# THEME

## VEGETATION AND AMBIENT CONTROL/MICRO-DIM

Project cofinanced by
European Regional Development Fund

Lead Partner
Provincia di savona

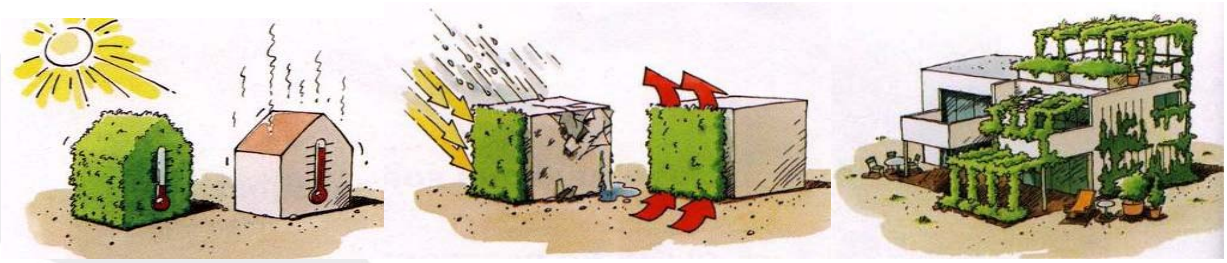
Sustainable Construction in Rural and Fragile Areas for Energy efficiency

# THEME

## VEGETATION AND AMBIENT CONTROL/MICRO-DIM

## DECLINATIONS

- ✓ new constructions
- ✓ requalifications of recent buildings
- ❑ renovation and refit works of historical buildings
- ❑ works "ex novo" in historical contexts



Although using vegetation to cool a space is not a new concept, many recent attempts to build energy-efficient buildings have totally ignored its significance. The primary reason for this omission is the lack of detailed quantitative data as to how effective vegetation is in reducing the energy used in heating and cooling a place. In addition, many of the recommendations for energy-conserving landscape design concepts have not been verified through actual experimentation.

There is a widespread belief in the past that plants are not friendly to built structures, ripping out the mortar and prying apart joints with their roots. The evidence suggests that only where decay has already set in then plants can indeed accelerate the process of deterioration. Certainly little evidence shows that plants will actually damage building walls. In some cases, the plants covering the wall are acting as a protective layer to the wall from the elements. Furthermore, a layer of vegetation which protects a building from solar radiation may greatly reduce the thermal tensions within the building structure.

Contrary to popular belief, walls covered with plants can also be drier. Rainfall is shed by leaves onto the ground whilst the walls remain dry. This can also help to prevent the harmful effects of acid rain since carbonic acid (formed by carbon dioxide and rainwater) is one of the substances responsible for chemical weathering of stonework buildings

Because vegetation block and filter solar radiation, inhibit wind-flow, transpire water into the atmosphere, reduce evaporation from soil, a controlled microclimate exists under a forest-like cover of plants. They stabilize temperature, keeping it lower than the surrounding air during daytime and preventing it from dropping greatly at night. The primary reason that vegetation has not been applied more widely in energy-efficient buildings is a notable lack of experimental verification of its effectiveness.

Building thermal performance can be significantly affected by the influence of vegetation on microclimate. Influence on solar irradiance is probably the most significant with substantial influences on air temperature, humidity, and airflow as well. When the weather is cool, it is important not to shade the building surfaces that can benefit from solar heating. In some cases, use of deciduous plants will allow summer shading and winter sun, in other cases careful integration of native vegetation and building can give excellent results.

## CASE STUDIES

**Showroom GEVO – Limassol:** The exhibition centre of GEVO is an environmentally friendly building, since it combines perfectly the rational use and the implementation of several new technological systems utilizing renewable energy sources

**Ayii Anargyri Natural Healing Spa Resort :** The idea/concept was to design a spa resort with the following criteria: to respect the environment and the existing old trees, to keep the original monastery architecture an the exterior of the buildings using stone, wood, roof, tiles etc. and modern design on the interior, to use the natural sulfur water through modern machinery and technologies and to use renewable energies to cover part of the final energy consumption.

## LEGAL AND REGULATORY ASPECTS

- EU directives reference:

DIRECTIVE 2002/91/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2002 on the energy performance of buildings
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:001:0065:0065:EN:PDF

- National laws and decrees reference:

• energy efficiency of buildings law N142(i) 2006
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## STRENGTHS/BENEFITS

❑ reduction of resources consumption: Trees and shrubs can help reduce overall energy use in buildings. The amount of energy saved depends on the building type, choice of tree species, positioning around the building and the prevailing climate.
For example, by planting deciduous trees on the correct side of an exposed building:
● wind penetration can be significantly reduced
● shading is provided in the summer
● solar gain is achieved in the winter.
Savings on energy costs by the careful planting of trees can, for a conventional house over a one year period, be as much 25%

❑ reduction of environmental impacts: plants can absorb pollutant gases such as formaldehyde, benzene, VOCS and trichloroethane, which are released by a whole range of materials and human activities. The saving in energy use achieved materializes as reduced carbon dioxide emissions at the power plants.

❑ improving the quality of the indoor environment: Interior plants have an impressive ability to multi-task. As well as looking beautiful, it can be shown also that they improve indoor air quality and help regulate the indoor environment. One other important benefit is their ability to reduce noise levels in buildings, reducing the need for expensive (and often ugly) manufactured acoustic panels.
Green walls, also known as vertical planting systems, vertical gardens, plant walls or vegetated walls have been successfully implemented around the world over the last years. With plant life visible from nearly every floor, the wall acts as an indoor air purifier, pulling air through the wall and into the mechanical air ducts. The biowall could supply all of the building's fresh air intake needs. Irrigated by a vertical hydroponic system, it naturally cools the building in the summer and humidifies in the winter. Today, architects and design teams are specifying brilliant walls of live greenery with functions ranging from fully scrubbing the air to simply humanizing windowless and 'nature deficient' indoor spaces.

❑ other :The natural ability of plants to orient their foliage towards a light source helps to ensure that direct sunlight is intercepted by the leaves. Diffused light of variable brightness will make its way to the inside of the building adding atmosphere and interesting shadows to complement the visual appeal of the plants themselves.
The shading benefits of plants can be exploited in all types of building and location. Small plants near windows can obviate the need for blinds and still provide the benefits of a view. In atriums and other highly glazed spaces, large plants and trees can be used to replace manufactured products such as external louvers and provide other indoor climate benefits such as cooling through evapotranspiration and improving air quality.

## WEAKNESSES/DISADVANTAGES

❑ difficulty of building integration:There are some difficulties however besides the difficulty of the choice of the plant or the tree to be the right one for the area and of the house or the building. A supporting system must be installed for climbing shrubs and an irrigation system if one opts for a green wall. Plants need care and they can attract infestation, bird nests and may be infected by plant diseases. So nice as they may be they do need care and attention. Deciduous plants will require the collection of the fallen leaves.

❑ cultural: No cultural obstacle is anticipated. Cypriots used plants to shade verandas and patios since ancient times. In some houses scent producing plants are also used to freshen the air. It may be more difficult to convince owners to have the plants inside the house rather than outside. For plant lovers it will be an easy transition. Others will admire the creation and the effect as long as someone else is taking care of the new lining creature introduced into the house.

❑ normative: There are no legal obstacles in planting trees and non contolled plants (prohibited are all drug producing plants and tobacco is also regulated). There may be difficulties with multi-ownership buildings

❑ other : Architects may need to be better aware of interior landscaping examples and possibilities so that they may influence desisions of their clients early on in the design phase. Interior designers need also to be made more aware of the various botanic possibilities.

❑ There may be a business opportunity for the development and marketing of small automatic hydroponic systems suitable for retrofitting into existing houses and appartments. Some research will be required of course.

*House with vertical plant*

❑ technical difficulties of installation / assembly: The technical difficulty anticipated is that this sort of “arboreta” need expert planning, installation and caring beyond the abilities of an ordinary person. They certainly are not install-and-forget systems.

❑ difficulties in the context of local production: The difficulty in vegetation around buildings is water. Cyprus has a major problem with water resources so watering plans and trees especially in summer is a major problem. Indoor plants have a better chance of being cared for. There are plenty of gardening centres who can undertake the installation and care but the decision rarely involves the architect.

❑ other: There needs to be better and broader awareness about the benefits of living plant systems for natural climate control.

## SUGGESTIONS TO OVERCOME THE WEAKNESSES

To increase awareness one must use cross communication techniques. Landscape architects must write articles in energy conservation and technical magazines in order to make engineers and technical designers go to gardening experts to seek further ideas and examples. Interior designers’ attention must also be turned to gardening magazines for ideas and energy saving benefits.

*American Heart Institute*

# THEME

## GREEN ROOFS

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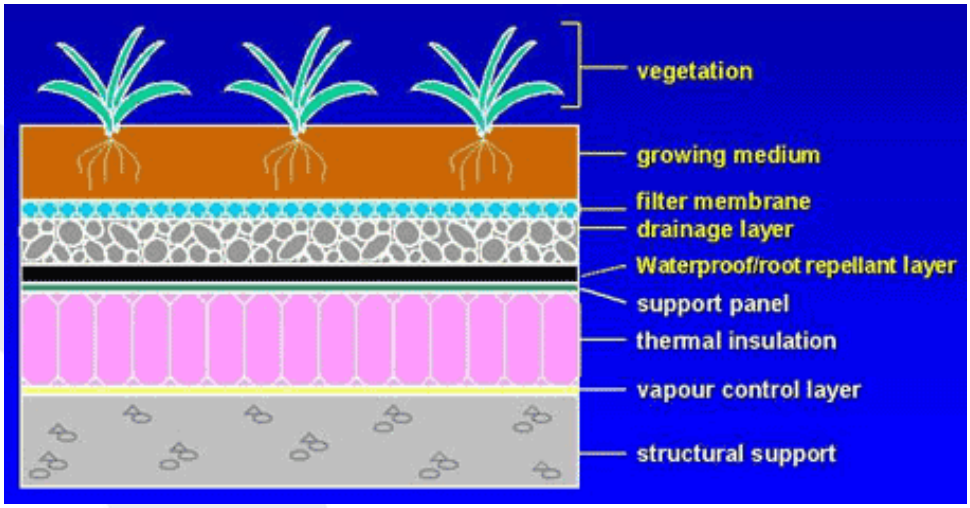


A green roof system is an extension of the existing roof which involves a high quality water proofing and root repellant system, a drainage system, filter cloth, a lightweight growing medium and plants.

Green roof systems may be modular, with drainage layers, filter cloth, growing media and plants already prepared in movable, interlocking grids, or, each component of the system may be installed separately. Green roof development involves the creation of "contained" green space on top of a human-made structure. This green space could be below, at or above grade, but in all cases the plants are not planted in the "ground".

Extensive or Intensive Green Roof systems can be divided into the categories of Complete Systems, Modular Systems, or Pre-cultivated Vegetation. The advantages gained from installing a green roof carry much more value than the traditional installation of a regular roof. The expenses involved in the installation of a green roof are initially much higher in comparison to a conventional roof, however, long-term, it is observed that financial cutbacks are attained as a result. Green roofs last longer than regular roofs and increase the real estate value of the building. Maintenance is dependent on several factors including time, fertilization, water, and weather conditions. The liability issues can be reduced for green roofs' installation and maintenance by various beneficial ways via communication, contracts, GRP professionals, and having engineers/architects give their responsibility for liability issues, if possible. Management solutions by green roofs are implemented in environmental impact reduction applicability to ensure successful long-term continuation for green roofs.

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## STRENGTHS/BENEFITS

❑ reduction of resources consumption:Green roof systems are recognized as providing greater thermal performance and roof insulation for the buildings they are laid on. This can vary depending on the time of the year, and the amount of water held within the system.

Cooling [summer]: Poorly protected and insulated roofs can lead to substantial overheating of spaces beneath them. This can lead to the need for increased air-conditioning. A green roof not only acts as an insulation barrier, but the combination of plant processes [photosynthesis and evapotranspiration] and soil processes [evapo-transmission] reduces the amount of solar energy absorbed by the roof membrane, thus leading to cooler temperatures beneath the surface.

Thermal Insulation [winter]: Green roofs can help to reduce heat loss from buildings during the winter when root activity of plants, air layers and the totality of the specific system create heat and thereby provide an insulation membrane. However the efficiency of green roofs as thermal barriers is dependent on the amount of water held within the system. Water retention can increase the amount of heat lost through the system and therefore any efficiency gains are dependent on daily conditions. It is therefore difficult to provide accurate figures on the net effect of green roofs on energy efficiency during the winter months.

❑ reduction of environmental impacts:
Air quality: Extensive planting within cities is now widely recognized as a means of improving air quality. Therefore, green roofs contribute to the reduction of a number of polluting air particles and compounds not only through the plants themselves, but also by deposition in the growing medium itself.

Plants reduce carbon dioxide in the atmosphere and produce oxygen Green roofs reduce the heat island effect, which contributes significantly to ozone production Plant roofs remove heavy metals, airborne particles and volatile organic compounds Being absorbed into the green roof system these polluting particles do not enter the water system through surface run off leading to improvement in water quality.
(http://greenroofs.org/index.php/about-green-roofs/green-roof-benefits)

❑ other (economic, managerial, related to additional services,
**Health:** There is a growing body of evidence that the visual and physical contact with natural greenery provides a range of benefits to people. These include both mental benefits (such as reduction of stress) and physical benefits (including the provision of cleaner air). Access to green space can bring about direct reductions in a person's heart rate and blood-pressure, and can aid general well-being
**Recycled Materials:** A number of materials used in green roofs are from recycled sources, such as the membranes and growing mediums, such as crushed porous brick, which is used by some suppliers.
**Noise and sound Insulation**: The combination of soil, plants and trapped layers of air within green roof systems can act as a sound insulation barrier. Sound waves are absorbed, reflected or deflected. The growing medium tends to block lower sound frequencies whilst the plants block higher frequencies. The amount of sound insulation is dependent on the system used and the substrate depth. A green roof with a 12 cm substrate layer can reduce sound by 40dB and one of 20 cm by 46-50dB.

## WEAKNESSES/DISADVANTAGES

❑ difficulty of building integration: Most roofs in Cyprus are flat concrete slabs. This makes it easy to construct green roofs. Green roofs cannot easily be integrated into inclined tiled roof unless designed into the building from the start.

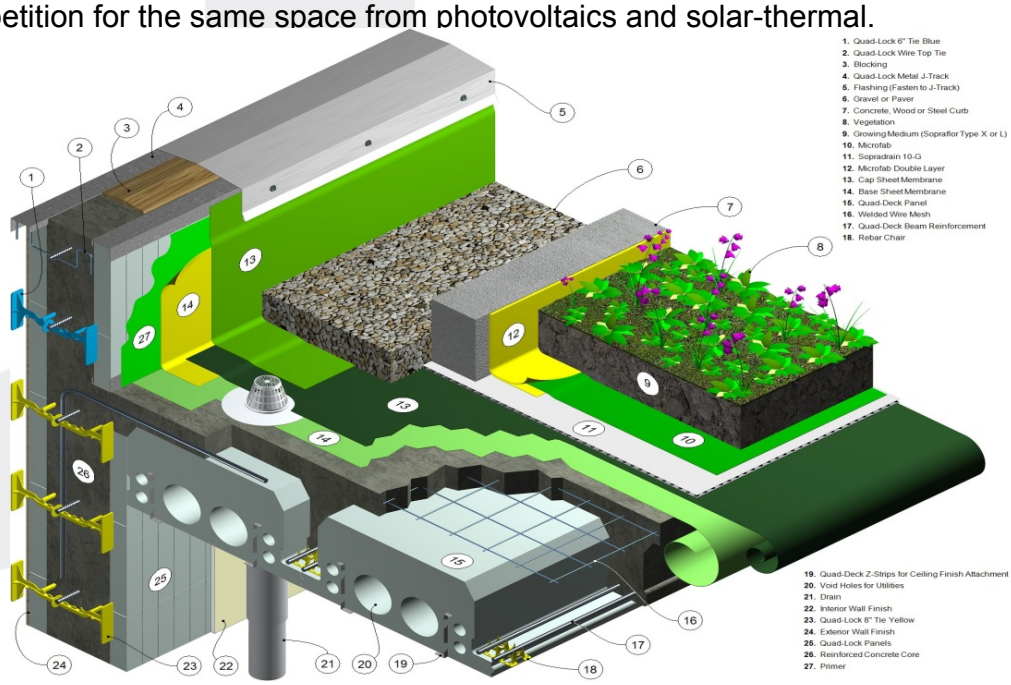
❑ cultural: As a rule the “roof-scape” in Cyprus is highly degraded. The view down from high rise buildings or hill tops is not pleasing at all simply because designers and owners ignore its importance. There are some houses with roof gardens but these can hardly be considered as green roofs. The latter will need considerable water in the summer months and if left unattended and uncared for will dry out and become a fire hazard or will harbour weeds. It is not easy not to regard them as extensions of the garden which translates into extra hassle for the owner. In high rise buildings the benefits stated are only for the occupants of the last floor.

Traditionally in the village regions, grape vines used to be grown on the ground but pruned in a way that would allow them to spread on the roofs, thus providing shade while also producing fruit (grapes)

❑ normative:It is not expected that there would be any difficulties in incorporating green roofs into an existing or new building. However there is no experience on the type of the plants to be grown or the amount of care such roofs will require.

❑ other (specify): The main disadvantage is that roofs are as a rule not cared for and abandoned and the owners will be required to devote a lot of effort to keep a green roof functional

Competition for the same space from photovoltaics and solar-thermal.



❑ technical difficulties of installation / assembly:There will have to be proper design and layout as a roof also accommodates water tanks, solar water heaters, air conditioning compressors and antennas. In older days roofs were also used for clothes drying while in villages people still use roofs to dry produce. Some older buildings might not be able to support the extra weight. Before considering to build an eco-roof, it would be better to check the building's specifications.

❑ difficulties in the context of local production: Any business created by the demand for green roofs will be absorbed by landscape and garden designers. These will need to look at a green roof as an energy saving feature rather than just a garden.

❑ other
Cost: Because of the great quantities of roofing materials, green roofs are more expensive than conventional solutions. However, if one considers the energy savings they provide and their longer life, everyone can tell that they are economically profitable as well. Also the maintenance of roof is costly after installation of a green roofing system.

## SUGGESTIONS TO OVERCOME THE WEAKNESSES

With government financing, costs can be reduced significantly and the economic incentive of green roof installation, be even larger. It needed, therefore, more coordinated planning on the part of the government to seize the opportunities offered, with the indispensable presence of officers who will be effective in monitoring and enforcement the existing legal framework. The target should be, to produce a more comprehensive and long-term result and not the exploitation of EU funds for individual investment, which will have a result in a building level only. It is also appropriate to amend the current legislation to include more subsidies for investments in passive saving energy activities on the basis that the reduction of energy consumption is more important than increasing production. A prerequisite is the adoption of a more visionary perception and long-term planning, in truly environmentally friendly policies.

Usually greening activities face a difficult situation because of disordered urbanization and the escalation in land prices. With increasing population and limited land, the government had to adopt a high-density and high-rise strategy. Space constraints have reduced the applicability of green surfaces in various areas surrounding the building envelope. Consequently, green roofs become the only promising choice for densely populated urban areas.

Many large rooftops of school buildings, industrial buildings, shopping malls, or gymnasiums, can be sites for green roofs . The vacant roof spaces of large public buildings such as industrial, commercial, or community buildings are potential sites for vegetable gardens. Although there are some difficulties such as moving the vegetations, finding the access to roof areas, or maintaining vegetations on the roof, the all-day exposure to sunlight is suitable for vegetable growing.

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## Lead Partner

- Province of Savona (ITALY)

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## Project Partner

- READ S.A.-South Aegean Region (GREECE)
- Local Energy Agency Pomurje (SLOVENIA)

LEA Pomurje
Lokalna energetska agencija za Pomurje
Local Energy Agency Pomurje

- Agência Regional de Energia do Centro e Baixo - Alentejo (PORTUGAL)

ARECBA

- Official Chamber of Commerce, Industry and Navigation of Seville (SPAIN)

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- Chamber of Commerce and Industry - Drôme (FRANCE)

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DEVELOPMENT COMPANY OF KEFALONIA & ITHAKI S.A.
DEV.C.KE.I. S.A.

- Rhône Chamber of Crafts (FRANCE)

CHAMBRE DE COMMERCE ET D'INDUSTRIE DE LA DRÔME

NÉOPOLIS

- Cyprus Chamber Of Commerce and Industry - Kibris (CYPRUS)

CYPRUS CHAMBER OF COMMERCE AND INDUSTRY

- Marseille Chamber of Commerce (FRANCE)

MARSEILLE PROVENCE
CHAMBRE COMMERCE et INDUSTRIE

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