

Layman report

myBUILDINGisGREEN

LIFE17 CCA/ES/000088

February 2024

my building is green
A LIFE PROJECT

CSIC · Real Jardín Botánico · Instituto de Ciencias de la Construcción Eduardo Torroja · Cartif · Diputación de Badajoz · Porto. · Alentejo Central



Green roof with photovoltaic panels at EB1 Falcão

Introduction

Climate change is one of the most serious environmental, social and economic challenges facing the world. European educational buildings will face multiple challenges in the coming decades, such as the complete renovation of buildings that are experiencing structural failure over time and where insulation measures have been largely ignored. In addition, climate change will add to this pressure through a wide variety of impacts induced by heat waves or changes in annual and seasonal precipitation patterns. This may affect the health and well-being of children who are the main users of these buildings.

The LIFE-myBUILDINGisGREEN project aims to address the effects of climate change related to the increase in temperature in school buildings, intensified in recent years due to consecutive heat waves experienced across Europe, but with more adverse effects in the southern region of the continent. As a result, education and social care facilities in southern Europe experience indoor temperatures above 32 °C for several months of the year, when the recommended maximum is 27 °C, making it very difficult to use these buildings.

LAYMAN REPORT

LIFE17 CCA/ES/000088 “Application of Nature-Based Solutions for local adaptation to climate change in educational and social buildings”
Name: “Application of Nature-Based Solutions for local adaptation to climate change in educational and social buildings”.
Abbreviation: LIFE-myBUILDINGisGREEN
Reference: LIFE17 CCA/ES/000088
Coordinating partner: Spanish National Research Council (CSIC)
Beneficiary partners: CARTIF; Diputación of Badajoz; Municipality of Porto; Intermunicipal Community of Central Alentejo
Total budget: 2,854,105 €
UE Contribution: 1,697,369 € (59.99 %)
Website: https://life-mybuildingisgreen.eu/en/home/
Duration: from September 1, 2018 to February 29, 2024

The project

LIFE-myBUILDINGisGREEN is a project developed by a group of partners from the Iberian Peninsula, co-funded by the LIFE programme of the European Union, whose **objective is the design, development and testing of prototypes of Nature-Based Solutions (NBS) to improve the bioclimatic comfort of educational buildings to increase the well-being of the users of these buildings**.

The implementation of this type of solutions has taken place in three pilot buildings which are pre-schools and primary schools located in Solana de los Barros (Badajoz, Spain), Évora (Portugal) and Porto (Portugal).

In order to achieve its general objective, the LIFE-myBUILDINGisGREEN project has worked on the following specific objectives:

- Improving the knowledge of NBS at building level;
- Analysing the cost-benefit of NBS as climate adaptation tools;
- Promoting governance actions to improve the transferability of the implemented solutions by facilitating their inclusion in local, regional and national regulations;
- Transferring and replicating the prototypes of NBS implemented and tested in this case study, through capacity building initiatives for specialised staff.

The proposed NBS consisted of a series of green roofs, green façades and other NBS aimed at shading and water harvesting that aim to (i) keep indoor temperatures low during hot periods and thus minimise energy use for cooling, (ii) create shade and (iii) improve water retention around buildings by minimising rainwater run-off.

The LIFE-myBUILDINGisGREEN project is co-funded by the LIFE programme of the European Union and implemented by a consortium composed of the Royal Botanical Garden (RJB-CSIC, coordinating entity), the Eduardo Torroja Institute of Building Sciences (IETcc-CSIC), CARTIF, the Diputación of Badajoz, the Municipality of Porto and the Intermunicipal Community of Central Alentejo (CIMAC).

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Pilot experiences

Gabriela Mistral Elementary and Primary school (Solana de los Barros, Badajoz, Extremadura, Spain)

Falcão Elementary and Primary school (Porto, North Region, Portugal)

Horta das Figueiras Elementary and Primary school (Évora, Central Alentejo, Alentejo, Portugal)





Green roof and green façade of the CEIP Gabriela Mistral

CEIP Gabriela Mistral

The implementation works of the NBS prototypes of this pilot building started in May 2021 and were completed in December 2021 (9 months).

The solutions implemented in this pilot building can be classified into four main categories: green roofs, green façades, ventilation and outdoor conditioning.

The pilot building tested three types of ***green roofs*** with a variety of more than 25 indigenous plant species. Two of these green roofs reuse surplus water by gravity to make it available for irrigation.

The ***green façade*** system implemented includes a system of planters placed on metal structures anchored to the façades of the buildings, including climbing plants. There is also a system of vertical awnings with mineral substrate for the growth of vertical vegetation and an interior vertical garden with a wide variety of plant species to maintain adequate humidity levels and contain the high temperatures inside the building.

A ***ventilation system*** was included in the building by programming the closing and opening of five windows to allow fresh air to circulate in the school and reduce indoor CO2 concentrations, favouring re-oxygenation inside the classrooms.

Outside, in addition to planting more ***trees*** to provide natural shade, ***pergolas***, ***draining pavements*** and ***wooden structures*** were installed to shade recreational areas.

PRELIMINARY RESULTS

- 145.52 % increase in green areas, reaching a total area of 2,577.7 m^2.
- Installation of 451.70 m2 of permeable paving that allows the growth of vegetation.
- Reduction of the temperature inside the building compared to the values before the interventions. Although the vegetation has not yet grown enough, the temperature is already below 27 °C in September.
- Significantly lower building envelope temperatures in green roof areas compared to non-intervention areas.
- Reduction of rainwater loss from 13% to 3%.
- Increase of 77 new species, of which 16 were native species that have colonised the implemented NBS.

EB1 Falcão

The implementation works of the NBS prototypes of this pilot building started in October 2022, finishing in February 2023 (5 months).

Three ***green roofs*** with different characteristics have been implemented at the Falcão school. The most extensive roof is based on a natural cork-based substrate, another one integrates a photovoltaic panel system that reduces the building's energy dependence, while the third one is a sloping roof that allows rainwater to be collected and channelled to a ***pond*** that serves as a reservoir of biodiversity in the environment and has been the main outdoor conditioning measure in this pilot building.



On a trial basis, a ***green façade*** was installed at EB1 Falcão, consisting of a system of cables that guide the growth of climbing plants whose base is placed in planters on the ground. Deciduous species are planted which, as they develop and climb up the wiring, will shade the building in the warmer months, while allowing light and radiation to enter during the colder months of the year.

PRELIMINARY RESULTS

- 168.94 % increase in green areas, reaching a total area of 1,076.94 m^2.
- Installation of a 28 m^2 natural pond that serves as a reservoir of biodiversity (amphibians, aquatic macro-invertebrates) and provides a living educational resource.
- Building envelop temperature in green roofs 5.4 °C lower after NBS implementation.
- Reduction of rainwater loss from 30 % to 3.74 %.
- Increase of 26 new species, mainly flying insects, flies, mosquitoes, hymenopterans and some species of the genus *Armadillium*, which are indicators of habitat quality.
- Annual production of 28,625 kWh of photovoltaic energy, reducing CO_2 emissions by 7.39 tonnes per year.



Sloping green roof and green façade in cables in EB1 Falcão



Green roof in trays in EB1 Horta das Figueiras

EB1 Horta das Figueiras

The implementation works of the NBS prototypes of this pilot building started in April 2023, ending in February 2024 (11 months).

The solutions used in Évora have been mostly a replica of some of those already described in the previous buildings, however, they present certain specificities related to the context of this pilot building.

In this school, a unique type of ***green roof*** has been included, consisting of a series of trays where vegetation carefully selected to withstand the arid climate of the Evora environment is planted. The system is designed to reduce the loss of rainwater and moisture generated by the plants themselves, so that once the vegetation has reached its optimum growth stage, additional irrigation is practically non-existent.

As for the ***green façades***, a cable system similar to the one used in the Porto building and an awning system similar to the one used in the Solana de los Barros building have been installed. In both cases, the lessons previously learned in the two aforementioned buildings have been incorporated, so that the solutions implemented in Évora are improved alternatives.

The outdoor solutions consisted of a type of ***draining wooden paving*** that improves rainwater filtration and the growth of vegetation while reducing the heat island effect produced by intense and constant solar radiation on inert building materials, a ***wooden structure*** for shading similar to the one installed in the case of Solana de los Barros and the ***replanting of the existing flowerbeds*** with native species.

PRELIMINARY RESULTS

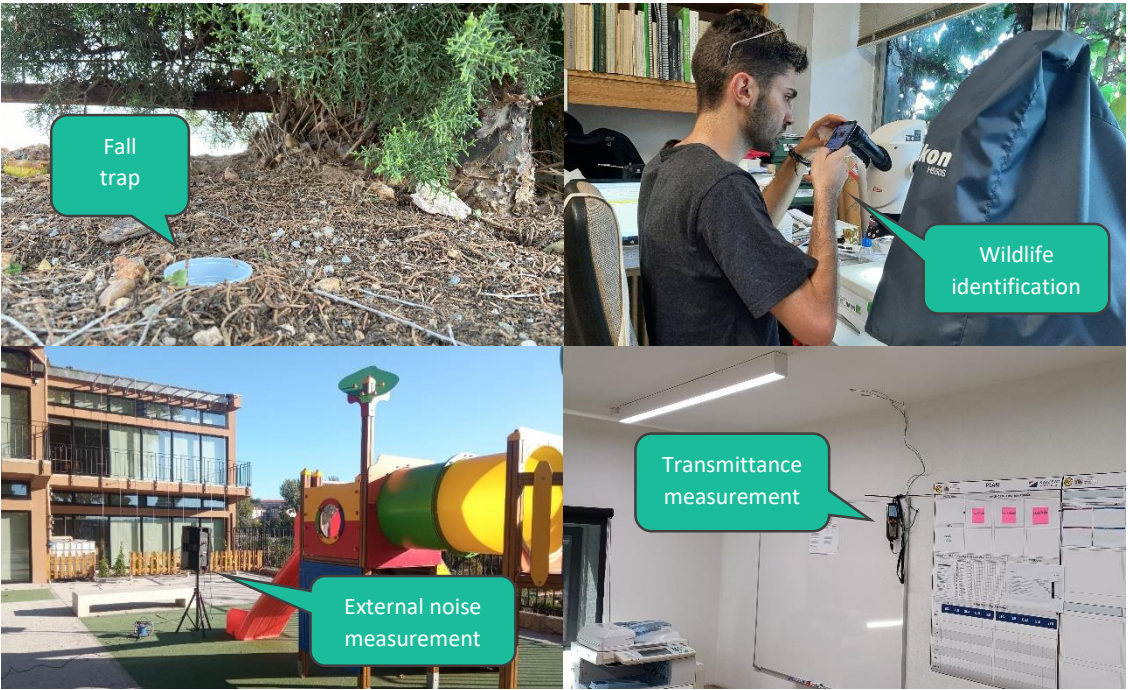
- 31,2 % increase in green areas, reaching a total area of 1,726.71 m^2.
- Installation of 366 m^2 of of draining wooden paving that improves rainwater management, reduces the heat island effect and allows the growth of vegetation on the surface.
- Estimated annual reduction in cooling demand of up to 55 % compared to the pre-intervention situation.

Monitoring scheme

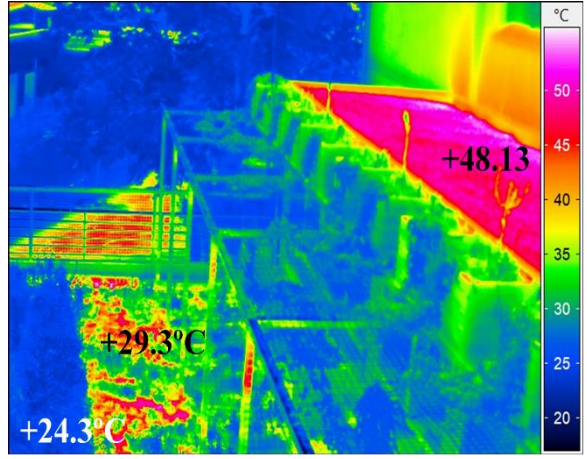
Assessing the impact of NBS implementation is essential to ensure that these solutions are effective, sustainable and beneficial at environmental, social and economic levels. Impact assessment at these three levels can determine their effectiveness in solving specific problems. In turn, impact assessment of NBS supports replication by providing critical information to decision-makers, enabling them to make evidence-based decisions and prioritise solutions that are beneficial to both the environment and society.

To measure the impact of the actions developed in each pilot building, the improvement of the thermal comfort of school users, the increase of the green surface in a sustainable way, the reduction of the carbon footprint, the improvement of the water management of the buildings, the recovery and promotion of local biodiversity in the urban environment, as well as the awareness of the value of nature and the ecosystem services that are produced have been monitored.

The methodology used to measure the impact of the actions consisted of: measurements of CO_2 inside and temperature and humidity inside and outside the buildings; calculations of rainwater captured; estimates of savings in indoor air conditioning and water consumption for irrigation of green areas; sampling of biodiversity (fall traps and colonising plants) and the grade of development of bio-indicator species; measurement of transmittance (outside temperature penetrating the buildings); measurement of temperature in the building envelope and outside noise levels; surveys of the population affected by the pilot buildings.







Incidents in monitoring

During the course of the LIFE-myBUILDINGisGREEN project, several events took place that were difficult to foresee, such as the COVID-19 pandemic, which made it difficult to obtain administrative permits for the construction works, or the war in Ukraine, which made the supply chain more expensive, such as some construction materials and energy resources. These events caused significant delays in the start of the construction works in the pilot buildings, so it has not been possible to carry out the full monitoring of these buildings, estimated in 2 years after the implementation of the NBS. The level of monitoring of these solutions varies depending on the building, being practically complete for the Solana de los Barros school, somewhat less complete for the Porto school and not having been carried out in the case of Évora. Even so, periodic sampling was carried out to obtain the baseline of the three buildings (situation prior to the interventions).

To complete the monitoring process of the three buildings, as well as the long-term monitoring of the solutions in which there is an optimal state of vegetation growth, the project partners have elaborated an After-LIFE monitoring plan, which is available in the results section of the project website.

The monitoring periods for each pilot building are detailed below:

- CEIP Gabriela Mistral: The baseline monitoring period ran from May 2019 to December 2021. NBS monitoring started in January 2022 and will end in October 2024. Long-term monitoring will take place from November 2024 to February 2028.
- EB1 Falcão: The baseline monitoring period ran from May 2019 to October 2022. NBS monitoring started in March 2023 and will end in October 2025. Long-term monitoring will take place from November 2025 to February 2028.
- EB1 Horta das Figueiras: The baseline monitoring period ran from May 2019 to December 2023. SNBS monitoring will start in March 2024 and end in June 2026. Long-term monitoring will take place from July 2026 to February 2028.

Socio-economic benefits

In order to quantify the social and economic benefits in addition to the environmental advantages of the project, monitoring actions have been carried out based on a series of indicators that will act as a reflection of the level of sustainability of the project and the achievement of its objectives.

The socio-economic impacts have been measured through surveys of the users of the educational centres where the project is taking place, as well as the population in the area of influence of these buildings. In addition, the various socio-economic aspects of the project have been analysed to determine its impact on the regions where the interventions take place.

LIFE-myBUILDINGisGREEN has mobilised a large amount of economic resources (1,836,215.83€) that directly affect the economy of the regions where the pilot buildings are located, as well as the creation of employment within the beneficiary entities of the project. **During the project, a total of 30 jobs have been created, covered by 47 different people in different phases of the project**. Table 1 shows a breakdown of the budget mobilised with direct impact on the project regions and the number of jobs created per participating entity.

Beneficiary partner	External assistance	NBS prototypes, equipment, consumables	Personnel*	Jobs created	Persons recruited
CSIC	33,818.82 €	37,507.62 €	315,898.87 €	2	6
CARTIF	-	25,540.37 €	407,566.43 €	6	18
DIPBA	10,907.62 €	260,221.01 €	141,200.85 €	10	11
MP	114,026.32 €	216,362.78 €	-	7	7
CIMAC	48,117.60 €	225,047.54 €	-	5	5
TOTAL	206,870.36 €	764,679.32 €	864,666.15 €	30	47

Table 1. Direct economic impact and job creation of LIFE-myBUILDINGisGREEN.
***Only the budget used for the recruitment of new staff for the implementation of the project is included.**

Some of the costs incurred during the implementation of the project will be reimbursed after its completion.

The Diputación of Badajoz maintains the two jobs created for the maintenance of the NBS (control of plant species, irrigation systems, etc.) and plans to mobilise budget allocations for awareness-raising and transferability services, using the NBS as an educational resource.

The Évora school also plans to continue the maintenance of its solutions, which will be carried out by the Évora City Council itself, which will allow the creation of a job for the specific maintenance of these solutions, whose dedication will be more significant as the NBS are transferred to other schools and public buildings in the city. In addition, CIMAC plans to continue the telecommunications contract concerning the communication with the sensors installed in the school to measure the impact of the implemented NBS.

In the case of Porto, the maintenance cost of the green roofs is estimated at 500 €/month, especially in the first years of development. In addition, 8-12 h/month of specialised staff from the Câmara do Porto will be used for issues related to the dissemination and transferability of Falcão's solutions. Porto is also exploring the possibility of carrying out additional monitoring to those programmed in the After-LIFE Plan. If confirmed, this additional monitoring would be carried out in collaboration with the Interdisciplinary Centre for Marine and Environmental Research (CIIMAR). These samplings will mobilise economic resources from both institutions and will allow the creation of new jobs.

In addition to the economic and job creation benefits, the implementation of the project's NBS has led to an increase in green areas in the pilot buildings, which has resulted in an unquestionable improvement in the landscape value of the environment, an increase in living educational resources and recreational spaces for the enjoyment of school users, as well as an increase in biodiversity, abundance and local ecosystem services.

Reducing the temperature in the pilot buildings means improved well-being of students, teachers and other school staff, which can be related to improved attention in class, reduced absenteeism, or improved health of the people who use these buildings.

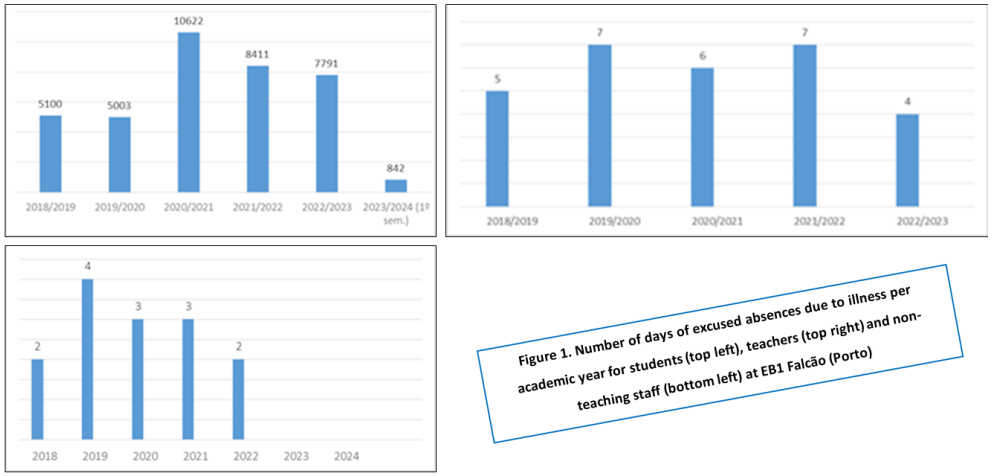


Figure 1. Number of days of excused absences due to illness per academic year for students (top left), teachers (top right) and non-teaching staff (bottom left) at EB1 Falcão (Porto)

The reduction in temperature also leads to savings in energy consumption for air-conditioning inside the buildings, which translates into economic savings. In the case of Solana de los Barros the reduction in electricity consumption is 11.2 %, while in Porto the energy production by the photovoltaic panels will lead to a saving of €3,502 per year in energy costs.

For more detailed information on the socio-economic impacts and the perception of nature by the citizens of the areas of influence of the project, please consult the socio-economic impact report available in the results section of the LIFE-myBUILDINGisGREEN website.

Participation

During the development of the LIFE-myBUILDINGisGREEN project, a total of 360 stakeholders have been involved in the project, representing a wide range of professional profiles.

In order to better meet the needs of the people in the area of influence of the pilot buildings of the project, during LIFE-myBUILDINGisGREEN 13 events involving participatory processes have been organised, involving a total of 421 people. Some of these events allowed to co-design the NBS of the school playgrounds according to the needs of the pupils, to meet the demands of institutions such as the General Directorate of Schools (DGesTE) or the Portuguese Environment Agency (APA), etc.

The project organised a series of workshops with pupils from the schools with the aim of improving their knowledge of NBS and its benefits for the adaptation of buildings to climate change. These workshops were delivered to a total of 448 students, a number that will increase in the coming years, as training programmes have been developed to be delivered in the three pilot buildings and in other schools in the city of Porto, Évora and the province of Badajoz.

In terms of visibility and awareness-raising, the project has organised a large number of face-to-face and virtual events with the participation of 2,530 people. In addition to these events, members of the LIFE-myBUILDINGisGREEN team participated in 34 external events (congresses, conferences, workshops, round tables, etc.) to make the project visible, create collaboration networks with other entities and share the results obtained.



EURESFO 2022, Athens

Dissemination activities

The main tools used to promote the project have been:

- Project website and communication channels (X, LinkedIn and YouTube)
- Noticeboards
- Explanatory posters and brochures
- Videos explaining the project
- Articles in specific media
- Presence in external media and institutional websites
- Collaborations in knowledge platforms on climate adaptation
- Participation in fairs, congresses and other regional, national and international events



Transferability and exploitation of results

In order to improve the transferability of the project and the subsequent use of the implemented NBS, a series of demonstration workshops were held in the three pilot buildings with the participation of 330 people (local and regional political representatives, municipal technicians, school managers, experts in topics related to the project, etc.).

A series of face-to-face and online workshops were also held to teach about the work carried out by LIFE-myBUILDINGisGREEN and to reach a wider audience from different environments than the project intervention areas. In this sense, professional workshops on green roofs and green façades were held in the facilities of the Royal Botanical Garden, workshops on sustainable construction and bioclimatic strategies given by the Eduardo Torroja Institute of Construction Sciences and an online training on the experience of LIFE-myBUILDINGisGREEN. These professional workshops served to improve the technical skills on the design, use and maintenance of NBS of 621 people (111 people in the face-to-face workshops and 501 people in the online training). The online training "Nature-Based Solutions: the LIFE-myBUILDINGisGREEN project" is still operational after the end of the project implementation period, so the number of people who can benefit from its content will increase in the coming years.

Thanks to the enormous effort made by the project partners to achieve the highest possible transferability of the NBS implemented by LIFE-myBUILDINGisGREEN and the large number of meetings held with various key people and entities in the field of green infrastructure and climate change, 8 declarations of interest and 14 commitment agreements have been signed by municipalities in the province of Badajoz and the Central Alentejo region, respectively, for the future transferability of the project's NBS in the buildings of these municipalities.

In Porto, the experience of the LIFE-myBUILDINGisGREEN project inspired the introduction of NBS in the Porto Environmental Index. This is a new municipal regulation in the process of being created (foreseen in the 2021 Municipal Master Plan) which aims to encourage developers to introduce NBS in their projects through fiscal and construction benefits.

Work has also been done to include the NBS of the project in the Computer Catalogue of Construction Solutions of the Technical Building Code, although more testing time is needed.

As can be seen, the great potential for transferability of the NBS implemented by LIFE-myBUILDINGisGREEN will multiply the socio-economic effects of this pilot project and will reach sectors of the population beyond the project's own areas of intervention.



Demonstration workshop with educational community (Porto, Sep 2023)





CIMAC meeting with municipalities of Central Alentejo (Évora, Nov 2022)

Opinions on the project from some of the people affected by LIFE-myBUILDINGisGREEN



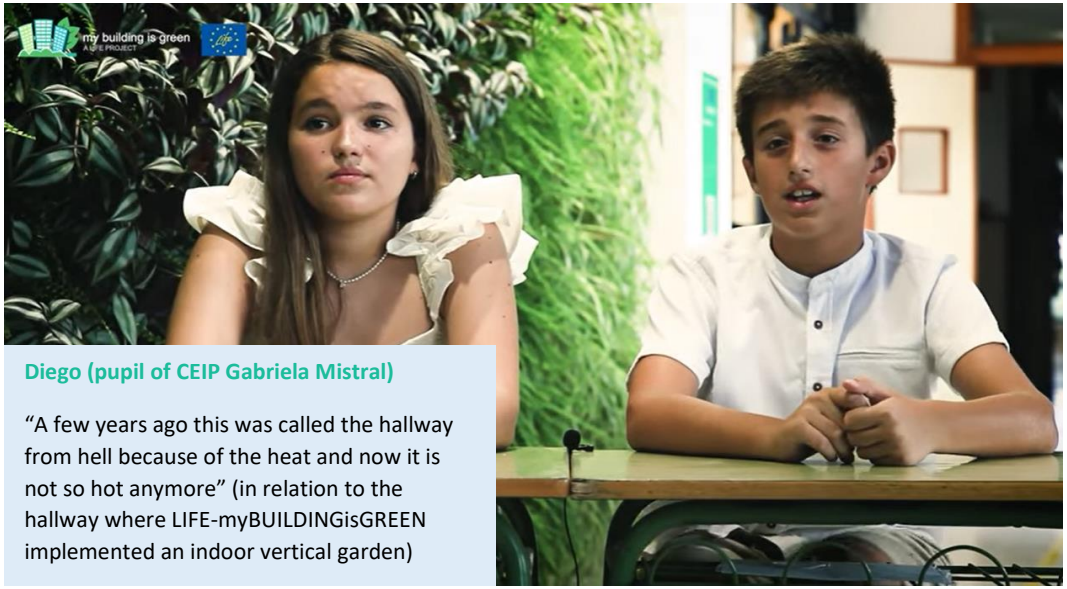
Ana Mª Rangel (mother of a pupil of CEIP Gabriela Mistral)

"The students' awareness that such solutions exist enables them to implement them in the future as adults"



María González (head of studies of CEIP Gabriela Mistral)

"The pupils have been interested in the type of plants that have been planted here and they are becoming more and more aware"



Diego (pupil of CEIP Gabriela Mistral)

"A few years ago this was called the hallway from hell because of the heat and now it is not so hot anymore" (in relation to the hallway where LIFE-myBUILDINGisGREEN implemented an indoor vertical garden)



Helena Ribeiro (director of EB1 Falcão)

"When we were presented with the project they wanted to do in our school, I thought it would be useless. Now I am the first advocate of the advantages of this type of solutions"

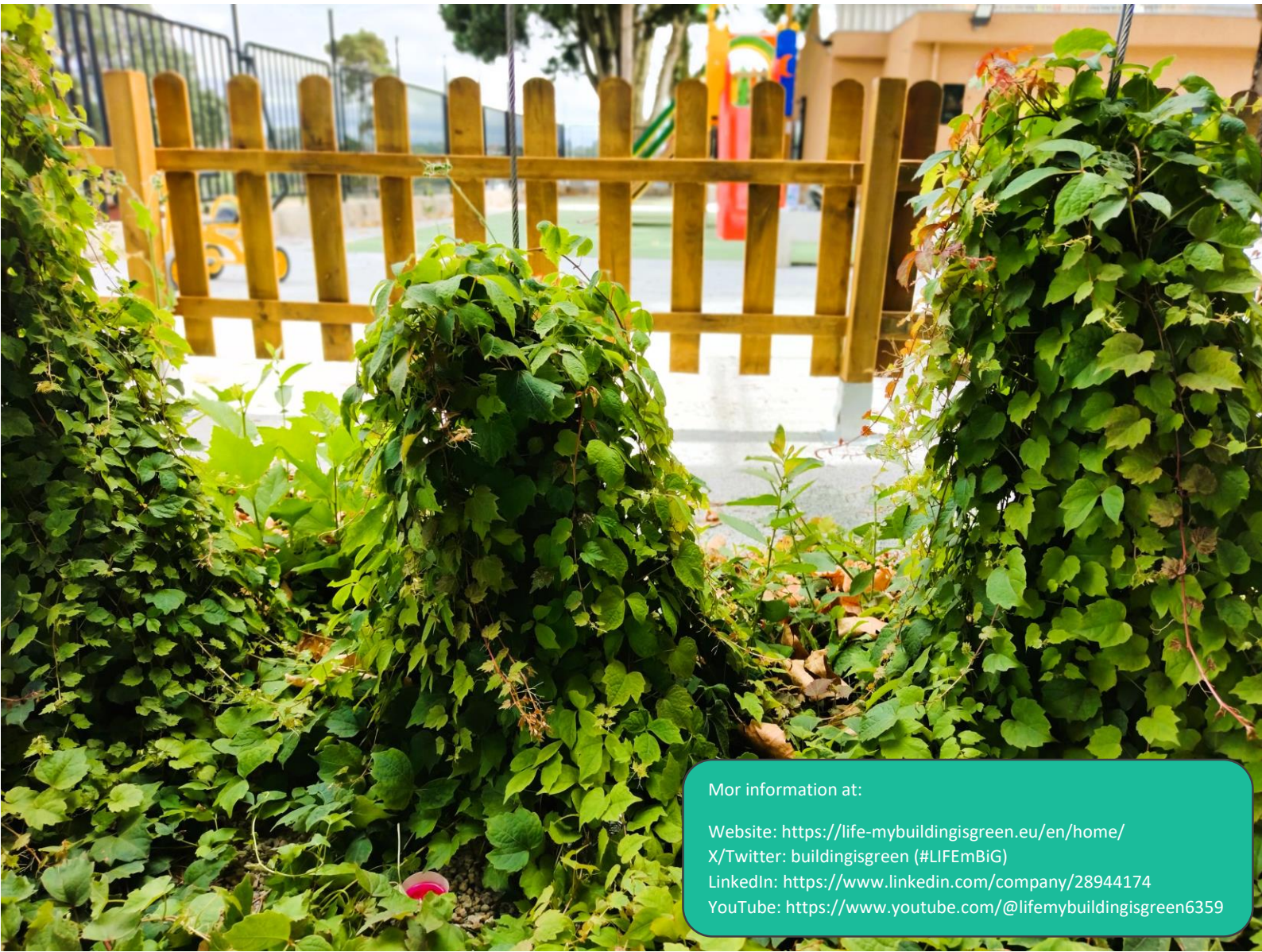


Photo of the project team during the latest visit of the LIFE external monitor (Porto, 30 Nov 2023)

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Mor information at:

Website: https://life-mybuildingisgreen.eu/en/home/
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