

# **Green Wall- The Creative Solution in Response to the Urban Heat Island Effect**

**Yu-Peng YEH**  
National Chung-Hsing University

## **Introduction**

While the economic advance is improving people's financial needs, brings a lot of conveniences, yet they are also sources of serious environmental problems. Since the latter part of the 18<sup>th</sup> century and in the early part of the 19<sup>th</sup> century, when the Industrial Revolution took place in Europe, countries around the world have been attracted into going with the flow of industrialization, believing that this is the way to create outstanding growths in the economy and social development. In industrialized countries, cities kept drawing large numbers of people into the land due to job opportunities resulting to migration and thus brought about a phenomenon called the Urbanization. The industrialization and the Urbanization are believed to have made dramatic changes to our natural world. Even though whether or not all the environmental problems are caused by them is yet a subject to debate, researchers do find an environmental problem never seen in the pre-industrial times and is happening in urbanized places, the Urban Heat Island Effect. In recent years, scientists have been making efforts to find out solutions for this problem. Finally, they came up with the most constructive and creative way to deal with The Urban Heat Island Effect, which is to plant vegetations on walls and roofs. References show that people first publish the idea of combining plants with roofs to make nature roofs on the Paris Universal Exposition in 1868. In 1960, German researchers put this idea into practice and popularize it to other countries, such as the United States and Great Britain. After few decades, a French researcher named Patrick Blanc devised a new system. Blanc made plants climb up a wall and formed the first green wall. Green walls do not only solve the Heat Island Effect but also beautify the surroundings, and better people's dwelling place. Taiwan, in recent years, has adapted this concept too. Green walls are built in many places, like schools, music halls, shopping malls and MRT stations etc. Those green walls did meet our expectation in lessening the Heat Island Effect, and both of their appearances and functions are very much appreciated by the citizens.

## What is the Urban Heat Island Effect?

An urban heat island (UHI) is a metropolitan area which is significantly warmer than its surrounding rural area, especially at winter season. To avoid confusion with global warming, scientists call this phenomenon the "Urban Heat Island Effect." There are several reasons that may explain the Heat Island Effect, but the main reason is the excessive urban development. For instance, in order to construct rooms, large numbers of vegetation spaces have been replaced by concrete and asphalt, which will 'soak up' heat in the daytime and store it. The energy is then released during the night time. Moreover, heat released from vehicles, air conditioners and places like factories also add to the heat problem. Heated gases are being produced everyday, but there is not enough vegetation to absorb them. Another reason why temperatures in cities tend to be warmer than its surroundings is due to decreased amounts of evaporation. As the water evaporates the process of changing from a liquid to a gas uses latent heat, which cools the surroundings. However, in order to have more lands, ponds and lakes in cities are being filled, leaving cities less water and less evaporation than the countryside. With the concrete and asphalt working as giant storage heater, vehicles, factories and air conditioners producing heated gases, the serious lack of vegetation and water, the Urban Heat Island Effect is getting more and more serious in over-populated cities.

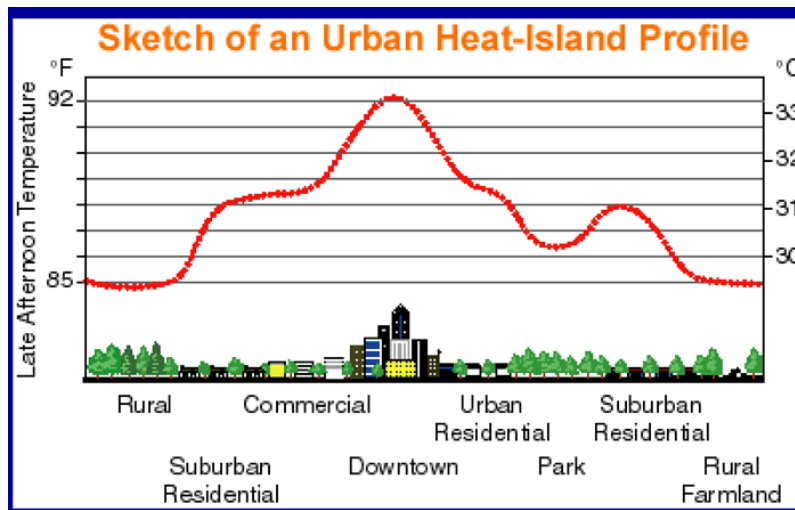


Figure 1: An urban heat island is a metropolitan area which is significantly warmer than its surrounding rural areas especially in late afternoons and nights.

Source: [http://www.ssbx.org/images/projects/heat\\_island\\_big.gif](http://www.ssbx.org/images/projects/heat_island_big.gif)

## **Problems brought about by the Urban Heat Island Effect**

The most obvious problem is the intolerably hot weather. Take Taipei city as an example, which owns the highest population and construction density in Taiwan. Although Taipei city is located at a relatively high latitude than most places in Taiwan, sometimes the temperature will be the highest because of the Urban Heat Island Effect. Due to the hot weather, people prefer to stay in air-conditioned buildings than going outside. However, while these buildings are cooled, the heat which has been removed from the buildings is extracted into the outside air by the air conditioning systems. In short, air conditioners will release hot gases when they are working. This will bring about a serious problem – the increase of the outdoor temperature. Furthermore, as urban heat islands lead to increased temperatures within cities, they contribute to poor air quality. As for air pollutions, pollutants in an urban heat island will go up to the sky along with the warm air and diffuses to the rim of the city, but later they will be forced to go back to the center of the city because of the surrounding cool air. And as for water pollution, hot pavement and rooftop surfaces transfer their excess heat to storm water, which then drains into storm sewers and raises water temperatures as it is released into streams, rivers, ponds, and lakes. Rapid temperature changes can be stressful to aquatic ecosystems. Air pollution and water pollution are seen every where nowadays, modern people usually do not detect the seriousness of them. The terrifying thing about air pollution and water pollution is that they circulate, and during the circulation, pollutants in air and water kept accumulating. Such circulation will severely harm residents' health and lower their life quality. Therefore, how to solve the Urban Heat Island Effect becomes an issue that concerns everyone.

## **Ways to fight the Heat Island Effect**

There are many ways to fight the Heat Island Effect. For example, restrict the waste heat released by vehicles, factories and air conditioners; sprinkle water in order to lower the temperature; use materials that can reflect sunlight to build constructions; disperse the crowd to the suburbs, reduce the waste that are produced by people, and so on. However, the most effective way is to increase the vegetation spaces. So green walls and green roofs are by far the most popular ways to cooling the city.

## Green Wall

Green walls are walls that are either partially or completely covered with vegetation, and they have exuberant green looks. Green walls are not only spectacularly beautiful, but also helpful in enlivening the ambiance. Green walls can absorb heated gas in the air, lower both indoor and outdoor temperature, providing a healthier indoor air quality as well as a more beautiful space. For urban areas, this is undoubtedly the best solution for the Heat Island Effect. Therefore, the practice of building green walls is now widely applied to many places.

We can distribute green walls into two primary types—the green façade and the living wall.

### 1. Green façade

Green façades are walls that are covered with climbing plants or cascading vegetation. At first, builders make climbing plants climb directly on walls. But recently, they usually build supportive frameworks and make plants climb on them for fear that the root systems of some plants will harm the structure of the building if being planted directly on walls. Plant materials can be rooted at the base of the buildings, in intermediate planters, or on rooftops. Soon after, the walls will be covered by these plants and become green walls. Green facades can be attached to walls or work as freestanding structures.

Plant Name	Advantages
<i>Parthenocissus heterophylla</i>	grow fast, good at climbing, suitable for greening areas
<i>Campsis grandiflora</i>	easy to propagate ,bloom, look beautiful
<i>rachelospermum jasminoides</i>	bloom, flowers smell fragrant, can be use as herbs
<i>Euonymus fortunei</i>	look beautiful, can be use as herbs
<i>Ipomoea nil</i>	bloom, look beautiful, can be use as herbs
<i>pomoea quamoclit</i>	bloom, look beautiful, can be use as herbs
<i>Wisteria sinensis</i>	bloom, look beautiful, can be use as herbs
<i>Hedera helix</i>	good at climbing, look beautiful
<i>Lonicera japonica</i>	bloom look beautiful, can be use as herbs
<i>Pyracantha fortuneana</i>	Easy to propagate, anti-pest, bloom, can be use as herbs

Figure 2: Plants suitable to make green façade.

### 2. Living Wall

Living walls, also called bio-walls or vertical gardens, are made with three parts: a metal frame, a PVC layer and an air layer (do not need soil). Due to its extremely light weight, we can build it almost everywhere and in any sizes. This system supports a variety of plant species, such as a mixture of vegetation, perennial flowers, low shrubs, and ferns etc. It performs well in various climate environments. However, the selection of better species may adapt to the prevailing climatic condition, so that the maintenance of the system be made easy. Living walls need more protection than green façades because of its diversity and density of vegetation. Therefore, researchers developed a special system, self-automated watering and nutrition system, to make maintenance of the living walls easy.

Last year, Taiwan Textile Research Institute (TTRI) developed a new type of green walls, which is plant vegetation on Non-woven cloths without other organism. This new technique will surely save a lot of time and money that were once used to device frameworks.

### **3. Examples**

The Park Land by CMP is the most famous example in Taiwan that had applied green wall to construction. This building was abandoned for market and parking area, which had fell into disuse for a long time. Fortunately in 2007 another company took it over and transformed it into a new one which has the most massive green wall in Asia (0.2 ha.) now. This huge piece of green wall is composed of over 150 thousand pots of various plants, such as Scandent Scheffera, Common Lantana, spider ivy, Calico plant, and so on. It helps to purify ambient air, lower both indoor and outdoor temperatures, and beautifying the surroundings. It became the new landmark of Taichung city that never fail in attracting tourists and visitors. According to the record, a green wall of this size could absorb 200kg of CO<sub>2</sub>, while producing 150kg of O<sub>2</sub> everyday.

There are many other examples in Taiwan such as, the green wall in the National Concert Hall, which was made by Patrick Blanc (the green wall researcher mentioned above), is the first green wall in Taiwan. Another one in the Taipei MRT (city Hall station) was also a successful example; it not only purified the air but also made the station a lively place. However, lately it was removed for some unknown reasons. Besides, many schools, companies, and even personal dwelling place also use this idea to better their living quality.

## Green roof

Green roof, also known as rooftop garden, it is a layer of soil and plants on the top of a building. Like green walls, green roofs can also increase the vegetation spaces, lower the indoor temperature. Moreover, roof gardens can work as farms, and can be planted with crops for food. They also provide venues for relaxation and entertainment, especially for the urban residents who lead fast-paced lives. Green roofs are common in many urban areas throughout the world, especially in the developed countries such as Germany, France, The U.S., Australia and Japan. Recently, Taiwan has, likewise, adopted this practice. For instance, the Xinyi District Office of Taipei used this idea to make a roof garden. This set a good example for the residents of Taipei city, and attracted many companies, schools or other organizations into imitating them. Therefore, as believed, Taipei city will soon become a “green city”, not only beautiful but also eco-friendly.

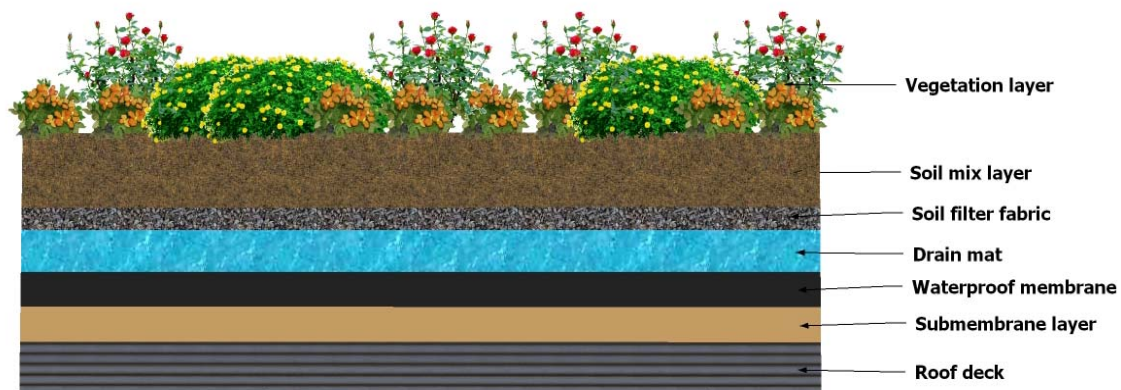


Figure 3: The profile of green roofs

Below is some important information about making a green roof. Firstly, make sure the work of waterproofing is complete, or the water will dripped down from leaks into the roof. Secondly, calculate the carrying capacity of the roof, or it will have the risk of collapsing if being too heavily planted. Thirdly, select the right vegetation to guarantee that all efforts and money spent on making the roof won't be in vain. Generally speaking, green wall builders won't choose plants with stretching root systems for fear that the structure of the building will be destroyed by the root. Lastly, Taiwan is a typhoon-prone area, so the green roof should be able to withstand high winds and heavy rains brought by typhoons.

Name	Advantages
<i>Callisia elegans</i>	grow fast, can withstand dryness,
<i>Phyla nodiflora</i>	can grow in water, could be use as herbs
<i>Plectranthus cv.</i>	ant-pests, can withstand heat and dryness
<i>Ajuga pygmaea</i>	easy to reproduce, look beautiful
<i>Ficus vaccinioides</i>	can withstand infertility, anti-pests, fruits are edible
<i>Aptenia cordifolia</i>	easy to tend, long florescence
<i>Indigofera spicata</i>	can withstand dryness and infertility
<i>Sedum mexicanum</i>	can withstand dryness, easy to cultivate
<i>Sedum sarmentosum</i>	can withstand dryness and heat, anti-pests
<i>Arachis pintoii</i>	grow fast, propagate in large amount

Figure 4: Plants suitable to make green roofs

Source: [http://hsiliu-greenroof.blogspot.com/2008/02/blog-post\\_2422.html](http://hsiliu-greenroof.blogspot.com/2008/02/blog-post_2422.html)

## Conclusion

The green house effect is becoming more and more severe, and the environmental problems it brings about are also getting more and more serious. As we all know, the rise of global temperature, especially in urban areas, is accelerating in recent years. If this problem is not taken seriously and no actions done to solve it, dwelling areas will no longer be suitable for lives. To mitigate the urban heat island effect, many countries have started to develop green buildings. Although green buildings do save energy, it costs too much material resources and manpower when building one. Therefore, building green walls and green roofs is the best way to Green houses and overpopulated cities that are not spatial enough to grow vegetation on the ground. The positive influence brought by green walls and green roofs are not only on the insulation of heat, but also on the landscaping of urban environment. According to a scientific research, the color green can bring harmony to people's mind. People living or working in cities especially need to slow down their fast-paced life through looking at green plants. Hence, the practice of building green walls and green roofs should be popularized in urban areas so as to improve the residents' health (both physical and mental ways), and life quality. Hopefully in the future, governments would give financial aids to people

who want to build green walls and green roofs. Maybe, common people are not powerful enough to actually save our planet from getting hotter, yet at least we could start from building green walls and green roofs that could help lower temperature in urban areas. By popularizing this practice, more and more people would like to start building such eco-friendly roofs and walls, and it will certainly make a difference to our world. Fighting the Urban Heat Island Effect requires everyone to join hands together and work hard. After all, Unity is strength.

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