value equivalent to the 97% percentile of the rainfall regime in the locality. That is to say, only 3% of the days it rains were exceeded on average. That 86% of the water managed by the system can be reused or returned to the hydrological cycle via evapotranspiration or infiltration.

From the point of view of the improvement of the quality of the water filtered by the system, the results show percentages of elimination of suspended solids of around 80%, and very significant reductions in BOD5, COD, hydrocarbons, fats and oils. From the microbiological point of view, the water stored in the tank is suitable for reuse in irrigation.

Training material

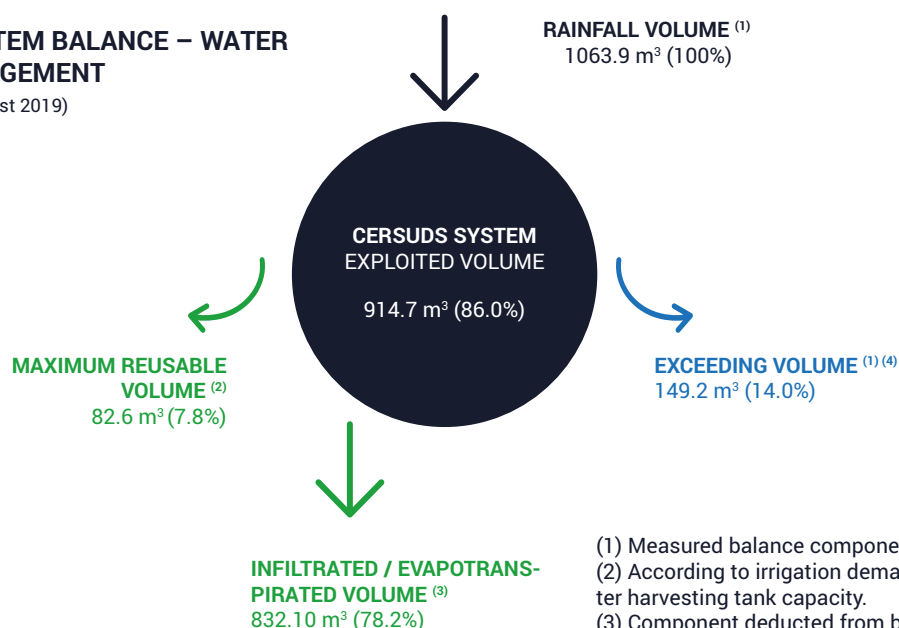
The experiences accumulated during the design and implementation stages of the ceramic system and the demonstrator, together with the knowledge gained in Urban Water Management Systems have allowed for the generation of training material and precise technical documentation for the replication of permeable pavements based on the principles of the demonstrator in other cities. This material is available in four languages (Spanish, English, Portuguese and Italian) and can be downloaded at www.lifecersuds.eu/es/documentos.

Replication

As for the replication of the system in other locations, we are collaborating with the LIFE Lugo+Biodynamic project for the inclusion of the system in the project demonstrator. The project for the remodeling of the surroundings of Anselm Clavé Square in Sabadell is also being drafted. The H2020 GrowGreen project, which is being developed in Valencia, has also shown interest in incorporating the pavement in some of its interventions. On the other hand, work continues on the blueprints so that the same system can be replicated in Italy and Portugal.

HYDRAULIC SYSTEM BALANCE – WATER QUANTITY MANAGEMENT

(September 2018 – August 2019)



- (1) Measured balance component (monitoring)
- (2) According to irrigation demand study and rainwater harvesting tank capacity.
- (3) Component deducted from balance closing
- (4) Water filtered by the system

Awards

LIFE CERSUDS has won several awards and recognitions:

- First Prize SOM CERAMIC 2018 to the Use of Ceramic Product of Castellón Provincial Council.
- Honorable Mention at the Innovation Space of Tektónica 2019, Portugal's International Construction and Public Works Trade Fair.

- Prize for innovative product or material at Future Arena de Construmat 2019, International Construction Exhibition.

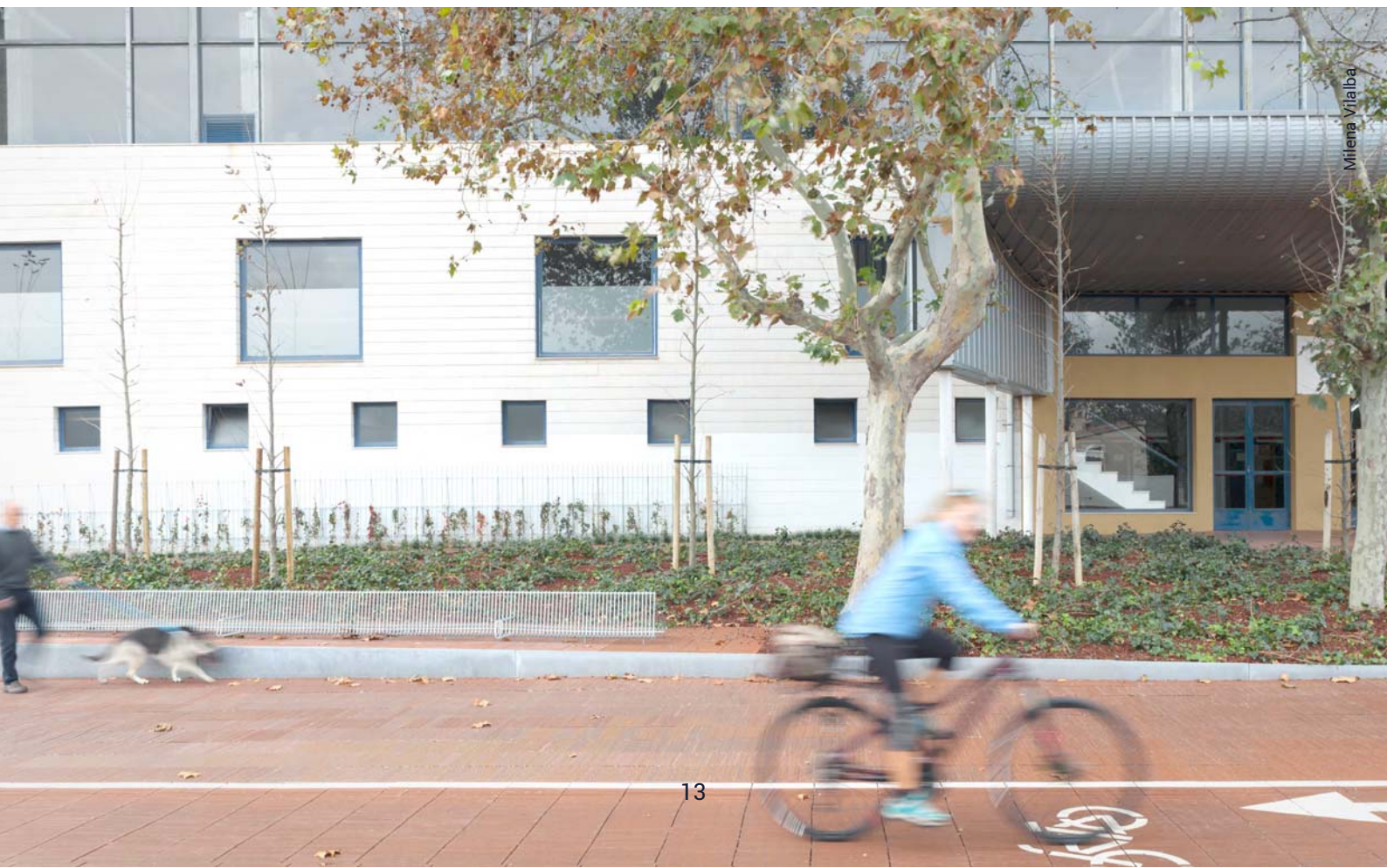
In addition, it was selected in 2018 by InvestEU as an example of a project funded by the European Union.

The LIFE CERSUDS system has a permeability capacity of between 8,000 and 10,000 litres of water/m² per hour.

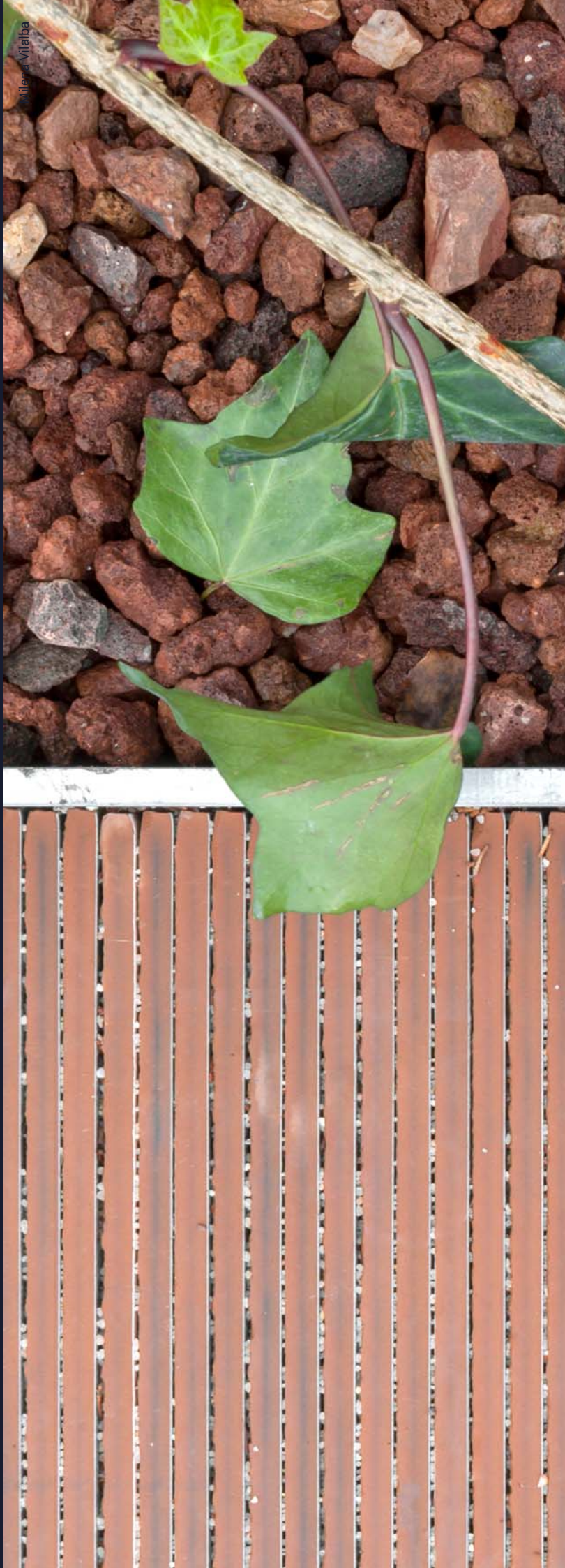
During its first year of operation, LIFE CERSUDS has infiltrated more than 900,000 litres of very high-quality runoff water underground.

The installation of about 2,000 m² of permeable ceramic pavement in the demonstrator has resulted in a reduction of 12 tons of CO₂ emissions, compared to the installation of other permeable pavements.

The LIFE CERSUDS Sustainable Urban Drainage ceramic system has paved 1,950 m² in Torre de Sant Vicent street in the municipality of Benicàssim (Castellón-Spain) and will also be replicated in other cities in Spain, Italy and Portugal.



Mirena Vilalba



LIFE
CERSUDS

More information about LIFE CERSUDS at:
www.lifecersuds.eu