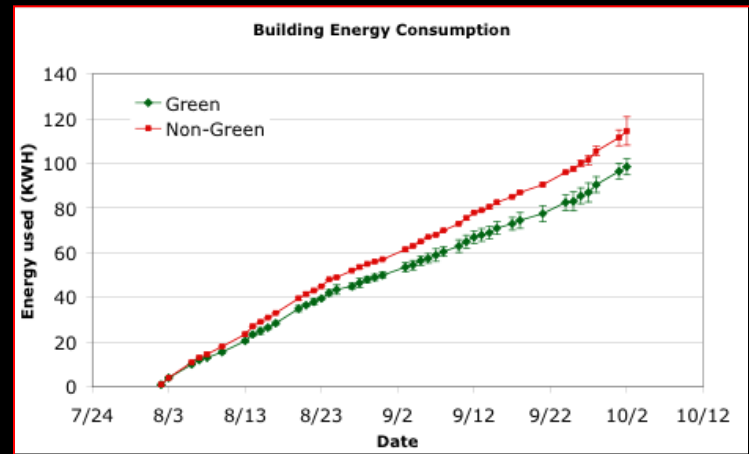
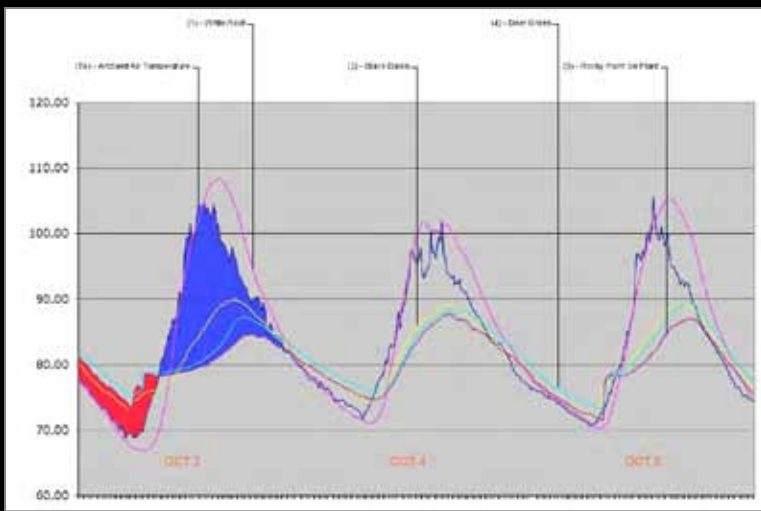




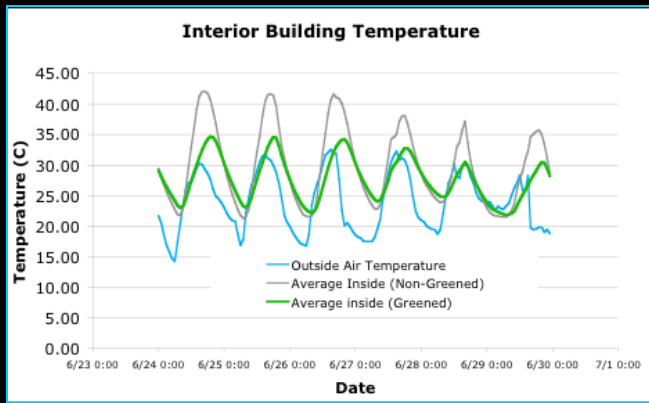


“How About Low Tech for a Change”....OR....
...Everything Once Was “High Tech”!

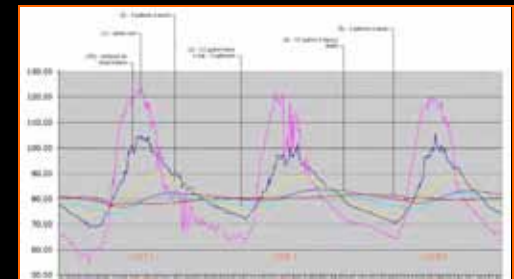
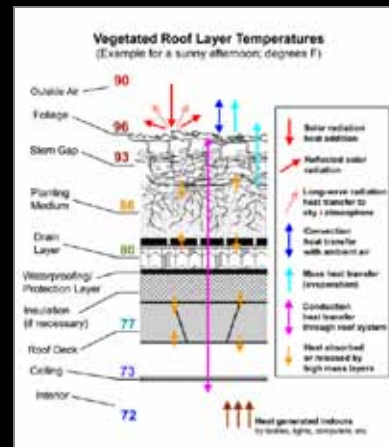
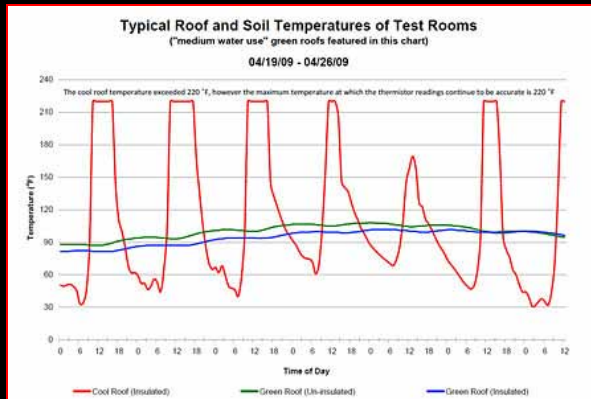
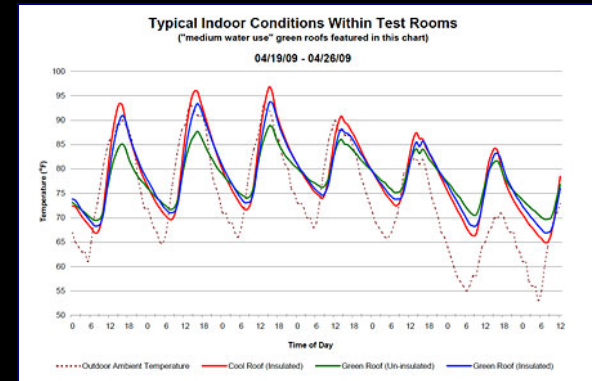




$$I = 7.54 + 3.97 \ln (H/S)$$



$$Q = h "A" \#T$$







FLORASOURCE, Ltd. ®









Why Green Roofs?

- Conserve Energy
- Reduce storm water runoff
- Bio-filtration (provide cleaner air and water)
- Noise reduction
- Glare reduction
- Fire prevention
- Extend roof life (limit UV, temp. fluct., drying/cracking, etc.)
- Habitat replacement / biodiversity
- Expand buildings useable space (green decks, garden areas)
- Aesthetics (better looking, more soothing views)

“Buildings consume 36% of total energy use and 65% of total electricity consumption.”

(Kula, 2005)

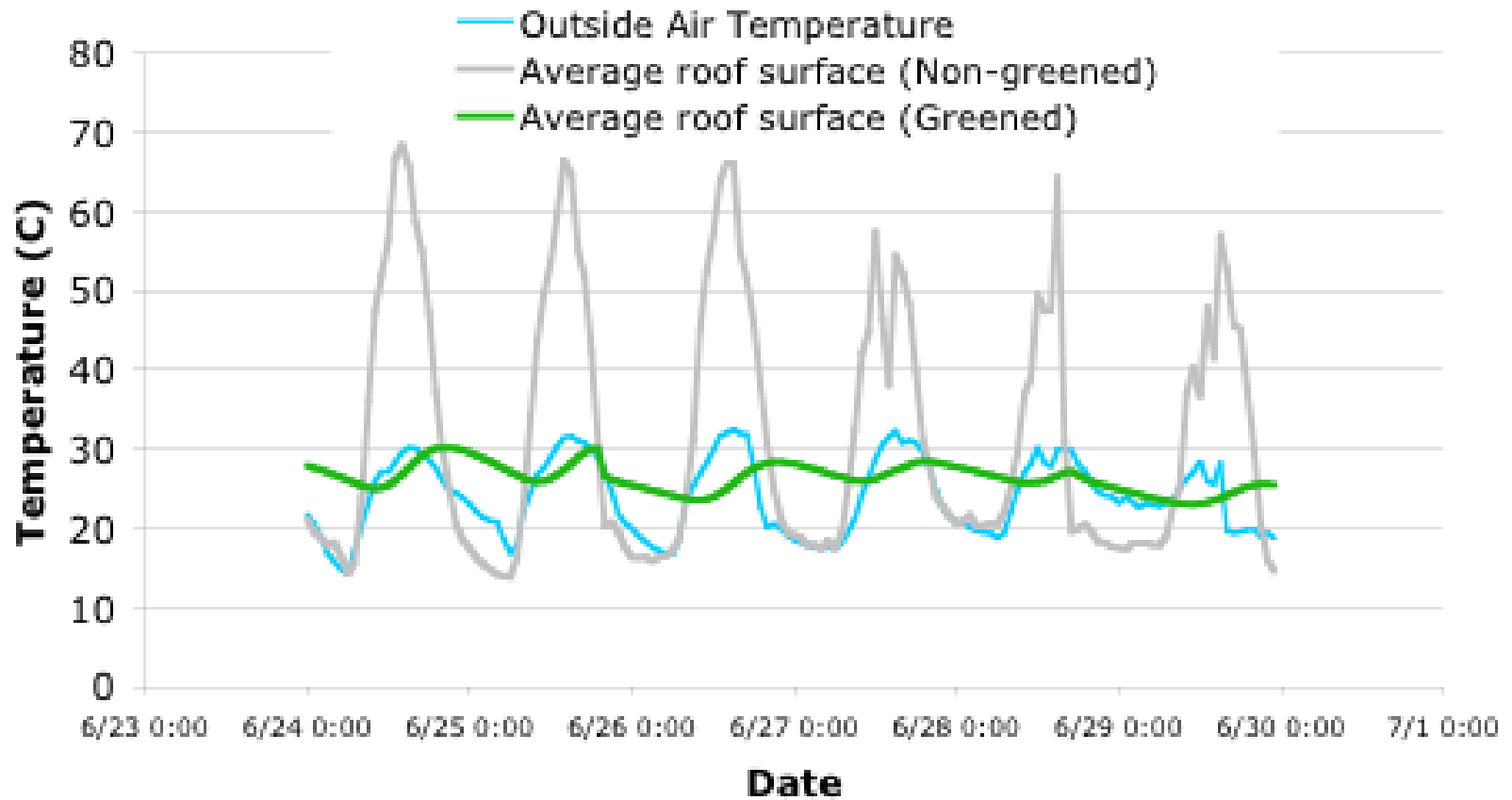
ENERGY CONSERVATION WITH GREEN ROOFS

Green roofs conserve energy (and reduce energy costs) in the following ways:

- (1) Plants and soil medium intercept and dissipate solar radiation.
- (2) Physical shading the roof reduces solar gain.
- (3) Plants, soil provide thermal mass and insulation.



Average Roof Surface Temperature



Gaffin, et.al. Penn. State (2005)



(4) Evaporative cooling of the roof surface and surrounding areas





SPEED
LIMIT
25

STOP

**HARD
HAT
AREA**

MCCARTHY





Ambient Ground Temp:
106 F

Roof Top Temps:

Pavers/Ballast: 154 F

Solar Panels: 144 F

Cool Roof PVC: 128 F

Green Roofs: 98 F

Green roof plants / soil intercept solar radiation
and dissipate heat

+

Physical shading of roof surface

+

Thermal Mass / Insulation

+

Evaporative Cooling

= 5) Reduce Urban Heat Island Effect



Urban temperatures can be as much as 3 to 5 degrees F warmer than just miles outside of a city, due to impervious surfaces (roofs, streets, sidewalks, roads) that absorb heat during the day and re-radiate heat at night.

For every increase in temp. of 1 degree F, peak utility loads increase 1.5-2%.

(6) Reduce AC Use and Improve Efficiencies of AC Units



“Buildings consume 36% of total energy use and 65% of total electricity consumption.”

(Kula, 2005)

Air conditioners make interior spaces cool and discharge heat to exterior spaces.



- Green roofs can reduce temperatures below roofs (indoors) by 6 to 8 degrees F when outdoor temperatures are between 77- 86 F. (Peck et al, 1999)
- Green roofs can reduce air conditioning use in a single story building by 25 to 50%. (Wong, 2003)
- Green roofs can reduce cooling load on an 8 story structure by 10% in peak demand period for the entire building, and by 25% for the 8th floor, 9% for the 7th floor, 2% for 6th floor, and 1% for the floor below. (Saiz, et. al, 2006)
- In climates where AC is considered essential for indoor working and living conditions, every reduction of internal temperatures of 1 degree F can reduce electricity use for AC units by 8%. (Dunnet and Kingsbury 2004)



“Cool air exported from green roofs acts to cool the surrounding spaces, decreasing the temperature of intake air of neighboring air conditioning units, increasing their efficiencies and decreasing costs.”

Green Roofs and Local Temperatures

Mankiewicz et. al (2005)



TABLE 1

A comparison of the cost (in USD) of electricity used in air conditioning units to the cost of potable water used by vegetation on green roofs to produce a ton of cooling capacity.

	Cost of 33 gallons water (= 1 ton of AC) on a green roof	Cost per 84.4 kWh-ton AC	Ratio of AC to green roof cooling cost
New York	\$0.26	\$13.50	51
Philadelphia	\$0.20	\$7.93	41
Chicago	\$0.09	\$8.44	91
Seattle	\$0.13	\$5.57	43
Average	\$0.17	8.86	56



“In summary, electricity costs for air conditioning are 51 times greater in the City of New York than the water costs for an equivalent quantity of heat removal by green roof systems using the local drinking water supply.”



Is it more cost-effective to utilize potable water for cooling than for the production of electricity?







SOLAR vs GREEN ROOFS.....

.....which gets the roof space?



7) Increase efficiencies of PVs



Kohler (2007)



**8) Increase life of roof membrane
(and less energy consumed in
the discarding, manufacturing
& replacement of new
membrane)**



GREEN ROOF COSTS

Assumed Roof Area: 20,000 sf.

Traditional Roof (single ply membrane): \$ 6.00 to \$ 9.00 per sf

Extensive Green Roof: \$ 12.00 to \$ 20.00 per sf

Intensive Green Roof: \$ 25.00 to \$ 45.00 per sf

Green Roof Benefits

- Conserve Energy
- Reduce storm water runoff
- Bio-filtration (provide cleaner air and water) – PUBLIC HEALTH
- Noise reduction
- Glare reduction
- Fire prevention
- Extend roof life
- Habitat replacement / biodiversity - WILDLIFE
- Expand buildings useable space (green decks, garden areas)
- Aesthetics (better looking, more soothing views)

Reduce construction costs (project dependent):

- Allow for more developable space*
- May reduce roof insulation requirement*
- Downsize AC Equipment requirement*
- Reduce stormwater mitigation fees*
- Possible incentives / tax breaks*
- Fastrack Project Approval (LEED)*

