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LIFE17 ENV/EN/000088

Application of Nature-Based Solutions for the Local Adaptation of Educational and Social Buildings to Climate Change

Action: C4. Governance for Active Climate Change Adaptation in Education and Social Services Buildings.

Deliverable: C4.3) Favorable Report on NBS in the Technical Building Code and Municipal Regulations.

Data: 31/03/2023



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Favorable Report on NBS in the Technical Code of Building and Municipal Regulations.

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A LIFE PROJECT

LIFE my building is Green
LIFE17 ENV/EN/000088

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*

INDEX

1.	SUMMARY.....	4
2.	INTRODUCTION.....	5
3.	COMMITMENTS, AGREEMENTS AND ADVANCES ACHIEVED BY THE LIFE-MYBUILDINGISGREEN PROJECT.....	8
3.1	NBS IN BUILDING CONSTRUCTION AND MAINTENANCE REGULATIONS	8
3.2	COMMITMENTS AND PROPOSALS FOR MUNICIPAL REGULATIONS.....	10
3.3	TAX INCENTIVES OF CITY COUNCILS	11
3.4	RECOMMENDATIONS FOR PRIVATE BUILDINGS.....	12
3.5	NBS INTEGRATED INTO MUNICIPAL GREEN INFRASTRUCTURE STRATEGIES	13
3.6	SBN INTEGRATED INTO MUNICIPAL URBAN PLANNING REGULATIONS	17
3.7	NBS AS REFERENCE TOOLS FOR ASSOCIATIONS OF MUNICIPAL ENTITIES	19
3.8	TERRITORIAL AND INTER-MUNICIPAL AGREEMENTS	26
3.9	NBS INTEGRATED INTO REGIONAL GREEN INFRASTRUCTURE STRATEGIES	27
3.10	SBN INTEGRADAS IN THE TECHNICAL BUILDING CODE (CTE).....	30
3.11	NBS INTEGRATED INTO THE NATIONAL STRATEGIES FOR CLIMATE CHANGE AND GREEN INFRASTRUCTURE.....	34
3.12	CERTIFICATION OF SUSTAINABILITY CRITERIA IN BUILDINGS.....	37
4.	BIBLIOGRAPHY	44



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A LIFE PROJECT

LIFE my building is Green
LIFE17 ENV/EN/000088

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*

1. SUMMARY

This document is part of action C4. " Governance for the active adaptation of Climate Change in Education and Social Services Buildings ".

To achieve the transferability objectives of the project, it is necessary to identify and address the key actors that allow the governance pillars to be sustained within and outside the geographical context of the project.

Action C4 is divided into three sub-actions: C4.1 "Collection of information from responsible administrations and identification of actors"; C4.2 "Data analysis and development of tools for the governance of public works"; and C4.3 "Integration of NBS into enforcement policies and regulations".

This document describes the results obtained from the application of some of the governance tools at the local, regional and national level identified in the delivery "Reference report with the creation of governance tools" of sub-action C4.2. In some cases, it was not possible to implement specific agreements or commitments with the institutions addressed, but useful information was obtained and the steps to be taken in the future to reach these agreements and commitments were redefined. All information will be shown throughout this document.



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LIFE my building is Green
LIFE17 ENV/EN/000088

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*

2. INTRODUCTION

The project LIFE - My building is green is a project developed by a group of partners from the Iberian Peninsula, co-financed by the LIFE program of the European Union, and which aims to design, develop and test innovative solutions based on nature (NbS prototypes) to improve the bioclimatic comfort of educational buildings that allow the improvement of the well-being of the users of these buildings.

The project consortium is led by the Superior Council for Scientific Research (CSIC) through the Royal Botanical Garden (RJB-CSIC) and has the technical support of the Eduardo Torroja Institute of Construction Sciences (IETcc-CSIC). The beneficiary partners are the technological center CARTIF, the Provincial Chamber of Badajoz (DIPBA), the Intermunicipal Community of Central Alentejo (CIMAC) and the Municipality of Porto (MP).

For the implementation of Nature-Based Solutions (NBS), three pilot buildings were selected under the A1 action of the project, which are children's and primary schools located in Solana de los Barros (Badajoz, Spain), Évora (Portugal) and Porto (Portugal).

This project comes to address one of the effects of climate change that has intensified the most in recent years due to the consecutive heat waves experienced throughout Europe, but with more adverse effects on the southern region of the continent. For this reason, education and social assistance centres in southern Europe experience temperatures above 32°C inside for several months of the year, making it very difficult to habit these buildings.

To this end, the project will implement the aforementioned NBS in different parts of these buildings, such as roofs, facades or outdoor spaces, with a view to improving air quality and bioclimatic comfort both inside and outside buildings, as well as soil permeability.

The development of the project will allow to achieve a series of environmental, social, economic and governance results aimed at improving the adaptation of cities to climate change. Among the results related to the achievement of this delivery, the following stand out:

- Installation of 19 NBS distributed in the 3 pilot buildings in Spain and Portugal;
- Reduction of at least 4°C inside the buildings and improvement of the well-being of the users of these buildings;
- Reduction of energy consumption for cooling and water consumption for irrigation;
- Reduction of carbon dioxide (CO₂) and nitrogen oxide (NO_x) emissions;
- Empowering citizens to use NBS as a way to adapt to climate change;



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A LIFE PROJECT

LIFE my building is Green
LIFE17 ENV/EN/000088

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*

- Elaboration of manuals of good practices for the application of NBS as tools of adaptation to climate change.

IMPORTANCE OF ACTION C4. GOVERNANCE FOR THE ACTIVE ADAPTATION OF CLIMATE CHANGE IN EDUCATION AND SOCIAL SERVICES BUILDINGS

The state of assets and the management and maintenance of the pilot buildings of the project have different jurisdictional statutes in terms of responsibility and performance of public administrations in Spain and Portugal. In the case of Spain, the patrimonial status of education and social services buildings falls on the autonomous communities which have assumed their competences through the Ministries of Education and Health. This situation does not occur with the management and maintenance of these buildings, which is mostly up to the municipalities where they are located. In the case of Portugal, it is the municipalities together with the State that assume responsibility for the management, maintenance and heritage of these buildings.

In this sense, the project works with different administrations that have different levels of competence (national, regional and local) and that are responsible for these buildings. Therefore, action is needed to enable the generation of consensus, synergies, equipping work and a positive flow of institutions at various levels of competence. In this way, it is about centralizing and incorporating the climate problem of temperature rise in the educational and social buildings of southern Europe and the application of the NBS as a solution for adaptation to this problem in the agenda of the different political positions and citizens responsible for decision-making.

The prototypes and NBS implemented in this project are multidisciplinary in nature. This allows a continuous interaction with the different public administrations and allows the participation of the target groups and stakeholders, such as the ministers responsible for the educational centers, their users (staff, students, families of the students, etc.), construction sector, training schools, among others. These target groups are fundamental to achieve the objectives of the project and to be able to transfer and replicate its results.



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A LIFE PROJECT

*LIFE my building is Green
LIFE17 ENV/EN/000088*

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of Edification and Regulations Municipal.*

INTEGRATION OF AS NBS INTO POLICIES AND REGULATIONS

It is essential that the results of the project are included in regulations and action programmes so that they are transferred and replicated by the different regional authorities that consider Nature-Based Solutions (NBS) as sustainable climate adaptation measures at the local level.

In this sense, applying some of the governance tools included in the delivery "Reference report with the creation of governance tools" of sub-action C4.2, the project team worked with different forms of institutional dialogue with different government teams, decision-makers and technicians from different administrations (local, regional and national), to integrate the NBS in the Regulation of Sustainable Construction of Public Buildings, in the Technical Building Code, in the Regional and Municipal Strategy of Green Infrastructures of Extremadura, Alentejo and Porto and in different municipal urban regulations.

The following section presents the results obtained for each of the governance tools addressed by the project.



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LIFE17 ENV/EN/000088

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*

3. COMMITMENTS, AGREEMENTS AND ADVANCES ACHIEVED BY THE LIFE-MYBUILDINGISGREEN PROJECT

Within the framework of the C4 action "Governance for the active adaptation of Climate Change in Education Buildings and Social Services" numerous meetings and interactions have been held with entities and key actors to explore the possibility of including Nature-Based Solutions (NbS) designed, implemented and tested by the project LIFE - My building is green in the climate change adaptation regulations and initiatives and sustainable infrastructure currently available.

The following are the commitments, agreements and progress achieved by the LIFE - My building is green project under action C4, classified on the basis of the list of governance tools presented in delivery C4.2 "Reference Report with the creation of governance tools".

For more information, consult the [Documentary Platform](#).

3.1 NBS IN BUILDING CONSTRUCTION AND MAINTENANCE REGULATIONS

DIPBA

DIPBA, within the scope of Rede + Biodiversidad and, of which it has been a member since 2021, has participated in its annual meetings as well as in the green Infrastructures working group, transferring the experience gained from the implementation of the LIFE project - My building is green and knowing the experiences in this area of the network partners. Through them, the Economic Study of the Competition for Conservation and Maintenance Services of Green Infrastructures was known and disseminated. He has also participated in different training actions on:

- Recommendations for contracting the services of conservation and maintenance of the Green Infrastructure", 15/12/2021 and 28/03/2022.
- Tender for conservation and maintenance services of the Green Infrastructure", 21/06/2022.



Image 1: Brochures of the meetings held.

The dissemination of the actions has been carried out through the Office of Assistance to the Mayors of the DIPBA, depending on the Area of the Presidency of the Provincial institution.

On the other hand, DIBPA has reached an agreement with the Chamber of Solana de los Barros to ensure the proper maintenance of the prototypes installed in the Gabriela Mistral school in the first two years, which will be funded until the plant species are properly acclimatized.

CIMAC

CIMAC has been promoting the awareness and dissemination of knowledge about NBS, since the beginning of the project, through meetings with the different key actors identified.

On December 15, 2020, a digital event - round table was held, promoted by CIMAC, whose main objectives were to present the prototypes and nature-based solutions designed and developed for the pilot buildings of the project; to present the project of the EB School of Horta das Figueiras; talk about the importance of raising awareness of climate change in the school community; to highlight the impact of the LIFE project - My building is green in the school community; and to discuss the Local Strategy for Adaptation to Climate Change.

This meeting was attended by different national, regional and local bodies, such as the Administration of the Alentejo Hydrographic Region (APA, IP/ARH do Alentejo); the Commission for Coordination and Regional Development of Alentejo (CCDR); the University of Évora; the Regional Administration of and Health of Alentejo (ARS Alentejo); the National Green Roofing Association; the Interdisciplinary Center for Social Sciences (CICS. NOVA. UÉvora); the Service for the Protection of Nature and the Environment of the GNR (SEPNA); GeoAtributo - CIPOT, Lda; the Southern Daily Group; the association of parents of the EB School of Horta das Figueiras; and designer kippahs; the DIPBA; the CSIC; the CARTIF Foundation; and representatives of the various Portuguese municipalities.



Image 2: Digital event – Round Table.

All the information related to the meetings held is contained in the Alfresco platform and in the [Documentary Platform](#).

3.2 COMMITMENTS AND PROPOSALS FOR MUNICIPAL REGULATIONS

DIPBA

As for the DIPBA, the Local Government Network FEMP + Biodiversity and the Spanish Association of Public Parks and Gardens (AEPJP) are developing a Municipal Planning Model for Green Infrastructures, with the collaboration of the Association for the Management of Green Infrastructures (ASEJA) and the Ministry of Ecological Transition and Demographic Challenge (MITECO), which on 10/02/2023 was in the draft phase.

The existence of a standardized ordinance that serves as a model for Spanish municipalities facilitates the planning and execution of the NBS at the local level. It is a transversal tool that involves different areas of management of a local entity and has the potential to ensure the replication of the results of the LIFE project - My building is green in the territory of the province of Badajoz.

Regarding the consultation process in the Network + Biodiversity, it was disclosed through the Office of Mayors of the DIPBA, dependent on the Presidency Area of the Provincial institution. Once the final drafting is completed, the DIPBA will disseminate the ordinance to the local entities

of the province of Badajoz, in order to promote its knowledge and adoption. In addition, it will pass it on to the project partners for your use.

CIMAC

Currently, most of the 14 associated municipalities are in the process of defining strategies and reviewing their Municipal Master Plans.

Along with the project LIFE - My building is green, the project "Adapta.Local.CIMAC - Planning of Municipal Climate Adaptation in Central Alentejo" is taking place at CIMAC, which also addresses the theme of climate adaptation.

The Adapta project is in the operational strategy phase and aims to integrate, in the instruments of territorial management, climate adaptation measures. Some municipal technicians are already working, together with CIMAC, on this project.

With regard to NBS, awareness-raising actions for their consideration in the context of the climate change adaptation plan began to develop at the beginning of the LIFE - My building is green project. However, CIMAC does not have the authority to impose on municipalities the inclusion of NBS in its regulations and policies. The way to achieve this goal has been through awareness and dissemination of knowledge achieved with the project.

3.3 TAX INCENTIVES OF CITY COUNCILS

DIPBA

The development of a system of tax incentives was linked to the approval and set in motion by the Regional Green Infrastructure Strategies, which is currently in the approval phase in the different Autonomous Communities. In the case of Extremadura, it is expected to be approved in the first half of 2023.

The implementation of the NBS in Spain is supported by the National Strategy for Infrastructure, Green Connectivity and Ecological Restoration, which responds to the demands established by the European Union and is the strategic planning document that regulates the implementation and development of Green Infrastructure in Spain. It entered into force on July 14, 2021 through Order PCM/735/2021, of July 9, which approves the National Strategy for Green Infrastructure, Connectivity and Ecological Recovery.

Given the implementation phase of the National Green Infrastructure Strategy, it is premature to define a system of tax incentives to be implemented in the short term, which should include the tools defined in the C4.2 delivery.

CIMAC

The implementation of NBS in Portugal is supported by the National Strategy for Adaptation to Climate Change (ENAAC).

ENAAC aims to improve the level of knowledge about climate change and promote the integration of climate change adaptation into sectoral policies and territorial planning instruments. ENAAC also aims to help central, regional and local government and policy makers to find the means and tools for the implementation of adaptation solutions based on technical-scientific knowledge and good practices.

At this time, local knowledge of NBS is beginning to be incorporated into municipal management, so it is premature to establish a system of tax incentives based on this. Within the scope of the LIFE-Mybuildingisgreen project , it is intended that municipalities adopt strategies that enable the implementation of NBS in both public and private buildings. The starting point has been the awareness of municipal mayors and technicians.

3.4 RECOMMENDATIONS FOR PRIVATE BUILDINGS

DIPBA AND CIMAC

Currently, local knowledge about the NBS is beginning to be incorporated into municipal management, so that the phase that would allow the establishment of recommendations for private buildings has not yet begun. The potential advances in the inclusion of these in the Technical Code of Building and other regulations, would serve as a normative basis for the delimitation of activities in the matter, within the scope of municipal competences.

Given the degree of integration of NBS in local entities and the current constitution of the regulatory framework, it is premature to delimit this type of recommendations in the short term which, in any case, should include the tools specified in delivery C4.2.



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LIFE my building is Green
LIFE17 ENV/EN/000088

Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.

3.5 NBS INTEGRATED INTO MUNICIPAL GREEN INFRASTRUCTURE STRATEGIES

DIPBA

Currently in Extremadura, the definition of municipal strategies for Green Infrastructures is pending the approval of the Regional Strategy for Green Infrastructures. In this sense, the DIPBA has actively participated in its formation, through meetings at technical and political level, which are described in point 3.9.

On the other hand, within the scope of Red and + Biodiversidad and, the procedures were initiated, through the approval at the General Assembly of 04/10/2022, for the development of the project "Infraestructura verde in small and medium-sized municipalities and Local Supramunicipal", which will be developed during the year 2023 and is complementary to other NBS actions at the local level.

Through the Conference "Natural solutions for the adaptation of buildings to climate change", held in Badajoz (13/11/2019), and the virtual seminars on nature-based solutions for the adaptation of public buildings to climate change (17/6/22 and 10/11/22) and the demonstration workshops, held in Solana de los Barros (10/03/2023 and 14/03/2023), were transferred to political and technical profiles in the province of Badajoz and the region of Extremadura, the impact and functionality of NBS as sustainable tools for climate adaptation in buildings and cities, as well as their contributions in terms of improving the quality of life, taking the first steps to incorporate NBS into local strategies and management.



Image 3: Conference "Natural solutions for the adaptation of buildings to climate change".



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LIFE my building is Green
LIFE17 ENV/EN/000088

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*



Image 4: Demonstration workshops, Solana de los Barros.

CIMAC

Along with the project LIFE - My building is green, the project "Adapta.Local.CIMAC - Planning of Municipal Climate Adaptation in Central Alentejo" is taking place at CIMAC, which also addresses the theme of climate adaptation.

The Adapta.Local.CIMAC project aims to achieve the following objectives:

- Promote the integration of the Intermunicipal Plan for Adaptation to Climate Change of Central Alentejo at the municipal level;
- Provide the municipalities of Central Alentejo with a strategic and operational instrument for adaptation to climate change that increases local resilience;
- Promote the integration of adaptation to climate change in the Municipal Spatial Planning Plans;
- Define an operational framework for adaptation to climate change to be implemented by 2030;
- Increase the adaptive capacity of municipalities by promoting the training of municipal technicians in the field of local climate adaptation;
- Increase the sensitivity and preparedness of local and regional actors to deal with the implications of climate change.

Benefits of the Adapta.Local.CIMAC project, intended for CIMAC and local authorities:

- Develop 14 Municipal Plans for Adaptation to Climate Change (one for each Municipality) that will allow:



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LIFE my building is Green
LIFE17 ENV/EN/000088

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*

- Deepen and implement at the municipal level the strategy recommended in PIAAC-AC – Intermunicipal Plan for Adaptation to Climate Change of Central Alentejo;
- Develop, within each of the 14 WFPs, action plans for climate adaptation, consisting of action/project fiches that will allow the systematisation of investment programmes for the programming period of European Structural and Investment Funds 2021-2027, for the Environmental Fund and for other European programmes, as well as the subsequent preparation of individual and joint application processes;
- Support municipalities to integrate adaptation to climate change in the review process of Municipal Master Plans;
- Strengthen the training of municipal technicians in the field of local adaptation to climate change;
- Increase the sensitivity and mobilization of local actors and the general population to the vulnerabilities and opportunities associated with climate change, at the level of each municipality;
- Transfer knowledge between universities, companies, research centers and local government;
- Share knowledge and experiences with international partners.

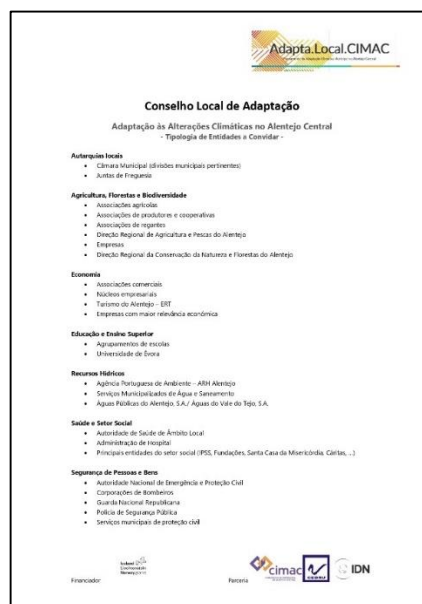


Image 5: Local Council of Adaptation – Adapta.Local.CIMAC Project.

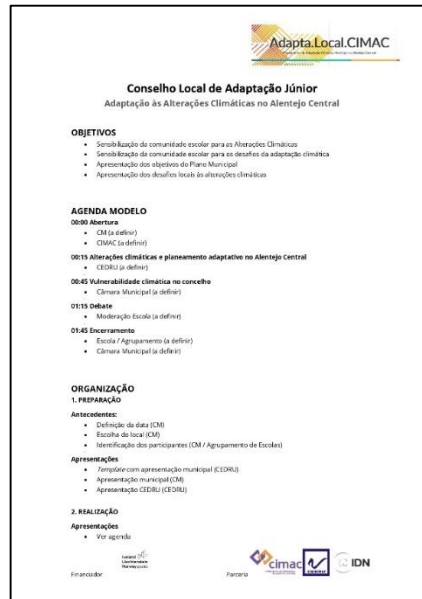


Image 6: Junior Local Adaptation Council – Adapta.Local.CIMAC Project.

In addition to projects LIFE - My building is green and Adapta.Local.CIMA, CIMAC is also underway the project AlémRisco, which aims to strengthen the capacity of the local populations of the Central Alentejo to adapt to the effect of heat waves on public health.

The Promoter of the project is Science Retreats. CIMAC participates as a partner. This process involves three axes of action:

- Elaboration of a manual of good practices providing technical guidelines on how to create a green structure of urban character that has characteristics of effectiveness in reducing high temperatures in summer periods. A simplified version should also be created for the general public and for young people and children. The main indicators of success of this axis consist of the publication of a technical manual of good practices and its simplified version;
- Conducting an extensive awareness campaign and building partnerships with a view to planting trees in all urban agglomerations of the region. Schools, voluntary associations and municipalities are preferred, if not exclusive, partners. The most relevant indicators of success boil down to the holding of a public awareness session by each of the 14 municipalities of Central Alentejo, the holding of technical awareness sessions for *influencers* from public and private institutions in the territories of the Intermunicipal



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LIFE my building is Green
LIFE17 ENV/EN/000088

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*

Community of Central Alentejo and the wide dissemination of the video material produced, both on the website and on social networks;

- Development of living laboratories where trees will be planted with the participation of local communities. The main indicators of success for the last axis of intervention will consist of the number of living laboratories created, as well as the number of trees planted.

CIMAC supports the project in its capacity as a partner in order to contribute to accelerating the transition to a carbon-neutral society, driving solutions and mitigating the negative effects of climate change on people, the environment and the economy, and promoting a more resilient society prepared for the global changes of the future, protecting in particular the most vulnerable. (Site of the project: <https://alemrisco.org/>).

With the involvement of the various entities of the Central Alentejo in all climate change adaptation projects, summarized to those presented in the previous paragraphs, it is intended that, with the LIFE project - My building is green, the impact and functionality of NBS as sustainable tools for climate adaptation in buildings and cities, as well as their contributions in terms of improving the quality of life, are widely disseminated and integrated into local management strategies.

3.6 SBN INTEGRATED INTO MUNICIPAL URBAN PLANNING REGULATIONS

DIPBA

The powers of urban planning occupy different administrative levels. As for the local level, in the case of Extremadura, the managers involved in the urban planning process are the municipalities, the Associations of Municipalities and the Provincial Councils (Provincial Council of Cáceres and Provincial Council of Badajoz). Through different dissemination and demonstration activities, it is intended to promote the integration of NBS in urban planning, as innovative tools for adaptation to climate change and the improvement of biodiversity. In this sense, the information obtained about the performance of the deployed prototypes is fundamental, as a lever to facilitate their deployment and replication in other environments.



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LIFE17 ENV/EN/000088

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of Edification and Regulations Municipal.

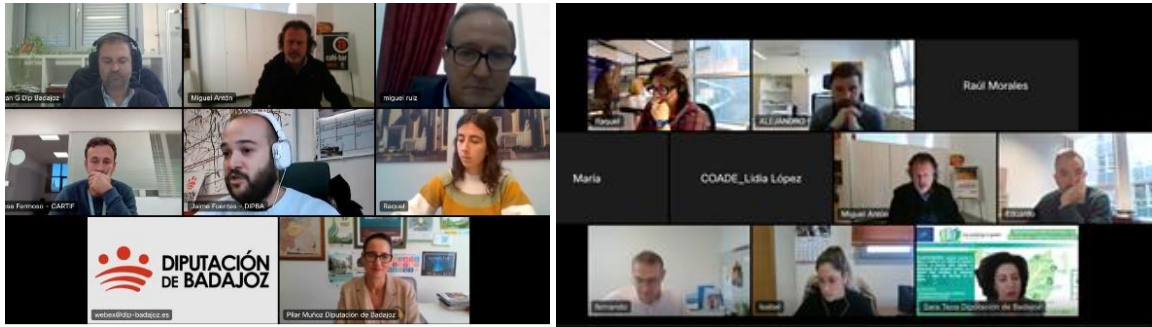


Image 7: NBS outreach meetings.

Through the Conference "Natural solutions for the adaptation of buildings to climate change", held in Badajoz (13/11/2019), the virtual seminars on Nature-based solutions for the adaptation of public buildings to climate change (17/6/22 and 10/11/22) and the demonstration workshops, held in Solana de los Barros (10/03/2023 and 14/03/2023), were transferred to political and technical profiles in the province of Badajoz and the region of Extremadura, knowledge about NBS, as well as examples to start the path of your consideration in urban planning .

CIMAC

Throughout the project, meetings have been held with all the municipalities that are part of CIMAC, with the objective of sensitizing and disseminating knowledge about the NBS, so that they are integrated into the Municipal Plans and Regulations.

Through the presentation of the prototypes developed, the projects of the schools of Évora, Porto and Solano de los Barros, it is intended that the benefits of the implemented solutions reach all municipalities and that the results achieved are a reference for the integration of NBS in public and private buildings in the region.

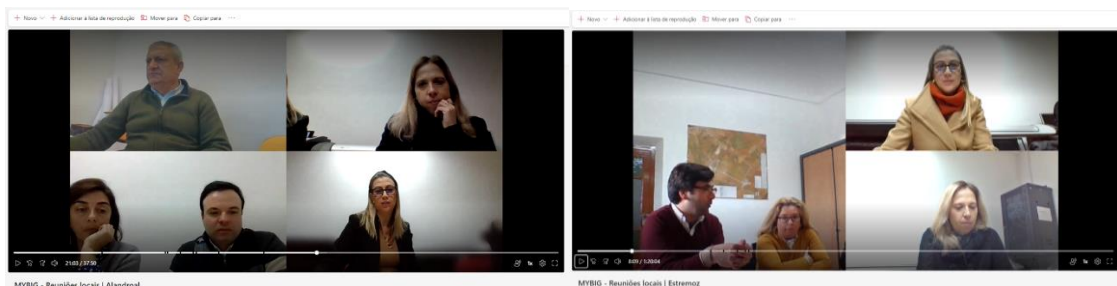




Image 8: NBS dissemination meetings with the municipalities of Central Alentejo.

3.7 NBS AS REFERENCE TOOLS FOR ASSOCIATIONS OF MUNICIPAL ENTITIES

DIPBA

FEMP, through the Spanish Network of Cities for Climate and the Network + Biodiversity, promotes the knowledge and implementation of NBS at the local level, especially through training actions and manuals/guides: Economic Study for the Competition for Conservation and Maintenance Services of Green Infrastructures: models and case study; Municipal Green Infrastructure Guide; Recommendations for contracting services of conservation and maintenance of Green Infrastructure; City Requalification Program; Nature-Based Solutions as a tool against climate change; among other actions.

As a member of the FEMP + Biodiversity Network, DIPBA has participated in its annual assemblies and with it has maintained frequent contacts to develop different transfer actions of the LIFE - My building is green project. As a result of this activity, DIPBA participated in the Round Table of Municipal Experiences of the Municipal Conference on Implementation and Management of Green Infrastructures, organized by FEMP (11/13/2019).

In addition, the application LIFE - My building is green was presented for the IV "Good Practices" Award for Biodiversity of the PEMP Network + Biodiversity, and it was awarded in the category of Flora.



Image 9: "Good Practices" Award for Biodiversity of the FEMP Network + Biodiversity.

On the other hand, DIPBA, as a member of the Spanish Network of Cities for Climate and a member of the Council of Government, has participated in its annual assemblies and maintained frequent contacts to develop different transfer actions of the LIFE project - My building is green. As a result of this activity, DIPBA participated in:

- 03/03/2021. ONLINE Workshop – Nature-based solutions as a tool against climate change;
- 02/14/2023. Journey of Exchange of Experiences in the Adaptation of Educational Centers to Climate Change.

CIMAC

CIMAC, through the LIFE project - My building is green has promoted knowledge about NBS, especially through the meetings that have been held over the last 3 years, with the various national, regional and local entities.

Along with other Climate Change Adaptation projects, CIMAC has sought to show the progress and results in the LIFE project to all the municipalities that make up the Central Alentejo.

All municipalities in the region, due to the high temperatures recorded in the summer, are interested in introducing measures that minimize the impact of climate change and provide comfort and well-being.

The partnership between CIMAC and the municipalities of Central Alentejo was formalized with the signature

of the Agreement on Principles on the Use of NBS in Adapting to Climate Change on 28 May 2021.

However, since the beginning of the actions of the project, all municipalities have been involved and made aware of its objectives.



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of Edification and Regulations Municipal.

COLLABORATION PLATFORM FOR CLIMATE NEUTRALITY IN SPANISH CITIES

The possible collaborations between this platform and the LIFE - My building is green project were discussed in November 2022 in a virtual meeting between the General Coordinator of the project and the organizer of the Platform and in email communications.

This platform is an initiative launched in October 2022 that is in the planning and contact making phase. For its part, the LIFE - My building is green project is in the final stages of implementation, so it is possible that the collaborations between both initiatives do not coincide in time. Still, the platform is interested in the collaboration of the project partners in the medium-long term, sharing the experience gained throughout the LIFE project - My building is green.

Among the possible forms of collaboration, it is proposed to include the partners of the LIFE project in the multi-city projects that the platform intends to launch, where companies and research organizations working in green infrastructure and other areas, such as energy rehabilitation or regulatory *sandboxes*, take place.

They are also interested in including the DIPBA as a member of it so that the municipalities of Extremadura have representation on the platform.

The LIFE - My building is green project has proposed the signing of collaboration agreements between both initiatives, but this will not be possible when the platform is more consolidated.

In addition to these collaborations and support at the governance level, Climate-KIC and the Collaboration Platform for Climate Neutrality of Spanish Cities are invited to participate in the final congress of the project that will take place from September 19 to 21, 2023.



Image 10: Capture of the presentation image of the collaboration platform for climate neutrality in Spanish cities during its launch.

REGIONAL LEVEL

DIPBA

The DIPBA, since the beginning of the project, has maintained frequent contacts with the Junta de Extremadura, in particular, with the different Ministries responsible for the NBS:

- Ministry of Education and Employment. General Secretariat and General Secretariat of Education;
- Ministry of Ecological Transition and Sustainability - General Directorate of Sustainability;
- Ministry of Mobility, Transport and Housing - Directorate-General for Architecture and Construction Quality and Directorate-General for Housing;
- Ministry of Agriculture, Rural Development, Population and Territory - Directorate-General for Urbanism and Spatial Planning.

It has been essential to collaborate with the Ministry of Education and Employment to identify the educational centers that can benefit from the implementation of the prototypes LIFE - My building is green, authorize the interventions and advise them to make the works compatible with the needs and activity of the educational center.

On 12/14/2018, there was a meeting with the General Secretariat of Education to present the project and start identifying potential beneficiary centers. In addition, there have been numerous meetings, even a technician from the Ministry participated in the first follow-up meeting with the project monitor (07/05/2019). Likewise, the Ministry of Education and Employment authorized the works through the letters of 17/10/2019 (A1.3) and 29/08/2019 (A1.3).

On the other hand, the competent Ministries were invited to the local events organized by DIPBA within the scope of the project, having participated in the following:

- Badajoz Conference 'Nature-Based Solutions for the adaptation of buildings to Climate Change (13/11/2019 - E 2.1);
- Seminars (17/6/22 e 10/11/22);
- demonstration workshops (10/3/2023 and 14/03/2023).

Work is currently being done with the Provincial Delegation of Education of the Ministry of Education and Employment to transfer the results of the project to other educational centers.

As a synthesis of the work carried out, the following conclusions stand out:



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LIFE17 ENV/EN/000088

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*

- Need to disseminate the concept and benefits of the NBS among the municipalities of the province of Badajoz and the region of Extremadura, in order to sensitize managers to their potential;
- Facilitate the availability of training tools, directed to the training of NBS managers and promoters and, in particular, focused on the solutions and prototypes developed by the LIFE project - My building is green;
- The implementation of NBS at the local level with the objectives and priorities established by other territorial policies such as those related to the fight against climate change, as well as the strategies of green infrastructure and biodiversity.

CIMAC

After the choice of the EB school of Horta das Figueiras in Évora as the object of intervention (pilot building), based on the selection criteria defined in the LIFE - My building is green project, the entire educational community was widely included in the actions of the project.

In this context, several activities were developed to publicize the project for the integration of students, teachers, school staff and parents/guardians.

Activities carried out in 2019, with the educational community:

- 10/26/2019 – Presentation of the LIFE project - My building is green to the students and teachers of the Horta das Figueiras Basic School and to parents/guardians. The responsible team presented the project to the school community, making known some of the ideas of what is intended to be done in the school and what are the added value of the implementation of the project in the Basic School Horta das Figueiras. The technical guidelines for carrying out the work to be developed by the children in order to integrate them into the project were also presented.



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LIFE my building is Green
LIFE17 ENV/EN/000088

Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.



Image 11: Event at the EB school of Horta das Figueiras (10/26/2019).

- (11/2019) – Elaboration of the students' proposals of how they would like to have the "green courtyard" of their school and pre-selection of the works. Each student was challenged to imagine/create their ideal green patio and to design it with the involvement of their family at home;



Image 12: Students' proposals for the school's "Green Courtyard".

- (9/11/2019) – Based on the previous activity, a final model was developed by the school community;
- (4/12/2019) – Presentation of the proposals on the "green courtyard" by the students/class delegates in School Assembly and the presentation of the model of the school community.

This activity allowed the entire educational community to get to know better the LIFE project - My building is green and actively participate in the sharing of knowledge and in the development of ideas that contributed to the intervention in the Basic School of Horta das Figueiras.

With this activity proposal was involved the entire educational community of the Basic School of Horta das Figueiras, namely, students, parents, teaching staff and non-teaching staff, allowing their active participation in the project, transmitting and deepening knowledge on the subject of climate change and implementation of solutions based on nature. The works were developed by all 97 students in a family and educational context.

In addition, a model was elaborated by some parents and children, with the identification of intervention proposals, for the various spaces of the courtyard. The involvement of children in the creative process of presenting solutions, actively promotes their participation and is an essential contribution to their appropriation of the outdoor space and the project itself to be implemented. The results of these activities were an added value for the support elements that served as the basis for the elaboration of the final solution by the design team.

In addition to these activities, several meetings were held with the regional entities, of which stands out, on December 15, 2020, the digital event, which was attended by national, regional and local entities, such as the Administration of the Alentejo Hydrographic Region (APA, IP / ARH do Alentejo); the Commission for Coordination and Regional Development of Alentejo (CCDR); the University of Évora; Regional Health Administration of Alentejo (ARS Alentejo); the National Green Roofing Association; the Interdisciplinary Center for Social Sciences (CICS. NOVA. UÉvora); the Service for the Protection of Nature and the Environment of the GNR (SEPNA); GeoAtributo - CIPOT, Lda; the Southern Daily Group; the parents' association of the EB School of Horta das Figueiras; design teams; the DIPBA; the CSIC; the CARTIF Foundation; and representatives of the various Portuguese municipalities. The main objectives were to present the prototypes and nature-based solutions designed and developed for the pilot buildings of the project; to present the project of the EB School of Horta das Figueiras; to talk about the importance of raising

awareness of climate change in the school community; to discuss the impact of the LIFE project - My building is green in the school community; and talk about the Local Strategy for Climate Change Adaptation.

3.8 TERRITORIAL AND INTER-MUNICIPAL AGREEMENTS

DIPBA

The Provincial Council of Badajoz has made detailed information on the LIFE Project - My building is green available to all municipalities in the province (175), through different tools and, in particular, through the Office of Mayors of the DIPBA. As a result of this flow of information, the declaration of interest of seven municipalities in the province of Badajoz for the promotion of initiatives to implement the NBS was obtained:

- 1 - Burguillos del Cerro.
- 2 - Guarena.
- 3 - Herrera del Duque.
- 4 - Olive tree.
- 5 - Saint Vincent of Alcantara.
- 6 - Valverde de Leganés.
- 7 - Villafranca de los Barros.

At the regional level, a flow of information on the implementation of the Project was established with the Junta de Extremadura, specifically with the Ministries and Directorates General mentioned above.

CIMAC

CIMAC and the 14 associated municipalities signed the Agreement of Principles on the use of NBS in adapting to climate change on May 28, 2021.

The Agreement defines the terms to establish broad lines of collaboration to promote the joint implementation of consultative or other activities that result in the climate adaptation of school centres through the implementation of nature-based solutions described in the European project LIFE17 CCA/ES/000088 – LIFE - My building is green.



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A LIFE PROJECT

LIFE my building is Green
LIFE17 ENV/EN/000088

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*

To ensure the momentum of the Partnership Agreement, a one-member Monitoring Committee was set up for each of the parties. This Commission will be the decision-making, monitoring and evaluation body of the actions arising from the agreement and will present reports and proposals to the bodies of both parties.

Municipalities involved:

1. Municipality of Alandroal.
2. Municipality of Arraiolos.
3. Municipality of Borba.
4. Municipality of Estremoz.
5. Municipality of Évora.
6. Municipality of Montemor-o-Novo.
7. Municipality of Mourão.
8. Municipality of Mora.
9. Municipality of Portel.
10. Municipality of Redondo.
11. Municipality of Reguengos de Monsaraz.
12. Municipality of Vendas Novas.
13. Municipality of Viana do Alentejo.
14. Municipality of Vila Viçosa.

3.9 NBS INTEGRATED INTO REGIONAL GREEN INFRASTRUCTURE STRATEGIES

DIPBA

The Ministry of Ecological Transition and Sustainability of the Junta de Extremadura, through the General Directorate of Sustainability, is competent in terms of promotion, implementation and control of nature and environmental conservation, programming and proposal of actions in relation to protected natural areas and biodiversity. In addition, it is responsible for the planning, management and control of activities and projects with repercussions on the environment, for the environmental assessment of plans, programs and projects, for the granting of environmental



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A LIFE PROJECT

LIFE my building is Green
LIFE17 ENV/EN/000088

Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.

authorizations to which projects and activities are subject, as well as for their control and monitoring. Likewise, it is responsible for the functions of air quality and protection of the atmosphere, landscape protection, noise, light and radiological pollution.

The General Directorate of Sustainability is responsible for the elaboration of the Green Infrastructure Strategy of Extremadura (EExIVCRE), Connectivity and Ecological Restoration, for which it developed a process of meetings and consultations that involved local entities of the region, including the DIPBA.

Specifically, there were two meetings, the first face-to-face and the second virtual:

- 11/15/2021 – Technical meeting to present the project for the elaboration of the IV Strategy Extremenha, Connectivity and Ecological Restoration and data collection of the DIPBA;
- 12/03/2021 – Virtual meeting to work on the Green Infrastructure Strategy of Extremadura, with the Provincial Councils and FEMPEX - Federation of Municipalities and Provinces of Extremadura.



Image 13: Virtual meeting presentation sheet (13/03/2021).

In addition, the General Directorate of Sustainability, by letter dated 13/06/2022, informed the DIPBA of the opening of the consultation phase to make preliminary proposals for sectoral actions to the Working Document of the Strategy of Extremadura for EExIVCRE, related to its activities. In response to this consultation, DIPBA submitted, on 18/07/2022, its contributions.

On the other hand, the General Directorate of Sustainability was invited to the demonstration workshop 2 (technical profiles) to talk about the prototypes of solutions based on nature implemented at the Municipal School "Gabriela Mistral", held virtually on 14/03/2023 and in person on 22/03/2023.

CIMAC

The Intermunicipal Community of Central Alentejo (CIMAC) elaborated, in 2018, the 'Intermunicipal Plan for Adaptation to Climate Change of Central Alentejo' (PIAAC-AC).

This Plan was co-financed by the Operational Program Sustainability and Efficiency in the Use of Resources (PO SEUR), registered in the public funding framework 'Portugal 2020'. Included in priority axis 2 – 'Promoting adaptation to climate change and risk prevention and management'.

The main objectives of the PIAC-AC are to make known, in a more in-depth way, the phenomenon of climate change in the central Alentejo, while at the same time allowing the identification of the options and measures necessary for the adaptation of populations, sectoral methods and practices, infrastructures and equipment, and the very functioning of public and private entities in future scenarios of extreme climate changes and phenomena.

The Plan also promotes the integration of adaptation to climate change in the practice and instruments of intermunicipal and municipal planning, creating a culture of transversal cooperation between the different sectors and socioeconomic actors of the Central Alentejo.

The elaboration of PIAAC-AC involved the 14 associated municipalities of CIMAC. Its development was in charge of a team of consultants from the CEDRU – IGOT – WE CONSULTANTS consortium, in close articulation and under the supervision of the technical structure of CIMAC and the municipalities involved.

The reports resulting from this Plan can be consulted in [CIMAC - PIAAC REPORTS](#)

With the involvement of the various entities of the Central Alentejo in all the climate change adaptation projects that have already been developed and completed and others that are now in the preparation phase, such as the LIFE project - My building is green, it is intended that, the impact and functionality of NBS as sustainable tools of climate adaptation in buildings and cities, as well as their contributions in terms of improving the quality of life, are widely disseminated and integrated into regional and local management strategies.

3.10 SBN INTEGRADAS IN THE TECHNICAL BUILDING CODE (CTE)

SPAIN

Throughout the project, meetings and communications were held between those responsible for updating the Technical Building Code (CTE) of Spain and the members of the LIFE - My building is green project. The Eduardo Torroja Institute of Construction Sciences of CSIC, one of the partners of the project, is one of the entities that collaborates advising the Sustainable Construction Unit of the Ministry of Transport, Mobility and Urban Agenda (MITMA), in charge of the management of the CTE.

At the end of October 2022, the LIFE - My building is green project held a meeting with MITMA's Sustainable Building Unit. In this meeting the options to integrate the Natural Base Solutions tested by the project were specified.



Image 14: Meeting held between LIFE - My building is green and the Sustainable Building Unit of MITMA on October 27, 2022 © Arturo Martínez (IETcc-CSIC).

AMENDMENT OF THE TECHNICAL CODE OF THE BUILDING

In the Technical Code of Buildings (CTE) there are stages of the normative process where elements related to the NBS can be incorporated, especially elements of plants. The methods of weighting energy consumption and the catalog of materials and constructive elements require the cataloguing and characterization of constructive components that allow the calculation of factors, demands, consumptions and other aspects related to the energy economy of the building.

Regarding the weighting processes, in the section "Procedure for determining energy consumption" it is considered feasible to use computer models to facilitate the calculation. These programs require identification of the architecture and layout of the building; thermal behaviours



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A LIFE PROJECT

LIFE my building is Green
LIFE17 ENV/EN/000088

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*

related to space and its environment; the demands of air conditioning, ventilation and lighting and the characteristics of the related equipment; and the energetic behavior of the surroundings, among other characteristics.

Regarding the last concept, the thermal performance of the envelope, involves thermal and optical properties that allow to estimate to what extent the heat is transmitted (by conduction, radiation and convection) through the facade. Although the source of information offered by the CTE is extensive and mainly integrates the thermal and acoustic properties of different materials, it would be convenient to complement these databases with the materials and properties of these to facilitate their incorporation into energy assessment programs.

In this sense, one of the objectives of the LIFE project is to carry out competent studies that allow the achievement of results appropriate to the standardization of the thermal and optical properties of the vegetation and substrates considered in the project. The properties to be defined must be consistent with the input data of the accepted simulation programs and those by the CTE and with those requested by the same standard. In the Construction, Maintenance and Conservation section of the HE Basic Document, it is necessary to determine the characteristics of the products that influence the heat transfer processes that occur on the facades, such as emissivity, conductivity, density and specific heat. Considering the product as "the final form of a ready-to-use material, of determined shape and dimensions and that includes any coating or covering". Similarly, the same characteristics can be considered to characterize certain variants of substrates and sets of plants.

Before incorporating SBN as construction systems, their energy behavior must be studied in order to meet the conditions established by the construction standards, including the identification of the type of systems that are intended to be incorporated. In the CTE there are requirements related to the thermal properties of the building and the surrounding, being established the minimum value of U to be met. These requirements also cover relevant or negatively impactful rehabilitations of the property's energy needs. However, it is established that systems whose performance in heat transfer does not depend only on the value of U. Therefore, as for the inclusion of SBNs, such as green roofs and facades, physical and biological mechanisms inherent to their materiality must be taken into account, in addition to the specific configurations that are being taken into account. studied in the pilot buildings of the LIFE project. For example, in the FAVE and CUVE prototypes there is an influence of the wind on the transmission of heat to the



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A LIFE PROJECT

*LIFE my building is Green
LIFE17 ENV/EN/000088*

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*

surroundings, since ventilated chambers are generated between the system and the façade that modify the heat transfer coefficient of the integrated system.

The supporting documents of the basic documents establish procedures for the calculation of different parameters. Regarding thermal resistance, DA DB-HE/1 establishes that the determination of the U value of the construction systems requires obtaining the total thermal resistance of the set of layers, including the resistance of the inner and outer surface. Thus, in the process of determining the U value of green roofs and facades, the studies to be carried out by the LIFE project should aim to carry out experimental tests and contrasts with bibliographic bases to establish thermal resistance values for each of the components of the system. In this sense, special attention should be paid to those layers that present uncertainty in the calculation of thermal resistance due to existing variants, such as the vegetation layer.

Another of the calculations established by the DA DB-HE/1 and that can be linked to the incorporation of the NBS is the transmission of energy to the spaces when there are moving elements of shading. Although, in the section on the Shadow factor, vegetation is considered an element that requires a different procedure from the one established, based on the shape and expiry of the leaves, it is estimated that there are properties of the plant elements that can be normalized. The included factors are organized according to a reference thermal transmission associated with three examples of solar control devices, with the characteristics of four types of glazing and the associated reflectivity values based on its location and color (white, pastel, dark and black). In the notes it is established that for the calculation of the table were used "standard values" of thermal transmission and reflectivity. In this sense, it is sought that from the studies carried out in the LIFE project can be generated standard values of some plants so that they can be included in this table, assuming the property of "m óveis" based on their duration and considering that in some of the subsequent tables they consider the activation time in monthly periods, that is, mobility is not only subject to short periods.

INCLUSION OF LIFE-MYBUILDINGISGREEN NATURE SOLUTIONS IN THE COMPUTER CATALOGUE OF CONSTRUCTIVE ELEMENTS OF THE TECHNICAL BUILDING CODE

The inclusion of standardized values for plant elements makes it easier to estimate their potential benefits. Despite the great variability between plant elements, it is assumed that, in statistical



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LIFE my building is Green
LIFE17 ENV/EN/000088

Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.

terms, there are standard values that allow the establishment of reference data for these materials.

Thus, once the relevant studies and tests have been carried out, it would be advisable to include some plant materials and systems in the catalogue of constructive elements of the CTE, where their hygrothermal properties can be consulted. As the same document indicates: "The Catalog is not a closed document and will be completed with other elements in successive phases." For this purpose, it is considered appropriate to incorporate different materials and constructive elements of green roofs and facades that have not been considered. Although the catalog included "Flat not traversable. Notventilated. Landscaped" among the constructive elements where its U value and other acoustic properties are established, this concept does not cover the different configurations of a green roof or façade so that they can be simulated in an energy modeling program.

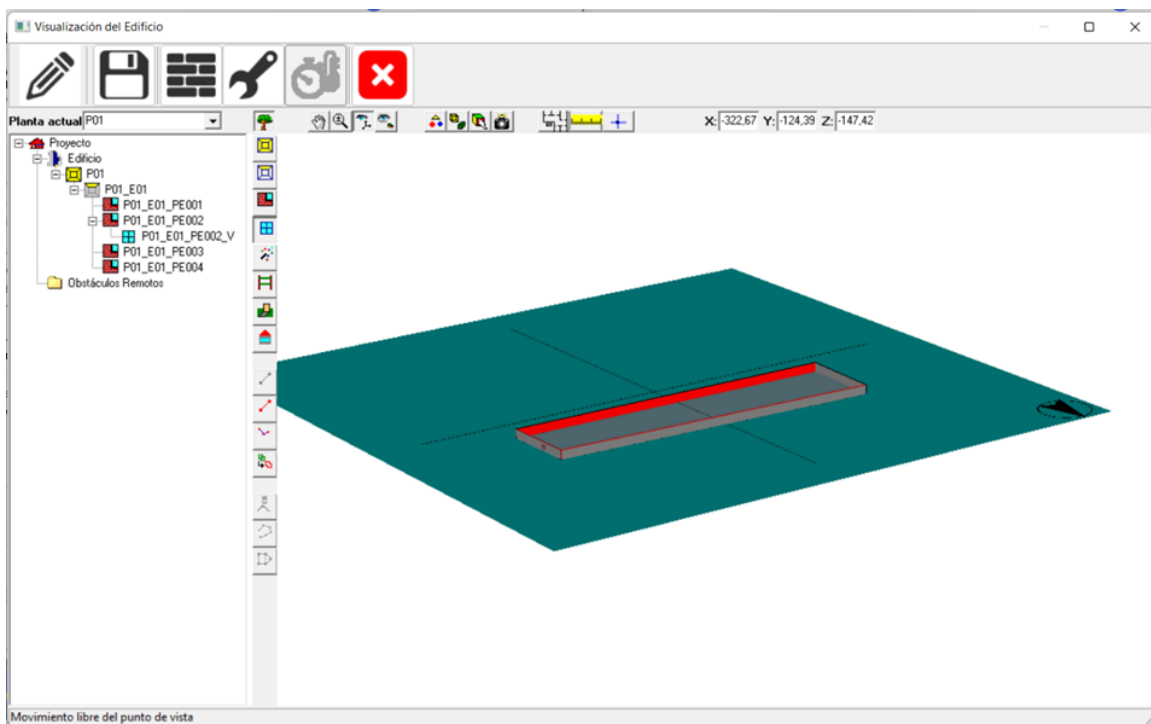


Image 15: Simulation Program - Unified Tool LEADER-CALENER © Directorate-General of Urban Agenda and Architecture of the Ministry of Transport, Mobility and Urban Agenda.

In the market, most of the layers that make up a green roof have their technical characteristics defined. However, the layers of substrate or vegetation do not have this information or, at least, not so that their transient conditions are contemplated.



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A LIFE PROJECT

LIFE my building is Green
LIFE17 ENV/EN/000088

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*

On the other hand, there are programs that, through the characteristics of the vegetation and the substrate, allow to establish the thermal performance of the vegetation covers. In this context, the necessary studies can be carried out to establish some of the most common and significant scenarios of the component materials of plant systems, considering specific aspects such as: type of substrate, moisture level, type of vegetation, leaf type, flowering periods, stomatal resistance, plant density, leaf area, etc.

By including part of NBS in the material catalogue, it promotes its use and facilitates the estimation of its benefits. Although a long period of study is necessary, it is considered important to start with the incorporation of the most basic components and to establish the knowledge bases and research methodologies that allow resuming this task in future projects.

The IETcc-CSIC has already started the process of characterization and standardization of the NBS implemented as CIEP Gabriela Mistral.

3.11 NBS INTEGRATED INTO THE NATIONAL STRATEGIES FOR CLIMATE CHANGE AND GREEN INFRASTRUCTURE

Currently, Spain's National Plan for Adaptation to Climate Change (PNACC) 2021-2030 and the National Strategy for Green Infrastructure and Ecological Connectivity and Restoration in force in Spain since July 2021, incorporate Nature-based Solutions (NBS), to a greater or lesser extent, as an alternative to mitigate the effects of climate change and contributing to the benefits of Green Infrastructure at the national level.

Although the Strategy includes the influence of the urban environment on the national green infrastructure network in Spain, a more specific link and greater detail on the importance and effects of nature-based solutions implemented in cities, such as reducing the heat wave effect or creating urban green corridors, is needed. among others. This is a need to be taken into account so that future projects in the line of action LIFE - My building is green that should be discussed with the institutions and agents that develop the future National Green Infrastructure Strategies. The elaboration of both the National Plan for Adaptation to Climate Change 2021-2030, and the National Strategy for Green Infrastructures and Connectivity and Ecological Recovery, has been led by the Ministry of Ecological Transition and Demographic Challenge, through various entities dependent on it, such as the Biodiversity Foundation, the Spanish Office for Climate Change and the Institute for Energy Diversification and Savings.

The development of these plans and strategies has also relied on the contributions of other ministries, as well as several state bodies such as the CSIC (coordinating partner of the project) and autonomous entities.

The direct participation of the LIFE - My building is green project in the preparation of this documentation was not possible due to the incipient character of the project during the phase of analysis, reflection and public participation. However, the project has contributed to give visibility to the importance of NBS in the urban environment with the relevant entities in the design of Work Plans and National Programs for Adaptation to Climate Change, contributing, in some way, to the integration of NBS in this type of Strategies related to the climatic changes.

At the beginning of the project, LIFE - My building is green, meetings and working communications were held with the Spanish Office of Climate Change and the Biodiversity Foundation of the Ministry of Ecological Transition and Demographic Challenge, both responsible for the elaboration of the National Plan for Adaptation to Climate Change 2021-2030.



Image 15: Meeting held between LIFE-myBUILDINGisGREEN, OECC and the LIFE-SHARA project of the Biodiversity Foundation, on January 17, 2022 © RJB-CSIC.

At the end of 2019, a working meeting was also organized between LIFE - My building is green and the Institute for Diversification and Energy Saving (IDAE) to present the project and explore synergies with this entity. After the meeting, the LIFE project - My building is green, committed to send the results of the monitoring of the impact of NBS on the pilot buildings of the project through the IETcc-CSIC. These results will be collected by IDAE and will serve to incorporate them into the energy certification program of buildings where vegetation is considered as a building material.



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A LIFE PROJECT

*LIFE my building is Green
LIFE17 ENV/EN/000088*

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*

DIPBA

DIPBA, as a member and spokesperson of the FEMP Climate network, has maintained frequent contacts with it to develop different actions for knowledge transfer on the LIFE project - My building is green and on NBS. In addition, it has participated in the annual General Meetings during the years of the project.

The Spanish Network of Cities for Climate, which is the Section of the FEMP formed by the Local Governments that are integrating climate change mitigation and adaptation into their policies, as well as by the Spanish Office of Climate Change, under the Ministry of Ecological Climate Transition and the Demographic Challenge, arises from the need detected between the Municipal Councils and the Provincial Boards for coordination in the fight against climate change. It is a demonstrably useful tool for local policy-making and consideration of NBSs.



Image 16: Conference brochure – Spanish Network of Cities for the Climate.

DIPBA participated in the meetings and work of three technical committees for the preparation of the National Congress of the Environment – CONAMA 2022: CT-40 Public-private collaboration in the construction of sustainable cities; TC-14 Towards a local agri-food strategy; and TC-2 Adaptation to climate change in the planning of cities and municipalities. During the meetings, the progress and results of the LIFE - My building is green project were discussed and shared.

3.12 CERTIFICATION OF SUSTAINABILITY CRITERIA IN BUILDINGS

One of the strategic aspects that will facilitate the transferability of Nature-Based Solutions (NBS) is the certification of the pilot buildings where they were implemented, using calculation methodologies and sustainability of buildings.

In Spain, the leading sustainable construction organization and reference in the transformation to a sustainable model of the construction sector is the Green Building Council Spain (GBCe).

Since the beginning, the LIFE - My building is green project has maintained a close relationship with GBCe officials and organized several working meetings, such as those held in December 2018, a few months after the beginning of the project, with the aim of involving the council and exploring the possibility of each pilot building for r obtain the GREEN certification, accredited by GBCe), upon completion of the NBS implementation work.

During these meetings, remote contact was also maintained with those responsible for the *LEVEL(s)* of the European calculation methodology, to study the possibilities of its application by the LIFE - My building is green project.

After these meetings, it was agreed to explore the possible sustainability certification of the pilot buildings of the project when it was at a more advanced stage and with the NBS implemented in the educational centers. Even so, an open workflow was maintained between the project and GBCe.

At the end of November 2022, the members of the LIFE - My building is green project met again with the GBCe Board. This working meeting served to present the progress of the project and study the application options of the available certifications to the pilot buildings. The subjection of these buildings to certification processes, through national and European calculation methodologies, will allow not only the obtaining of these certificates in the buildings, but also the discovery of some deficiencies in the biodiversity indicators included in the certifications. In this way, it will be possible to prepare and issue reports of recommendations to the official certifying bodies and, which allow will include a greater number of criteria related to biodiversity or improve existing ones.



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A LIFE PROJECT

LIFE my building is Green
LIFE17 ENV/EN/000088

Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.



Image 17: Meeting between the LI FE project - My building is green and GBCe, on December 5, 2018. © GBCe.



Image 18: Meeting between the LI FE project - My building is green and GBCe, on November 25, 2022. © GBCe.

After studying the certification options, it was decided to carry out the applicability analysis of the European LEVEL *tool*.

This system evaluates the sustainability of buildings through sixteen indicators grouped into six macro-objectives. Each indicator is evaluated at one of three levels of the project: "design conceptual", "detailed design and construction" and "performance as built and in use". The following figure presents the macro-objectives, their indicators and the relevant levels of evaluation.



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A LIFE PROJECT

LIFE my building is Green
LIFE17 ENV/EN/000088

Report Favorable about NBS in the Technical Code of Edification and Regulations Municipal.

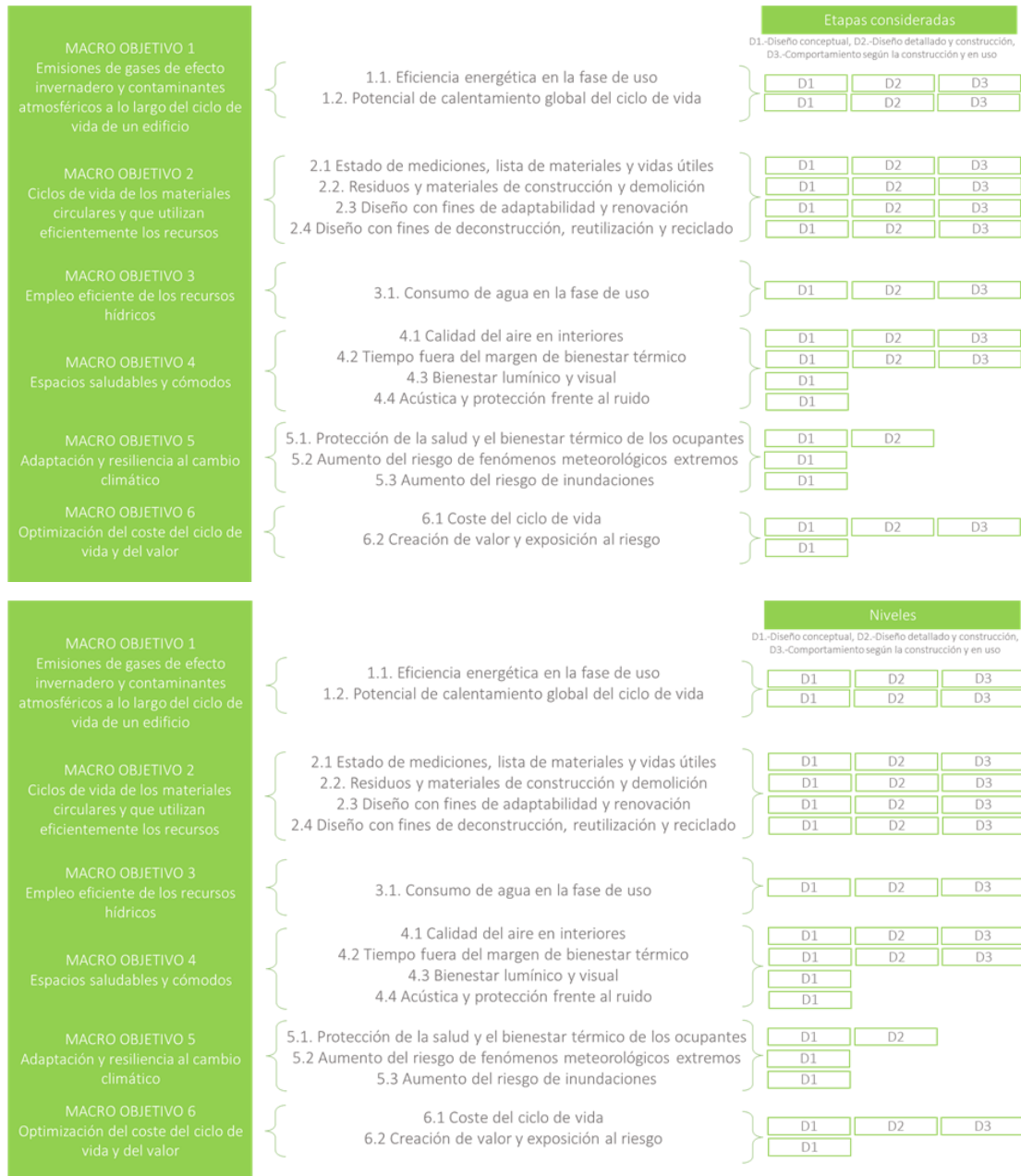


Image 19: Outline of the evaluation process of the *LEVEL(s) method*.

There are indicators that are evaluated only at the first or first and second levels. In cada one of the indicators is established the unit of measurement. At each level, the professionals or guardians and a set of sequential actions to carry out the evaluation are determined. Each indicator has different reference standards and some of the indicators are related to each other. There is an online tool based on the *LEVEL(s)* system called "Calculation and Evaluation Tool (CAT)" and integrates the framework of objectives and indicators to facilitate evaluation.



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A LIFE PROJECT

LIFE my building is Green
LIFE17 ENV/EN/000088

Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.

Image 20: Calculation and evaluation tool (CAT). © European Commission.

The most relevant indicators in the application of NBS in the *LEVEL* tool are discussed below:

The SBN incorporated in the project follow some of the guidelines mentioned in the indicators of the *LEVEL(s)* system, such as the s relative to energy efficiency in the use phase. The rehabilitation projects developed in the LIFE project were designed to improve the thermal performance of the surroundings and include the use of renewable energies, always considering the climatic conditions. The *LEVEL(s)* indicates that, for rehabilitation works, it is necessary to take into account the initial situation of the building, identifying elements such as air conditioning equipment and the influence of the layout of the building and its interior spaces, in the mediation between the external and interior environmental conditions and natural ventilation and lighting. In this sense, the LIFE project has collected all the technical information about the buildings and the regions where they are located. Through the climatological archives, the appropriate bioclimatic strategies, the solar control requirements and the selection of ventilation strategies were defined.

Once the works are completed, tests and monitoring may be carried out to verify the efficiency of the added elements, according to the procedure indicated in *the LEVEL(S)*. Through the readings of energy expenditure, it will be possible to verify the benefits of the NBS.

Regarding water consumption in the use phase, the *LEVEL(s)* establishes that it is necessary to describe the plant species and determine the water they consume. These data are well identified, as they have the support of the Royal Botanical Garden, which has descriptive studies of the plants



my building is green
A LIFE PROJECT

LIFE my building is Green
LIFE17 ENV/EN/000088

*Report Favorable about NBS in the Technical Code
of Edification and Regulations Municipal.*

and has determined their correspondence with each region. According to the evaluation system, attention was paid to the water consumption required by each species and to the appropriate irrigation techniques and systems.

The restructuring that favors the evaluation of water consumption are the implementation of stormwater use systems, which contribute to the demand for irrigation water from systems and areas with vegetation, and the drainage floor system and. In this sense, the LIFE project will meet the requirements of the *LEVEL(s)*. Systems and areas that include vegetation should keep a record that includes the areas of occupation of each plant species, water consumption, vegetation density, and the associated microclimatic factor.

Regarding the indicator "indoor air quality", it is intended to reduce the concentrations of formaldehyde, VOC and CO₂ in the classrooms of pilot buildings through cross-ventilation and vegetation on the walls. Similarly, wooded areas and outdoor plant systems can contribute to air quality by reducing the influx of pollutants indoors. On the other hand, humidity levels in indoor spaces are continuously monitored, which makes it possible to anticipate the appearance of molds. As established in the indicator, there is the necessary equipment to monitor CO₂ levels and determine protocols to recover optimal conditions.

Regarding the indicator "Time outside the thermal comfort range", from the conceptual project, it is proposed to identify the elements that can generate thermal discomfort in buildings, namely elements linked to the location of the property or its own architectural design (for example, percentage of glazed surfaces). At this stage, the shading of the facades with the highest solar incidence, the thermal insulation properties of the surroundings, the solar control elements and the natural ventilation systems are taken into account. In this context, in the LIFE project, a series of previous studies were generated to know the initial situation of the buildings and the elements that surround it, such as information on the design and construction of each of the pilot buildings, having been identified the elements that may generate thermal discomfort.

The same indicator suggests the use of nature-related systems to mitigate environmental conditions on a small scale, through plant elements in the surrounding free spaces or integrated into the façade, systems that incorporate water for recreational containment or drainage purposes, and soils that allow the re-incorporation, conduction or storage of water. Most of the pilot buildings are based on these concepts, integrating vegetation into roofs, walls and awnings; providing more green areas for the enjoyment of users; and including water recovery systems and floors. Draining.



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The indicator establishes on what occasions it will be necessary to simulate the energy behavior of the building and consider the modeling of the building with and without artificial air conditioning systems. One of the studies that the LIFE project intends to carry out is based on the estimation of energy savings in the air conditioning of pilot buildings through computer models. Although pilot buildings have never used active cooling, simulations will be run to hypothetically determine the heating and cooling demands required in the original and post-construction situations. To perform this task, it is necessary to correctly characterize the SBN to be incorporated into the model, so it is intended to generate experimental investigations that allow the calibration of simulation models.

At the end of the work, the LIFE project plans to hold meetings with the population and obtain qualitative data on the level of improvement of the facilities. This action meets the suggestion of the *LEVEL(s)* method, to collect information about the perception of users regarding the built space.

With regard to lighting, the entry of natural light into the premises was considered before projecting on the vegetable pergolas on the facades, considering the overexposure that can be generated by the orientation of the windows (southeast and southwest), according to the requirements of the indicator of "lighting and visual well-being", considering it important to correctly integrate the shading elements into the building.

The indicator "Protection of the thermal health and well-being of users" is related to the "Time outside the thermal well-being range" contemplating the importance of determining the factors that may threaten thermal well-being. In the LIFE project, the risk factors were identified before the implementation of the NBS, considering the facades whose orientation overexposes them to solar radiation, a situation aggravated when the frames with this arrangement include large glazing areas or lack sun protection elements. These reflect a lack of design criteria that can provide comfortable thermal conditions inside, as addressed in the indicator on "protection of the health and thermal well-being of the occupants".

According to the indicator, in the plots surrounding the pilot buildings, the areas that may contain trees and the appropriate roofs to house vegetation were identified. This last solution not only addresses the benefit of temperature control, but also contributes to flow control. In the parts of the lot destined to public space, it is intended to use plant shading devices, to avoid health problems derived from over-sun exposure.



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Another of the indicators of the *LEVEL(s)* method considers the reduction of the impact of extreme climate change on the building. One of the steps for the evaluation of the project with reference to this indicator is to carry out an analysis of the weaknesses of the building to face extreme climate change. As mentioned, the LIFE project focuses on addressing the increased frequency and intensity of heat waves. According to this indicator, in the evaluation of the conceptual design, the costs derived from the implementation of the NBS were analyzed, identified in the method as "Green adaptation measures". In this sense, the potential benefits of these interventions, the aesthetic improvement of the building, the increase in biodiversity and the reduction of indoor temperatures were considered.

With reference to the indicator "sustainable drainage" it is assumed that the design is better and the original situation of the building, incorporating draining floors, green roofs and trees for stormwater management. These solutions bring benefits in the points mentioned in the *LEVEL(s)* generating recreational value, increasing biodiversity and improving the quality and quantity of water.



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