

Documentary analysis to gather eu and national legislation, practices on nature-based solutions





Nature Based Solutions:
Green roofs training for urban and
building sustainability

2021-KA220-VET-7D7D053A

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ABOUT NATURBUILD

Naturbuild project seeks to create a comprehensive, module-based training course to skill construction blue-collar workers in the installation, maintenance, and deconstruction of nature-based solutions for urban and building sustainability, improving education, awareness and institutional capacity on buildings and cities impact mitigation.

The Partnership will collaborate from February 2022 to August 2024 to design an online course, structured in 4 modules:

-  Module 1. Awareness-raising: necessary training to gain a perspective on the benefits that green roofs bring not only to improve the building's energy bills, but also to the urban climate and biodiversity.
-  Module 2. Green roof installation: on the steps to follow to install different solutions depending on the type of roof.
-  Module 3. Maintenance of green roofs: on how to preserve the different elements of green roofs: vegetation, installations, etc.
-  Module 4. Deconstruction of green roofs: on how to deconstruct a green roof to install a new one, and how to deconstruct a common roof to install a green roof.

All modules will be developed separately but under the same work methodology:

-  Task 1. Documentary analysis to gather the latest legislation, documentation, and practices at EU and national levels.
-  Task 2. Identification of the scope and learning outcomes.
-  Task 3. Expert's consultation to deepen the results of the previous task.
-  Task 4. Development of the content based on the needs identified in the previous tasks.
-  Task 5. Pilot testing with experts.
-  Task 6. Translation.

This document collects the information regarding Task 1, provided by the project's partners and experts working in the four countries working in the Partnership.

METHODOLOGY

According to the project, the first task to define each training module is called *Documentary analysis to gather the latest legislation at EU & national level, documentation, and practices on nature solutions*.

The task has been developed through desk work by partners and with the valuable collaboration of external experts, that have answered a questionnaire designed by the partners.

The **questionnaire** is divided in five (5) sections:

Section 1. Green Roofs definition and regulation → With the objective to share to what extent green roofs are regulated in the four countries working in the Partnership. It has been interesting to share public legislation as a strategy to promote green roofs, as well as legal and technical documents that specify criteria which Green Roof installation, maintenance or deconstruction should meet. The answers are useful to know the legal framework that any worker should consider when carry out their task during installation, maintenance, and deconstruction of green roofs.

Section 2. Green Roofs benefits → The questionnaire covers the advantages that green roofs bring to the building performance, the environment, and even social. This information should be translated in a pedagogical way to Result 1 – Global awareness module.

Section 3. Green roofs examples → Naturbuild develops a course for workers with the European-Mediterranean approach. The four countries share types of climates, different from other EU countries. It is crucial to find references of as many types of solutions as possible already implemented. These good practices will be a good visual resource during the course, besides to be the basis for the Interactive Map included in the project website.

Section 4. About the technical professions → where there is an identification of trades and professionals involved in installation and maintenance of green roofs.

Section 5. National/Regional organizations, clusters that publish technical information related green roofs → with the objective of reference relevant institutions for green roofs execution and promotion of green roofs.

The whole questionnaire is included in the **Annex I** of this document, linking the questions with the training module related.

QUESTIONNAIRE RESULTS

SECTION 1. Green Roofs definition and regulation

Q1. Do you agree with the following European Green Roof definition?

It is a roof system designed to make the development of vegetation in its last layer viable. To achieve this, it is necessary to create a system that imitates the functioning of the natural environment of a plant and to ensure that the vegetation uses it to grow and stay alive, without damaging the structural, constructive, and environmental conditions of the building. Typically, the designs of green roofs are site-specific depending on climatic conditions and they are executed using a system with various materials arranged in layers (i.e., substrate and drainage layer)¹

In **Portugal**, the definition of green roof can be quite comprehensive, however, the one adopted by the ANCV is as follows: “It is called green roof (or landscaped cover or living cover) all type of vegetation installation on a built structure, regardless of the type of construction or type of vegetation. Only green walls built with vines or vertical garden systems are excluded. Typically, they are executed using a system with various materials arranged in layers, which must ensure the proper development of vegetation, respecting and promoting the physical integrity of the built structure.”

In **Spain**, they agree with the definition provided.

In **Greece**, experts agree with the European definition, as it is well developed, emphasizing the central purpose of green roofs. Nevertheless, having read the North American literature some more essential elements could be added, so that the definition becomes more descriptive. Elements that could be added are first that designs of green roofs are site-specific depending on climatic conditions; access, slope, structural capacity and intended use and second that green roof standard components are tested waterproofing membrane; root barrier; drainage outlets; drainage layer; geofabric; grow media; vegetation; irrigation; maintenance regime.

In **Italy**, the three experts interviewed have different opinions about this definition: one doesn't agree at all, without giving any other elements, the second one agrees, and the last one thinks that the definition could be improved. In the latter's opinion, the focus in this definition is the vegetation survival. Plant development is one of the most important features of green roofs, but other key feature should be considered, such as the choice of layer materials (i.e., substrate and drainage layer) and some of the green roof's benefits should be introduced at *urban and building level*.

Q2. What are the political strategies aimed at promoting the green roofs in your country? Do they follow any European Strategy?

PORTUGAL	<p>The country is aiming to meet the European objectives via:</p> <ol style="list-style-type: none"> 1. the National Energy and Climate Plan 2021 – 2030 and 2. the Long-Term Strategy for the Renovation of Buildings. <p>Green roofs are indicated in the XXII Constitutional Government Program and in various municipal regulations and recommendations. Moreover, there are sustainability assessment systems for assessing the sustainability of buildings. (LEED, BREEAM, LiderA)</p>
SPAIN	<p>The country has plans to promote the installation of green infrastructure applied to buildings both on national and local level. Especially, on the national level, there the following:</p> <ol style="list-style-type: none"> 1. the National Strategy for Green Infrastructure and Ecological Connectivity 2. the Programme of aid for energy rehabilitation actions in existing buildings
GREECE	<p>The country follows the EU regulations through the National Energy and Climate Plan in order to promote urban bioclimatic restructuring and smart cities</p>
ITALY	<p>The Italian territory is divided into six different climate zones and each Italian municipality, listed in Annex A of Presidential Decree 412/93, has assigned an identification code, which corresponds to a specific climate zone and degree days. Accordingly, there are local-level policies, which foster the construction of green roofs.</p>

In **Portugal**, green roofs are indicated in the XXII Constitutional Government Program and in various municipal regulations and recommendations, which are indicated below.

In **the government program**, green roofs are referenced, inter alia, by:

“II.I. Energy transition

Encourage the installation of green facades and roofs as a way to promote energy efficiency, water management, and air quality in structures and buildings.

(...)

Fostering smart and sustainable cities

Develop and strengthen the networks of ecological corridors in cities, promoting the infiltration of water in the soil, in combination with urban vegetable garden systems, as well as facades and green roofs; “

On the **level of direct** financial incentives at a national level, the most recent initiative was from the Ministry of Environment and Climate Action which established the financial support program, called “Program to support more sustainable buildings”, implemented through the Environmental Fund, provided for in the Economic and Social Stabilization Program (PEES), adopted by Council of Ministers Resolution No. 41/2020, of June 6. It started in 2020 and was developed in two phases, ending In March 2022.

This initiative is part of the National Energy and Climate Plan 2021-2030 (PNEC 2030) and the Long-Term Strategy for the Renovation of Buildings (ELPRE) adopted through Council of Ministers Resolution 8-A/2021 of 3 February, which aims to meet the European and national objectives to achieve the carbon neutrality and the promotion of the energy efficiency of existing buildings with a view to their transformation into NZEB buildings.

The objective of the “More Sustainable Buildings” program is to finance measures that promote rehabilitation, decarbonization, energy efficiency, water efficiency, and the circular economy in buildings, contributing to the improvement of the energy and environmental performance of buildings. In this context, six types of projects to support are susceptible to financing, and typology 6 is applied in interventions for the incorporation of bioclimatic architecture solutions where green roofs and green facades are mentioned, favoring natural-based solutions. The incentive amount corresponds to 70% of the total eligible amount with a maximum limit of €3,000.

At the level of the municipal councils, there are several examples of incentives and recommendations for green roofs such as:

 Maia Town Hall:

Regulation No. 375/2017 on the Amendment of the Municipal Regulation of Urbanization and Building of the Municipality of Maia (RMUE):

Article 29a “Waterproofing Coefficients” of Section I of Chapter IV of Urbanization and Building has been inserted in Article 29 a;

Annex I, which accompanies the Regulation in question, and defines the Rules for the Construction and Recovery of Public, Private, Private Green Spaces for Public Use and Play and Recreational Spaces, was inserted point 2.3 on “Plant surfaces on slabs” as an option in landscape integration projects.

Valongo Town Hall:

Under the Municipal Regulation of the Valongo Incentive System (SIV) currently being drafted (under the provisions of Article 92a of the Municipal Master Plan of Valongo-PDMV), the “Use of Green Roofing” is one of the actions that the City Council is of relevant municipal interest, and to which tax benefits and urban credits will apply, in proportion to the municipal interest determined, to be determined by this Regulation.

At the same time, this is one of the issues to be considered also in the framework of the 2nd revision of the DMV under preparation.

Barreiro Town Hall:

Regulation No. 712/2019 - Municipal Regulation for The Granting of Incentives for Investment, in Article 7:

“Article 7

a) Focus on energy efficiency

1) Increased use of passive solar measures - e.g. adapt the building to the climate (prevailing winds, humidity, solar orientation), guide buildings to the south by integrating pales, eaves, blinds, and blinds that shade this elevation in summer, and allow to capture the sun in winter, passive heating systems, such as the walls of “Trombe”, passive cooling systems (ground cooling system), privilege the landscaped roofs, ventilation, and natural lighting, in addition to the most current approaches, such as placement of double glazing, thermal insulation (e.g. cork) on facades and roofs, insulation of foundations;”

Lisbon Town Hall:


Recommendation 035/12 (ENP) of September 18, 2018, of the Lisbon Municipal Assembly - Implementation of Green Roofs. In this context, the Lisbon City Council decided to recommend to the City Council of Lisbon that:

- “1. Study the possibility of implementing green roofs in buildings and municipal structures.*
- 2. Proceed to the exhaustive survey, in partnership with the National Association of Green Roofs and University Institutions, of all buildings that can meet the requirements for the implementation of green roofs.*
- 3. Include in the new projects, and whenever possible, the existence of green roofs and encourage the implementation of these structures in projects promoted by other entities.*
- 4. Present the results of the studies and surveys proposed in the numbers before the 4th Permanent Commission on Environment and Quality of Life. More deliberates still:*
- 5. Send this deliberation to the Environmental Protection Associations and the National Association of Green roofage”.*



Approval of the amendment of the Municipal Regulation of Urbanization and Building of Lisbon (RMUEL), which maintains in Article 60 the indication (Notice 16520/2021):

Article 60 - Energy efficiency in point 6 states – *“The design of new buildings or the design of new buildings or the profound alteration of existing buildings shall promote good energy performance, inter alia by installing a central air conditioning system, using systems or constructive techniques for passive air conditioning, insulating the roof and facades, the tightness and thermal cutting of the spans and the installation of green roofs.”*

 **Espinho** Town Hall: In the 1st revision of the Municipal Master Plan, article 46 encourages the construction of green roofs as a compensation measure for the index of impermeability of urban soil, in the construction of new buildings (Notice 10906/2016):

“Article 46 Building regime

1 – In the expansion or construction of new buildings in the Consolidated Central Space of the City of Espinho, the following rules apply:

(...)

c) A weighted plant surface (Svp) greater than 0.20 of the building area must be observed, calculated according to the following parameters and weighting factors: $Svp = A + 0.6 B + 0.3 C$ where:


A – minimum unit value in m² of organic soil without construction below or above ground, applicable to the street area or the settlement area plus the areas transferred to green spaces and collective use;

B – unit value in m² of plant surface on slab with a minimum of 1 meter of living earth/substrate, not including drainage layer;

C – unit value in m² of plant surface on slab with a minimum of 0.3 meters of living earth/substrate, not including drainage layer, plus unit value in m³ of well or infiltration trench or water storage tank, obtained from equivalence

 **Porto** Town Hall: In the 2nd revision of the Municipal Master Plan of Porto (Notice 12773/2021), of July 8, it is indicated in Article 71:

Article 71 - Complementary Green Corridors in paragraph 8 *“Environmental recovery interventions should be given priority, namely, directed to the use of green roofs, permeable pavements and the use of rainwater for irrigation and cleaning of outdoor spaces”.*

 **Sintra** Town Hall: Municipal Regulation of Urbanization and Building of Sintra - RMUES (2017), (Notice 1267/2017), states:

“...Art.49 Energy efficiency

5 - The design of new buildings or major intervention in existing buildings shall promote good energy performance, including the installation of a central air conditioning system, the use of passive air conditioning systems or techniques, the insulation of the roof and facades, the water tightness and thermal cutting of the spans and the installation of green roofs....”

It should also be noted that, in terms of sustainability assessment systems, there are several systems for assessing the sustainability of buildings (LEED, BREEAM, LiderA) that aim to evaluate the sustainability of built environments, assigning them credits associated with certain parameters valuing the positive environmental contributions of green roofs.



The LiderA (<http://www.lidera.info/>), a Portuguese volunteer system, acronym of Leading for the Environment for sustainable construction, aims to efficiently and integrated support, evaluate and certify the built environment that seeks sustainability.


The LiderA system has at least nine credits related to green roofs, namely, interconnection with habitat, passive design, local water management, local food production, light-thermal pollution, air quality levels, and comfort.

ADENE has also created the AQUA+ system, which understands that more water-efficient buildings are essential to increase the resilience of cities. The AQUA+ classification determines and communicates, on a scale from F (less efficient) to A+ (more efficient), the water performance of buildings. Buildings with AQUA+ classification have some advantages, among them: Evaluation and comparison, by a recognized method, of the water performance of the building; Identification of opportunities for efficiency in water use in buildings to be designed, rehabilitated, or in use; Valuing the best solutions that allow users to save water and energy; Distinction of the most efficient buildings and recognition of their owners.

In Spain, to this day, Spanish national Plans to promote the installation of green infrastructure applied to buildings are:

National Strategy for Green Infrastructure and Ecological Connectivity and Restoration

This is the strategic planning document that regulates the implementation and development of Green Infrastructure in Spain. Among its goals is *“To reduce the effects of fragmentation and loss of ecological connectivity caused by changes in land use or the presence of infrastructures”*. Therefore, one of its recommended lines of action to be carried out by local administrations is the *“promotion of the implementation of new types of green spaces (façades, green roofs and walls, green balconies, etc.), in those places where traditional landscaping has no place”*.

 **The Programme of aid for energy rehabilitation actions in existing buildings (PREE)** regulated by Royal Decree 737/2020, of 4 August. The programme has a large budget allocation of 300,000,000 euros. The aid is granted through the autonomous communities and municipalities. Its aim is to boost the sustainability of existing buildings through various actions, including changes in the

thermal envelope. The Plan does not mention solutions such as green roofs or green walls, however, it specifies that they should be actions that achieve a reduction in the energy demand for heating and air conditioning and mentions shading systems. Green roofs and green walls could be included because of their properties, but it is not very clear in the text of the programme.

 Some examples of **Local Plans** are the following:

In Barcelona, the “Urban Green Infrastructure Promotion Programme” responds to municipal commitments such as the Citizen Commitment for Sustainability 2012-22, which promotes the “renaturalisation of the city”, and the Barcelona Climate Commitment, which sets the goal of “increasing urban greenery by 1 square metre for every current inhabitant by 2030.”

Green roofs form part of the programme, and for this reason the City Council is promoting various actions to promote the environmental and social improvement of green roofs. These actions include: providing financial aid for the rehabilitation and renaturalisation of roofs, offering citizens documentation and technical support, promoting the revision of current regulations, promoting direct or indirect financing measures, publishing educational material on roofs and roof terraces, and providing an interactive online map with geolocation of existing roofs, among other measures.

In September 2017, Madrid City Council approved the Air Quality and Climate Change Plan for the City of Madrid and Change, Plan A. Within Plan A, there are two initiatives related to the creation of green roofs and green facades: Madrid+ Natural and the MAD-Re (Madrid Rehabilita) programme.

The ‘Rehabilita 2020’ plan subsidises four lines of action in the common elements of buildings, including boosting energy efficiency, which includes installing green roofs.

San Sebastian City Council has published the document “*Catalogue of Natural Solutions for adaptation to climate change in the local area of the Autonomous Community of the Basque Country. Methodological guide for their identification and mapping. Case study Donostia-San Sebastián*”. These solutions include the creation of green roofs and façades on public buildings.

The City Council is considering subsidising the fitting out of this type of roofs on private buildings, proposing architectural measures or including measures in the New General Plan of San Sebastian.

Building stock to be renovated.

The Sustainability Observatory estimates that, in Spain, 10% of the existing building stock could be converted into green roofs, that is, 35,000 hectares³.

In Spain, only 0.3% of existing buildings have undergone energy rehabilitation interventions⁴. There is a very small percentage of green roofs and walls. For example, in Madrid there are only 109 green roofs and 29 green façades listed. Among the factors that have slowed down their implementation are the following:

- Their price is higher than a conventional roof, between 10% for extensive roofs and 60% for intensive roofs.
- Lack of knowledge of the technology on the part of designers, builders, and roof installers. They are more complex systems than conventional roofs.

3 <https://elpais.com/economia/2020-12-25/los-tejados-verdes-se-marchitan-en-la-ciudad.html>
4 Real Decreto 737/2020, de 4 de agosto

- Their installation requires specialised labour.
- Maintenance and repair costs are higher than those of a conventional roof.
- Lack of awareness of the energy, environmental and social benefits of these solutions for the building and the urban environment.

In existing buildings, the replacement of conventional roof systems with green roofs has the disadvantage of weight. The building structure has been calculated to receive a certain roof weight, if the weight of the water-saturated green roof is higher, it is necessary to assess the reinforcement of the structure by a competent technician. New technologies are currently being developed for extensive, low-maintenance roofs with a similar weight of a conventional roof⁵. Those are Applicable to existing buildings, including industrial buildings.

The construction of green roofs and walls in Spain is more common in singular corporate buildings, offices, bank headquarters, museums, hotels, etc., and in buildings that aspire to obtain a sustainability certification such as LEED, BREEAM or GREEN n that gives value to this type of installation.

In general, Greece is promoting energy conservation in newly constructed and existing buildings. The first significant energy conservation measure in Greece, namely the Thermal Insulation Regulation of Buildings was introduced in 1979 that was followed by a 30-year hiatus, interrupted by sporadic, fragmented legislative acts, such as the Regulation on Rational Use of Energy and Energy Conservation that was published in 1998, though never implemented in practice.

Specifically, about green roofs, Greece is following the European Strategy but there is still room for improvement. The term “green roof” appeared in the renewed general Greek Construction Code in article 18, promoting the creation of green roofs, in 2012. Subsection b of article 18 of the Greek Construction Code, allows the construction of green roofs in already-existing buildings without the requirement of planning permission, facilitating, and thus promoting the creation of green roofs. In 2019, the Hellenic Ministry of the Environment and Energy published the National Energy and Climate Plan setting out a detailed roadmap regarding the attainment of specific energy and climate objectives by 2030. In this context, the Greek government promote urban bioclimatic restructuring and smart cities development.

In the context of the National Energy and Climate Plan, urban bioclimatic restructuring is clearly associated with green roofs referring that proper town planning and architectural bioclimatic design and the use of sustainable materials in bioclimatic design (cool materials, shading structures, plants) are essential requirements for the sustainable development of cities.

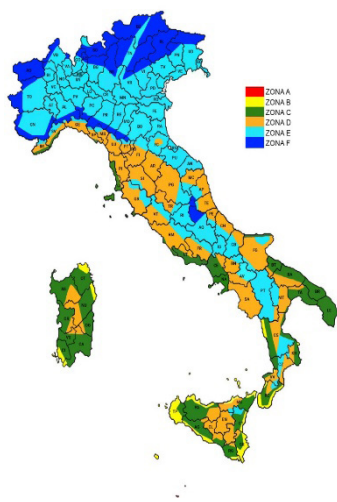
Greece is also making attempts to encourage research on the topic: the Ministry of Economics and Finance, with funding from the European Union’s Horizon 2020 research and innovation program launched research to evaluate the thermodynamic effect of a green roof in Athens. Two studies of the thermodynamics of the roof were carried out (in September 2008 and August 2009), which concluded that the thermal performance of the building was significantly impacted and benefitted by the installation. A green roof was built at the Greek Ministry of Economics and Finance, a prestigious public institution in Greece, and the environmental, as well as economic benefits of that initiative, were published.

According to Italian experts: Energy Efficiency Directive (EU) 2018/844 of May 30, 2018, calls on European mayors to encourage the development of action plans aimed at the implementation and dissemination of green roofs and walls, roof gardens, and the cultivation of hedges and trees along roads and adjacent to buildings.

To answer the question, whether there are in Italy any political strategies aimed at promoting green roofs, it is essential to start from the following map.

Since transmittance values are regulated according to zones, it is considered essential to report the zone mapping in force in Italy.

The Italian territory is divided into six climate zones, from A to F⁶, i.e., from the hottest to the coldest, distinguishing according to the criterion of Day Degrees (GG), regardless of geographical location.



Zone A: municipalities with GG (day degrees) less than 600.

Zone B: municipalities with GG (day degrees) between 600 and 900.

Zone C: municipalities with GG (day degrees) between 900 and 1.400.

Zone D: municipalities with GG (day degrees) between 1.400 and 2.100.

Zone E: municipalities with GG (day degrees) between 2.100 and 3.000.

Zone F: municipalities with GG (day degrees) more than 3.000.

Each Italian municipality, listed in Annex A of Presidential Decree 412/93, has assigned an identification code, which corresponds to a specific climate zone and degree days. Rome, for example, has been assigned climate zone D and 1.415 GG (degree days). Milan, on the other hand, is in climate zone E with 2.404 GG.

The only municipalities in the zone A are Lampedusa, Linosa and Porto Empedocle.

As far as Italy is concerned, it is in effect the so-called “Green Bonus” (Bonus Verde) introduced with the 2018 Budget Law Art. 1, commi da 12 a 15, della legge 27 dicembre 2017, n. 205 (Italy was one of the first countries at the European level to include such a measure), which consists of an IRPEF tax deduction of up to 36 % on expenses incurred for greening uncovered areas of existing building, real estate units, appurtenances and fences, irrigation systems and well construction, as well as for the construction of green roofs and roof gardens up to a maximum of 5000 euros. This tax reduction is scheduled to run until 2024⁷.

Whether the construction of a green roof is included in the scope of “Ecobonus systems”, this tax reduction can reach 65% or even 110% whether it is included among the planned works to make the double jump in energy class, i.e. to improve the energy class of a building by two energy classes

In fact, if a green roof intervention, with innovative materials and techniques, produces the same beneficial effect as more classic but energy-consuming tools and means, then it will be enough to certify the project (carried out by professionals) and send to ENEA (National Agency for New Technologies, Energy and Sustainable Economic Development) the documentation certifying that the intervention complies with the established standards.

6 <https://www.gazzettaufficiale.it/eli/id/1993/10/14/093G0451/sg>

7 <https://www.agenziaentrate.gov.it/portale/documents/20143/233439/Tutti+gli+sconti+della+precompilata+2022+-+Bonus+edilizi.pdf/4dcc4c9f-bf97-71eb-3f59-74a4954e0e91>

Specifically, to be eligible for the 65% benefits, the coverage must be:

Extensive, i.e. made from plants of the genus *Sedum*, a species of succulents and perennials that does not need much care and lots of water. Cover installation requires thin thicknesses of substrate (less than 15 cm) and minimal maintenance;

Or


Intensive, with greater substrate thicknesses (up to 50 cm) useful to beautify and insulate the environment; is more demanding in terms of care and maintenance, because different plant species such as trees, shrubs, herbaceous perennials and turf are used here.

Finally, the construction of a green roof is included among the “Ecobonus interventions” when it meets the thermal transmittance requirements defined by the Minister of Economic Development *Ministro* 11 marzo 2008, published on [Gazzetta Ufficiale n. 66 del 18 marzo 2008](#).


The values are displayed here⁸:

	DESCRIZIONE	SPESSORE (m)	CONDUTTIVITA [λ] W/mK	RESISTENZA TERMICA[R] m ² K/W	TRASMITTANZA TERMICA [T] W/ m ² K
	RESISTENZA TERMICA STRUTTURA [R_struttura]			2,380	
	TRASMITTANZA TERMICA STRUTTURA [U_struttura]				0,42
GREEN	Substrato **	0,100	0,280	0,357	
	Strato drenante	0,058	0,033	1,758	
	RESISTENZA TERMICA GREEN [Rgreen]			2,115	
	TRASMITTANZA TERMICA GREEN [UGREEN]				0,47
	RESISTENZA TERMICA TOTALE [Rtotale]			4,495	
	TRASMITTANZA TERMICA TOTALE [Utotale]				0,22
	PERCENTUALE di guadagno				47,05%

In Italy there are **local-level policies**, which foster some types of intervention aiming at mitigate soil sealing. Among them, green roofs:

-  The Municipality of [Torino](#) has approved Article 39, Paragraph 8 for the construction of “green roofs,” that is, all gardens and vegetable gardens that will be built on the flat roofs of buildings such as houses, garages, yards.

In particular, the Regulations recognize and encourage the actual environmental, social and economic benefits of urban green roofs by providing full exemption from paying contributions due to the Municipality on green roof construction costs.

-  The Municipality of Torino is aware that it is another step for environmental, social and economic change as green roofs can save energy, reduce CO₂ and particulate matter levels in the air, lower temperatures, protect biodiversity and prevent flooding by modulating rainwater runoff to the sewer system during heavy rainfall.

🌱 The Municipality of Bolzano continues in its efforts to promote the construction of green roofs in the area. After initiating a working table on the topic with Eurac Research and IDM (Innovators, Developers, Marketers Alto Adige) in past years and after some in-depth discussions with the Province, the Laimburg Experimentation Center, the University of Trento and the Free University of Bolzano, a project focused on the Bolzano South production area is now beginning.

The choice of the South Bolzano area is strategic because it is the most susceptible to the effects of the heat island phenomenon and because of the presence of numerous flat roofs, already mapped by the municipality, that are potentially suitable for hosting a green roof.

🌱 Since 2007 the Municipality of Firenze has had a R.E. (Regolamento Edilizio, Building Codes, Art. 3, All. D) which gives interesting indications regarding the use of greenery as a shading system for facades most affected by sunshine, but without going so far as to define “green coefficients” for evaluation.

Paragraph three of Article 3⁹ defines that “the use of greenery has not only a decorative value but must be designed and quantified in such a way as to produce effects on the microclimate of the area, mitigating summer temperature peaks through evapotranspiration and allowing shading of surrounding surfaces during different hours of the day.”

Paragraph 4 of the same article defines, “with regard to buildings, it is appropriate to arrange vegetation or other screens in such a way as to maximize summer shading of the following surfaces, in order of priority:

- the glazed and/or transparent surfaces facing south and southwest;
- the external heat dissipation sections of air-conditioning systems;
- *roofs and the roofing*;
- the exterior walls facing west, east and south;
- the surfaces capable of absorbing solar radiation within 6 m of the building;
- the ground within 1.5 m of the building.”

In order to achieve optimal shading of buildings, Paragraph 5 of Article 3 recommends the selection of “trees planted at such distances that the foliage is located at:

- no more than 1.5 meters away from the façade to be shaded, if facing east or west;
- no more than 1 meter away from the facade to be shaded if facing south.”

Paragraph 8 of Article 3 “recommends, compatibly with artistic and architectural constraints, the **use of greenery for roofs** as well,” but without going into it and without referring to the UNI 11235 standard, which came out in May 2007, thus before the R.E. under review came into force.

🌱 The Municipality Codes in force in Piacenza provide for a reduction of 2% in charges of zoning fees in case of construction of green roofs, roof gardens on roofs, terraces or flat roofs¹⁰.

9 http://www.comune.firenze.it/comune/regolamenti/edilizio/RE%202007_140807_3.pdf

10 <https://www.comune.piacenza.it/documenti-e-dati/documenti-tecnici-di-supperto/rue-regolamento-urbanistico-edilizio>

Q3. Which public organism are involved in the Green Roofs promotion and installation in your country?

PORTUGAL	Ministry of Environment and Climate Action
	Town Halls (i.e. Maia, Valongo, Barreiro, Lisbon, Espinho, Porto, Sintra) Leading for the Environment for sustainable construction (LiderA)
SPAIN	Three public administration levels: Town Halls, Autonomous Community and Ministerio para la Transición Ecológica y el Reto Demográfico (Ministry of Environment)
	Universities. Non-profit organizations.
GREECE	Ministry of Environment and Energy.
ITALY	Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA, Minister of Ecological Transition).
	National Agency for New Technologies, Energy and Sustainable Economic Development. Provincia autonoma di Bolzano, at a local level.

According to the experts, in **Portugal** there is no national legislation on green roofs, however, there are financial incentives for their installation, through the Ministry of Environment and Climate Action.

In **Spain**, In Spain, there are three public administration levels able to launch public funding: Town Halls, Autonomous Community, and National.

Public organisms more involved so far are City Halls, universities, and non-profit organizations.

In **Greece**, the Greek Ministry of Environment and Energy has the primary role in creating and publishing legislation, including construction codes and regulations that must be followed. The regulations surrounding the promotion and installation of green roofs in Greece are the responsibility of the Greek Ministry of Environment and Energy which created a renewed construction code in 2012. Article 18 of the code addresses several issues regarding green roof construction¹¹.

In **Italy** there are two main public organisations involved, ISPRA and ENEA.

ISPRA is a public research institution, with legal personality under public law, technical, scientific, organizational, financial, managerial, administrative, patrimonial and accounting autonomy. It is under the supervision of the Minister of Ecological Transition (MITE).

ENEA is the National Agency for New Technologies, Energy and Sustainable Economic Development, a public law entity aimed at research, technological innovation in the fields of energy, the environment and sustainable economic development.

In both cases, Green Roofs are not the main issue of the organisation, but the subject is part of their work.

Another public body, the Provincia autonoma di Bolzano, at a local level, is strongly working at promoting Green Roofs in its area, also through the publication and dissemination of a leaflet on the topic.

Moreover, we would also like to point out **ANIT** (Associazione nazionale per l'isolamento termico e acustico, National Association for Thermal and Acoustic Insulation), a non-profit association founded in 1984. The general objectives of the Association are the dissemination, promotion, and development of thermal and acoustic insulation in construction and industry as a means of safeguarding the environment and the well-being of people. ANIT promotes legislative and technical regulations by actively participating in the main committees and working groups of the sector at the Ministry of Economic Development, Ministry of the Environment, UNI, Italian Thermomechanical Committee. The Association also collaborates with others with agencies and institutions to promote energy conservation and acoustic comfort in buildings such as ENEA.



Q4. In your country, is there any obligation to install green roofs in new buildings? Is it foreseen to implement them in rehabilitation works?

In **Portugal** there is still no obligation to install green roofs in new buildings, however, there are financial incentives for their installation in existing buildings.

In **Spain**, building construction is regulated by Construction Technical Code, a set of mandatory standards that establishes the minimum requirements to be met by roofs in general. In relation to damp protection and water drainage, but does not contain specifications for the design, construction, maintenance, and upkeep of green roofs. There are also no specifications for green walls.

There are no obligations for green roofs. There is regulation only for solar panels.

In **Greece**, the new construction code, subsection 2, article 18 does not make the construction of green roofs in new buildings mandatory and it is not foreseen to implement green roofs in rehabilitation works¹².

In **Italy**, two experts agree, by saying that there are no generalized formal obligations mandating the use of green roofs, even at the level of municipal master plans, nor in new buildings either in rehabilitation works. Such kind of obligation should be required to speed up the implementation of green roofs.

The third expert (Silvia Rossi) detects a sort of obligation regarding the reduction of the Building Impact which consists of an index certifying the quality of the building intervention with respect to the permeability of the soil and greenery, or the impact on UHI.

Conclusion

None of the countries has the obligation to install green roofs in new buildings.

Q5. In case of Green Roofs promotion, do you find any difference between Installation and Maintenance of Green Roofs? In your opinion, does this promotion consider the Green Roof deconstruction?

According to **Portuguese** experts, the Installation and Maintenance of Green Roofs are two different procedures. The installation of the green roof is understood as the act of implementing the green roof. The maintenance of the green roof is understood as the act of accompanying and maintaining the green roof ensuring its proper functioning and operation.

The deconstruction or dismantling of the green roof is understood as another action differentiated from the two mentioned above that lacks attention and compliance with rules that ensure compliance with the routing of materials resulting from dismantling.

Spanish expert highlight that there are differences: green roofs to be promoted for inauguration by public or private institutions. However, maintenance should be done by the community and for beneficiaries in neighbourhoods.

Green roof promotion in **Greece** mostly emphasizes the installation of green roofs as well as the environmental and economic benefits that green roofs have to offer. More research and promotion should be implemented on maintenance and deconstruction. Having said that, I do not think that this promotion considers Green Roof Deconstruction. I believe that the Greek promotion of green roofs is in an early, however developing stage¹³.

In **Italy** there is little promotion of Green Roofs. It is focused on the Installation of Green Roofs. Less attention is paid to Maintenance, no attention at all to Deconstruction.

According to the opinion of the Experts the whole life cycle of a Green Roof should be considered, from the design to the deconstruction.

Conclusion

Even if Installation, Maintenance and Deconstruction are different processes, the promotion of green roofs is almost exclusively about Installing. In some cases, green roofs should be maintained by the community (social impact and consequent promotion). Deconstruction is not promoted in any country.

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Greek Ministry of Environment and Energy. (2012). Article 18, Construction Code. <http://www.opengov.gr/minenv/?p=3931>

Q6. According to greenroofs.org (American organisation), Do you agree, regarding your country?

In North America, the benefits of green roof technologies are poorly understood, and the market continues to mature, despite the efforts of industry leaders. In Europe however, these technologies have become very well established. This has been the direct result of government legislation and financial support. Such support recognizes the many tangible and intangible public benefits of green roofs. This support has led to the creation of a vibrant, multi-million-dollar market for green roof products and services in Germany, France, Austria, and Switzerland, among others.”

In **Portugal**, the installation of green roofs has not yet been generalized, and there are some pioneering projects. To highlight the project Quinto Alçado do Porto (PQAP), authored by Eng^o Paulo Palha, President of the ANCV-National Association of Green Roofs, which had as its main objective the definition of a model of integration of green roofs in the environmental and urban strategy of the city of Porto, making them part of the green infrastructure strategy of the city. The project began in August 2016 and was developed by the National Association of Green Roofs (ANCV) for the Municipality of Porto, with the participation and commitment of the technical teams of the Departments of Urbanism, Environment, and Green Spaces of CM Porto and with several research institutions and international partners. This project is very important as it was the first time that a City Council has officially expressed its willingness to include green roofs in the city planning legislation.

In addition, in civil society, and construction professional green roofs are increasingly perceived as they contribute to the development of more sustainable and climate-resilient cities. Thus, there are courses in universities and also through the Order of Engineers, the Order of Architects, and the National Association of Green Roofs, on the advantages of green roofs, design, and design of roofs, and maintenance operations.

In **Spain**, the boost to green infrastructures have come from private initiative. More recently from Town Halls and some Ministry. Nowadays, there is no social awareness

On the other hand, although **Greece** is gradually comprehending terms like sustainability and green infrastructure, there are still several steps the country needs to take to fully embrace the new eco-friendly reality of green roofs. While initiatives are taking place and the term “green roof” has entered our vocabulary, with many privately-owned companies being established that are occupied with the construction of green roofs, there is still a lack of financial motive, as well as a knowledge gap. Certainly, the green roof industry is not a multi-million-dollar market in Greece. Increased promotion, policy, research as well as dialogue are necessary¹⁴.

In some parts of **Italy**, such as Provincia autonoma di Bolzano or Comune di Torino, numerous examples of green roofs have been implemented over the past few years. It should not be forgotten that the proximity to Austria and Germany, where roof gardens are widespread, have fostered sensitivity to green roofs in the Trentino Alto-Adige area.

In general, even if some Municipalities show to be aware of the importance of green roofs especially in urban centers, they are not so common on the Italian peninsula. In Italy there is not great support for green roof installation and the benefits are poorly understood. In addition, there would be a need

for improved technology. In Milano and Torino two EU Projects are supporting the promotion and the creation of green roofs: City Water Circle (Interreg Central Europe) in Torino, and Clever Cities in Milano.

- <https://www.interreg-central.eu/Content.Node/CWC.html>
- <https://www.torinocitylab.it/it/cwc>
- <https://clevercities.eu/milan/>
- <https://milanoclever.net/>

Conclusion

There is a lack in terms of social awareness and general knowledge in regards with the Green Roofs in all the participating countries. Along the same line, the financial motive is derived mostly from the private sector -especially in Greece and Spain. In Italy, despite the fact the Municipalities seem to be more aware of the benefits of Green Roofs there is not great support for green roof installation.

Q7. What are the main legal documents at national, regional, and local level that regulates the green roofs building? Is there a change in the legislation expected?

PORTUGAL	There are not legal documents
SPAIN	There are not legal documents
GREECE	Renewed construction Code (2012)
	Presidential Decree No. 59 of 2/6/2009
ITALY	Law No. 10 of January 14, 2013
	Standard UNI 11235:2015

In **Greece**, the **Renewed construction Code (2012)** (v.4067/2012) was published by the Ministry of Environment and Energy and it is the primary and most essential document regarding green roof regulations. Legislation and instructions surrounding the installation of green roofs can be found in this document.

In **Italy**, there is the **Presidential Decree No. 59 of 2/6/2009** “Regulations implementing Article 4(1)(a) and (b) of DLG No. 192 of August 19, 2005, concerning the implementation of Directive 2002/91/EC on energy performance in buildings.”

AIVEP has prepared a proposal to amend and supplement Decree Law 192/2005 (“Implementation of Directive 2002/91/EC on the energy performance of buildings”).

Today Aivep continues its lobbying for the implementation of Directive 2002/91/EC. Specifically, in fact, the directive mentions:

“... the designer, in order to limit the energy needs for summer air conditioning and to contain the internal temperature of the environments (...) shall use (...) or green roofs that allow to contain the fluctuations

of the temperature of the environments according to the solar radiation pattern. In this case, appropriate documentation and certification of technologies and materials certifying equivalence with the above provisions shall be produced.”

Also, the **Law No. 10 of January 14, 2013**: Regulations for the development of urban green spaces. In its article 6. Promotion of local initiatives for the development of urban green spaces. For the purposes of this law, the regions, provinces and municipalities, each within its own jurisdiction and available resources, shall promote the increase of urban green spaces, “green belts” around conurbations to delimit urban spaces adopting measures for staff training and the development of specifications aimed at the better use and maintenance of areas, and adopt measures to promote energy saving and efficiency, the absorption of fine particulate matter and reduce the “summer heat island” effect, while promoting regular rainwater harvesting, with special reference to:

- a. to new construction through the reduction of building impact and greening of the area subject to new construction or significant building renovation.
- b. to existing buildings through the increase, preservation and protection of the existing tree stock in the uncovered areas pertaining to these buildings.
- c. to green roofs, as referred to in Article 2, paragraph 5, of the regulations referred to in Presidential Decree No. 59 of April 2, 2009, as structures of the building envelope capable of producing energy savings, in order to encourage, as far as possible, the transformation of solar terraces into roof gardens.
- d. to the greening of building walls, either through vertical greening or vertical hanging green techniques.
- e. to the provision and implementation of large public green areas in urban planning, with special reference to areas of higher building density.
- f. to the provision of specifications for green works that include the requirement for the necessary irrigation and drainage service infrastructure and specific technical data sheets on plant essences.
- g. to the creation of training program for green maintenance personnel, including in cooperation with universities, and to raising public awareness of green culture through communication and information channels.

And the last document in Italy, the **Standard UNI 11235:2015** (which replaced the previous standard UNI 11235:2007): “Instructions for the design, execution, control and maintenance of green roofs”.



Q7. In your country, which organism(s) or organization (s) elaborate technical documents in implementation/maintenance/deconstruction of Green Roofs?


PORTUGAL	National Association of Green Roofs
SPAIN	Association of Green Roofs and Vertical Landscaping Landscape and Garden Foundation
GREECE	Ministry of Environment
ITALY	Italian National Unification Body UNI

In **Portugal**, the National Association of Green Roofs (ANCV) presented 2019 the “Technical Guide for Green Roofs”, a technical guide for the design, construction, and maintenance of green roofs.

This guide is the reference document of the “Program to support more sustainable buildings”, which defines that applications for typology 6 in green roofs should follow the rules of good practice defined in the “Technical Guide to Green Roofs”.

This guide is the reference document of the “Program to support more sustainable buildings”, which defines that applications for typology 6 in green roofs should follow the rules of good practice defined in the “Technical Guide to Green Roofs”.


In **Spain**:

 Spanish Association of Green Roofs and Vertical Landscaping (ASESCUVE) states that “the absence of specific regulations for green roofs means that many of these roofs already built do not comply with the quality standards of existing international regulations”.

The Landscape and Garden Foundation has produced Technological Standards in Gardening and Landscaping:

- NTJ 11C: Green roofs, 2012
- NTJ 11V: Vertical gardens

These technological standards were published with the intention of becoming a new “code of practice”. These documents are based on international standards, recognised, and referenced in the field, defining quality standards for the design, construction, and maintenance of green roofs.

 Currently some manufacturers and distributors of “proprietary” green roof systems publish installation guides and/or provide training for installers.

In **Greece**, The Greek Ministry of Environment and Energy has the primary role in creating and publishing legislation, including construction codes and technical documents. The regulations surrounding the promotion and installation of green roofs in Greece are the responsibility of the Greek Ministry of Environment and Energy which created a renewed construction code in 2012. Article 18 of the code addresses several issues regarding green roof construction¹⁵.

15 Greek Ministry of Environment and Energy. (2012). Article 18, Construction Code. <http://www.opengov.gr/minenv/?p=3931>

In **Italy**, the body that prepares the technical documentation is UNI, the Italian National Unification Body.

Q8.- Are there technical criteria that regulate or recommend the quality of the Green Roofs regarding?

	GREECE	PORTUGAL	ITALY	SPAIN
Construction system (material)	YES	YES	YES	YES
Installation	YES	YES	YES	Recommendations
Maintenance	NO	YES	YES	Recommendations
Deconstruction	NO	NO	NO	NO

Summary of technical requirements for green roofs required by law

In **Portugal**, as well as in Europe, in the case of green roofing materials having free movement, they must have:

- 🌱 The CE marking contributes to the uniformity of the quality of goods transacted within the European Union. Products marked as CE show that the products comply with the provisions of the Community Directives applicable to them, allowing them to be free to move.
- 🌱 ETA - European Technical Assessment is an alternative for construction products that are not covered by a harmonized standard. It is a document that provides information about your performance evaluation. The procedure is set out in the Building Products Regulation and offers manufacturers a way to draw up the performance declaration and implement the CE marking. It contributes to the free movement of construction products and the creation of a strong single market (EU, 2022).

The first European Technical Assessment ETA 13/0668 of 2013 for constructive solutions of green roofs was issued in June, replaced by ETA-13/0668 of 12 June 2018. It was carried out by the Technical Evaluation Body issuing to the European Technical Assessment: Deutsches Institut für Bautechnik, with the commercial name of the construction product:

- Extensive Green Roof – Type 1. Sedum Carpet
- Extensive Green Roof – Type 2. Rockery Type Plants
- Basic Intensive Green Roof – Type 3. Heather with Lavender
- Intensive Green Roof – Type 4. Roof Garden

Currently, there are new ETA for other solutions such as the European Technical Evaluation ETA 21/0882 of 18/11/2021 with the Portuguese version prepared by Itecons - Institute of Research and Technological Development for Construction, Energy, Environment and Sustainability with the commercial designation of the construction product: LECA® NUTROFERTIL GREEN ROOF D.

„The rated product, LECA® NUTROFERTIL GREEN ROOF D, is a green roof kit consisting of the following layers (bottom to top):

- Protective layer: provides protection against mechanical damage to the waterproofing layer and can also retain moisture.
- Drain layer absorbs excess water by draining it into the gutters.



- Filter layer: prevents the passage of fine from the vegetation layer.
- Vegetation support layer provides the area for plant roots and provides water and nutrients. Green roof kits are placed on flat or sloping covers, with a maximum inclination of up to 15°. The waterproofing layer and plants are not part of the kit.”

It should be shown that for the correct installation of a green roof, the structure should be adapted to the weight of the green roof that is to be installed, develop the appropriate rainwater drainage plan, and ensure that the waterproofing is functional. It should also, if possible, have anti-root characteristics. In the climate of Portugal, it is appropriate to provide a water and electricity point to connect a possible irrigation system.

In **Spain**, in general, there are “technical rules” from professional organizations, but they are not compulsory.

In **Greece**, there are several technical criteria specifying the requirements as well as the protocols for green roof installation. Such regulations include instructions regarding green roof construction in old as well as new buildings. However, article 18 of the renewed construction code includes no technical criteria regarding maintenance or deconstruction of green roofs¹⁶.

In **Italy**, Standard UNI 11235:2015: Instructions for the design, execution, inspection, and maintenance of green roofs. It gives information about design, inspection, and maintenance of green roofs, but there is nothing about decommissioning/deconstruction.

16 Greek Ministry of Environment and Energy. (2012). Article 18, Construction Code. <http://www.opengov.gr/minenv/?p=3931>

CONCLUSION

- In Spain, Greece, Italy, and Portugal the green roofing materials having free movement in market, they must have CE marking or comply with an ETA - European Technical Assessment.

The CE marking contributes to the uniformity of the quality of goods transacted within the European Union. Products marked as CE show that the products comply with the provisions of the Community Directives applicable to them, allowing them to be free to move. ETA - European Technical Assessment is an alternative for construction products that are not covered by a harmonized standard.

- In Portugal and Spain are “technical rules” from professional organizations, but they are not compulsory.
- In Greece and Italy beyond the “technical rules” “ there are regulations in Greece, the regulations include instructions regarding green roof construction in old as well as new buildings but no technical criteria regarding maintenance or deconstruction of green roofs. In Italy there is Standard UNI 11235:2015: Instructions for the design, execution, inspection, and maintenance of green roofs, but there is nothing about decommissioning/deconstruction.
- For the four countries nothing exists about decommissioning/deconstruction.

Q9.-How do you foresee the right technics to demolish a roof in anticipation of the reconstruction of a green roof?

According to Portuguese experts, before demolition work begins, a careful assessment of the feasibility of this type of solution should be carried out:

- The slope of the cover may condition the type of solution to be prescribed - excessive inclinations may make it impossible to apply the most current solutions and the dimensioning of specific fixation strategies.
- The load capacity of the slab has to be evaluated and there should be a prescription of a solution that does not exceed that capacity under the condition of saturated substrates.
- The drainage system may have to be revised to respond to the specificity of green roofs.
- Waterproofing of the cover should be revised and watertight testing of the new solution should be carried out before the installation of the new coverage begins.

The demolition work of roofs for the installation of green roofs should be done by specialized teams (the correct demolition of a roof always involves consultation with a civil engineer), the treatment of waste should follow the legal requirements and should be determined the existence of materials with hazardous substances. For example, coating solutions with the use of asbestos are referred to. In such or similar cases, appropriate treatment should be made.



According to **Spanish** expert, following the European normative, there will be in next future.

In **Greece**, there is a specific process in place that must be followed. First, a demolition company is needed to demolish the old roof. Then, roofing debris removal is necessary and finally a roof cleanout company is needed¹⁷

CONCLUSION

Before replacing a roof with a green one, a careful evaluation must be carried out. The demolition of a roof must meet all law requirements foreseen in the country, especially regarding the disposal of inert waste and any possible hazardous waste. A preliminary thorough assessment of feasibility of a green roof is needed.

Q10.-How to replace a green roof not properly installed? (as an introduction, since it will be further developed in Task 2)

According to **Portuguese** experts, when there is non-conformity of a green roofing system or if anomalies are identified caused by the green roof installation, it may be decided to carry out in the first phase an expert opinion involving specialist technicians with good suitability to understand the error made. This work of investigation should assess the degree of non-conformity of the problem and determine whether it is possible to correct punctually the causes that led to the anomalies or whether it is necessary to remove the cover in full and the repetition of the application.

One of the main mistakes made is the use of natural soils in multilayer systems. Over time, the filters are filled, and the drainage ceases to be carried out efficiently, causing soaking and consequent death of plants, as well as overload in the structure built. When this is the case, all materials from the roof should be lifted to the drainage element. Having been completed this stage should be all cleaned, and the coverage should be installed again with appropriate materials and according to the Technical Guide for Green roofings, ANCV - National Association of Green Roofs.

Specific projects for the installation of green roofs should be encouraged, with designed and written parts that support contractors. Detailed drawings of all singularities will be decisive for the success of the performance of the solutions.

In **Greece**, there are specific steps that must be followed. First, the roof deck must be waterproofed. Then the installation of a Root Barrier must take place. Third, a green roof drainage membrane must be installed and then growing substrate must follow. Finally, the planting of seeds and the creation of the vegetation layer are important¹⁸.

CONCLUSION

First and foremost: experts, together with specialist technicians, must investigate and identify the non-conformity of the green roofing system and then plan how to intervene to solve the problem. The problem may lie in the green layer, in the soil used, in the waterproof layer, in the structure of the roof. The installation of green roofs according to Technical Guide for Green Coverings should prevent problems.

SECTION 2. -ABOUT GREEN ROOF BENEFITS

Q11. Please, highlight and briefly explain the main benefits of green roofs.

All experts from Portugal, Spain, Greece and Italy mentioned the above benefits of green roofs:

For the building performance (E.g.: energy performance, water management).

- They increase thermal comfort as they increase relative humidity and decrease temperature. In other words, when the heating of external roof surfaces is greater due to the intense solar radiation, the use of green roofs reduces the surface temperature of the roof, improves the thermal insulation of the building envelope, and mitigates the incoming and outgoing heat flux through the roof.
- Improve the acoustic insulation of the building since the extra layers and the vegetation absorbs and isolates noise.
- Green roofs contribute to extend roof life: The construction of green roofs significantly reduces the wear and tear on building materials and can help to extend the life of waterproofing membranes, in turn reducing associated waste.
- By improving the energy efficiency of buildings, it can reduce the use of ventilation and air-conditioning systems, thus also extending their life (according to Saylor D. J. (2008), green roofs installation boosts 2% in electricity savings, and 9-11% reduction in gas consumption).

For the urban climate/climate change challenges:

- Reduces urban heat island effect and improves Air Quality: Vegetation covering conventional roofs absorbs heat and use solar radiation to evaporate water from the growing media and transpire (the absorption of water through a plants roots and release of it through its leaves as a vapor) moisture from the plants. This process of evapotranspiration lowers the temperature on the roof by using heat from the air to evaporate water. Green roofs foster drafts through so-called 'green corridors' that can connect indoor green areas (parks and gardens) with outer green rings. Renewal of air masses through urban green corridors.
- Another use is for local food production: Green roofs increase food sources in cities since they help to reduce the ecological footprint through the creation of a local food system. Green roofs allow the production of vegetable gardens and the implementation of fruit trees and beekeeping. One effect of this use would be to empower the community, give a greater sense of self-sufficiency and improve nutritional standards.

Biodiversity and ecological scale

- Enhance biodiversity by allowing the establishment of diverse flora and fauna, contributing, for example, to provide food, habitat, refuge, and resting places for numerous animals such as birds and butterflies.

In more detail, experts from **Portugal** explain that green roofs are installed using techniques and technologies that can be installed in new buildings, or existing buildings, providing various benefits to its users as well as the environment. They are facilities that must be monitored, from the design phase to their maintenance, by specialized professional teams.

Green roofs, when well designed and executed, must provide several services that can be divided into three areas:

Ecosystem services of green roofs in the building.

- Habitability of open spaces, providing valuable experiences from the aesthetic and recreational point of view.
- Increased asset value, valuing buildings and cities.
- Protects the slab, which is not exposed to direct insolation and temperature fluctuations.

Ecosystem services of green roofs on an urban scale:

- Large rainwater retention capacity and delay the effect of the arrival of remaining water (not retained in the green roof system) to the urban drainage system. Consequently, there is a decrease in pressure on the urban drainage system of rainwater and consequent episodes of floods.
- Creation of new green spaces.
- Benefit for the health of populations, for the positive psychological effect of the presence of nature in inhabited spaces.
- Improves the aesthetics of urban environments.

Eco-systemic services of green roofs on an ecological scale

- Reduction of pollution levels, retaining dust and suspended particles.
- Reduction of rainwater runoff, creation of rainwater retention and infiltration zones, replacement of the natural evaporation and transpiration cycle.

The installation of a green roof is an investment, and although its initial cost is high, this factor will be compensated for its numerous advantages, and all life-cycle costs should be considered. Thus, for example, green roofs have a longer duration, which is on average twice the time of conventional roofs. In addition, roofs also need maintenance, restoration, or replacement, such as green roofs, although not as periodic. Its construction must be carried out by skilled labor, and its maintenance must be carried out following the recommendations of a specialized team. It is important to realize that there may be restrictions in its construction, caused by the load capacity of the building.

Planting on green roofs and facades is rapidly developing in architecture, engineering, and agronomy. It is a bet that leads to greater efficiency and urban biodiversity.

Experts from [Spain](#), [Greece](#) and [Italy](#), have several contributions to the above and have classified the benefits as follows:

For the building performance (*E.g.: energy performance, water management*).

- Stormwater management and building performance: Green roofs improve stormwater management: green roofs capture up to 80% of rainfall during rainstorms, compared to 24% typical for standard roofs. Plants absorb sunlight and this helps to create a cooler and more pleasant climate. The cultivation layer reduces and slows down the outflow of outgoing water through the phenomenon of absorption. A green roof can reduce the outgoing water load by up to 90% compared to the incoming water load.

For the urban climate/climate change challenges:

- Reduces Greenhouse Gas Emissions: The reduction in cooling loads also helps reduce greenhouse gas emissions from fossil fuel combustion associated with the use of HVAC equipment. Adding plants and trees to the urban landscape in turn increases photosynthesis, reducing carbon dioxide levels produced by vehicles, industrial facilities, and mechanical systems. It also increases oxygen production.
- Stormwater management and urban climate: Green roofs optimize stormwater management, provide natural filtration that reduces the risks of urban flooding and improves the hydrological balance of the urban areas by reducing rainwater runoff. Many benefits can be highlighted from an environmental point of view.

Biodiversity

- There are still no studies about the effects of the components that the earth used in green roofs: phosphorus, nitrogens, heavy metals and fertiliser-derived compounds, which adhere to runoff water and are incorporated into the natural hydrological cycle.
- Green roofs can recreate the natural habitats in urban areas. Biodiversity can be sustained in urban areas through the selection of melliferous plants and the addition of features such as small pools, logs, perforated bricks, where pollinating insects can find a house and reproduce.

Others

- A green roof may improve property values and marketability, especially in urban areas with little green space¹⁹.
- Green roofs can meet leisure and relaxation needs if they are installed on the rooftops and roofs of residential buildings as community gardens. They can be used by the neighbourhood community, or as playgrounds, for example.
- In case of public administrations boost green roofs installation, this would create new job opportunities linked to the manufacture, care of the soil and plants, design, installation, maintenance, and deconstruction of green roofs.
- Green roofs provide a beautiful and positive living and working environment for people. Economic benefits include increased R-value of the roofing system along with reduced temperatures on the roof HVAC loads, resulting in energy cost savings. A green roof may improve the value of the property due to the sustainability and long life-span that green roofs have to offer.
- A green roof turns out to be a very useful tool for cleaning the air in the urban environment; if properly designed, the vegetation that develops is able to retain the dust carried at a certain altitude by the wind, which then settles on it, and to retain the harmful substances that are absorbed by the photosynthesis process of plants;
- Green roof create usable outdoor spaces, especially useful in cases where there is a reduced usable area on the ground.
- Green roofs create spaces for recreational activities. The roof of a supermarket can become a playground for children, the roof of garages in an apartment building can become a shared area for residents. On an intensive green roof you can have orchards and grow vegetables.

Q12. How do reconcile, in terms of benefits, green roofs with other renewable energy conversion technologies (PV, solar, wind)?

According to European Federation Green Roofs & Walls (EFB, 2002) a green solar roof, also called Biosolar Roof, is a combination of photovoltaic modules and a green roof. The integrated assembly solution allows the substrate and vegetation to provide their own masonry for installation. This eliminates the need to penetrate the waterproofing to secure the mounting units directly to the roof itself (EFB, 2022).

Photovoltaic modules can be arranged in various combinations, allowing a multifunctional use of the available surface. Depending on the space to be used and the desired function of the green surface, the arrangement of the technology can be one of the following (EFB, 2022):

When photovoltaic module sets – opaque, bifacial, or transparent – are installed vertically, they optimize performance and allow vegetation to grow freely. In case the photovoltaic modules are mounted more than 2 m above the green roof - also designated as pagoda - allows a multifunctional use of the green roof, creating shaded spaces under the solar system (EFB, 2022).

The diversity of vegetation and fauna when installing a green roof with photovoltaic panels should increase, providing spaces of shade combined with the flow of rain, thus creating wetlands ahead and drier areas at the back.

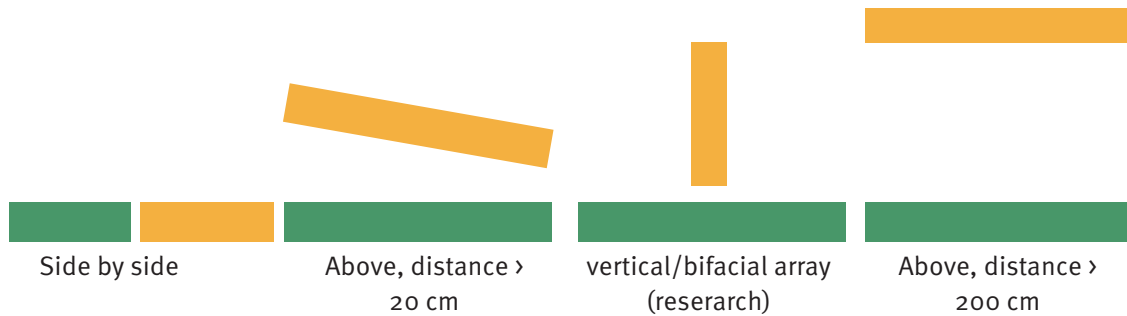


Figure X. Solar system layout options. Source: © GRÜNSTATTGRAU (<https://efb-greenroof.eu/green-roof-basics/>)

This creates a mosaic of habitats that allows a greater variety of vegetation to bloom and, in turn, creates an annulment of biodiversity.

On the other hand, the combination of Biosolar Roofs will create a synergy between the production of clean energy and shading created by photovoltaic panels, and the reduction of the internal temperature by up to 4°C. This is conferred by thermal insulation through the installation of green roofs, thus creating a great impact of thermal efficiency at the level of the building, also contributing to a natural thermal comfort within the dwelling.

The installation of Biosolar Roofs will also require mixed knowledge around solar and green roofs, and an urgent formative need.

In **Spain**, the answer refer to the Technological University of Sidney made a study in which two green roofs (normal green roof and biosolar green roof) were monitored. One of the conclusions was that, given that the efficiency of the solar panels decreases when temperatures exceed 25°C, so by reducing the surface temperature on typical hot summer days in Sydney thanks to the plants on the roof, the green roof allows the solar PV system to generate more electricity.

In **Greece**, It goes beyond doubt that all these green technologies belong in the same category of technological advancements that aim at saving the planet without impacting the rhythms and quality of everyday life. If anything, these green technologies have great socio-economic as well as environmental benefits to offer.

According to **Italy**, the presence of green roof allows a reduction in the temperature of the surrounding area and, therefore, greater efficiency of PVs. This is one of the most interesting research fields to explore in the future.

Q13. How the deconstruction of a green roof contributes to the circular economy?

According to **Portugal**, a circular economy is implemented through a combination of strategies that close, narrow, slow, and regenerate resource flows. The deconstruction of a green roof (as opposed to its demolition) contributes to these strategies, as it allows to separate the different components and reuse them as such or recycle their materials, as well as integrate the soil and plants in other green areas.

Unlike other types of constructive solutions, the components of a green roof do not have rigid connections and the separation of elements at the end of life becomes easier by promoting the circular economy. The utilization of the substrate is something possible, as well as other components (e.g. draining screen and insulation layer).



In this way, the negative impacts associated with the end-of-life of green roofs are addressed through a circular and resource-efficient approach.

According to Greece, with the deconstruction of green roofs, materials are re-used and that way materials are circulated, contributing to the accomplishment of the second principle of circular economy which is to circulate products and materials²⁰.

Recently in Italy a new Decree (Decreto n. 278 del 15 luglio 2022) has established the conditions under which demolition and construction waste ceases to be a waste. Under certain conditions - these are, in total, 29 parameters to be met - inert waste can be used in civil engineering, for the body of embankments of earthworks, as a subgrade for streets, rail, squares, environmental rehabilitation. In the future, the opportunity to use inert waste - as it is - can contribute to circular economy.

CONCLUSION

The deconstruction of a green roof, opposed to its demolition, can contribute to the circular economy, if the deconstruction is carefully completed. The main purpose is reducing the number of materials that cannot be recycled or reused.

The contributions of green roofs to the circular economy are:

- Organic materials (soil and plants) can be separated and used to make compost.
- Inert waste (rubble, bricks, plaster...) can be separated and re-used, as it is, as a subgrade.
- Inert waste can be reworked and transformed into concretes and mixture bound with hydraulic binders.

SECTION 3. -GREEN ROOFS EXAMPLES

Q14. Which are the main types of green roofs in your country?

In Portugal, according to the Technical Guide for Green Roofs (ANCV, 2019) and xxx from Greece²¹ green roofs can be divided into three different typologies, depending on the use, vegetation, and maintenance requirements:

The three typologies considered are: extensive green roof; semi-intensive green roof; and intensive green roof.

20 Ellen Macarthur Foundation. (2022). What is a circular Economy: Second Principle of Circular Economy. (Foundation)<https://ellenmacarthurfoundation.org/circulate-products-and-materials>

21 https://www.geotee.gr/lnkFiles/20111229_20111229-Protasi_Gia_Fytotechnikes_Meletes.pdf

The different types of green roofing's influence the final load that is exerted on the built structure and the selection of vegetation, the type of substrate, and subsequent maintenance.

Extensive green roof

Portugal: The extensive green roof is the lighter green roofing system, typically with reduced substrate thickness where small vegetation is installed, which should require little maintenance care for proper development.

An extensive green roof aims to accelerate the natural colonization process, using autochthonous vegetation to establish a lasting population that operates autonomously and sustainably.

The layer of vegetation of an extensive green roof consists essentially of juicy plants and vivacious plants. The vegetation of this typology of green roof can evolve through a natural process, with the regeneration of the species used, and/or incorporating new species, some of them spontaneously (e.g., wind action and birds in the dissemination of seeds), if they do not become dominant.

Greek experts complement this definition by stating that the extensive green roof counts on a special light growth substrate for plants 10 to 15 cm high, which together with the plant material creates a permanent ecosystem for its maintenance which requires minimal care. The saturated load ranges from 80 to 150 kg/m². The limited weight of the construction allows its installation on almost any roof with a slope of up to 35°. On slopes of more than 10°, the use of specialized drainage systems that protect the growing medium plants from erosion is required, while on slopes greater than 15° and up to 35° the use of *substrate* retention elements is necessary. Ideal for this type of green roof is the low vegetation plants, such as plant carpets, lawns, wildflowers, and surface-rooted groundcovers systems that regenerate easily.

Semi-intensive green roof

According to **Portuguese** experts, a semi-intensive green roof may include both intensive and extensive characteristics. These require a depth of the substrate layer usually between 15 – 25cm, and a greater diversity of plants can be used when compared to extensive green roof crops, namely shrubs and woody plants.

Semi-intensive green toppings are often composed of herbaceous ground-covering and shrub plants. The freedom of design in the design phase and the recreational opportunities created by this typology are, however, limited when compared to intensive coverage.

The plants used have few requirements regarding the thickness of the substrate layer, the load capacity of the building, and the irrigation and fertilization; however, it always requires basic maintenance throughout the year typically more often than extensive green toppings.

Greek bibliography contributes with some more information: the semi-intensive type has a special light substrate with a saturated load ranging from 150 to 280 kg/m². It is the go-between intensive and extensive type, applied to flat roofs, and requires basic maintenance (irrigation, lubrication, etc.). For its application to sloping roofs, it is necessary to use geocells or elements for holding the substrate and for supporting the load.

Intensive green roof

According to **Portuguese** experts, an intensive green roof is designed primarily for recreational uses and/or installation of medium and large vegetation. It usually has an average substrate thickness of more than 25 cm and requires regular maintenance, such as a garden in natural soil.

An intensive green roof allows the placement of perennial, herbaceous, shrubby plants, and even trees. These can be placed at different heights and profiles. The variety of vegetation available allows a diversity comparable with the plantations in natural soil and can have great requirements at the level of the thickness of the substrate layer, the layers of protection and drainage, and the load capacity of the structure.

This type of cover implies regular maintenance, through regular cleaning, watering, fertilization, and pruning, as is customary in a conventional park or garden.

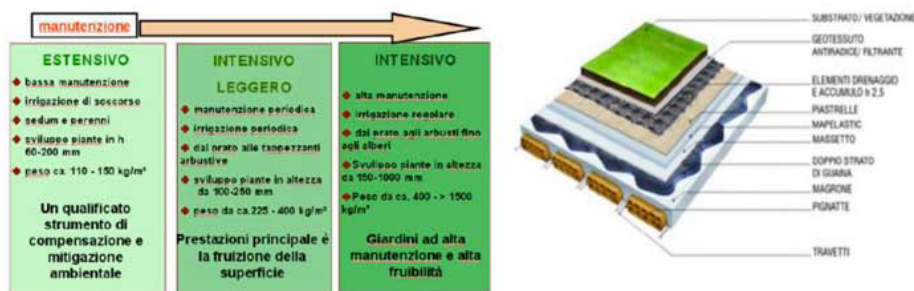
Greek bibliography specifies that these roofs have a substrate of 15-150 cm and a saturated load of at least 250 kg/m². This type of green roof/planted roof requires frequent maintenance (irrigation, fertilization, etc.). The intensive type of planted roof/ roof can support beyond the vegetal hardware, structures such as paths, water features, shading systems.

In Spain, the most frequent are the extensive green roofs since they are designed with the criterion of obtaining a naturalized space with low maintenance resources. However, there are also many roofs over garages, in which an increasing percentage of the space is devoted to the garden to the detriment of the paved area.

The installation of pitched roofs has grown significantly compared to 2020: 21% of residential buildings had pitched roofs (compared to 17% in 2020), while for single-family houses the figure increases to 31% in 2021 (29% in 2020).

In Greece, three types of planted roofs can be distinguished in Greece, depending on their use, the types of selected plants that grow in them, the height implementation of the infrastructure system, and the influencing factors of their maintenance.

In Italy, there are extensive and intensive green roofs. However, extensive green roofs are more present than intensive ones. It is due to the lower installation and maintenance costs compared to an intensive green roof.



Conclusion

- In the four countries, there are the same three types of green roofs: intensive, semi-intensive, and extensive.
- In both Spain and Italy, extensive roofs are the most frequent, as they have lower installation and maintenance costs compared to intensive roofs. In Portugal, there is no survey of green roofs at a national level and therefore it is not possible to know which are the most frequent.
- In Portugal, the most frequent are semi-intensive and intensive. Extensive is still recent.

Q15. Identification of good practices.

Nº	NAME	LOCATION	TYPE OF GREEN ROOF	M ²	PLANTS	BENEFITS
Subtropical highland climate or temperate oceanic climate with dry winters						
1	AKELARRE HOTEL	SPAIN 43.307776, -2.043173	Extensive	900	Aromatic plants, perennials, and grasses.	Common benefits
2	RAMÓN BILBAO WINERY	SPAIN 42°34'11.7"N 2°51'39.3"W	Extensive	2000	Regional vegetation	Common benefits
Hot-summer Mediterranean climate						
3	JARDIM DA FUNDAÇÃO CALOUSTE GULBENKIAN	PORTUGAL 38.7368° N, 9.1539° W	Intensive	7500	Grass, trees.	Leisure and living spaces
4	ETAR ALCÂNTARA	PORTUGAL 38°43'17"N 9°10'28"W	Intensive	27.000	Species that required a minimum of treatment.	Common benefits
5	WELLINGTON HOTEL	SPAIN 40°25'20"N 3°41'03"O	Intensive	300	Aromatic plants and vegetables (tomato plants, asparagus, etc.)	Food production Compost
6	EL MADROÑAL	SPAIN	Extensive	950	Sedum	Common benefits
7	GREEK MINISTRY OF ECONOMICS AND FINANCE	GREECE	Extensive	650	Wild perennial flowers such as hypericum and phlomis and annuals such as poppies, grasses, and chamomile	Common benefits
8	STAVROS NIARCHOS FOUNDATION	GREECE WMQR+QG Kallithea, Greece	Extensive	25.000	Regional flora (boxwood, oregano, lavender, and rosemary), shrubs, herbs and grasses. Above the car park there are olive trees.	Leisure and living spaces
9	ENEA – CASACCIA RESEARCH CENTER	ITALY Lat: 42°02'36", Lon: 12°18'28"	Extensive	230	Herbaceous perennials, wild accessions of Crassulaceae and native species of Echium for entomophilous fauna biodiversity	Common benefits
10	UFFICI VIVAIO ACCIARRI	ITALY 2RRP+W2 Massignano, Province of Ascoli Piceno, Italy	Intensive	208	Camphor trees and lawn. evergreen shrubs, small bushes, herbaceous plants, blooms and scents.	Leisure and living spaces

Warm-summer Mediterranean climate						
11	SALESSIANS SCHOOL	SPAIN 94VH+X5 Barcelona	Extensive	191	Aromatic plants	Photovoltaic Wind turbine Conservation or recovery of habitats for animals, insects, and plants VET training
12	SHOPPING CENTRE PREMIÀ DE MAR	SPAIN F9Q8+MF Premià de Mar	Extensive	8.000	Plants without irrigation system	Common benefits
13	PRAÇA DE LISBOA	PORTUGAL 41.1463° N, 8.6149° W	Intensive	45.000	Olive trees and lush lawns	Leisure and living spaces
14	FÓRUM MAIA	PORTUGAL 69MG+GR Maia, Portugal	Extensive	480	Autochthonous species (<i>verbena bonariensis</i> , <i>thymus serpyllum</i> and <i>Corynephorus canescens</i>)	Environmental education Living Lab Weather conditions monitoring
15	CASA DAS ALGAS	PORTUGAL 41.255837, -8.722636 Lavra, Portugal	Extensive	40	Species well adapted to locations near the sea (<i>ammophilla arenaria</i> , <i>crithum maritimum</i> , <i>lotus crecitus</i> , <i>Rosmarinus officinalis</i> , <i>sedum album</i> , <i>sedum sediformum</i> , <i>sedum telephium</i>)	Common benefits
16	PÓVOA DE VARZIM MUNICIPAL SERVICE CENTER	PORTUGAL 41.3790° N, 8.7593° W	Extensive	300	Sedum mix mat	Common benefits
17	NUOVA SEDE CRÉDIT AGRICOLE DI PARMA	ITALY R842+P5 Parma, Province of Parma, Italy	Semi-intensive	10.000	Grass	Common benefits

18	ORTOALTO OZANAM	ITALY 3MX9+2X Turin, Metropolitan City of Turin, Italy	Intensive	150	Orchard	Food production Education and training programmes
19	MONTECROCE BALESTRINO	ITALY 4567+I7 Balestrino, Province of Savona, Italy	Extensive	1.000m	Grass and aromatic plants	Common benefits
Humid continental mild summer. Wet all year.						
20	OSPEDALE DI BOLZANO	ITALY F8X5+9M Bolzano, Autonomous Province of Bolzano – South Tyrol, Italy	Extensive	23.000	Grass and aromatic plants	Common benefits
21	LEFAY RESORT & SPA DOLOMITI	ITALY 5Q88+RG Pinzolo, Autonomous Province of Trento, Italy	Intensive and Extensive	9.000	Grass, silver firs up to 12 metres high	Leisure and living spaces
22	PLAYGROUND ON A SUPERMARKET	ITALY 46.494, 11.311 Bolzano, Autonomous Province of Bolzano – South Tyrol, Italy	Semi intensive	2.000	Grass, trees, bushes	Leisure and living spaces

SUBTROPICAL HIGHLAND CLIMATE OR TEMPERATE OCEANIC CLIMATE WITH DRY WINTERS


Source: <https://zinco-cubiertas-ecologicas.es/referencias/hotel-akelarre-san-sebastian>

Nº 1 AKELARRE HOTEL	
Type of good practice	Installation
Type of roof	Inverted cover "Aromatic Plants". 900 m2.
Type of green solution	Extensive, with aromatic plants: perennials, grasses, and aromatic plants with different flowering colours throughout the year, which require only little maintenance.
Address (city, country)	Padre Orcolaga, 56. 20008 San Sebastián (Basque Country, Spain). 43.307776, -2.043173
Climate zone	Subtropical highland climate or temperate oceanic climate with dry winters
Year	2017
Description	On the roofs of the new hotel, which consist of five stone cubes housing the rooms, six terraces combined with landscaped areas and connected to the terrace of the existing building were installed.
Further information	https://zinco-cubiertas-ecologicas.es/sites/default/files/2021-05/ZinCo_ES_San%20Sebastian_Hotel%20Akelarre.pdf



Source: <https://zinco-cubiertas-ecologicas.es/referencias/bodegas-ramon-bilbao-la-rioja>

Nº2	RAMÓN BILBAO WINERY
Type of good practice	Installation
Type of roof	Vaulted roof. 2000 m2.
Type of green solution	Pitched roof up to 35°. Extensive, with typical vegetation of the region.
Address (city, country)	Av. Santo Domingo de la Calzada, 34, 26200 Haro, La Rioja (Spain).
42°34'11.7"N 2°51'39.3"W	Subtropical highland climate or temperate oceanic climate with dry winters
Climate zone	Subtropical highland climate or temperate oceanic climate with dry winters
Year	2017
Description	<p>Founded in 1924, the Ramón Bilbao winery underwent an extensive renovation in 2017 to expand its facilities, visited by 10,000 people every year. "Bringing the vineyard and the winery closer together" was the motto of the project. On arrival, the visitor is surrounded by vineyards: the roof of the entrance building is planted with vegetation typical of this region, and in front of the building there are numerous vines.</p> <p>For the vaulted roof, construction systems for pitched roofs were chosen, which stabilise the substrate and prevent it from sliding. In addition, numerous retaining barriers were concreted and sealed so that the considerable thrust forces are transferred to the roof structure.</p>
Further information	www.zinco-cubiertas-ecologicas.es/sites/default/files/2021-05/ZinCo_ES_La%20Rioja_Bodegas%20Ramon%20Bilbao.pdf

HOT-SUMMER MEDITERRANEAN CLIMATE



Source: <https://gulbenkian.pt/>

Nº3	JARDIM DA FUNDAÇÃO CALOUSTE GULBENKIAN
Type of good practice	Installation/Maintenance/Deconstruction
Type of roof	Garden built over the underground car park. It was the first green roof in Portugal.
Type of green solution	Intensive green roof.
Address (city, country)	Av. de Berna 45, 1050-078 Lisbon, (Portugal). 38.7368° N, 9.1539° W
Climate zone	Hot-summer Mediterranean climate
Year	1963
Description	It was necessary to place a very thick and resistant slab to support the weight. The tree roots are attached to a metal grid that allows them to remain stable and grow in a place where there is little soil, and they cannot grow in depth
Further information	https://gulbenkian.pt/



Source: <https://zinco-cubiertas-ecologicas.es/referencias/bodegas-ramon-bilbao-la-rioja>

Nº4	ETAR ALCÂNTARA
Type of good practice	Installation/Maintenance/Deconstruction
Type of roof	Flat roof
Type of green solution	Intensive green roof. The species that make up the beds and terraces were selected according to maintenance needs – species that could be used with this type of cover and that required a minimum of treatment.
The plants are watered by the water treated by the WWTP.	Av. Santo Domingo de la Calzada, 34, 26200 Haro, La Rioja (Spain).
The green roof also provides thermal and acoustic insulation for the facilities.	Subtropical highland climate or temperate oceanic climate with dry winters
Address (city, country)	Av. Ceuta, Alcântara, Lisbon (Portugal).
38°43'17"N 9°10'28"W	2017
Climate zone	Hot-summer Mediterranean climate
Year	2012. Valmor Award 2013.
Description	One of the most innovative aspects of this wastewater treatment plant (WWTP) is its green roof, covering 27,000 m ² , which reduces the landscape impact of this large infrastructure, located next to a forest park.
Further information	www.greenroofs.pt/pt/projetos



Source: <https://www.afuegolento.com/articulo/el-huerto-urbano-mas-grande-mundo-el-hotel-wellington-madrid/21143/>

Nº5	WELLINGTON HOTEL
Type of good practice	Installation/Maintenance
Type of roof	Flat accessible roof. 300 m2
Type of green solution	Orchard in the roof of a hotel
Address (city, country)	C. de Velázquez, 8, 28001, Madrid (Spain). 40°25'20"N 3°41'03"O
Climate zone	Cold semi-arid climate
Year	2014
Description	It is an orchard that provides food for the hotel restaurant. It counts with 2.600 plants (aromatic plants, tomato plants, asparagus, aubergines, peppers, lettuce, cucumbers, onions, beans, potatoes, radishes, carrots, and other vegetables, surrounded by tobacco plants.), 70 tons of earth from Navarra's region, organic seaweed compost, natural pesticide.
Further information	https://www.youtube.com/watch?v=HZn7sGBrySs



Source: www.urbanature.es/proyectos-de-jardineria/cubierta-verde-madronal/

Nº6	EL MADROÑAL
Type of good practice	Installation
Type of roof	Inverted roof with 2% slope. 950m ² .
Type of green solution	Extensive green roof with integrated irrigation in an individual house
Address (city, country)	El Madroñal, Málaga (Andalucía)
Climate zone	Hot-summer Mediterranean climate
Year	2022
Description	<p>It is a complex of 5 detached and independent villas located in a privileged environment. The villas are distributed on the plot in the form of a cascade, with the villa located in the highest part of the plot overlooking the roofs of the others. To reduce the visual impact of these roofs and to integrate the houses with the landscape, it was decided to install green roofs on the roofs of the villas.</p> <p>The aim was to create green surfaces with a high visual impact, but with low water and maintenance requirements. The chosen vegetation is Sedum, which is low growing and meets all the required criteria.</p>
Further information	www.urbanature.es/proyectos-de-jardineria/cubierta-verde-madronal/



Source: <https://una.city/nbs/athens/green-roof-ministry-economics-and-finance>

N°7 GREEK MINISTRY OF ECONOMICS AND FINANCE	
Type of good practice	Installation and maintenance
Type of roof	Roof with a 1% slope. 650m ²
Type of green solution	Extensive. Primarily, the plant selection was composed of indigenous Hellenic aromatic herbs such as several species of thyme, several species of sage, several species of lavender, several species of mint, marjoram, several species of oregano, and savoury. There are also several wild perennial flowers such as Hypericum and Phlomis and annuals such as poppies, grasses, and chamomile, all within a proprietary substrate from Oikosteges
Address (city, country)	Athens (Greece)
Climate zone	Hot summer Mediterranean Climate
Year	2008
Description	Energy savings of 50% were observed for air conditioning on the floor directly below the installation. In addition to the energy-saving benefits, the study also found increased biodiversity in the area. A plethora of birds and beneficial insects were observed on the roof, ranging from robin redbreasts, yellowhammers, yellow tits, coal tits, and sparrows to kestrels hovering high above eyeing up the smaller birds. Other species such as honey bees, tiger swallowtail, monarch butterflies, dragonflies and ladybugs were also seen (Ref 1). The study suggested in improved micro-climate and biodiversity of the constitution square
Further information	https://una.city/nbs/athens/green-roof-ministry-economics-and-finance



Source: <https://zinco-greenroof.com/references/snfcc-athens>

Nº8 STAVROS NIARCHOS FOUNDATION	
Type of good practice	Installation
Type of roof and green roof area	A complex of buildings. A total of 25,000 m ² -
Type of green solution	Intensive roofs: As the weather condition is harsh during the summer, selected plant species that are native to Greece have been planted on the base of the roof. Species of regional flora were used, such as boxwood, oregano, lavender, and rosemary, as well as various other shrubs, herbs and grasses. Above the car park there are numerous olive trees, which find perfect conditions for development in an up to 1.2 m deep substrate layer
Solar roofs (10.000 m ²).	El Madroñal, Málaga (Andalucía)
Address (city, country)	Athens (Greece). WMQR+QG Kallithea, Greece
Climate zone	Hot Summer Mediterranean Climate
Year	2014- 2016
Description	The new cultural centre SNFCC accommodating among others an opera, a library, and a car park.
Further information	https://zinco-greenroof.com/references/snfcc-athens



Source: <https://www.enea.it/it/Stampa/news/tetti-verdi-in-citta-anche-dinverno-per-contrastare-eventi-meteo-estremi>

N°9	ENEA – CASACCIA RESEARCH CENTER
Type of good practice	Installation/Maintenance/Deconstruction
Type of roof	Flat roof. 230m ²
Type of green solution	Extensive. Three types of plant species: herbaceous perennials, wild accessions of Crassulaceae and native species of Echium for entomophilous fauna biodiversity
Address (city, country)	ENEA - Casaccia Research Centre Via Anguillarese, 301 00123 S. Maria di Galeria (Rome) latitude: 42°02'36", longitude: 12°18'28"
Climate zone	Hot Summer Mediterranean Climate
Year	2018
Description	At the ENEA Casaccia Center, a research and development activity has been launched under the RDS (Electric System Research) program of the MiSE (Ministry of Economic Development). The demonstration platform (Figure 2) was built on the roof of a building called the "School of Energy," where the Energy Efficiency Unit Department holds training and/or updating courses for energy operators, public administration, high school students, and university students and/or researchers.
	Book Innovative Biosystems Engineering for Sustainable Agriculture, Forestry and food production. Springer. International mid-term Conference 2019 of the Italian Association of Agricultural Engineering



Source: <https://www.giardinigiordani.it/en/terrazzo-giardino-da-vivai-acciarri-en.html>

N°10	SUFFICI VIVAIO ACCIARRI
Type of good practice	Installation/Maintenance/Deconstruction
Type of roof	Terrace-garden. 208m2
Type of green solution	Intensive green roof, with camphor trees and lawn. evergreen shrubs, small bushes , herbaceous plants, blooms and scents.
Address (city, country)	Massignano, Italy
Climate zone	Hot Summer Mediterranean Climate
Year	2021
Description	The owner has an important tree nursery, this garden is intended to welcome the guests.From the office, a lift brings guests and customers to the green roof.
Further information	https://www.giardinigiordani.it/en/terrazzo-giardino-da-vivai-acciarri-en.html
Further information	https://zinco-greenroof.com/references/snfcc-athens

WARM-SUMMER MEDITERRANEAN CLIMATE



<https://www.eixverd.cat/es/treball/cubierta-verde-salesians-sarria/>

Nº11 SALESSIANS SCHOOL	
Type of good practice	Installation
Type of roof	Pergola separating two patios. 191 m2
Type of green solution	Aromatic plants with drip irrigation with moisture sensors Photovoltaic panels and a wind turbine installed by VET students “Hotel” for insects
Address (city, country)	Salesians School. Barcelona (Catalonia). 94VH+X5 Barcelona
Climate zone	Warm-summer Mediterranean climate
Year	2018
Description	Winner of Green Roofs' project, promoted by Barcelona City Council as part of the Barcelona 2020 Green and Biodiversity Plan. It has an area of photovoltaic panels, a drip irrigation system, an insect hotel to help the pollination of plant species, an area of aromatic plants and a vertical wall .The students of the centre who are studying for the intermediate level training cycle in Renewable Energies will have the opportunity to carry out different internships such as the maintenance of the installations.
Further information	https://www.eixverd.cat/es/treball/cubierta-verde-salesians-sarria/



Nº12 SHOPPING CENTRE PREMIÀ DE MAR	
Type of good practice	Installation
Type of roof	8.000 m2
Type of green solution	Extensive vegetation cover
Address (city, country)	Shopping centre. Premià del Mar (Barcelona, Catalonia). F9Q8+MF Premià de Mar
Climate zone	Warm-summer Mediterranean climate
Year	2017
Description	<p>Winner of Green Roofs' project, promoted by Barcelona City Council as part of the Barcelona 2020 Green and Biodiversity Plan</p> <p>One of the peculiarities of this of this roof is that it does not have an automated irrigation system. It is a multi-layer construction system that has a high-water retention capacity and requires low maintenance. Its exceptional water retention capacity, almost 12 L/m2, has been key to meeting the water to cover the water needs of this roof.</p> <p>As this is a large area, it was decided to replace the traditional planting phase with new technique in landscaped roofs: hydroseeding.</p>
Further information	<p>https://cdn.website-start.de/proxy/apps/aesai6/uploads/gleichzwei/instances/36ACA648-F046-4A16-BB49-C431C731CoC3/wcinstances/epaper/2ecoa682-6062-40d1-abfa-9a8277a3aa3b/pdf/Revista-o-ADESCUVE_web.pdf</p>



Source: <https://www.greenroofs.pt/pt/projeto/praca-lisboa>

Nº13	PRAÇA DE LISBOA
Type of good practice	Installation/Maintenance/Deconstruction
Type of roof	Flat cover. 4500m ²
Type of green solution	Intensive roof: 50 olive trees and lush lawns
Address (city, country)	Oporto (Portugal). 41.1463° N, 8.6149° W
Climate zone	Warm-summer Mediterranean climate
Year	2012
Description	Porto's largest intensive green roof - an oasis atop a semi-open gallery of shops, restaurants and cafes, with an underground garage. It is an urban park getaway, perfect for city workers, tourists and university students.
Further information	https://www.greenroofs.pt/pt/projeto/praca-lisboa



Source: <https://www.giardinigiordani.it/en/terrazzo-giardino-da-vivai-acciarri-en.html>

Nº14 FÓRUM MAIA	
Type of good practice	Installation/Maintenance/Deconstruction
Type of roof	Flat cover. 480m2
Type of green solution	Extensive with autochthonous species: <i>Verbena bonariensis</i> , <i>Thymus serpyllum</i> and <i>Corynephorus canescens</i> , chosen considering the climate of the region as well as the importance of promoting biodiversity. It provides a pleasant visual composition, which has sensorial interest throughout the year: greener and exuberant in spring/summer and more brownish and golden in autumn/winter.
Address (city, country)	Maia (Portugal). 69MG+GR Maia, Portugal
Climate zone	Warm-summer Mediterranean climate
Year	2021
Description	Funded by European Commission (POCI-01-0247-FEDER-003393) This green roof intends to be an object of environmental education and occasional use for workers in the municipality and their visits. As well as to be used as a living laboratory and, for this, thermal and humidity sensors were installed along the various layers that compose it, as well as a weather station that are interconnected and will be monitored by ITeCons technicians.
Further information	www.neoturf.pt/pt/projetos/cobertura-verde-forum-maia



Source: <https://www.greenroofs.pt/pt/projeto/praca-lisboa>

Nº15	CASA DAS ALGAS
Type of good practice	Installation/Maintenance/Deconstruction
Type of roof	Flat roof
Type of green solution	Extensive roof
Address (city, country)	Lavra, Matosinhos – Portugal
Climate zone	Warm-summer Mediterranean climate
Year	2015
Description	Flat cover that recreates a dune ecosystem using species well adapted to locations near the sea such as <i>Ammophilla arenaria</i> , <i>Crithum maritimum</i> , <i>Sedum album</i> , etc.
Further information	http://www.neoturf.pt/pt www.landlab.pt/pt/noticias/2015/06/02/cobertura-verde-em-lavra-casa-das-algas



Source: <https://www.greenroofs.pt/pt/projetos>

Nº16	PÓVOA DE VARZIM MUNICIPAL SERVICE CENTER
Type of good practice	Installation/Maintenance/Deconstruction
Type of roof	Flat cover
Type of green solution	Coverage with succulents
Address (city, country)	Póvoa de Varzim– Portugal . 41.3790° N, 8.7593° W
Climate zone	Warm-summer Mediterranean climate
Year	2021
Description	<p>With this project it was possible to bring vegetation to a building that had an unused roof. The plant set acts as a buffer that allows the building not to absorb as many sun rays as a classic roof. Furthermore, the combination of photosynthesis, plant evapotranspiration and soil evaporation allow the green roof to act as a natural air conditioner. This prevents heat from being distributed inside the building and allows you to reduce the use of air conditioning.</p>
Further information	https://www.greenroofs.pt/pt/projetos



Source: <https://www.architetturaecosostenibile.it/architettura/progetti/green-life-credit-agricole-parma-197>

N°17	CASA DAS ALGAS
Type of good practice	Installation
Type of roof	Flat cover.
Type of green solution	Semi-intensive. 10.000m ²
Address (city, country)	Via la Spezia, 138/A, 43126 Parma, Italy Parma, Italy. R842+P5 Parma, Province of Parma, Italy
Climate zone	Warm-summer Mediterranean climate
Year	2018
Description	Thanks also to this green roof, the new headquarter of Crédit Agricole Bank obtained Leed Platinum certification, the top level of the energy-environment protocol. The roof is covered with grass. The system permits to save 50 per cent of drinking water and 40 per cent of electricity.
Further information	https://www.architetturaecosostenibile.it/architettura/progetti/green-life-credit-agricole-parma-197



Source: <https://ortialti.com/portfolio/ortoalto-ozanam/>

N°18	ORTOALTO OZANAM
Type of good practice	Installation and maintenance
Type of roof	Flat roof.
Type of green solution	Intensive. Orchard. 150m2
Address (city, country)	Torino, Italy. 3MX9+2X Turin, Metropolitan City of Turin, Italy
Climate zone	Warm-summer Mediterranean climate
Year	2016
Description	OrtiAlti experiments here its model of intervention, a collaborative approach to urban regeneration, which starts from specific actions to trigger social impacts at different scales: environmental, social and economic. The active presence of different people who live and work in this building such as the young cooks, the restaurant staff and the inhabitants of the hostel, make it an ideal place for a collective project, in which the cultivation and production of local foods, they become an opportunity to activate social practices and engage other external subjects in educational and cultural programs. Furthermore, the roof garden reduces the energy consumption of the restaurant, improves the environmental quality of the surroundings and produces fresh "0 Km" vegetables that are used in the restaurant.
Further information	https://ortialti.com/portfolio/ortoalto-ozanam/



Source: <https://www.ingenio-web.it/30216-il-verde-leca-per-la-copertura-del-santuario-di-monte-croce>

N°19	CASA DAS ALGAS
Type of good practice	Installation
Type of roof	Special green roof with 65 different inclinations (max 45°)
Type of green solution	Extensive. 1000m ² . Grass and aromatic plants.
Address (city, country)	Savona, Italy. 4567+J7 Balestrino, Province of Savona, Italy
Climate zone	Warm-summer Mediterranean climate
Year	2020
Description	Architect: Renzo Piano. The architectural project aimed to contain as much as possible the elevation of new volumes, adapting to the morphology of the mountain and respecting the environmental characteristics of the area. For this reason, natural materials were preferred for the construction: a laminated wood structure and a green roof, completely covered by a garden, in continuity with the surroundings.
Further information	https://www.ingenio-web.it/30216-il-verde-leca-per-la-copertura-del-santuario-di-monte-croce

HUMID CONTINENTAL MILD SUMMER. WET ALL YEAR.



Source: <https://climagruen.com/it/progetti/ospedale-di-bolzano/>

N°20	OSPEDALE DI BOLZANO
Type of good practice	Installation
Type of roof	Flat roof. 23.000m2
Type of green solution	Extensive
Address (city, country)	Bolzano, Italy. F8X5+9M Bolzano, Autonomous Province of Bolzano – South Tyrol, Italy
Climate zone	Humid continental mild summer. Wet all year
Year	2020
Description	One of the largest green roof in Italy
Further information	https://climagruen.com/it/progetti/ospedale-di-bolzano/



Source: <https://climagruen.com/it/progetti/lefay-resort-a-pinzolo-tn/>

N°21	LEFAY RESORT & SPA DOLOMITI
Type of good practice	Installation
Type of roof	Flat roof
Type of green solution	Extensive and intensive. 9000m ² (6000 m ² intensive and 3000 m ² extensive). Grass, silver firs up to 12 metres high
Address (city, country)	Via Alpe di Grual, 16, 38086 Pinzolo TN, Italy 5Q88+RG Pinzolo, Autonomous Province of Trento, Italy
Climate zone	Humid continental mild summer. Wet all year
Year	2019
Description	Transforming the Lefay Resort & Spa Dolomiti in Pinzolo into a state-of-the-art climate hotel: with a total area of 9,000 m ² of extensive and intensive green roofs, Climagrün together with its partner Giardineria accomplished the mission. Thanks to the professional installation of green roof and green roof solutions, the Lefay Resort & Spa Dolomiti in Trentino is an exemplary project in terms of environmental sustainability and energy efficiency.
Further information	https://climagruen.com/it/progetti/lefay-resort-a-pinzolo-tn/



Source: <https://climagruen.com/it/progetti/ospedale-di-bolzano/>

N°23 PLAYGROUND ON A SUPERMARKET	
Type of good practice	Installation
Type of roof	Flat roof
Type of green solution	Intensive. 2000 m2 of grass, path of different materials, bushes and trees
Address (city, country)	Viale Druso. Bolzano, Italy
Climate zone	Humid continental mild summer. Wet all year
Year	2018
Description	The roof of a supermarket has been changed into a playground with grass and trees, equipped with benches, playscapes, a sandbox, ping pong area, and even a pétanque playing area
Further information	https://climagruen.com/it/progetti/parco-giochi-bolzano

SECTION 4.- ABOUT THE TECHNICAL PROFESSIONS (WHITE AND BLUE COLLARS) INVOLVED IN GREEN ROOFS

Q16.- Please, name the technical professions that you consider that are involved in the two following phases of Green Roofs (installation or maintenance):

PORTUGAL	<p>A. Installation – landscape architects, architects, agronomy engineers, civil engineers, masons, gardeners, irrigation technicians</p> <p>B. Maintenance - gardeners, masons, irrigation technicians.</p>
SPAIN	<p>A. Installation - architects, engineers, plumbers.</p> <p>B. Maintenance - agronomist, biologist, gardener.</p>
GREECE	<p>A. Installation- Architects, Civil engineer, Construction laborer Building inspector, Equipment operator, Electrician, Field engineer, Quality engineer, Construction safety manager, Construction superintendent, Construction project manager, Research engineer.</p> <p>B. Maintenance - Civil engineer, Customer Operations Specialist Laborer, Architect, Building Enclosure Technician, Environmental Technician, Building inspector.</p>
ITALY	<p>A. Installation- Surveyors, Engineers, Architects, Bricklayers, Electricians, Plumbers, Safety manager, Agronomist, Gardeners</p> <p>B. Maintenance - Gardener in normal condition for ordinary maintenance.</p> <p>In extraordinary cases - Technician (architect, surveyor, engineer), Plumbers, Bricklayers.</p>
COMPARISON	<p>From the analysis of the answers, it was found that for A -Installation and B - Maintenance two large groups of professions are evidenced:</p> <p>1º group with higher education. In this group are mainly indicated architects, biologists, and landscape architects and engineers (civil engineers, agronomy engineers), among others.</p> <p>2º group with technical professional training: gardeners, plumbers, electricians, irrigation specialists, bricklayers, equipment operator, etc.</p>

SECTION 5.- NATIONAL/REGIONAL ORGANIZATIONS, CLUSTERS THAT PUBLISH TECHNICAL INFORMATION RELATED GREEN ROOFS

Q17. Please, name your national or regional organizations that publish technical information related green roofs

	ORGANISATION/ COMPANY	CITY	COUNTRY	WEB	DESCRIPTION
1	Landscaping Systems	Athens	Greece	Web Facebook	Company that publishes info about green roof construction and is occupied with construction of technologically advanced green roofs.
2	Egreen Zinco	Athens	Greece	Web	Company that publishes info about green roof construction and is occupied with construction of technologically advanced green roofs.
3	Prasini Stegi	Athens	Greece	Web	Company that publishes info about green roof construction and is occupied with construction of technologically advanced green roof systems.
4	Topiodomi	Athens	Greece	Web	Company that promotes the construction of green roofs in Greece and includes info on new technologies
5	Simple green	Athens	Greece	Web	Company that promotes the construction of green roofs in Greece and includes info on new technologies
6	Sociedad española para la Promoción de la Naturación Urbana y Rural (PRONATUR)	Madrid	Spain	Twitter Web	A forum for researchers, entrepreneurs, academics and experts in green cities and urban agriculture, it carries out research, academic and dissemination activities with public and private, national and international institutions. It belongs to European Federation of Green Roof & Wall Associations. Organise and participate in events
7	Asociación Española de Cubiertas Verdes y Ajardinamientos Verticales (ASESCUVE)	Barcelona	Spain	Web Facebook LinkedIN	Its objective is the promotion of green roofs and façades in buildings, seeking to improve the environment in urban environments and sustainability in construction. They deliver training courses

	ORGANISATION/ COMPANY	CITY	COUNTRY	WEB	DESCRIPTION
8	National Association of Green Roofs/ Associação Nacional de Coberturas Verdes (ANCV)	Maia	Portugal	Web	A non-profit civil society association whose objective is to promote green infrastructure in cities, especially those that can be installed in buildings (new or pre-existing) as are the green roofs, highlighting their enormous importance, and the countless contributions they can make to make it possible to create healthy, sustainable, biodiverse, and resilient urban territories. In its mission, social bodies, and different activities, it promotes collaboration between companies, municipalities, and national and foreign research groups.
9	Ente nazionale italiano di unificazione	Milan	Italy	Web	UNi is the Italian national standardisation body, which carries out activities in all industrial, commercial and tertiary sectors with the exception of the electrical and electrotechnical sector
10	Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA)	Rome	Italy	Web	ISPRA is a public research institution, with legal personality under public law, technical, scientific, organizational, financial, managerial, administrative, patrimonial and accounting autonomy. ISPRA is under the supervision of the Minister of Ecological Transition (Mite).
11	Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA)	Rome	Italy	Web	ENEA is the National Agency for New Technologies, Energy and Sustainable Economic Development, a public law entity aimed at research, technological innovation and the provision of advanced services to businesses, public administration and citizens in the fields of energy, the environment and sustainable economic development (Art. 4 Law Dec. 28, 2015, No. 221). The Research Center "Casaccia" is the largest complex of ENEA laboratories.

	ORGANISATION/ COMPANY	CITY	COUNTRY	WEB	DESCRIPTION
12	Associazione Italiana Verde Pensile (AIVEP)	Padova	Italy	Web	Since 1997, AIVEP - Italian Association of Hanging Green aggregates professionals working in the field of hanging green: designers, producers, gardeners, maintainers, public sector technicians, and scholars. AIVEP uses the in-house expertise of its members to guide, disseminate and promote the culture and research of hanging green.
13	Associazione Nazionale per l'Isolamento Termico e acustico (ANIT)	Milan	Italy	Web	National Association for Thermal and Acoustic Insulation), a non profit association founded in 1984. The general objectives of the Association are the dissemination, promotion and development of thermal and acoustic insulation in construction and industry as a means of safeguarding the environment and the well-being of people. ANIT promotes legislative and technical regulations by actively participating in the main committees and working groups of the sector at the Ministry of Economic Development, Ministry of the Environment, UNI, Italian Thermotechnical Committee. The Association also collaborates with others with agencies and institutions to promote energy conservation and acoustic comfort in buildings such as ENEA

ANNEX I. THE QUESTIONNAIRE AND ITS RELATIONSHIP WITH THE TRAINING MODULES

Nº	QUESTION	MODULE
1	Do you agree with the following European Green Roof definition? “It is a roof system designed to make the development of vegetation in its last layer viable. To achieve this, it is necessary to create a system that imitates the functioning of the natural environment of a plant, and to ensure that the vegetation uses it to grow and stay alive, without damaging the structural, constructive, and environmental conditions of the building.”	1
2	What are the political strategies aimed at promoting the green roofs in your country? Do they follow any European Strategy?	All
3	Which public organism are involved in the Green Roofs promotion and installation in your country?	All
4	In your country, is there any obligation to install green roofs in new buildings? Is it foreseen to implement them in rehabilitation works?	All
5	In case of Green Roofs promotion, do you find any difference between Installation and Maintenance of Green Roofs? In your opinion, does this promotion consider the Green Roof deconstruction?	All
6	According to greenroofs.org (American organisation), “In North America, the benefits of green roof technologies are poorly understood, and the market continues to mature, despite the efforts of industry leaders. In Europe however, these technologies have become very well established. This has been the direct result of government legislation and financial support. Such support recognizes the many tangible and intangible public benefits of green roofs. This support has led to the creation of a vibrant, multi-million-dollar market for green roof products and services in Germany, France, Austria, and Switzerland, among others.” Do you agree, regarding your country?	All
7	In your country, which organism(s) or organization (s) elaborate technical documents in implementation/maintenance/deconstruction of Green Roofs?	All
8	Are there technical criteria that regulate or recommend the quality of the Green Roofs regarding? Installation Maintenance Deconstruction	All
9	Are there technical criteria that regulate or recommend the quality of the Green Roofs regarding?	All
10	How do you foresee the right technics to demolish a roof in anticipation of the reconstruction of a green roof?	4

Nº	QUESTION	MODULE
11	How to replace a green roof not properly installed?	4
12	<p>Please, highlight and briefly explain the main benefits of Green roofs... for the building performance (E.g.: energy performance, water management). for the urban climate/climate change challenges (E.g.: greenhouse gas emissions reduction, etc.) biodiversity Others (socio-economical such as wellbeing, health, etc.) How to reconcile, in terms of benefits, green roofs with other renewable energy conversion technologies (PV, solar, wind)?</p>	1
13	How the deconstruction of a green roof contributes to the circular economy?	4
14	Which are the main types of green roofs in your country?	1,2
15	Identification of good practices	All modules
16	Please, name the technical professions that you consider that are involved in the two following phases of Green Roofs: installation and maintenance	2,3
17	National/Regional organizations, clusters that publish technical information related green roofs	1

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