North American Green Roofs and Wall Developments

Oslo, Norway

Steven W. Peck, GRP, Honorary ASLA
Founder and President, Green Roofs for Healthy Cities

About Green Roofs for Healthy Cities (GRHC)

Big Sur
Award of Excellence 2009
Winner: Fred Ballerini

Phoenix Convention Center
Phoenix, AZ
Award of Excellence 2011
Winner: Ten Eyck Landscape Architects, Inc.

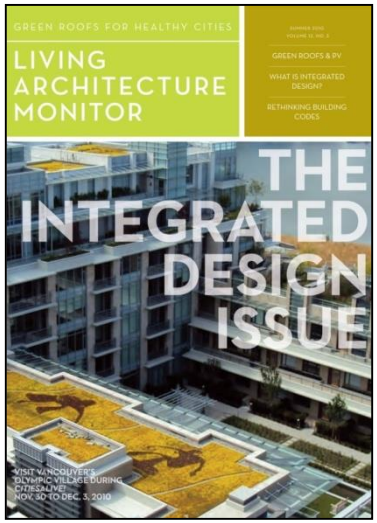
Member-based non-profit industry association established in 1999.

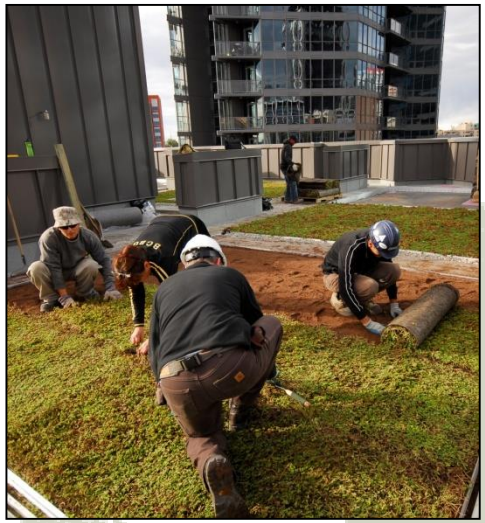
Mission

To increase the awareness of the economic, social and environmental benefits of green roofs and green walls, and other forms of living architecture in North America through education, advocacy, professional development and celebrations of excellence.

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

GRHC Activities





- Events
- Forums
- Webinars
- Specialized Training
- Executive Level Networking
- Brand Positioning
- Valuation Tools
- Publications
- Reports

GREEN ROOF PROFESSIONAL
GRP
ACCREDITED

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Nomenclature – Green Roofs

- Intensive green roofs – feature woody plants and shrubs
- Always accessible
- Greater maintenance, cost and loading capacity

- Extensive green roofs – sedums and grasses
- 6 inches of growing medium or less
- Less weight, loading capacity
- Not well suited to hot dry climates

- Loose laid/built up systems
- Modular systems-trays

Nomenclature – Green Walls

A ‘Green Wall is an all-encompassing term that is used to refer to various forms of vegetative wall surfaces:

- Green Facades
- Living Walls
- Retaining Living Walls

Source: Jakob Rope System

Source: Tournesol Siteworks

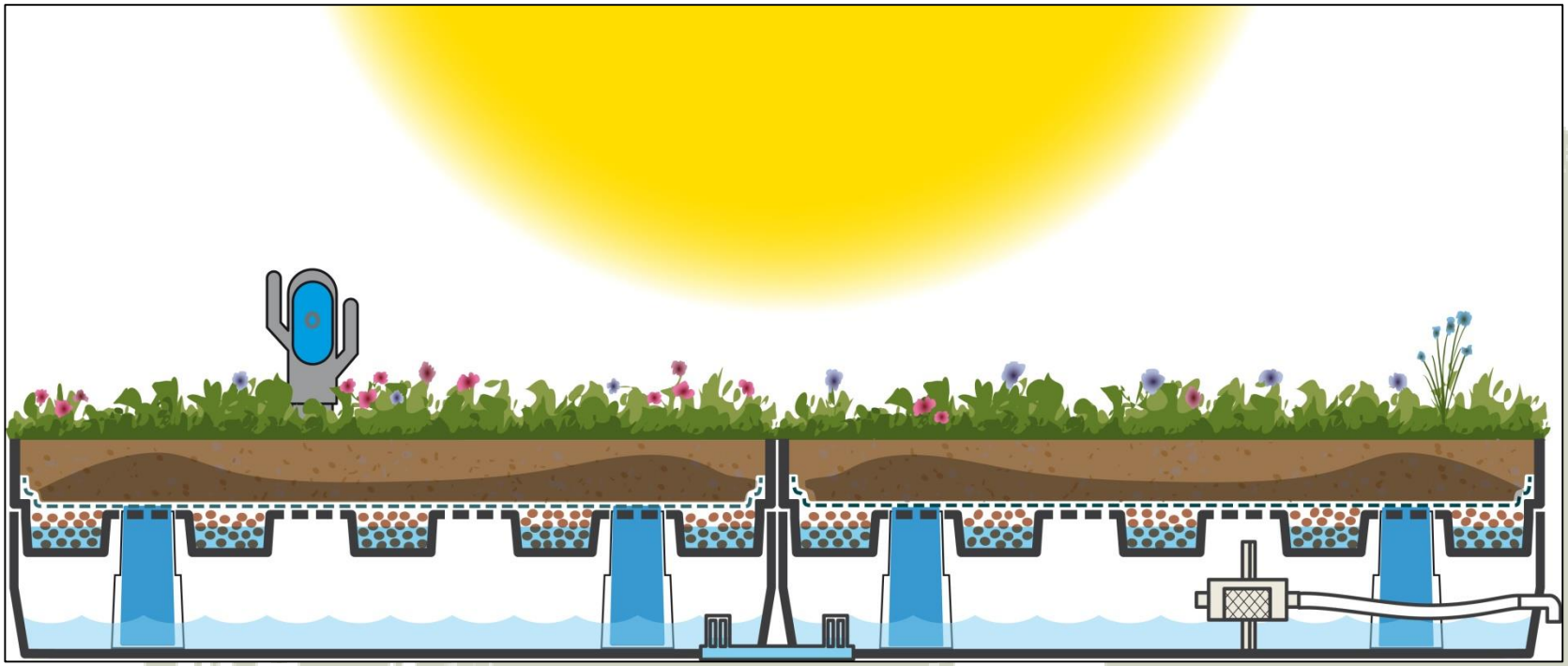
Source: Deltalock GTX

Designing Green Roofs That Pay Building Owners

- Need to overcome ‘first cost’ barrier
- Many opportunities to make green roofs pay, or reduce costs
- Some hinge on public policy, others depend on design
- Many cities have adopted incentives and or regulations to spur green roof development - extremely cost effective/multiple benefits
- Differences between new buildings and retrofits

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Public Policy and Green Roof Private Benefits



- Policy can turn public benefits into private benefits using regulatory requirements, grants and market based incentives
- Many green roofs are implemented to meet stormwater regulations
- Approximately 40 jurisdictions specifically promote green roofs in NA including San Francisco, New York, Chicago, Philadelphia, Portland, Denver , etc.

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Benefit Types – Public and Private

Public (community)

- Biodiversity
- Stormwater Management
- Urban Heat Island Reduction
- Employment Opportunities
- Climate Change

Private (building owner)

- Stormwater Management
- Energy Use Reduction
- Increase in Roof Lifespan
- Programming
- Property Value and Worker Productivity
- Membrane Durability
- Agriculture
- Noise Reduction

U.S. Coast Guard Headquarters
Washington, DC
Image courtesy of Sempergreen

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Green Wall Benefit Types – Public and Private

Public (community)

- Biodiversity
- Stormwater Management
- Urban Heat Island Reduction
- Employment Opportunities
- Climate Change
- Aesthetics

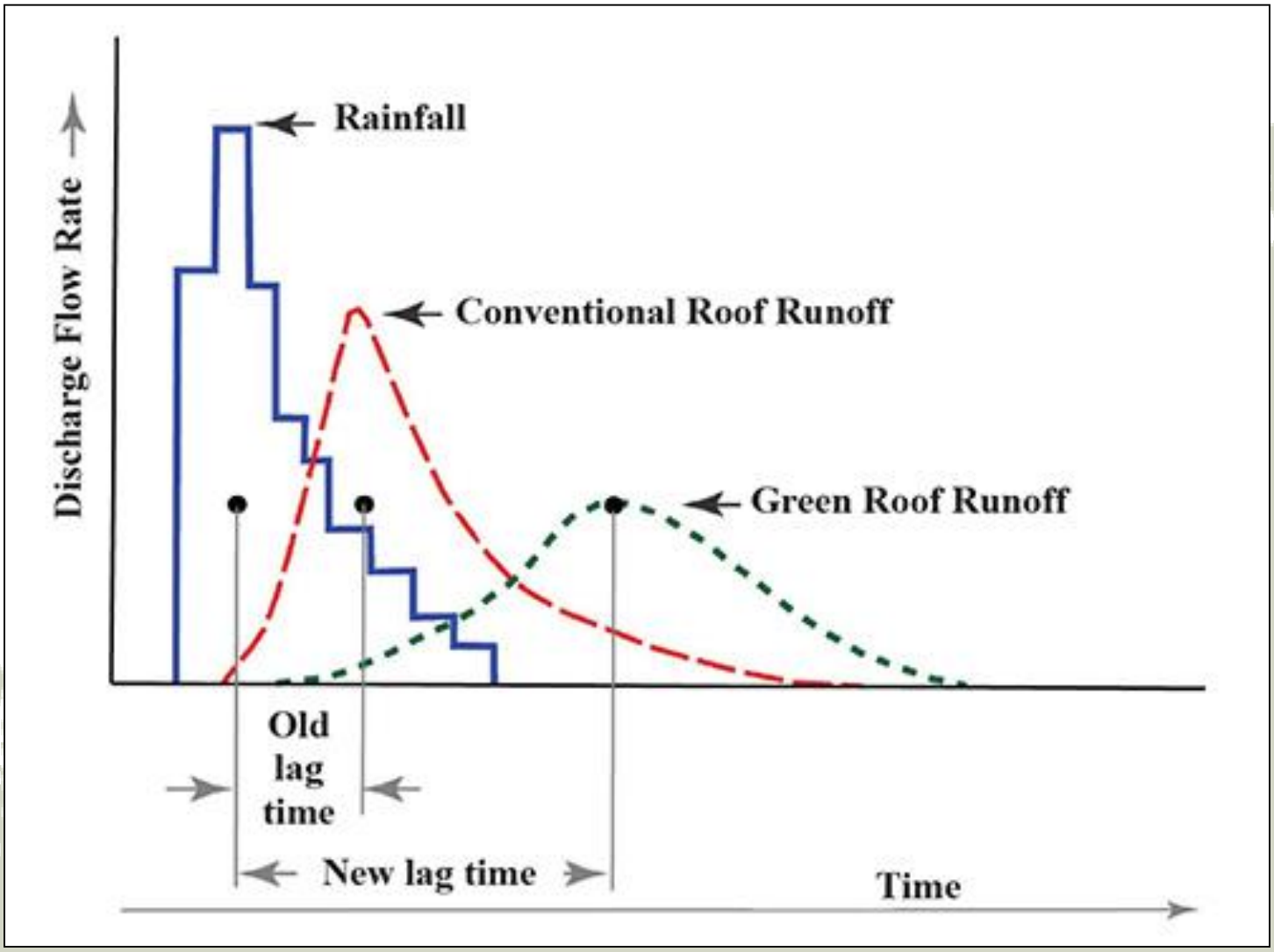
Private (building owner)

- Energy Use Reduction
- Property Value
- Biophilia
- Agriculture
- Noise Reduction
- Integrated Water Management

Jakob Cable Green Wall System

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

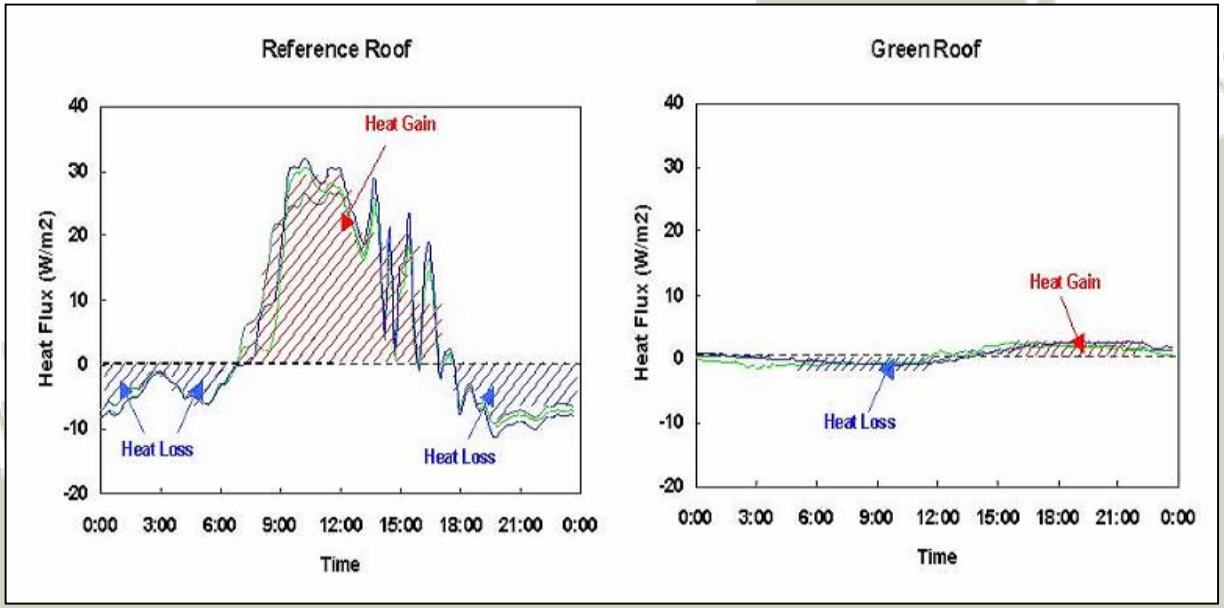
Stormwater Management



GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Energy Use Reduction

- Green roofs have been used for hundreds of years to insulate buildings
- Much more than just insulation:
  - Evapotranspiration
  - Convection
  - Reflectivity (Albedo)
  - Thermal Mass Transfer



Average Energy Use Savings is $0.166/sq. ft. annually (GSA, 2011)

Source: National Research Council , Institute for Research in Construction

GREEN ROOFS FOR HEALTHY CITIES
www.greenroofs.org

Solar PV – Green Roof Integration – “Biosolar Roofs”

Source: Green Roof Technology

- Ballast – no roof penetrations
- Membrane protection – no loss of solar during roof replacement
- Solar PV panel efficiency improvements
- Research indicates that Solar PV efficiency can be increased anywhere from 5 to 15% due to lower ambient roof temperatures

- HVAC efficiency improvements
- Cooler intake air means lower AC costs

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Urban Heat Island

Source: Conservation Design Forum

- Standard black roof: 169 degrees
- Green Roof: 90-119 degrees
- Difference: 60 degrees
- Chicago City Hall has estimated savings of 60k a year
- Can be used as part of a strategy to reduce UHI in cities – combine with trees, water features, reflective pavements/roofs
- 1 degree reduction = 4% off peak energy load demand

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Green Walls – Air Exchange Reduction

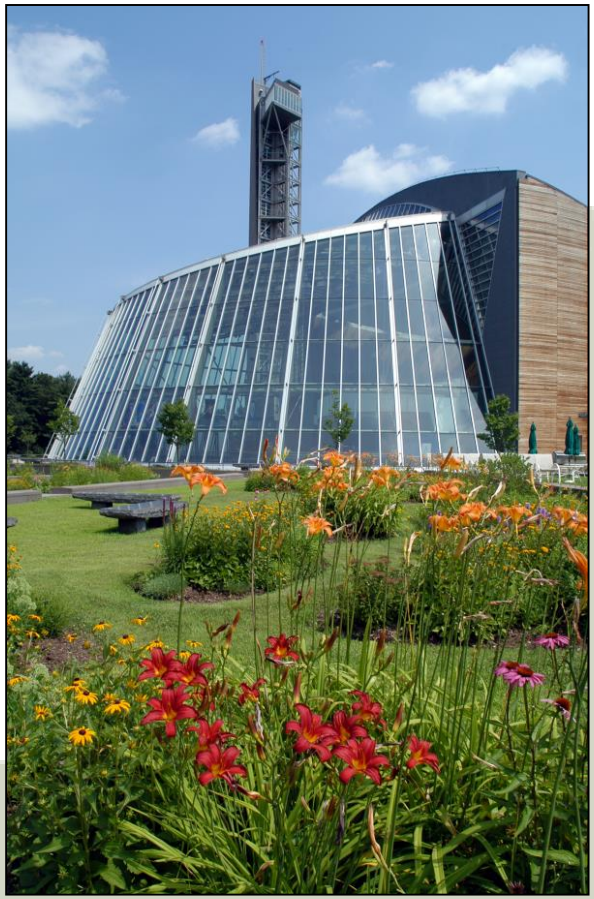
- Save energy by cleaning air and reducing need to bring hot or cold air into the building – less energy for conditioning intake air
- Micro-organisms filters out pollutants
- Recirculate water

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Special Programming – Green Roofs

- Programming – native plants
- Use for educational purposes
- Recreation

Brit's Pub
Minneapolis, MN
Photo: www.britspub.com

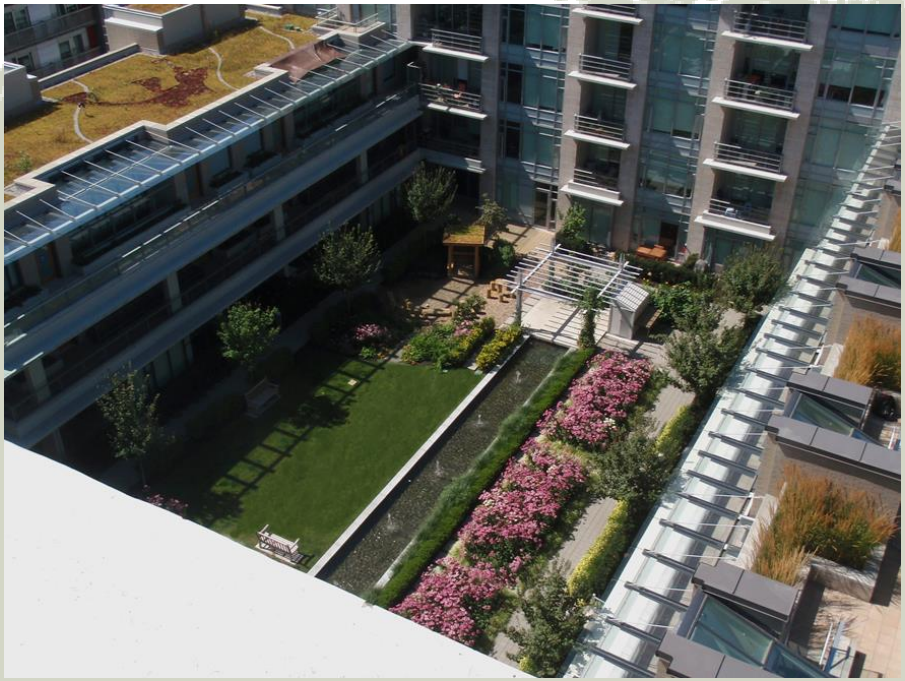


Mashantucket Pequote Museum
Mashantucket, CT
Award of Excellence 2006
Winner: Mashantucket Pequot Museum and Research Center

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Special Programming – Green Roofs

- Useable, saleable space in the building
- Increases property values
- 6% increase in property values – hedonic pricing study of condominiums in Portland



Vancouver, BC.
Athletes Village/Condos

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Special Programming – Green Walls

Live Wall
Award Winner 2013

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Property Value

Real estate effects – rent, risk, vacancy, absorption, and retention

- Value - $2.37/sq. ft. annually (San Francisco, 2015)

ESRI Canada
North York, ON
Award of Excellence 2010
Winner: Scott Torrance Landscape Architect

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Property Value - Related to Biophilia

A green roof installation in Boston, near Fenway Park (1330 Boylston Street Apartments)

Installation cost: $112,500

$120,000 in additional revenue annually

$2.4 million estimated increase in value of property according to J.P. Morgan Asset Management

Source: David Urkevic via Propertymanagamentinsider.com

GREEN ROOFS FOR HEALTHY CITIES
www.greenroofs.org

Productivity – Biophilic Effect

Biophilic effects – increased productivity, reduced absenteeism, less staff turnover

- (Net present value of $9/sq. ft over 25 years)

Hospitals

- More Rapid Healing
- Less Staff Turnover

Penn State Hershey Children's Hospital
Hershey, PA
Source: LiveRoof

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Marketing

Green buildings have been identified as facilitating:

- Sales
- Marketing and Promotion

Old Country Market
Coombs, BC

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Extend Roof Lifespan = Less Replacement $

Green roof membrane lifetime versus conventional roof membrane

Source	Membrane lifetime (years)	
	Green	Black
GRHC Life Cycle Cost Calculator	40	17
LBNL Research	29	14
Fraunhofer Institute	40	15
European Federation of Green Roof Associations	60	30
Mann, G. (2002) *Approaches to object-related cost-benefit analysis*	50	25
Single Ply Systems & Glass, GAF Materials Corp, SBS/TPO average	n/a	14
AOC Dirksen Green Roof Study	50	17

Source: (US GSA, 2011)

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Urban Agriculture – Multiple Benefits

Ledge Kitchen and Drinks
Dorchester, MA
Award of Excellence 2012
Winner: Recover Green Roofs

Brooklyn Grange Navy Yard Farm
Brooklyn, NY
Award of Excellence 2011
Award Winner: Brooklyn Grange

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Noise Reduction

Former GAP Headquarters
San Bruno, CA
Award of Excellence 2003
Winner: William McDonough + Partners

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Life Cycle Cost-Benefits: Is Bigger Really Better?

Table 4.4.3 **Cost-benefit analysis of green roof vs. black roofs**

NATIONAL LEVEL RESULTS	ROOF SIZE (ft^2)		
	5,000	10,000	50,000
Impact on Owners/Occupants/Investors			
Initial Premium, $/ft^2 of roof (extra cost of installing a green roof instead of a black roof)	(-$12.6)	(-$11.4)	(-$9.7)
NPV of Installation, Replacement, & Maintenance, $/ft^2 of roof	(-$18.2)	(-$17.7)	(-$17.0)
NPV of Stormwater, $/ft^2 of roof (savings from reduced infrastructure improvements and/or stormwater fees)	$14.1	$13.6	$13.2
NPV of Energy, $/ft^2 of roof (energy savings from cooling and heating)	$6.6	$6.8	$8.2
Net Present Value (installation, replacement & maintenance + stormwater + energy NPV)	$2.5	$2.7	$4.5
Internal Rate of Return (IRR)	*5.0%*	*5.2%*	*5.9%*
***Payback**, years*	*6.4*	*6.2*	*5.6*
Return on Investment (ROI)	*220%*	*224%*	*247%*
Other Financial Impacts (less realizable)			
NPV of CO_2, $/ft^2 of roof (emissions, sequestration & absorption)	$2.1	$2.1	$2.1
NPV of Real Estate Effect, $/ft^2 of roof (value, rent, absorption & vacancy)	$120.1	$111.3	$99.1
NPV of Community Benefits, $/ft^2 of roof (biodiversity, air quality, heat island, etc.)	$30.4	$30.4	$30.4

(US GSA, 2011)

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

PACE Financing for Green Roofs

- PACE – Property Assessed Clean Energy Financing
- Since 2010, this program has provided financing for energy efficiency, renewable projects and disaster resiliency improvements to buildings – they are now financing green roof projects.
- Loans can include capital and maintenance costs on Green Roofs can now be repaid over the course of 5 to 25 years.
- Property taxes are increased on the building at an agreed upon rate in order to finance these projects long term.
- PACE just was approved in New York State and is active in 20 states plus DC.

For more information visit pacenation.us/pace-programs/ or www.counterpointesre.com

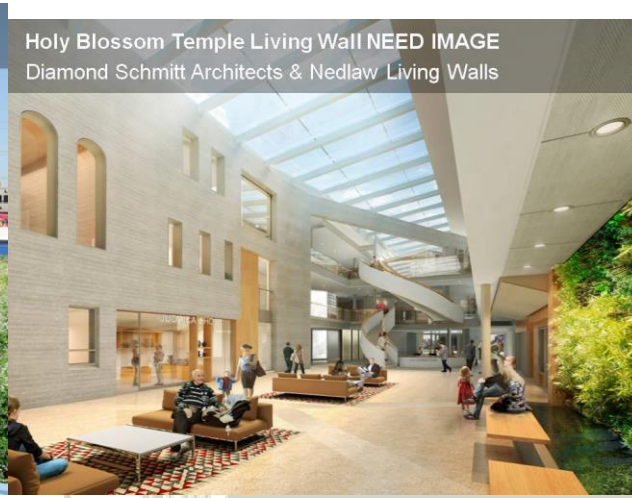
GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Living Architecture Performance Tool

- After five years development work - Launched Version 1.0 in 2018
- 110 Points Available Across 8 Different Areas – Water Management, Design, Energy etc…
- Projects that are green roofs and or green walls – completed or in progress can apply for certification.
- The cost is $1500 for small projects and $2500 for very large projects.
- Some companies in this room have registered to become certified
- System is similar to USGBC's LEED Program and Sustainable Sites – certified, silver, gold and platinum levels.
- System can be used for incentive programs - $$ per square foot to reach various levels of certification.
- To download the LAPT go to www.greeninfrastructurefoundation.org

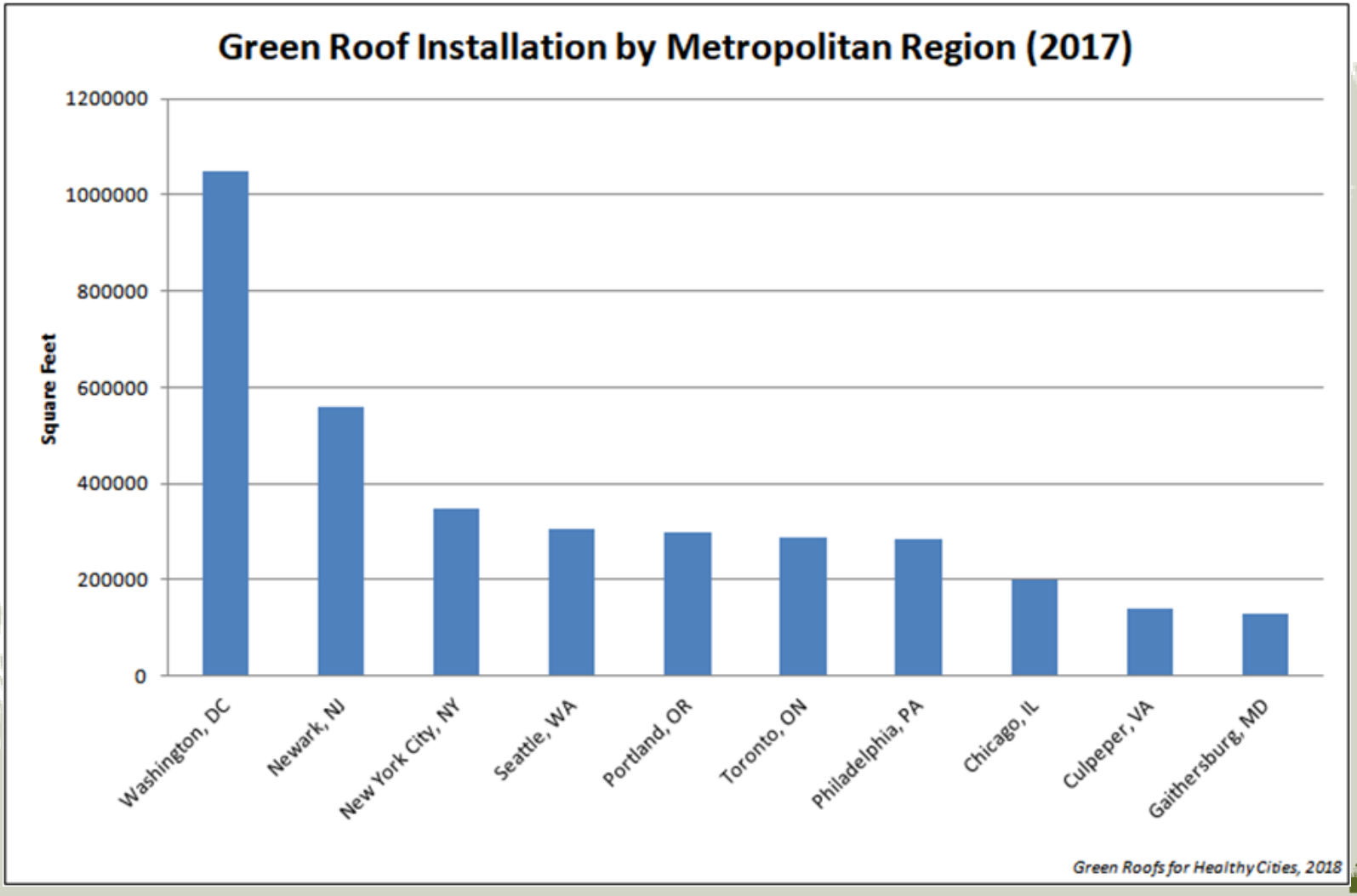
GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Living Architecture Performance Tool: Advancing Performance & Policy



GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Who is the Greenest of Them All?



GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Conclusion

- Green roofs and walls are too often value engineered out but they can be designed to generate many additional benefits for developers and owners.

- Supportive public policy helps to overcome first cost barrier and realize many community benefits on private roof spaces

- Integrative, multi-functional performance is key to success

Vancouver Convention Center
Award of Excellence 2008

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org

Thank You!

Questions, Comments?

Contact Info: speck@greenroofs.org

More Resources:

- greenroofs.org
- citiesalive.org
- livingarchitecturemonitor.com
- greeninfrastructurefoundation.org

GREEN ROOFS
FOR HEALTHY CITIES
www.greenroofs.org