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## Green Roofs

### *Technology Snapshot & Benefits:*

Green roofs are roofs on which plants are grown. The roofs are extensions of existing roofs that are suited with waterproofing systems, fiber cloth, drainage systems, irrigation systems, and soil to keep the roof safe while providing an environment where plants can grow. These roofs are beneficial in a variety of ways. The evaporative cooling of the plants and heat reduction from the added thermal resistance of the plants can help reduce monthly cooling costs. This reduction is even more significant in urban areas where the roofs can also help combat "heat island effect," which is caused by absorption of heat by buildings and other concrete masses in urban areas and often contributes to high cooling costs. Because of this, the size of heating, ventilation, and air conditioning (HVAC) systems on the roof can also be reduced in new or remodeled homes, which can save money. For homes or businesses with solar heating systems mounted on the roof, this cooling helps increase the efficiency of the solar units. Green roofs also extend a roof's lifespan an average of 20 years (depending on the compatibility and of the roof membrane, existing roofs may not be in good shape. An analysis of the roof condition by a professional familiar with green roofs is essential before installing a vegetation system on a roof. Certain types of roof membranes can last 80 years or more with a green roof over them. Root barriers are required for some types of membranes, but not others. By reflecting UV rays and preventing the roof from experiencing extreme temperature changes. Because the plants and soil act as insulators, (The plants and soil is not an insulator when saturated, however, the mass of vegetation will help with convection, i.e., when the wind is blowing the vegetation will reduce convective heat loss) homes with green roofs may require less traditional insulation. Green roofs act as a fire retardant and reduce noise pollution by buffering the roof. The



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buffering also eliminates nearly all electromagnetic penetration, which can be important in buildings with telecommunications equipment mounted on the roof.

Evidence has shown green roofs contribute to personal and societal well-being. Studies also show that green roofs help reduce stress, stress-related illness, and patient healing times. Food and flowers that can be sold or consumed by the homeowners can be grown on the roof. The plants on the roof help absorb CO<sub>2</sub> out of the atmosphere and produce Oxygen. Other pollutants are also filtered out of the rainwater. Having largely biodegradable roofs helps reduce the amount of roof waste filling landfills. They can also provide a habitat for small wildlife in urban or suburban areas. The work necessary to maintain, design, produce, and install green roofs can create much-needed jobs. Additionally, green roofs may be fashioned for specific purposes, such as playgrounds, day cares, or recreational/leisure areas that would provide additional outdoor community space.

### *Estimated Cost Savings:*

Estimated cost for green roofs is \$8-25 per square foot, depending on the quantity and type of roof (extensive or intensive; (Intensive cost could be much higher up to \$45/SF) see "Issues" and "Installation"), soil and vegetation desired, and location of the home or business. Costs may be higher in urban areas because of traffic costs, or in areas where materials aren't readily available. Savings for the homeowner on monthly cooling costs vary depending on climate, building type, and typical building use; however, according to a 2002 Canadian Research Council study, green roofs can reduce peak energy demands up to 75%, but the average homeowner utilizing a green roof reported 20-25% reduction in heating and cooling costs. Some insurance companies, such as State Farm, are also offering a reduction in home insurance costs of up to 33% for installing green roofs. Companies installing green roofs could also potentially gain

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emissions trading credits or LEED points. It should be noted that the cost of replacing or fixing a green roof is usually higher than that of replacing or fixing an ordinary roof, but the savings due to the extended lifetime of green roofs will counterbalance these costs in most cases. (This depends on the green roof system chosen. Extensive modular systems make it easy to repair the roof membrane)

### *Issues:*

There are several legal issues associated with green roofs. The homeowner or business owner is usually liable if there is any roof damage due to leakage or roots; therefore, it is very important that green roofs are properly installed and maintained. There is a time commitment for the homeowner or a hired caretaker of the roof, although this commitment can vary greatly. There are two types of green roofs: extensive and intensive. Intensive roofs can support a wider variety of plant life, even small trees, and are labor-intensive, requiring a lot of maintenance (maintenance cost is more related to plant types chosen). Extensive roofs are much less demanding and are set up to be basically self-sustaining, needing only to be weeded once or twice a year. The time that is available for one to care for the green roof should be taken into account when deciding what type of roof to get and what time of plants to grow.

If the roof is being used for recreation, there are obvious potential personal injury issues, so safety must be carefully considered. Another tip for those looking to install green roofs is to set up a system that can collect rainwater or runoff and use that water to irrigate the roof. This keeps water bills lower and is another easy way to recycle resources.



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*Regional Issues:*

Reduction in heating and cooling costs from green roofs is dependent on original demand, which is in turn dependent on local climate. Areas with more extreme temperatures are likely to see the most benefit.

In very dry regions, green roofs require more irrigation. Local weather, such as high winds, should be taken into account when choosing which type of plants to install and how to install them. Pollution reduction is most apparent in heavily polluted regions. Plant selections can be tailored to regional and micro climate conditions to optimize plant survivability consult a horticulturalist.

*Installation:*

Green roofs must be installed by a professional. Installation involves installing or verifying adequate structural support, (In this order) a waterproof membrane, thermal insulation, a root barrier, a filter fabric, a drainage layer, a water retention blanket, a roof stabilizer, growing medium (usually custom soil mixture), and any desired vegetation, drip line irrigation system (optional). Installation of intensive green roofs is more expensive, typically \$25-45 per square foot, than extensive green roof installation, typically \$10-25 per square foot.

Green roofs can be installed in new or old homes. It is highly recommended or necessary (depending on the roofing company's policy) to consult a structural analyst and roofing consultant before installing a green roof to ensure that the roof is adequate to work with a specific green roof.

To obtain a local green roof installer, [contact us](#).