



Growing Your Roof

By: Sarice Greenstein and Michael Weber

Background

Introduction

As children, we are taught that wearing dark clothes in the summer will make us hotter, while wearing light clothes will keep us cooler. This is because light colors reflect the sun's energy and dark clothes absorb it. While this basic science probably made sense even at a young age, most people probably do not realize that the same concept can be applied to entire buildings – and their roofs. A green roof will maintain the roof at a cooler temperature, and in a city, this decrease in temperature can help counteract the harmful Urban Heat Island Effect.

Urban Heat Island Effect

In America especially, most roofs are finished with a dark material such as tile. This absorbs up to 90 percent the sun's energy and makes buildings even hotter than the actual air temperature outside. According to the EPA, 90 percent of the roofs in the U.S. are dark colored, causing rooftop temperatures to reach up to 190 degrees Fahrenheit.¹ This results in 20-30 percent more air conditioning than is needed and thereby increasing the cooling costs of buildings.²

Furthermore, asphalt on the ground in developed areas pairs with dark-roofed buildings to create what is known as the "Urban Heat Island Effect." Cities and suburbs, which are covered in an average of 60 percent dark materials, become hotter than surrounding areas. Plants on top of buildings are not only more beautiful than drab concrete roofs – they also provide environmental, social and economic benefits. It is estimated that if every urban building in the world had a green or cool roof, it would be the environmental equivalent of taking every car in the world off the road for 18 years.³ Since formation of smog is directly related to rising air temperatures, a reversal of the Urban Heat Island Effect can also help reduce urban smog and particles in the air.

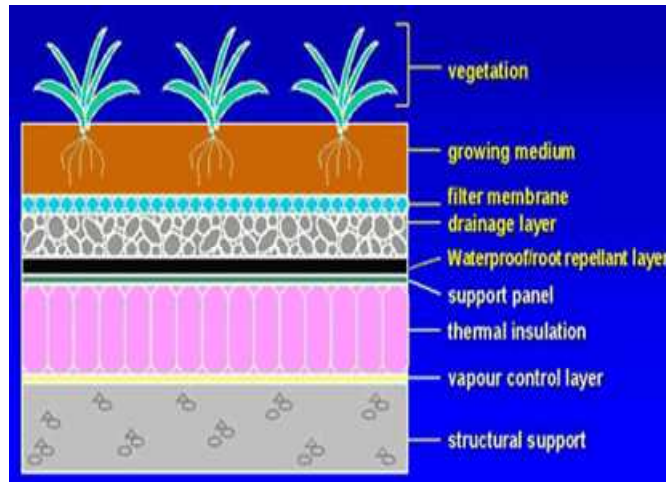
Environmental Benefits

Not only can the vegetation on the roof help stop climate change by providing more oxygen and absorbing carbon dioxide, green roofs can also serve as habitat "islands" to connect natural habitats isolated by urban areas. Congruently, green roofs can be built to mimic ecosystems for endangered or threatened bird and insect species. By helping to absorb rainwater, green roofs also help reduce runoff and drainage problems typical to many buildings.

With respect to the classroom, the open green space provides an ideal area for an outdoor classroom, materials for science labs, and an opportunity to demonstrate to students the possibilities of environmental innovation that are so important for our future.

What Makes a Roof Green?

A green roof is one that is covered with vegetation, providing insulation, habitat, rainwater drainage, and aesthetic appeal. To create a green roof, there needs to be sufficient structural support of the roof, because the vegetation adds additional weight. Usually, these layers include: insulation, waterproofing, a drainage layer, and finally the soil and vegetation on top. Sometimes these layers sit in trays, other times they do not.



Source: http://www.greenroofs.net/index.php?option=com_content&task=view&id=26&Itemid=40

Extensive versus Intensive

There are two main types of roofs than can be constructed – extensive and intensive. Extensive roofs have soil depth of two to four inches and vegetation is usually limited to drought-resistant and weather tolerant plants such as sedums, grasses, and some wildflowers. Sedums are especially popular in green roof construction because they are frost, drought and wind resistant and will therefore grow easily with minimal maintenance (a benefit of extensive roofs).



Source: <http://www.greenroofs.com/projects/pview.php?id=65>

Intensive have a soil depth of a foot or more, greater plant variety, and are more labor and cost intensive to produce and maintain. They are however, more aesthetically pleasing and will make your roof a better place for people to gather.

Cost

Including materials, preparation work and installation, an extensive green roof will cost about \$8 per square foot (this compares to the price of a conventional roof at \$1.25 per square foot).⁴ A more elaborate intensive roof will cost anywhere from \$15 to \$25 per square foot.⁵ The

intensive roof will require a significant amount of maintenance work, while an extensive one will only require minimal efforts once it is installed (annual maintenance checks).⁶

Still, if this process is incompatible with your building, or too costly for your budget, there are other alternatives to make your roof a “greener” place. One option is what is called a cool roof, or white roof. A simple way to keep the building from absorbing so much heat is to paint your roof a white color. The coating will last for 10 to 20 years and only costs about \$0.75 to \$1.50 per square foot. Metallic roofs are also much more reflective than those made of traditional materials and will cost about \$2.00 per square foot.⁷

Even if those options are too difficult, a roof does not need to be left as it is. Using empty space to put a few potted plants has an effect on reflectivity and also decreases the amount of carbon in the atmosphere.

A History of Green Growth

Although green roofs may seem like a new innovation, this is not actually the case. For centuries green roofs have been used in places like Iceland and Norway. These roofs were a bit different from our modern conception. They were simply grassed roofs placed mostly on residential buildings in order to help absorb rainwater and provide insulation.⁸ The U.S. is far behind the curve in the use of the modern green roofs. Since the 1960s Germany has been installing green roofs on their residential and business buildings. Today approximately 10 percent of roofs in Germany are covered in vegetation and the country continues to lead the way in new and expanding green roof technologies.⁹



Source: <http://weburbanist.com/2007/12/11/8-great-green-roofs-a-brief-pictorial-history-of-green-roofs-and->

Lastly, if your school is going for LEED, a green roof is worth a whole seven credits in the green building standards set forth by US Green Building Council’s Leadership in Energy and Environmental Design ([LEED](#)) certification system.

Earth Day Network Resources

- [Action Plan](#)
- [Lesson Plan](#)

Additional Resources

- [Chicago Green Roofs, A Guide for Building Green Roofs in Chicago](#)
- [Heat Island Effect.](#)
- [Green Roofs for Healthy Cities](#)

¹ U.S. Environmental Protection Agency. *What Can Be Done*. July 15th 2008

<http://www.epa.gov/hiri/strategies/index.html>

² Akbari, Hashem and Menon, Surabi. *Global Cooling: Increasing World-wide Urban Albedos to Offset CO2*. July 2008 <http://www.energy.ca.gov/2008publications/CEC-999-2008-020/CEC-999-2008-020.PDF>

³ "Cool World: A Modest Proposal to Cool the Planet by Cooling the Neighborhood «." Berkeley Lab News Center. 06 Apr. 2009 <<http://newscenter.lbl.gov/feature-stories/2008/12/11/cool-world/>>.

⁴ "Green Roofs" U.S. Environmental Protection Agency. July 22nd 2008

<http://www.epa.gov/hiri/strategies/greenroofs.html>

⁵ "Great Lakes WATER Institute Green Roof Project" Wisconsin Aquatic Technology and Environment Research. July 22nd 2008 <http://www.glwi.uwm.edu/research/genomics/ecoli/greenroof/roofinstall.php#costs>

⁶ "Green Roofs" U.S. Environmental Protection Agency. July 22nd 2008

<http://www.epa.gov/hiri/strategies/greenroofs.html>

⁷ "Cool Roof Product Information" U.S. Environmental Protection Agency. July 15th 2008.

http://www.epa.gov/hiri/strategies/level3_roofproducts.html

⁸ "8 Great Green Roofs" Web Urbanist. June 23 2008 <http://weburbanist.com/2007/12/11/8-great-green-roofs-a-brief-pictorial-history-of-green-roofs-and-roofing-systems-past-and-present/>

⁹ "Green Roof Research Program at MSU" June 23 2008 http://www.hrt.msu.edu/faculty/Rowe/Green_roof.htm