Types of Green Roofs
A green roof is divided into two types of systems. An extensive green roof system contains a very shallow growing medium between 3 to 5 inches of soil. This green roof weighs approximately 15 to 25 pounds per square foot, depending on the saturation level of the soil. Only drought tolerant plants are able to survive in this type of green roof system.

Abstract
Many people have viewed a green roof as an innovative solution towards restoring a healthy ecosystem. A green roof, also known as a vegetative roof, is a layer of live plants placed on top of a building that requires little maintenance after installation. This simple roof design produces advantages that have far-reaching, positive effects on both the environment and the human population.

Green roofs have the ability to reduce the heat island effect in metropolitan areas by reflecting the sun's energy. Air conditioning usage would be greatly reduced, allowing people to save money on energy costs while also limiting the use of non-renewable fuels. Ecosystems surrounding buildings would be less affected by rainwater runoff, since at least fifty percent of the water that falls onto a green roof is absorbed by plants and soil. A green roof is able to filter acid rain and increase the pH level of the rainwater from 4 to 7. Increasing the number of plants in metropolitan areas would capture airborne smog particles in the atmosphere, such as nitrogen oxide (NO₂), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂).

Installing a green roof onto new and current buildings at The Pennsylvania State University Brandywine Campus would publicize the advantages of an alternative roof system. Incorporating a green roof into an architectural design increases the visual quality of the building. It transforms a building constructed of concrete and glass into a living structure that is always changing. It would improve the air, land, and water quality of the campus as well as the surrounding community. The green roof would provide displaced animal and plant species with a protected, alternative habitat location. Reducing the carbon footprint of the buildings by lowering the energy consumption needed to operate the heating and cooling systems would be an additional advantage of a green roof. If Penn State Brandywine constructed a green roof, we would become a leading example of an energy efficient organization while aspiring to become a sustainable campus.

Evapotranspiration and the Heat Island Effect
Metropolitan regions with a high concentration of concrete, glass, and steel buildings encounter higher atmospheric temperatures. Building materials absorb and retain the sun’s radiated heat waves, which hinders the atmospheres ability to reduce its temperature after the sun is no longer visible. This retention of heat causes elevated air temperatures in metropolitan areas compared to surrounding communities. Foliation planted within densely populated regions helps to reverse the effects of increased air temperatures through evapotranspiration. This process occurs when water is absorbed by the roots of the plant and sent to the leaves where it perspires onto the foliage surface. The cold water evaporates off of the leaf surface thereby reducing the air temperature.

Atmospheres that contain a high concentration of pollution would greatly benefit from the installation of a green roof. When sunlight reacts with smog in the atmosphere, it produces a photochemical reaction. This interaction of pollution and sunlight increases the toxicity level of the air pollution. Plant and tree leaves have the ability to “capture” airborne smog particles, such as nitrogen oxide (NO), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂). When the smog adheres to the leaves, it reduces the concentration of pollutants in the atmosphere. During a rainstorm, the “captured” smog is washed into the soil allowing the leaves to continue removing smog from the atmosphere.

Reducing Acid Rain
High-density communities and regions with increased levels of air pollution often experience acid rain. When rainwater falls onto a traditional shingled or tar roof, it is funneled to one location on the property or into a local waterway. Plants and wildlife are unable to adjust quickly to drastic environmental changes. This flood of acidic rainwater into one habitat can shock the ecosystem and cause devastating effects.

Rainwater that contains a high concentration of acid can be absorbed and filtered through a green roof. Between 50 and 70 percent of rainwater that falls onto a green roof is retained within the soil. Over several days, the rainwater is absorbed by the plants growing on the roof. The water that is unable to be absorbed by the green roof is filtered through the soil. A green roof is able to reduce the acidity level of the rainwater runoff by increasing the pH level from 4 to 7. The excess alkaline rainwater that is funneled off of the green roof has a significantly reduced impact on the plants and wildlife within the ecosystem surrounding the building.

National Research Council of Canada
A 60-day study measured the surface temperature of a traditional tar roof and a vegetative green roof. The results of the study revealed that the green roof had a maximum recorded surface temperature of 103 degrees Fahrenheit for 18 days of the study. The traditional tar roof reported its highest recorded temperature of over 158 degrees Fahrenheit. A reduction in roof temperature reduces the internal temperature of the building.

Evapotranspiration and the Heat Island Effect

Aerial View of Penn State Brandywine
Installing a green roof on current and future campus buildings of Penn State Brandywine would improve the air, water, and land quality of the surrounding ecosystem. Our campus would become a leading example of a sustainable university campus.