Green Roofs
LID & Sustainable Design

Jessica Abrera
# Intensive vs. Extensive

**Intensive**
- More time, money, and energy
- Living and recreational space
- More aesthetically pleasing

**Extensive**
- Simple
- Basic
- “Get’s the job done.”
Green Roof Layers

- Vegetation
- Growing medium
- Filter membrane
- Drainage layer
- Waterproof/root repellant layer
- Support panel
- Thermal insulation
- Vapor control layer
- Structural support
Plant Selection

Dependent Upon:
- Substrate Depth
- Extreme Temperatures
- High Light Intensities
- High Wind Speeds
- Building Infrastructure
- Maintenance

Types
- Low, mat-forming
- Compact growth
- Evergreen foliage
- Tough, twiggy growth
- Drought tolerant
- Water-storing
Building Structure

- Tall buildings have greater support
- Smaller one-story buildings need more column support if it covers a greater area
- Erosion control for buildings with a slope
• Decrease the load of storm water runoff to the wastewater treatment plants
• Size of cisterns and storm-water management ponds are also reduced
• The precipitation is absorbed by the substrate for the vegetation and then is released through evapotranspiration
• Green roofs hold 70-90% of the precipitation during the summer, and 25-40% of the precipitation during the winter is retained
• Substrate depth is the main determinant of runoff retention
Filtration

**Air**
- 1m^2 plot of grass can remove up to 0.2 kilograms of airborne particulates from the air
- Carbon dioxide is converted into oxygen during photosynthesis
- 1.5 square meter plot of uncut grass generates a sufficient amount of oxygen per year to one human with their yearly oxygen intake requirement

**Water**
- “Natural” filters for any pollutants carried in by the rain
- Bioremediation and phytoremediation performed by the bacteria and fungi in the substrate
Roof Longevity

- roofs can be sustained for long periods of time without needing major repairs
- rooftops with green coverage can last more than 20 years
- green roofs protect the rooftops from damaging sunrays
Heat Insulator

- conventional roof can reach up to 180° F, while a green roof will only warm up to 80° F
- there is a reduction in heat flux because the green roof promotes evapotranspiration, shades the roof, and increases the insulation and thermal mass
Bitumen roof
Energy balance, daily mean

Disadvantages
Uncomfortable microclimate
Low durability of the sealing of the roof
High surface runoff, low evapotranspiration
Pollution of the surface waters

Main Influencing Factors:
- Surface colour (Albedo)
- Heat capacity of the surface
- Exposition

Global Radiation 5354 Wh
Reflection 482 Wh
Evaporation-cooling 123 Wh
Latent Heat 1827 Wh

Increased Thermal Radiation 2923 Wh
Thermal Radiation Balance 7555 Wh
Radiation Balance 1949 Wh

Ø Daily Mean in Wh/m² June-August 2000
UFA-Fabrik Berlin-Tempelhof
Extensive Greened Roof
Energy balance, daily mean

- Global Radiation 5354 Wh
- Reflection 803 Wh
- Evaporation-cooling 1185 Wh
- Latent Heat 872 Wh
- Increased Thermal Radiation 2494 Wh
- Thermal Radiation Balance 7555 Wh
- Radiation Balance 2057 Wh

Main Influencing Factors:
- Field capacity of the soil
- Exposition
- Percentage of cover of the vegetation

Ø Daily Mean in Wh/m² June-August 2000
UFA-Fabrik Berlin-Tempelhof
Urban Heat Island Effect

- The Urban Heat Island Effect is the temperature difference between an urban area and a rural, less populated area.
- Solar radiation is absorbed by roads and buildings then re-radiated back as heat.
- One meter-squared area of vegetation can evaporate 0.5 liters of water on a hot summer day and 700 liters annually.
- Dust and particulate matter in the air contributing to smog will decrease
Sound Insulation

- Sound waves generated from machines, traffic, and airplanes can be absorbed, reflected, or deflected with green roofs.
- The vegetation of a green roof can block higher frequencies than the substrate and a substrate layer that is 12 cm thick can reduce sound by 40 decibels and a 20 cm thick substrate layer can decrease sound by 46-50 decibels.
Ecosystem

- mimic endangered ecosystems/habitats
- rare and uncommon species of insects
- Green roofs provide a safe haven for different species of birds, insects, and plants and they promote biodiversity.
Therapeutic Benefits

- providing “visual relief”
- improve human health with relaxation and restoration
Roof Garden

- Growing herbs, fruits, flowers, and vegetables on a green roof helps make produce more accessible.
- Green roofs provide fresher produce, limit the food miles, or distance produce is transported, and give more control of soil, fertilizer, and pesticides.
Economic Benefits

- Energy savings from insulation
- Reduction in cost for not replacing or maintaining a conventional roof
- Savings derived from not treating large amounts of storm water runoff
- Reduction or elimination of roof drains and standard insulation
- New job opportunities
- Reduction in cost of meeting the greenhouse gas requirements
- Decreased construction for storm water related infrastructure
- Recycling of aggregate and compost
Costs

The price range of green roofs is from $8 to $28 per square foot, with $10 to $12 around the average.

- depth and type of the substrate
- type of vegetation
- the size of installation
- whether irrigation is used or not
- if it is extensive or intensive
Maintenance

- Watering, weeding, pruning, and re-application of organic fertilizer, and de-clogging drains and gutters are all a part of maintaining a green roof.
- The first two years of maintenance is when the price is the highest.
- A green roof must be maintained four to five times a year.
The End