

# Green Roof Energy

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Less air pollution and greenhouse gas is produced when cooling demands are lowered.

Green roofs can beautify an environment, as well as become a habitat for many creatures.

Green roofs can reduce and slow stormwater runoff.

A green roofs acts as an insulator for a building, which reduces heating and cooling demands.

Green roofs improve indoor comfort by reducing heat transfer, resulting in a more comfortable temperature.

# 5 Benefits of a Green Roof

# Who designed this tool?

## ❖ Researchers and Staff

- Portland State University
- University of Toronto
- Green Roofs for Healthy Cities

## ❖ Funded by

- US Green Building Council
- Those stated above
- Environment Canada

# When was it designed?

- ❖ 2004-2006 Dr. Sailor & colleagues at Portland
- ❖ In April 2007 module became part of standard release of the US Department of Energy's EnergyPlus model

# In what situation can we use this tool?

To compare annual *energy performance* and *cost benefit* of a building with green roofing to the same building with either dark roof or white roof

# What are the requirements to use this tool?

Access Online

Minimal Site Data

## Estimate Annual Green Roof Performance

Would you prefer to use US Customary or SI units?

- US Units  
 SI Units

### Building Information

What State/Province is your building located in?

Georgia  
Hawaii  
Idaho  
Illinois  
Chicago

What city is your building located in?

What is the total area of your **roof**?

133000 ft<sup>2</sup> (roof area)

Which Type is your building?

New Office Bldg.

### Green Roof Information

What is your Growing Media Depth? (2 to 11.5)

3 inches

What is your Leaf Area Index? (0.5 to 5)

1

Is your green roof irrigated?

No

What percentage of your roof does the Green Roof cover? (1 to 100%)

60 %

If your green roof covers less than 100% of your roof area, what type of roof covers the rest?

White (0.65 albedo)

### Utility Rate Information

This calculator uses utility rates for each city that were valid in May 2010. Would you like to enter your own utility rates instead?  Yes  No

# How to use this tool?

## Impact of a Green Roof

You specified a **New Office Building** in **Chicago, IL** with a total roof area of **133000 ft<sup>2</sup>**. The Green Roof you specified for this building has a **Growing Media Depth** of **3 inches**, a **Leaf Area Index** of **1**, covers approximately **60%** of the total roof area (the rest being a white roof), and is **not irrigated**. For reference, the annual whole building electricity consumption for the specified green roof was 5608378 kWh and the annual gas consumption of this green roof was 16329 Therms

### Annual Energy Savings compared to a Dark Roof (albedo = 0.15)

Electrical Savings: 28615.4 kWh  
 Gas Savings: -111.3 Therms  
 Total Energy Cost Savings(1): \$2774.09

### Annual Energy Savings compared to a White Roof (albedo = 0.65)

Electrical Savings: 7774.7 kWh  
 Gas Savings: 747.6 Therms  
 Total Energy Cost Savings(1): \$1680.75

### Average Sensible Heat Flux to the Urban Environment (W/m<sup>2</sup>)

	Dark Roof	White Roof	60% Green Roof System
Annual Average:	55.3	6.5	26.1
Summer Average:	82.1	20.4	37.4
Summer Daily Peak Avg.:	305.1	109.7	112.0

### Average Latent Heat Flux to the Urban Environment (W/m<sup>2</sup>)

	Conventional Roof	60% Green Roof System
Annual Average:	-	28.2
Summer Average:	-	35.8
Summer Daily Peak Avg.:	-	105.6

### Annual Roof Water Balance (in)

	Conventional Roof	60% Green Roof System
Precipitation:	31.8	31.8
Evapotranspiration:	-	14.9
Irrigation:	-	0.0
Net Runoff (2):	31.8	17.0

# What does it tell us?



# New Walmart Store #5402

## Chicago, Illinois

### ❖ Site Data

- 133,000 sq ft.
- 60% covered green roof, 40% white
- Growth Media 3 inches
- Leaf Area Index 1
- No irrigation

### ❖ Results

- Calculator [1 year] → \$1,756
- Walmart [2006-2009] → \$6,650
- Difference → 4,894 (66% difference)

# Disadvantages

- ❖ Doesn't include every city [Lubbock not included]
- ❖ Version differences between “Old” and “New”
  - Conduction Finite Difference [CFD] scheme to transfer solution
  - Precipitation schedule data
- ❖ “Old”--> doesn't use Canadian precipitation schedules
  - Similar US Cities precipitation adjusted and used instead
- ❖ No irrigation = Potential for dead Vegetation
  - By including irrigation schedule cost benefit will decrease [due to maintenance cost]

# Advantages

- ❖ Generally accurate +/- 20%
- ❖ Commercial or Residential Buildings
- ❖ “NEW” or “OLD” Buildings
- ❖ Compared with conventional white and black roofs
- ❖ Predict energy and cost savings based on input

# Works Cited

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