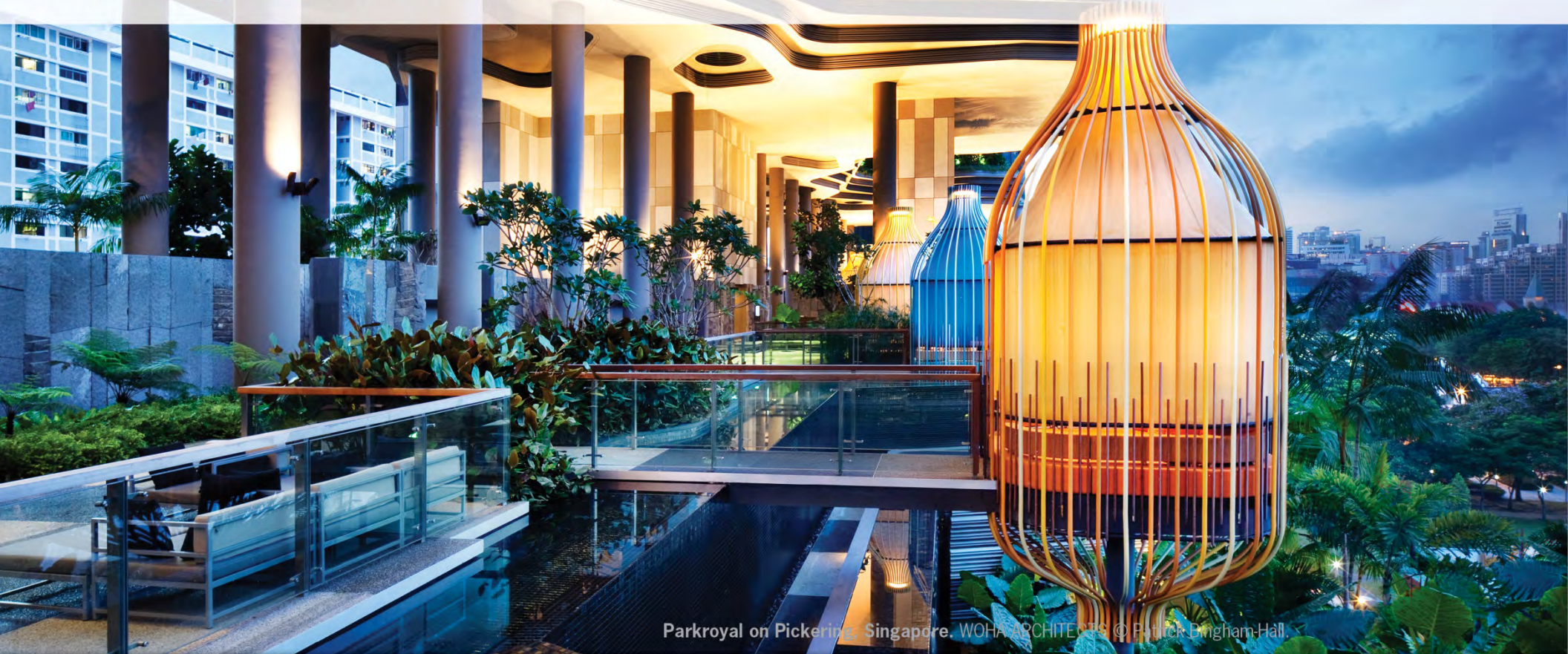


# Biophilic Design

Improving Health & Well-Being in the Built Environment



Parkroyal on Pickering, Singapore. WOHA ARCHITECTS © Patrick Bingham-Hall



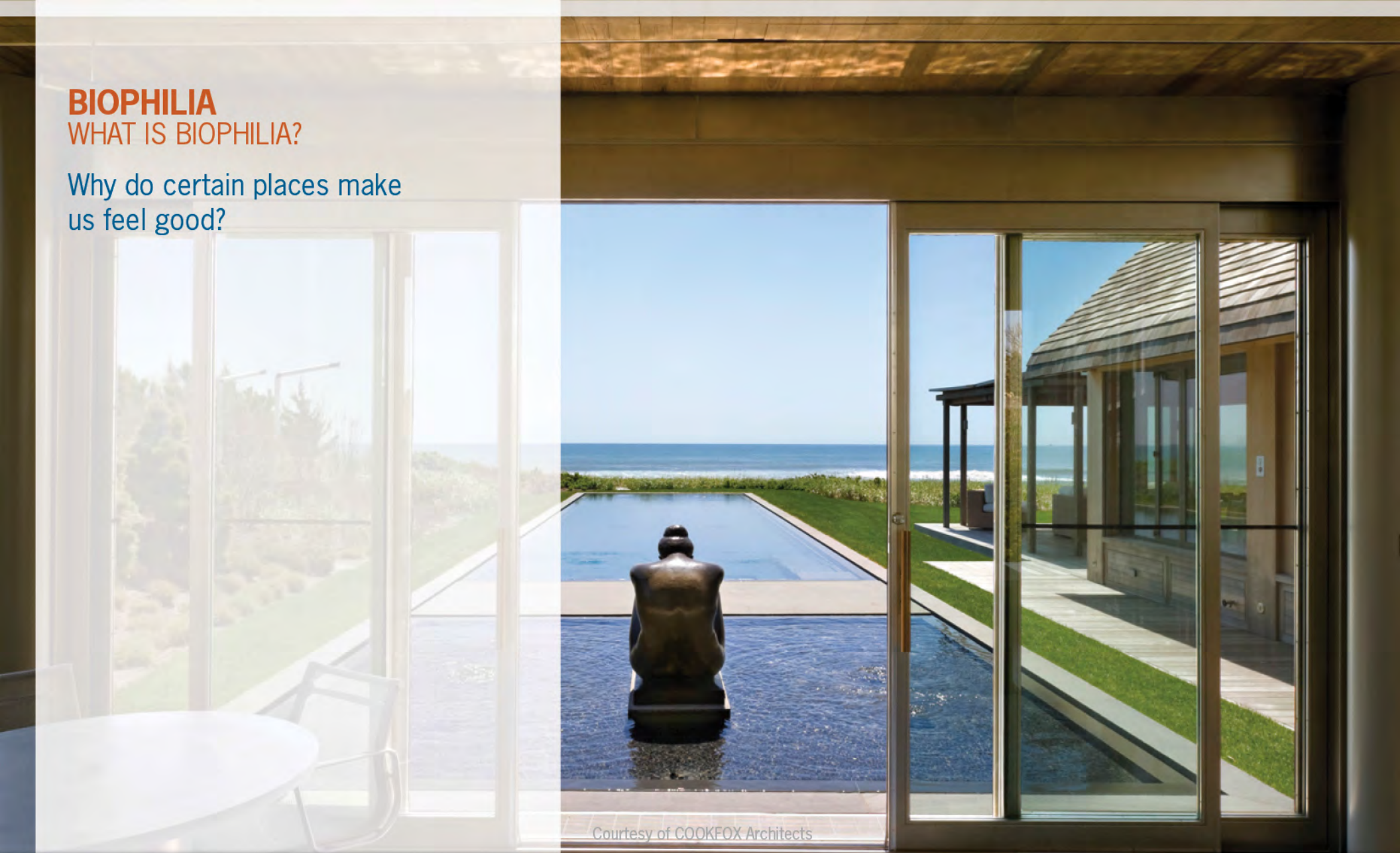
BIOPHILIC DESIGN

Improving Health and Well-Being in the Built Environment

# BIOPHILIA

## WHAT IS BIOPHILIA?

Why do certain places make us feel good?



**BIOPHILIC DESIGN**

Improving Health and Well-Being in the Built Environment

## BIOPHILIA

### WHAT IS BIOPHILIA?

Anthropologists tell us we are  
hardwired to respond to nature.



© Hugh Lunn/Flickr



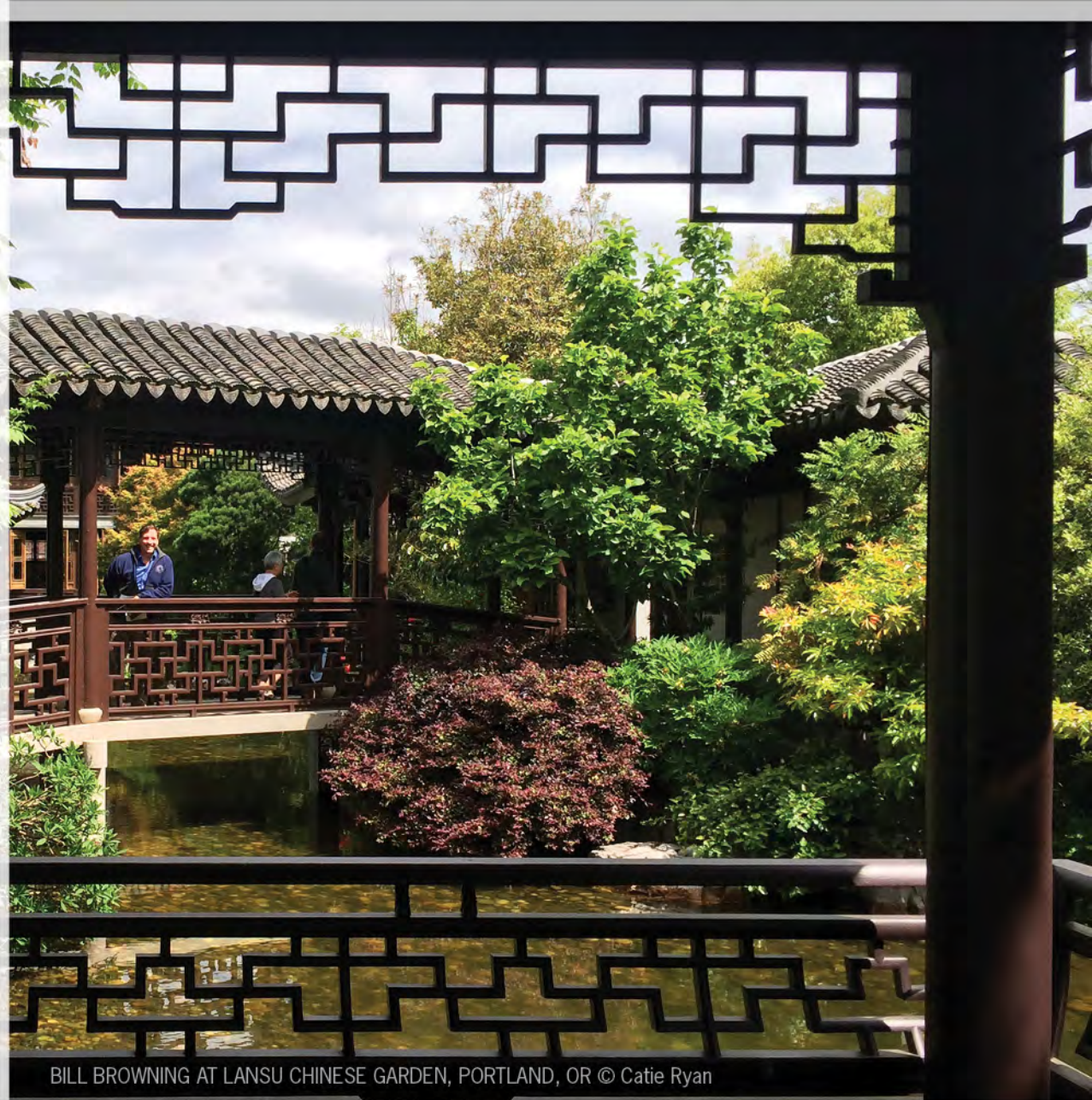
**BIOPHILIC DESIGN**

Improving Health and Well-Being in the Built Environment

## BIOPHILIA

### WHAT IS BIOPHILIA?

People viscerally respond to the same relationships in architecture because they make us feel good.



BILL BROWNING AT LANSU CHINESE GARDEN, PORTLAND, OR © Catie Ryan



# BIOPHILIA

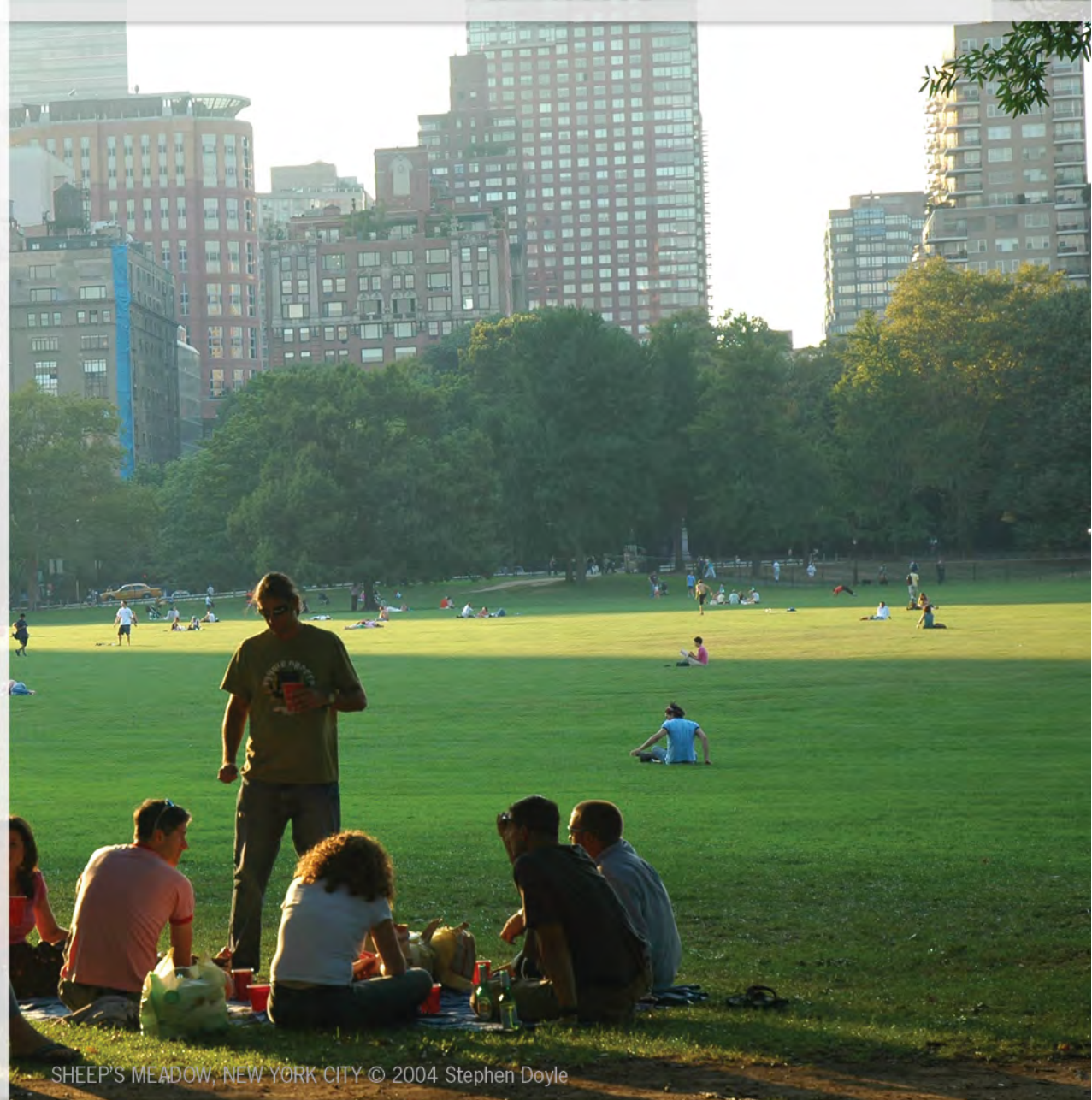
## WHAT IS BIOPHILIA?

“Biophilia...

is the innately emotional affiliation  
of human beings to other living  
organisms....

Life around us exceeds in complexity  
and beauty anything else humanity is  
ever likely to encounter.”

**Edward O. Wilson**  
*The Biophilia Hypothesis*



SHEEP'S MEADOW, NEW YORK CITY © 2004 Stephen Doyle



**BIOPHILIC DESIGN**

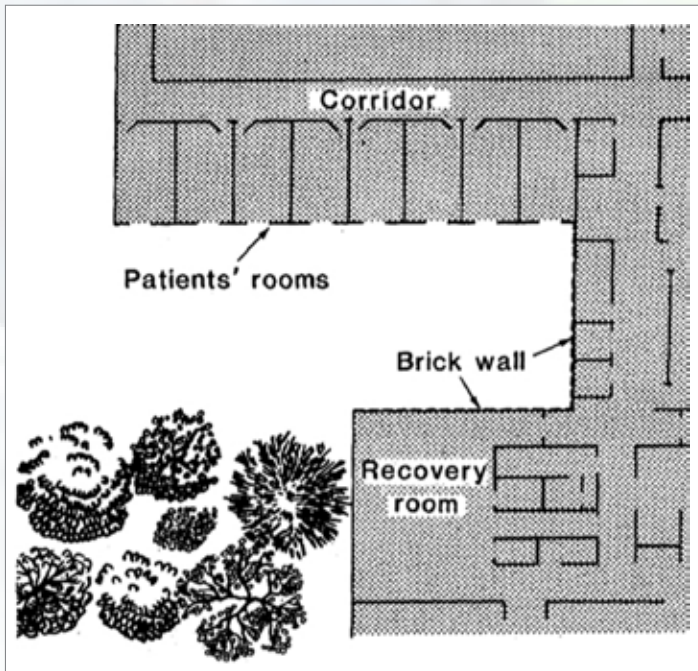
Improving Health and Well-Being in the Built Environment

## GREEN HELPS PEOPLE HEAL

ULRICH STUDY, 1984

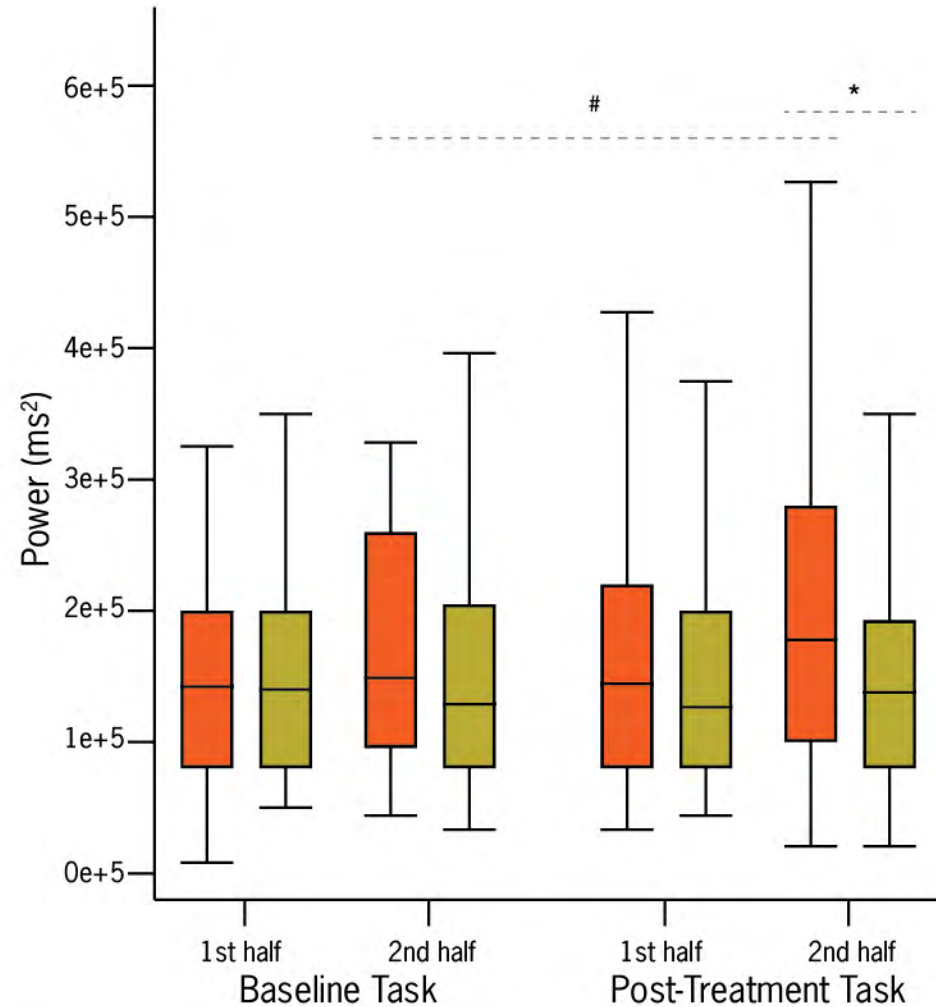
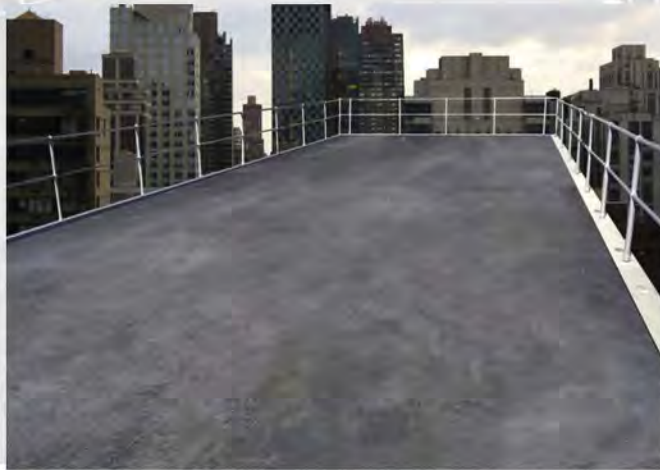
### A view to nature equals...

- Shorter hospital stays
- Fewer negative comments
- Fewer strong analgesics



# MICRO-BREAKS & ATTENTION RESTORATION

LEE, WILLIAMS, SARGENT ET AL., 2015



**Figure.** Boxplot of the median and variance of moment-to-moment response variability (reported as power). Participants viewed a concrete (orange boxes) or green (green boxes) roof. Data shown for the 1st and 2nd half baseline task, and the 1st and 2nd half post-treatment task indicates a significant difference between participants viewing a concrete and green roof. Source: Lee et al. 40-second green roof views sustain attention: The role of micro-breaks in attention restoration. *Journal of Environmental Psychology* 42(2015):182–189.



## CONSTRUCTS OF BIOPHILIC DESIGN

### Nature in the Space

Plants, water, and animals  
in the built environment



UNDER AFRICAN SKIES © StormSignal/Flickr

### Natural Analogues

Objects, materials, and  
patterns that evoke nature



### Nature of the Space

Differing spatial configurations  
of the built environment



WORMSLOE PLANTATION, GEORGIA © Bruce Tuten/Flickr



## 14 PATTERNS OF BIOPHILIC DESIGN

### Nature In The Space

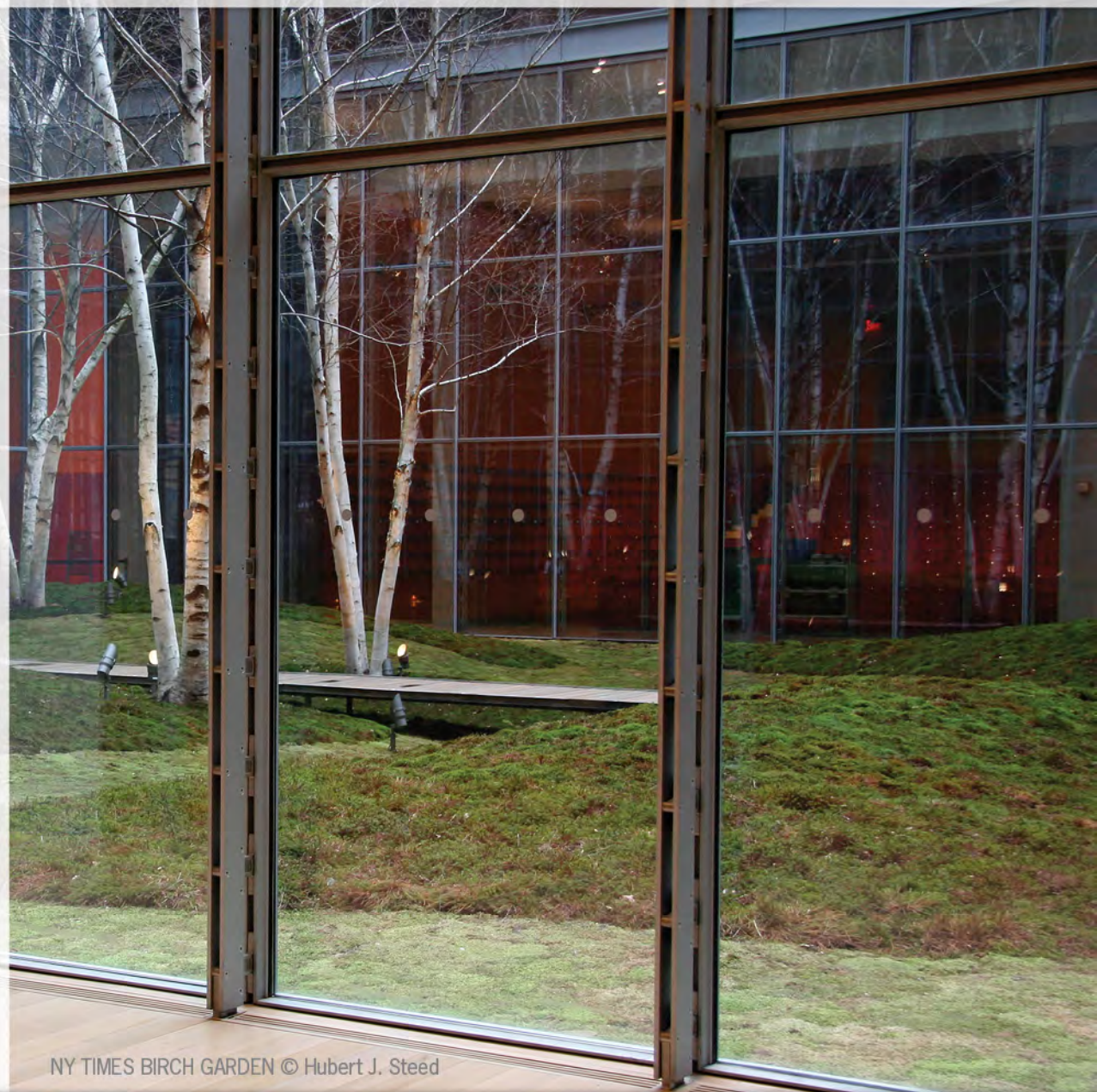
1. Visual Connection with Nature
2. Non-Visual Connection with Nature
3. Non-Rhythmic Sensory Stimuli
4. Thermal & Airflow Variability
5. Presence of Water
6. Dynamic & Diffuse Light
7. Connection With Natural Systems

### Natural Analogues

8. Biomorphic Forms & Patterns
9. Material Connection with Nature
10. Complexity & Order

### Nature Of The Space

11. Prospect
12. Refuge
13. Mystery
14. Risk



NY TIMES BIRCH GARDEN © Hubert J. Steed



# BIOPHILIC DESIGN PATTERNS & BIOLOGICAL RESPONSES

14 PATTERNS		STRESS REDUCTION	COGNITIVE PERFORMANCE	EMOTION, MOOD & PREFERENCE
NATURE IN THE SPACE	Visual Connection w/ Nature	Lowered blood pressure and heart rate	Improved mental engagement/ attentiveness	Positively impacted attitude and overall happiness
	Non-Visual Connection w/ Nature	Reduced systolic blood pressure and stress hormones	Positively impacted cognitive performance	Perceived improvements in mental health and tranquility
	Non-Rhythmic Sensory Stimuli	Positively impacted heart rate, systolic blood pressure and sympathetic nervous system activity	Observed and quantified behavioral measures of attention and exploration	
	Thermal & Airflow Variability	Positively impacted comfort, well-being and productivity	Positively impacted concentration	Improved perception of temporal and spatial pleasure (alliesthesia)
	Presence of Water	Reduced stress, increased feelings of tranquility, lower heart rate and blood pressure	Improved concentration and memory restoration; Enhanced perception and psychological responsiveness	Observed preferences and positive emotional responses
	Dynamic & Diffuse Light	Positively impacted circadian system functioning; Increased visual comfort		
	Connection w/ Natural Systems			Enhanced positive health responses; Shifted perception of environment
N. ANALOGUES	Biomorphic Forms & Patterns			Observed view preference
	Material Connection w/ Nature		Decreased diastolic blood pressure; Improved creative performance	Improved comfort
	Complexity & Order	Positively impacted perceptual and physiological stress responses		Observed view preference
NATURE OF THE SPACE	Prospect	Reduced stress	Reduced boredom, irritation, fatigue	Improved comfort and perceived safety
	Refuge		Improved concentration, attention and perception of safety	
	Mystery			Induced strong pleasure response
	Risk/Peril			Resulted in strong dopamine or pleasure responses

## CONNECTION WITH NATURAL SYSTEMS

- Evokes a relationship with the greater whole
- Makes one aware of seasonality and the cycles of life



BIOPHILIC DESIGN

Nature in the Space

## BIOMORPHIC FORMS & PATTERNS

- While not living things, our brain associates them as symbolic representations of life
- Certain proportions and sequences appear in nature and in sacred architecture
- Examples: Fibonacci sequence, Golden mean, Golden angle

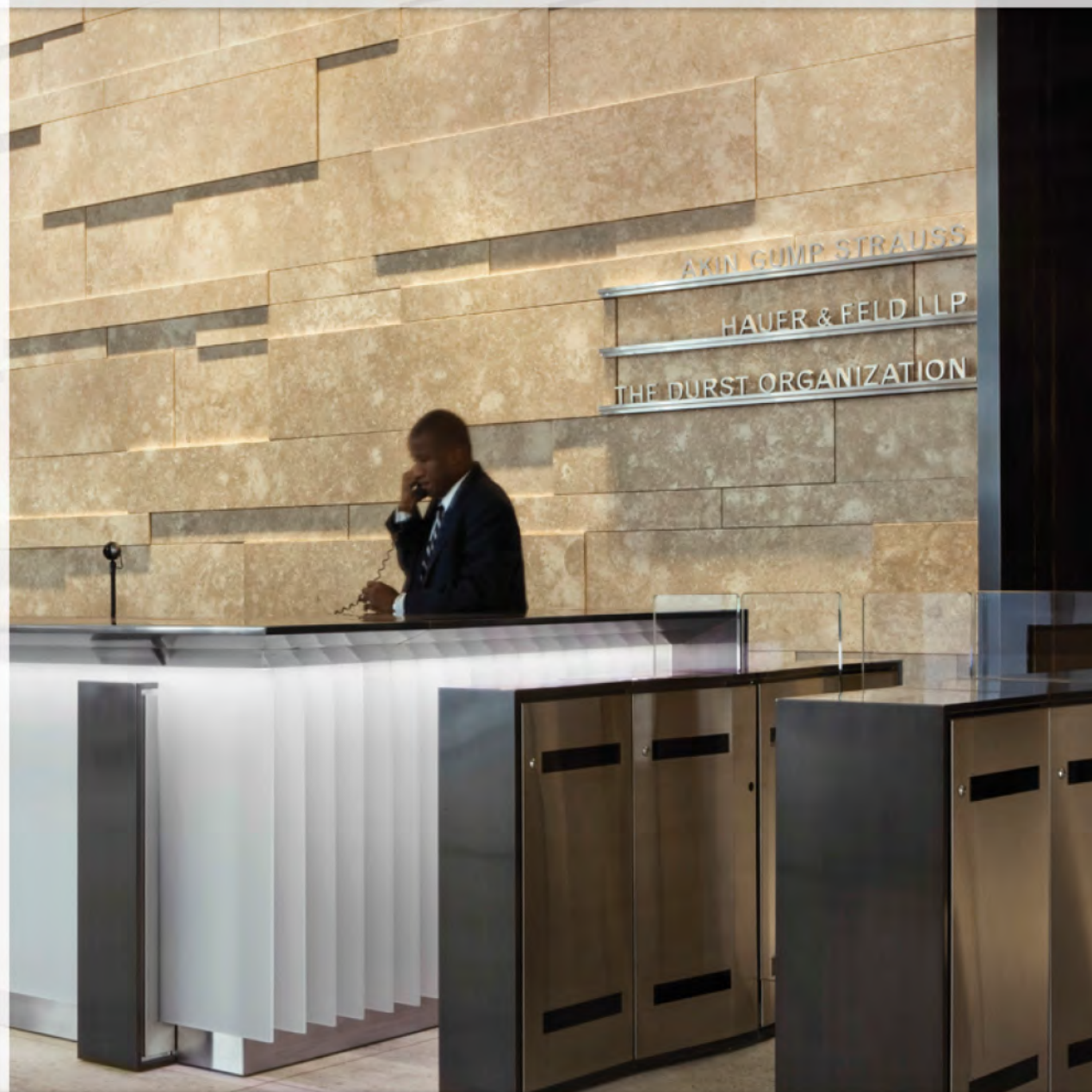


## MATERIAL CONNECTION WITH NATURE

- Use of natural materials in a space can lead to stress reduction



BANK OF AMERICA TOWER LOBBY, NYC,  
COOKFOX ARCHITECTS © Bilyana Dimitrova

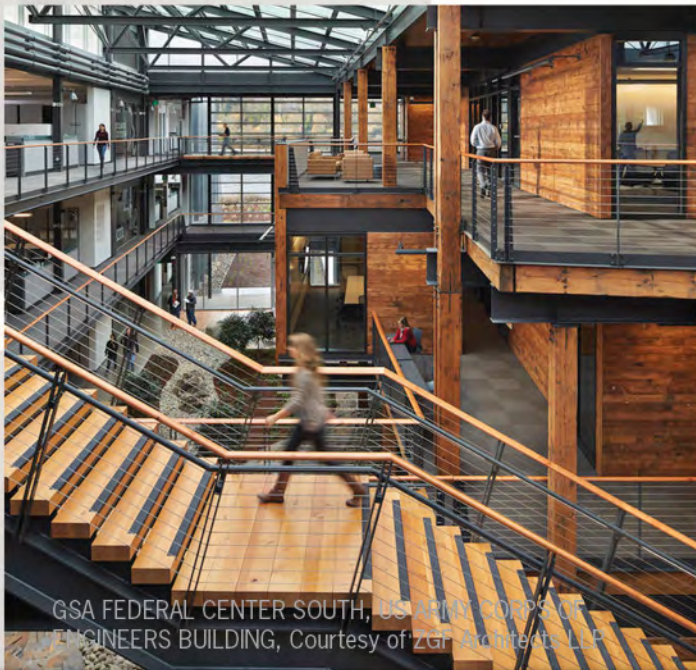


BIOPHILIC DESIGN

Natural Analogues

## PROSPECT

- An unimpeded view through space reduces fear and stress
- The experience is strengthened by having water, shade trees, and other preferred elements in the view



GSA FEDERAL CENTER SOUTH, US ARMY CORPS OF ENGINEERS BUILDING, Courtesy of ZGF Architects LLP



SALK INSTITUTE, LA JOLLA, CA, LOUIS KAHN, ARCHITECT © Heidi Theunissen



## REFUGE

- Provides retreat and restoration that leads to reduced stress, lower blood pressure, and a slower heart rate
- Usually achieved by a protected back and lowered canopy overhead



INGLENOOK, OAK PARK, IL



THE CLUB AT SPANISH PEAKS, MT © Bill Browning

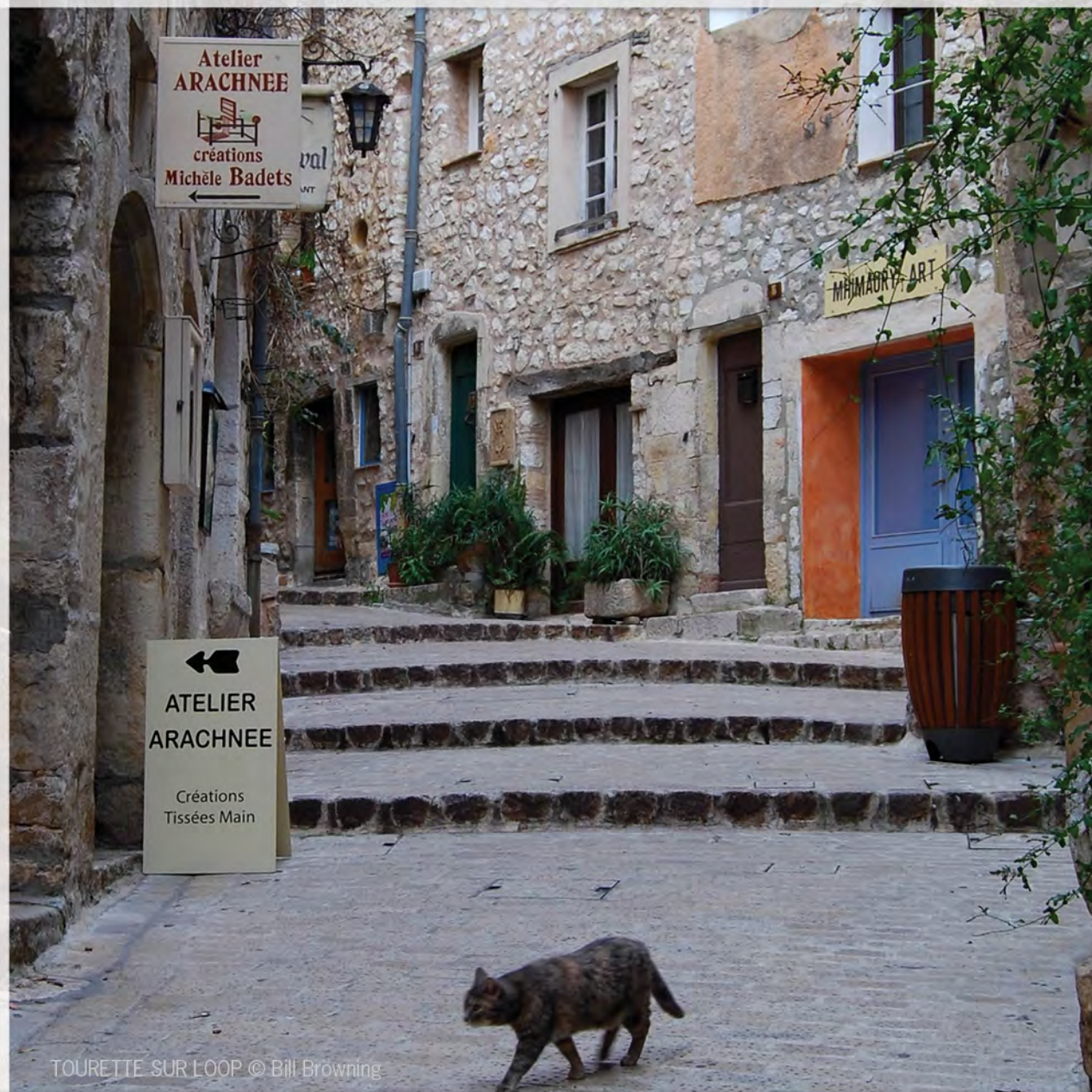


## MYSTERY

- Peaks curiosity
- Compells one to further explore a space



ONE JACKSON SQUARE © Michael Moran Studio



TOURETTE SUR LOOP © Bill Browning

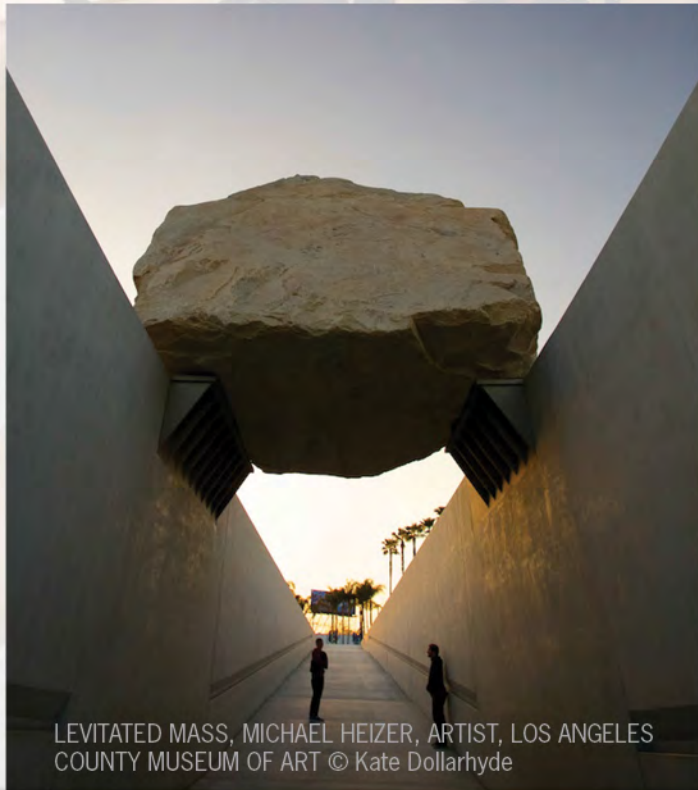


BIOPHILIC DESIGN

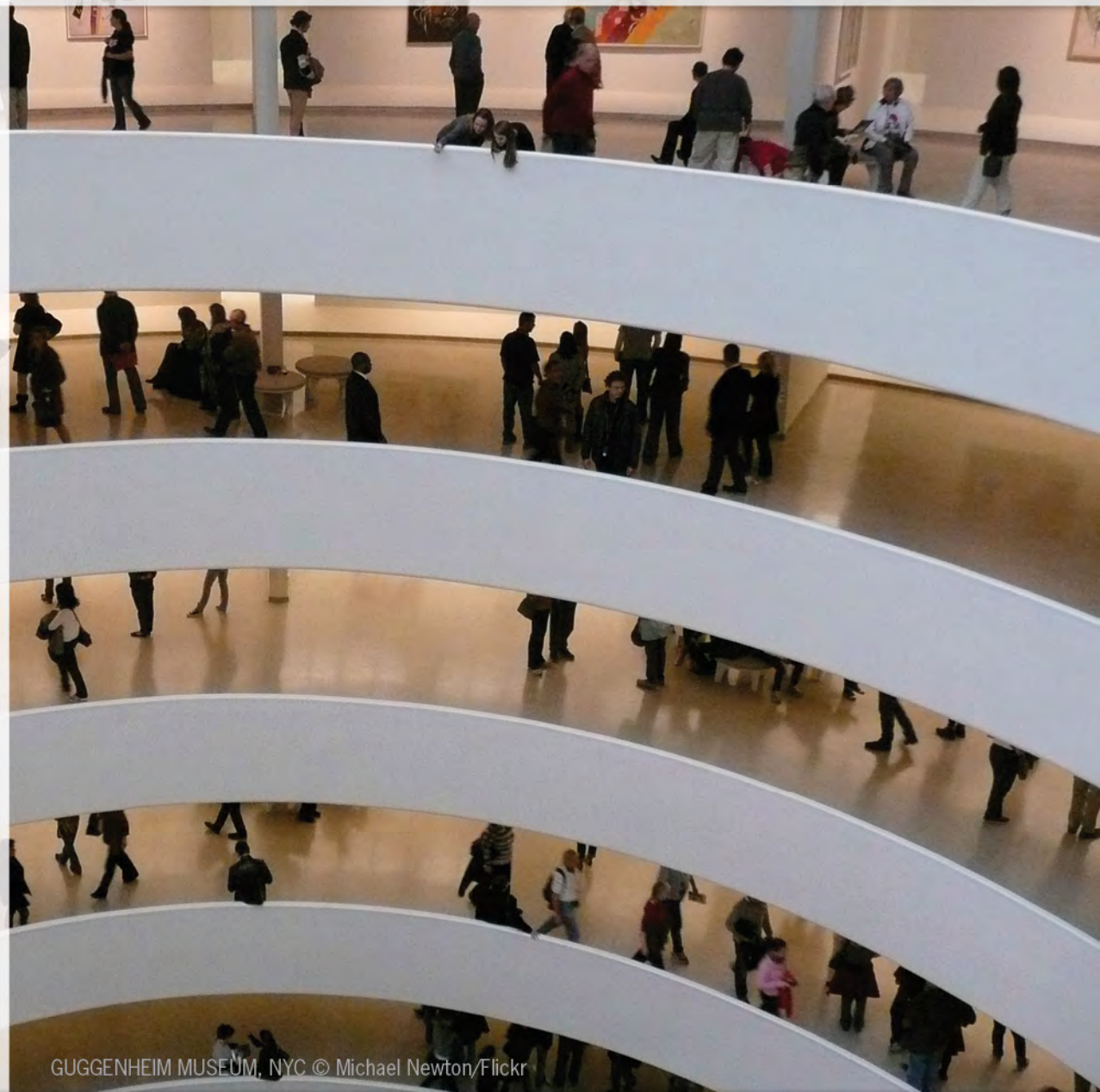
Nature of the Space

## RISK / PERIL

- Implied danger
- Identifiable safety



LEVITATED MASS, MICHAEL HEIZER, ARTIST, LOS ANGELES COUNTY MUSEUM OF ART © Kate Dollarhyde



GUGGENHEIM MUSEUM, NYC © Michael Newton/Flickr



BIOPHILIC DESIGN

Nature of the Space



**KICKSTARTER  
HEADQUARTERS**  
OLE SONDRESEN ARCHITECT



Kickstarter Headquarters, OLE SONDRESEN ARCHITECT © Ole Sondresen Architect



**BIOPHILIC DESIGN**

Patterns in Combination

# DIY BIOPHILIC DESIGN

## Guerrilla Gardening



GUERRILLA GARDEN BOOMBOX © MARK HOLLSWORTH

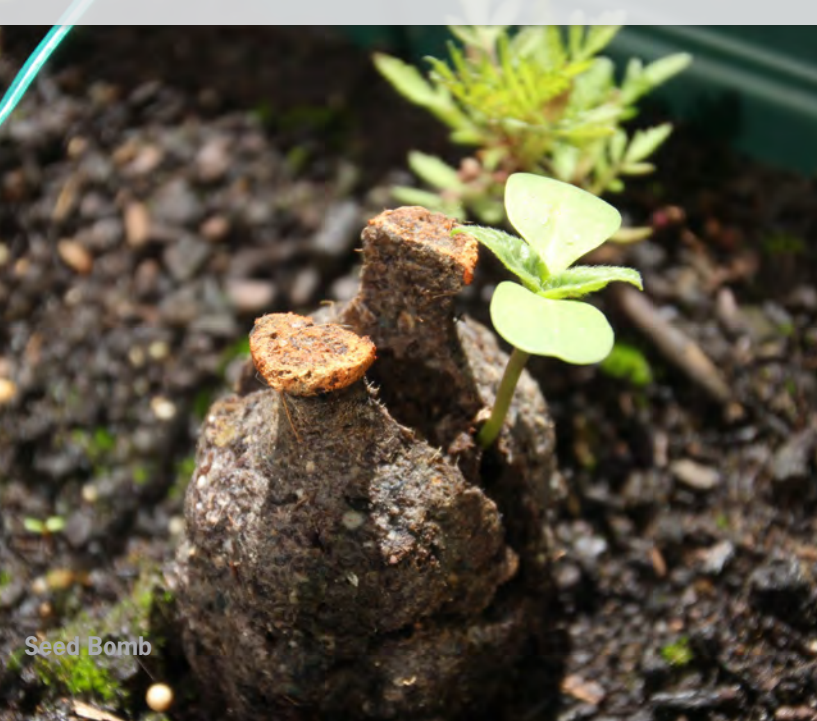


GUERRILLA GARDEN © Greenbook Pages



#ONENYC

DIY Biophilc Design



Seed Bomb



Newspaper Box Garden © Wired



Moss Art



Phoenix Grow House © Downtown Phoenix Journal



Grow House

© SA Studios



Streets of Melbourne

© Mark Hollsworth



Streets of Melbourne

© Mark Hollsworth



Tree Pit



## BIOPHILIC DESIGN

## DIY Biophilic Design

# DIY BIOPHILIC DESIGN

Parklets / ParkingDay



PARKLET © CITY OF PHOENIX



PARKING DAY © Onward State

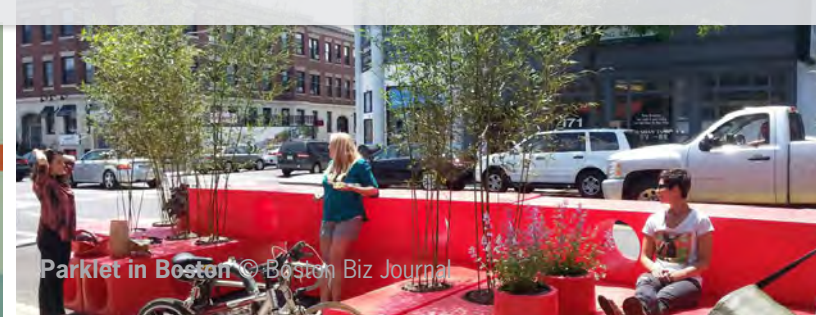


#ONENYC

DIY Biophilic Design



SF Park(ing) Day © ReBar



Parklet in Boston © Boston Biz Journal



Parklet in Bellingham WA © 21st Highways



Park(ing) Day in Brazil © Royston Rascals



Park(ing) Day at ASLA © ASLA



Park(ing) Day in London © The Green Dots

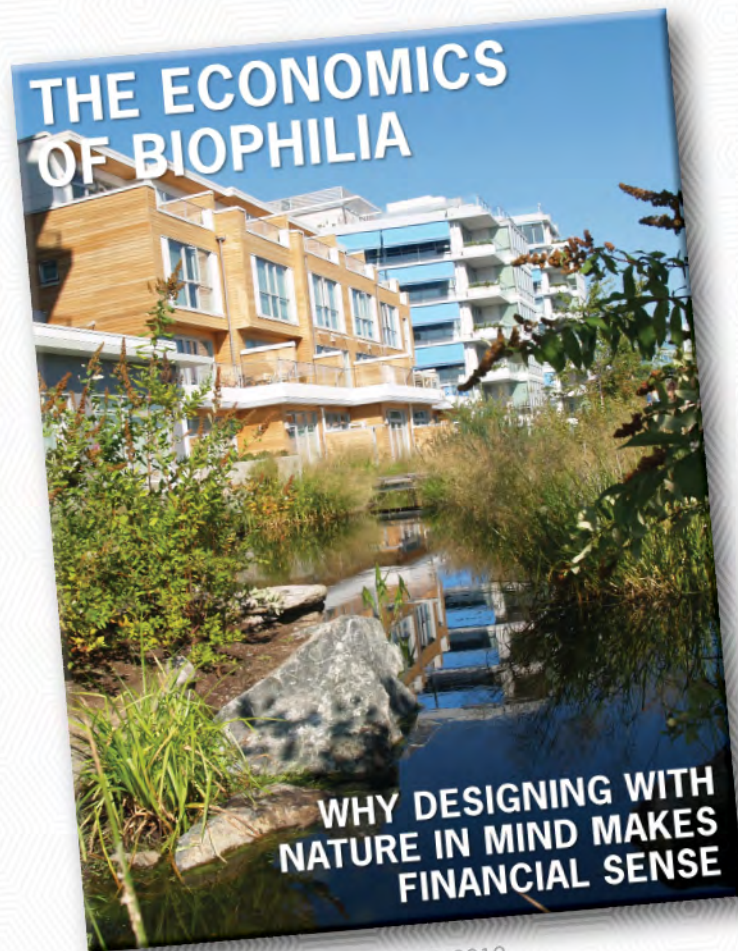


Park(ing) Day

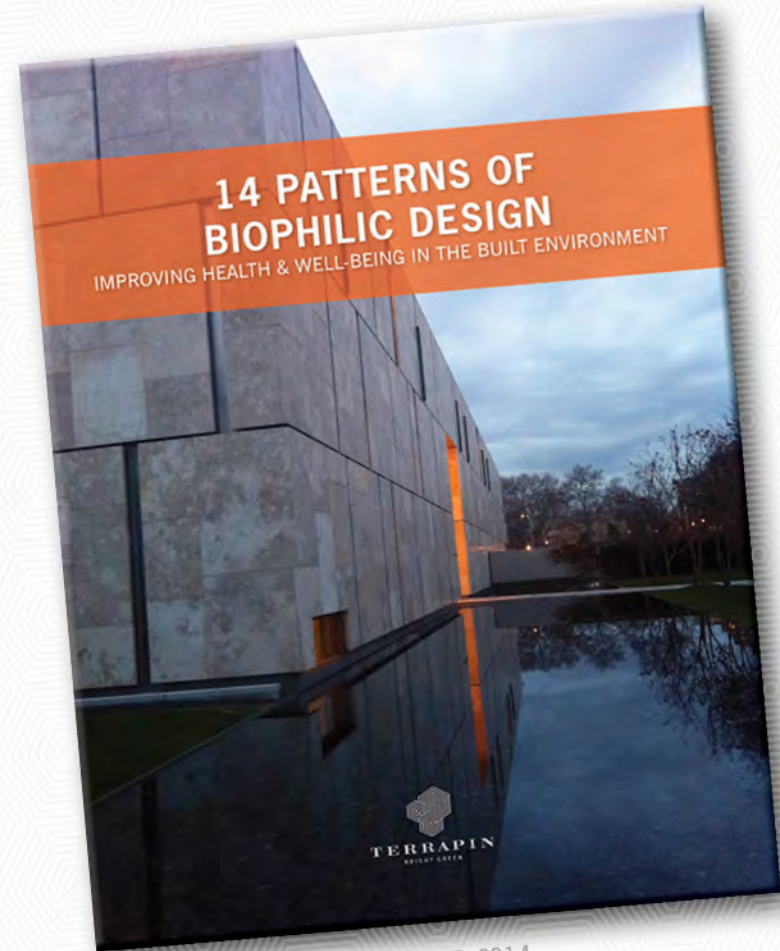


BIOPHILIC DESIGN

DIY Biophilic Design



PUBLISHED 2012



PUBLISHED 2014




BIOPHILIC DESIGN

@TerrapinBG | [www.TerrapinBG.com](http://www.TerrapinBG.com) | #14Patterns

# ASID ONLINE BIOPHILIC DESIGN COURSE

## “Biophilic Design: Improving Health and Well-Being in the Built Environment”

Take it today at  
<http://academy.asid.org/>


**BIOPHILIC DESIGN**  
WITH TERRAPHIL BRIGHT GREEN

MENU

- ▼ The Patterns
  - The Patterns
  - ▶ [P1] Visual Connection with Nature
  - ▶ [P2] Non-Visual Connection with Nature
  - ▶ [P3] Non-Rhythmic Sensory Stimuli
  - ▶ [P4] Thermal & Airflow Variability
  - ▶ [P5] Presence of Water
  - ▶ [P6] Dynamic & Diffuse Light
  - ▶ [P7] Connection with Natural Systems
  - ▶ [P8] Biomorphic Forms & Patterns
  - ▼ [P9] Material Connection with Nature
    - [P9] Material Connection with Nature
    - [P9] Practice Scenario
  - ▶ [P10] Complexity & Order
  - ▶ [P11] Prospect
  - ▶ [P12] Refuge
  - ▶ [P13] Mystery
  - ▶ [P14] Risk/Peril
- ▶ Design Guidelines
- ▶ Case Studies

### Biophilic Design: Improving Health and Well-Being in the Built Environment

## [P9] MATERIAL CONNECTION WITH NATURE



Project: Wooden furniture, Photo Credit: Tom Merton

**DEFINITION:** Materials and elements from nature that, through minimal processing, reflect the local ecology or geology to create a distinct sense of place.

**EXPERIENCE:** Feels rich, warm and authentic, and sometimes stimulating to the touch.

[P9]

ROOTS

DESIGN

EXAMPLES

RELATIONSHIPS

CLICK ON EACH TAB TO LEARN MORE ABOUT THIS PATTERN

CLICK NEXT TO CONTINUE

◀ PREV

NEXT ▶



BIOPHILIC DESIGN

Improving Health and Well-Being in the Built Environment

## NYC LEADERSHIP

#ONENYC

“In ten years, New York City will celebrate its 400th anniversary. #OneNYC envisions our city in its 5th century and sets goals to ensure that all New Yorkers can thrive in a city that is dynamic, livable, and safe.”

-Mayor Bil de Blasio



NYC SKYLINE © Time Magazine



#ONENYC

Zero Waste by 2030

## NYC LEADERSHIP

Enhance the City's curbside recycling program by offering single stream recycling by 2020.



ORGANICS COLLECTION © Gothamist



#ONENYC

Zero Waste by 2030

## NYC LEADERSHIP

Expand the New York City Organics program to serve all New Yorkers by the end of 2018.



PUBLIC COMPOST SORTING © Kris Venezia



#ONENYC

Zero Waste by 2030

## NYC LEADERSHIP

Reduce the use of plastic bags and other non-compostable waste.



BAN THE BAG © Green Schools Alliance



#ONENYC

Zero Waste by 2030

## NYC LEADERSHIP

Give every New Yorker the opportunity to recycle and reduce waste, including NYCHA housing.



PUBLIC RECYCLING © JJ via Flickr



#ONENYC

Zero Waste by 2030

## NYC LEADERSHIP

Make all schools “Zero Waste Schools.”



SCHOOL RECYCLING EFFORTS



#ONENYC

Zero Waste by 2030

## NYC LEADERSHIP

Expand opportunities to reuse and recycle textiles and electronic waste.

**BROADWAY**  
green  alliance  
broadwaygreen.com

**BROADWAY**  
green  alliance

SCHOOL RECYCLING EFFORTS



#ONENYC

Zero Waste by 2030

## NYC LEADERSHIP

Develop an equitable blueprint for a Save-As-You-Throw program to reduce waste.



NYC STREET COLLECTION © NY Times



#ONENYC

Zero Waste by 2030

## NYC LEADERSHIP

Reduce commercial waste disposal  
by 90 percent by 2030.



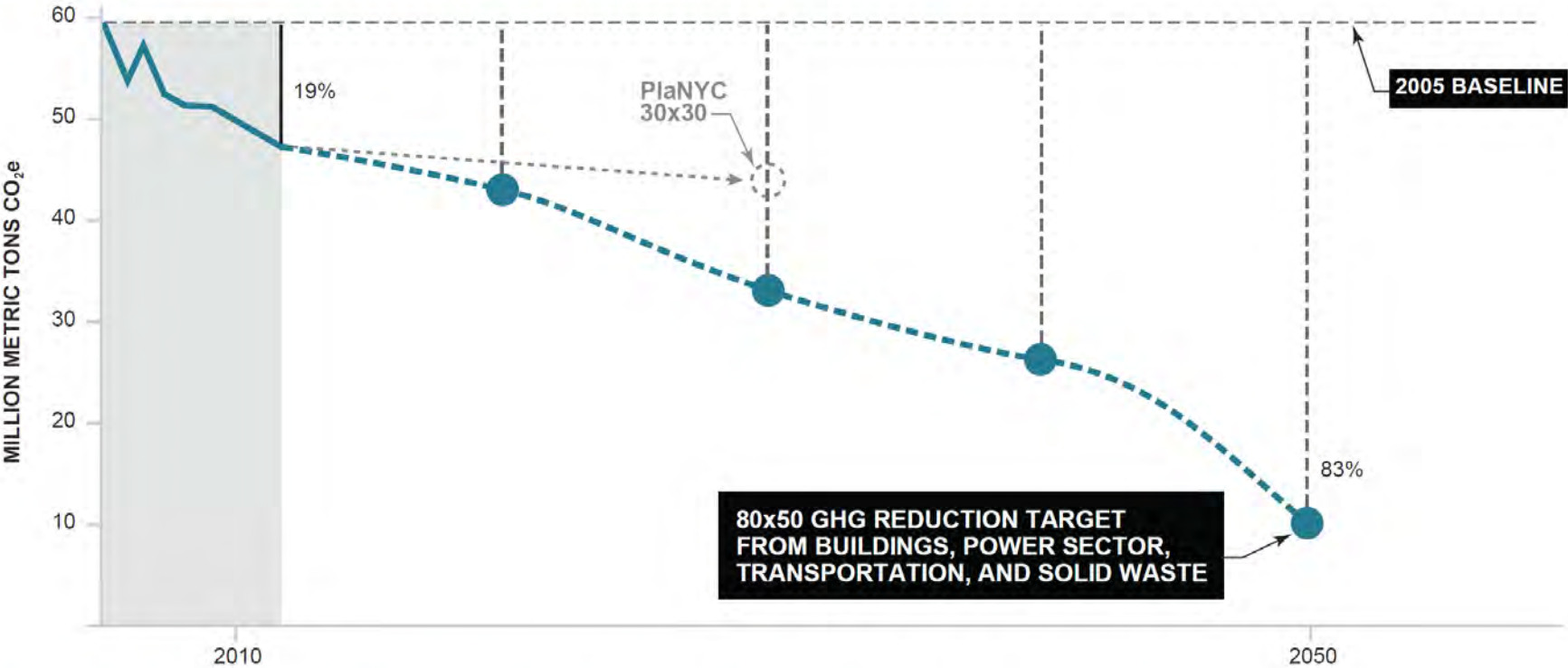
NYC RECYCLE CUBES



#ONENYC

Zero Waste by 2030

Pathways for Reductions in Citywide Greenhouse Gas Emissions



SOURCE: NEW YORK CITY MAYOR'S OFFICE OF LONG-TERM PLANNING AND SUSTAINABILITY



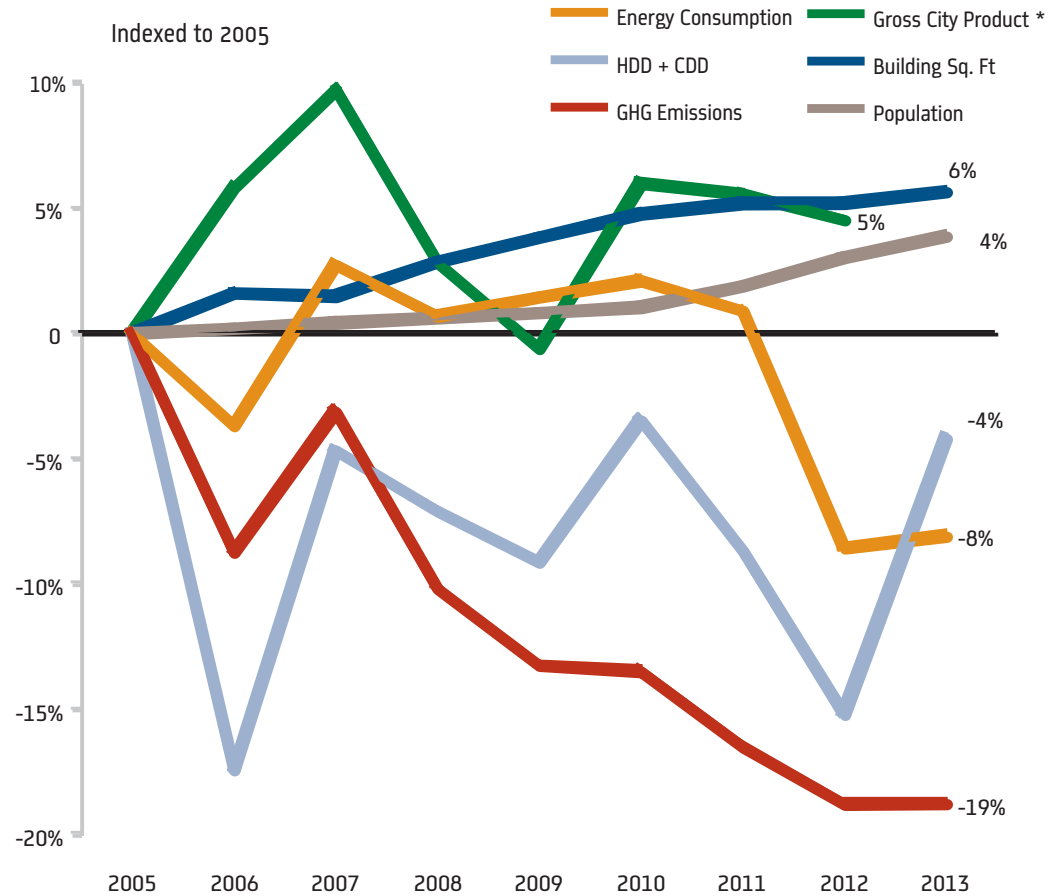
80X50

New York's GHG Mitigation Action Plan

## 5-YEARS AFTER PLANYC

- Growth in Population and in SQFT per person
- Energy Consumption pretty closely mirrors HDD+CDD until 2012-2013
- Reductions in GHG per kWh

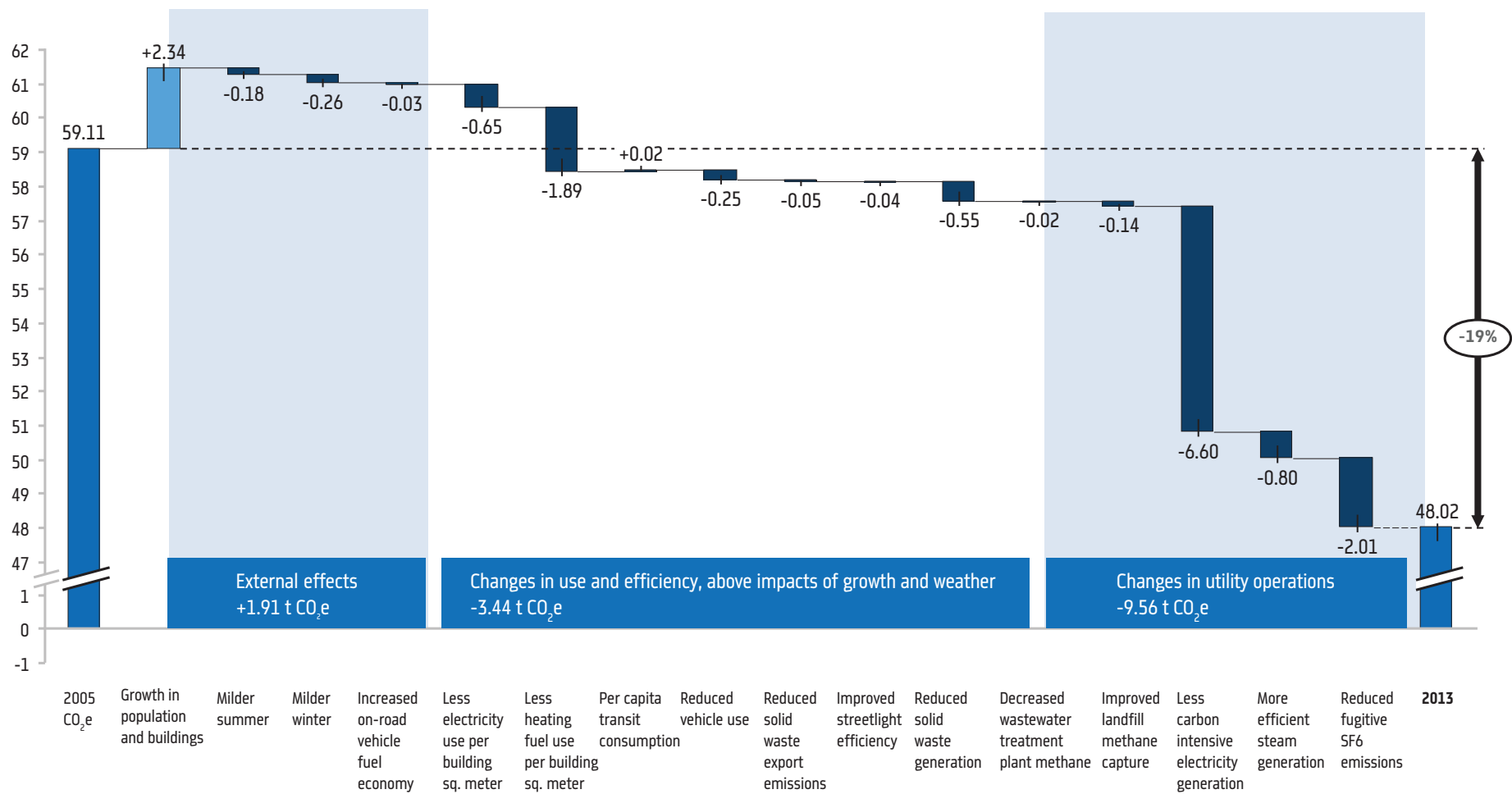
Fig. 1: Energy, GHG Emissions and Economic Indicators



Source: GCP - NYC Office of Management & Budget

SOURCE: MAYOR'S OFFICE OF SUSTAINABILITY; GCP - NYC OFFICE OF MANAGEMENT AND BUDGET



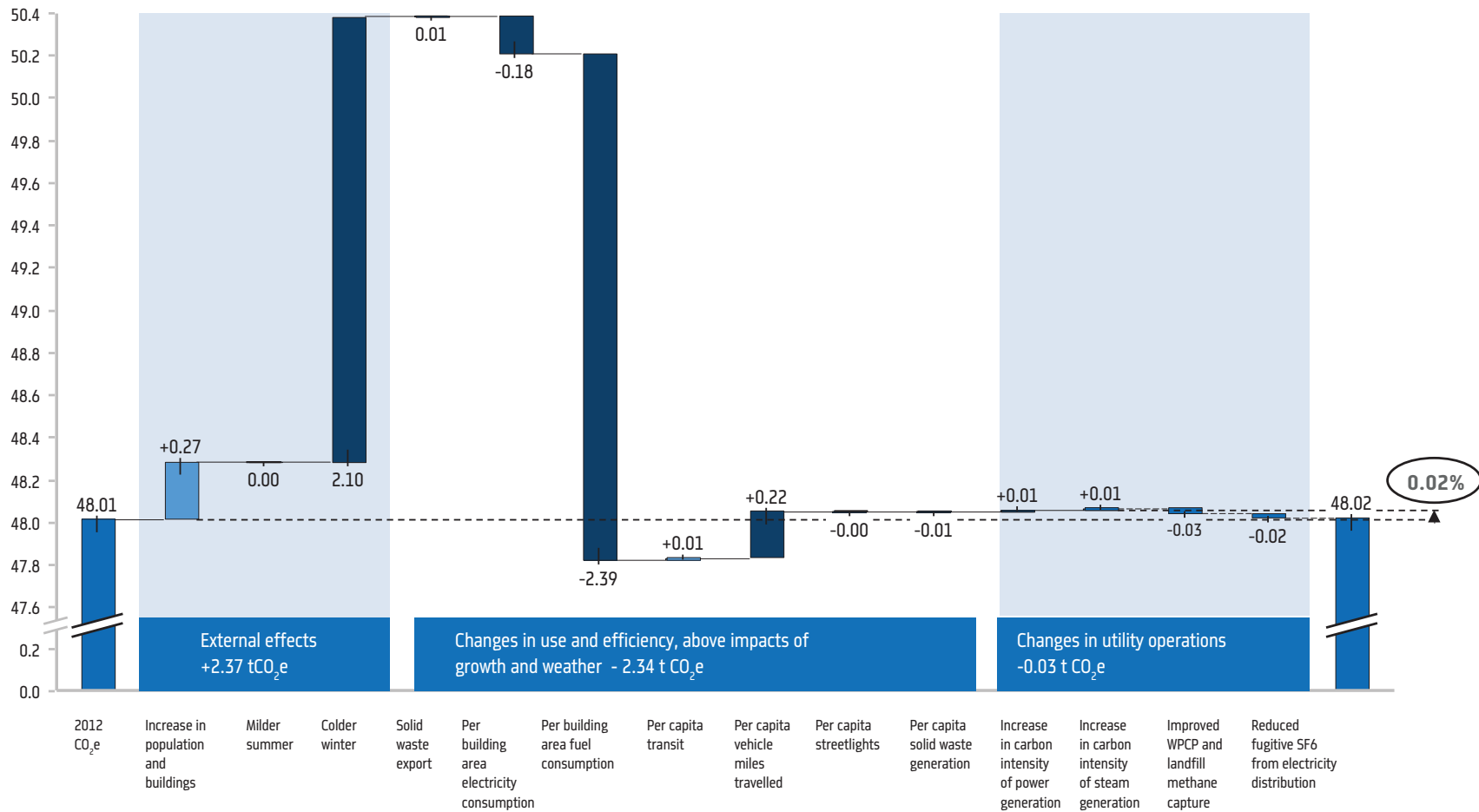


SOURCE: MAYOR'S OFFICE OF SUSTAINABILITY; 2014 GHG INVENTORY



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New York's GHG Mitigation Action Plan



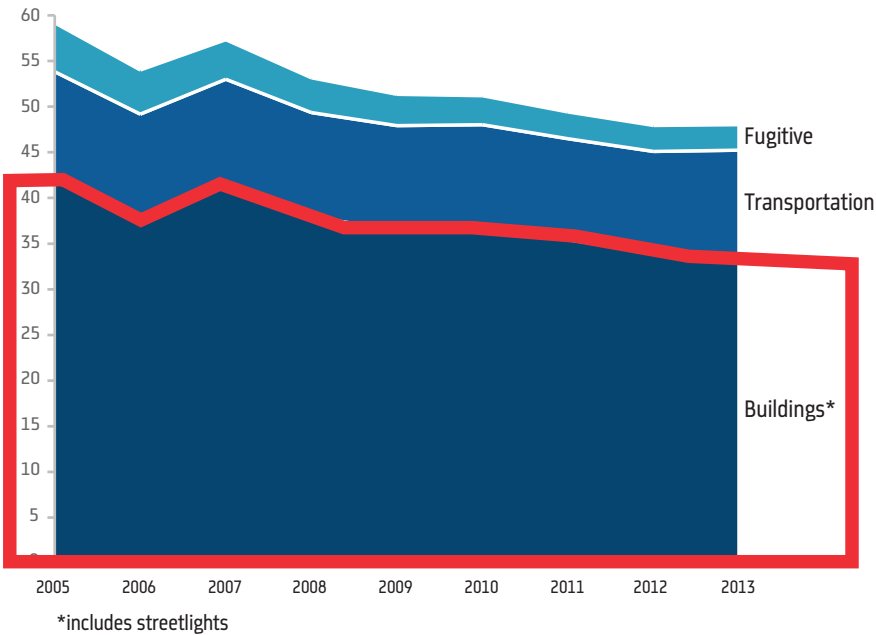
SOURCE: MAYOR'S OFFICE OF SUSTAINABILITY; 2014 GHG INVENTORY



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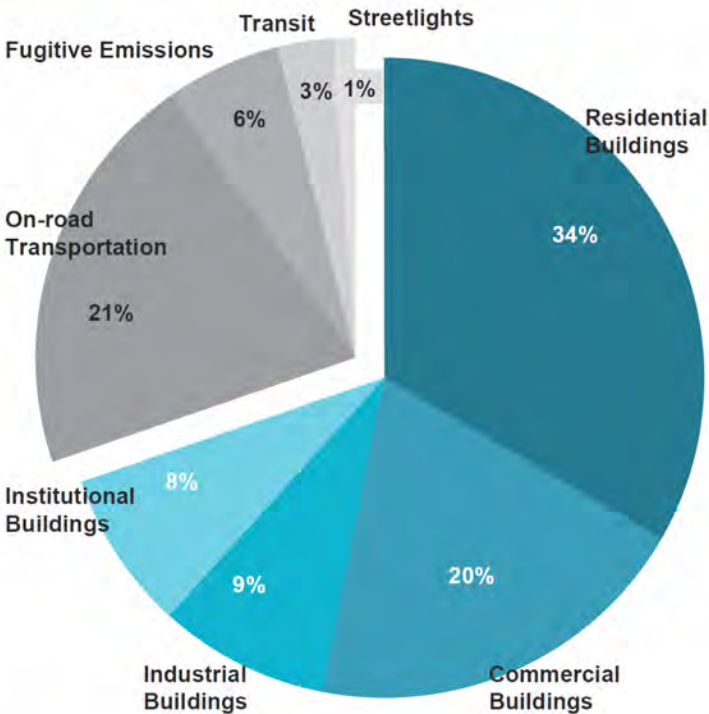
New York's GHG Mitigation Action Plan

**Fig. 8: 2005 to 2013 Citywide Annual GHG Emissions by Sector**  
 GHG Emissions  
 (Million tCO<sub>2</sub>e)



Source: NYC Mayor's Office

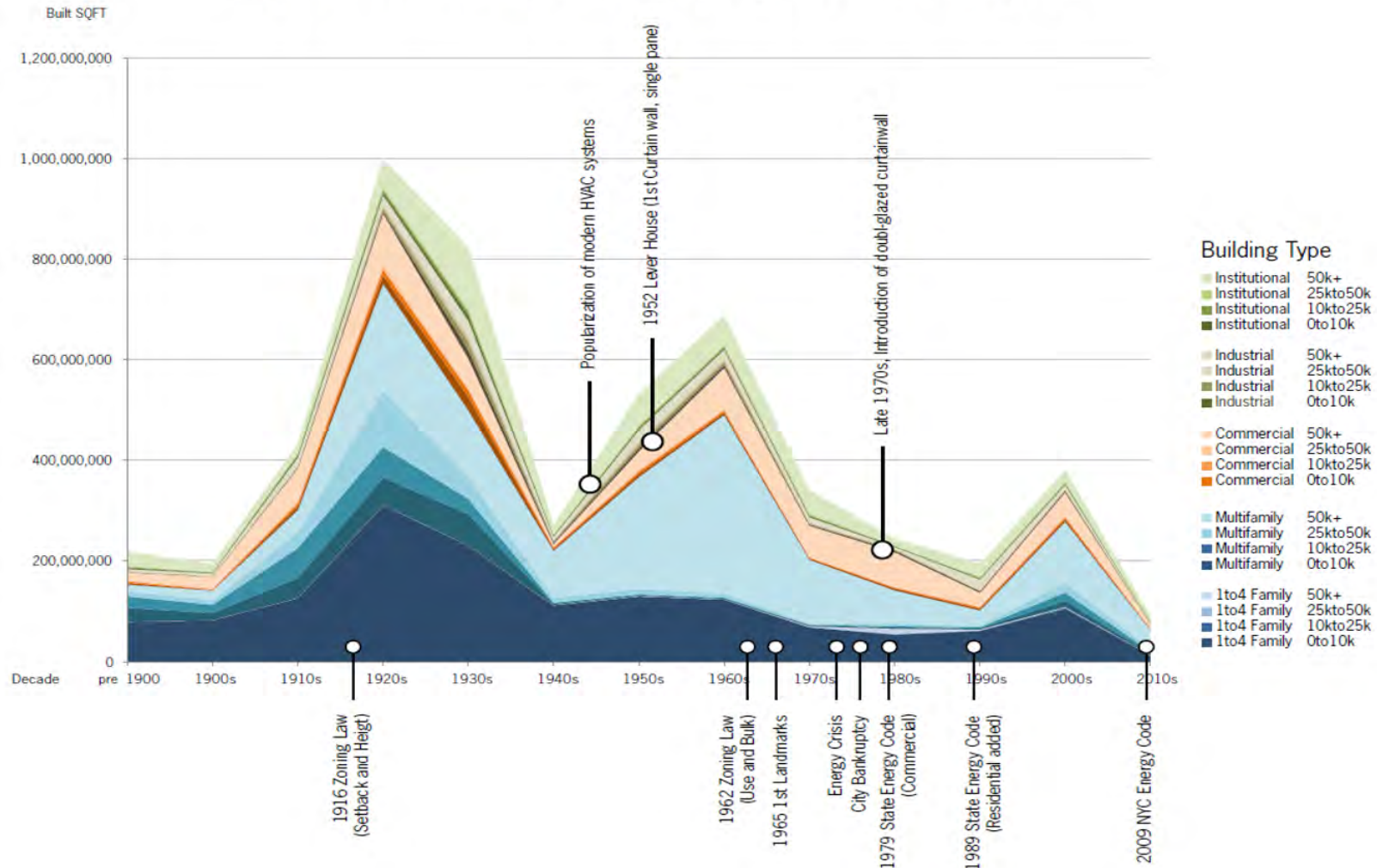
**New York City 2013 Greenhouse Gas Emissions by Sector**



SOURCE: MAYOR'S OFFICE OF SUSTAINABILITY; 2014 GHG INVENTORY AND ONE CITY BUILT TO LAST



# Age of NYC Built Area By Type/Size (SQFT)



SOURCE: PLUTO 14V2



80X50

New York's GHG Mitigation Action Plan

# Age of NYC Built Area By Type/Size (SQFT)



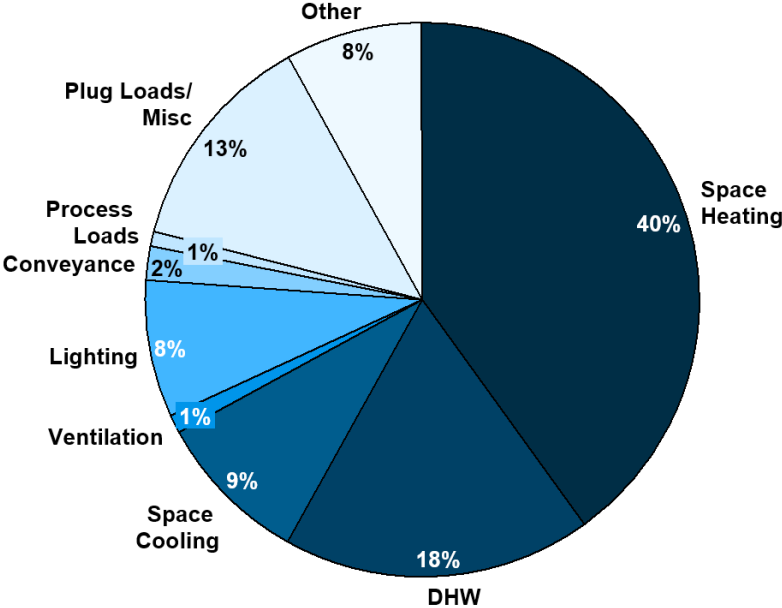
SOURCE: TERRAPIN BRIGHT GREEN



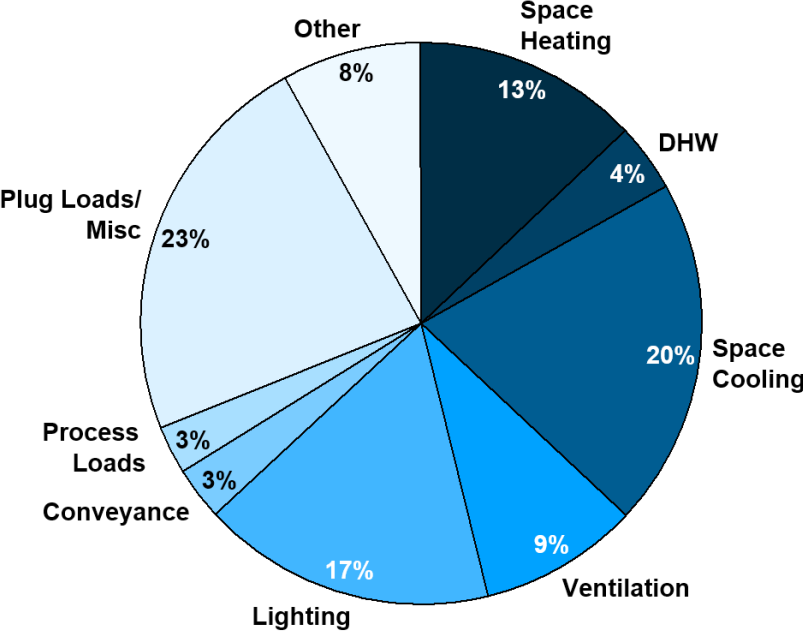
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New York's GHG Mitigation Action Plan

**Multifamily Buildings**  
(Over 50,000 Square Feet)



**Commercial Buildings**  
(Over 50,000 Square Feet)



SOURCE: ONE CITY, BUILT TO LAST



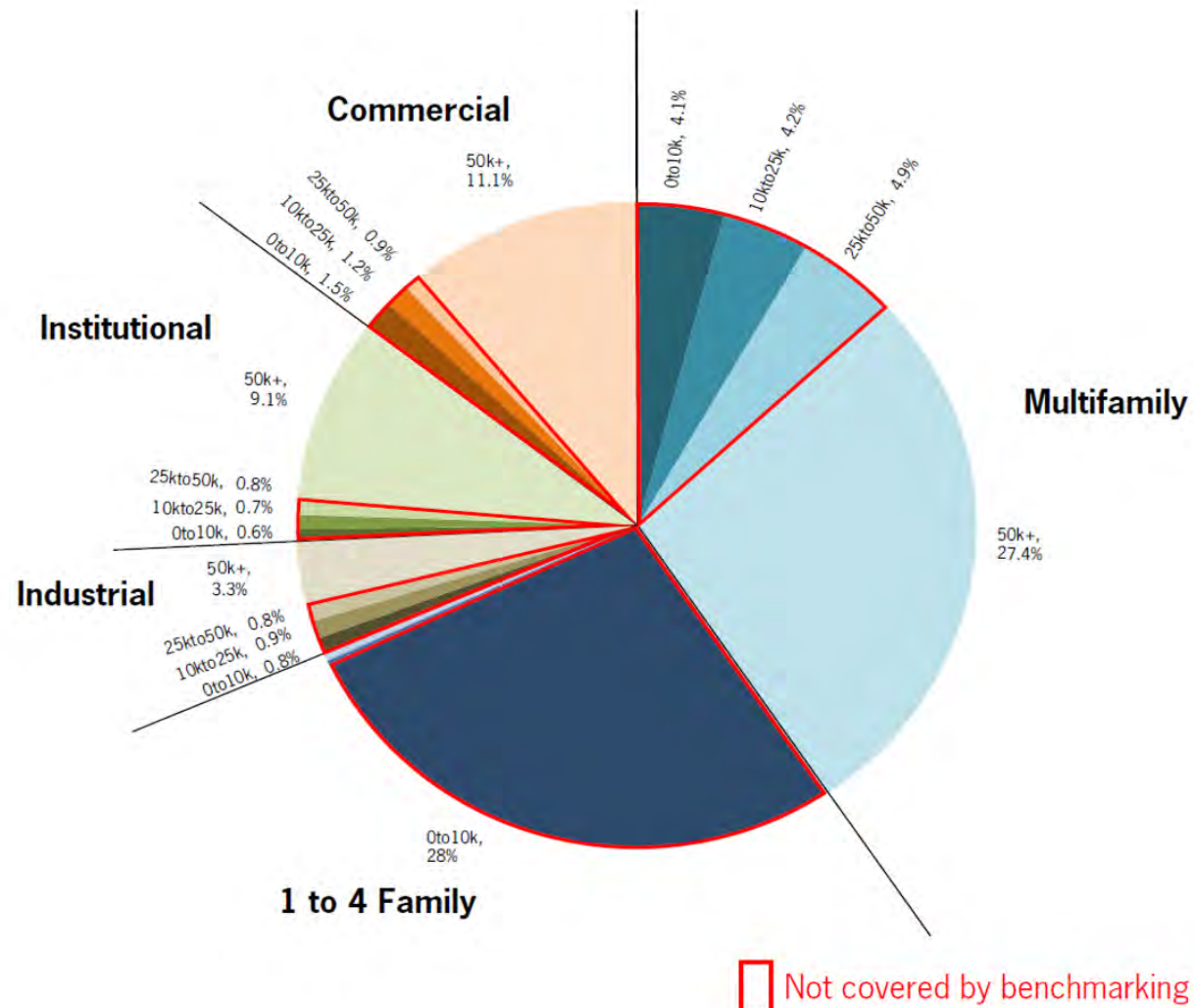
## NEWLY AVAILABLE DATA SOURCES

### NYC'S BENCHMARKING LAWS

New York City instituted benchmarking laws (LL84 and LL87) in 2010 with the Greater Greener Buildings Plan. These laws have resulted in a phenomenal new dataset:

- City Buildings and Buildings over 50,000 sqft only are benchmarked every year
- Retrocommissioning and audits every 10-years (cost carried by building owner)

**Over 10,000  
benchmark data  
points. 1,500  
comprehensive audits!**



SOURCE: PLUTO 14V2



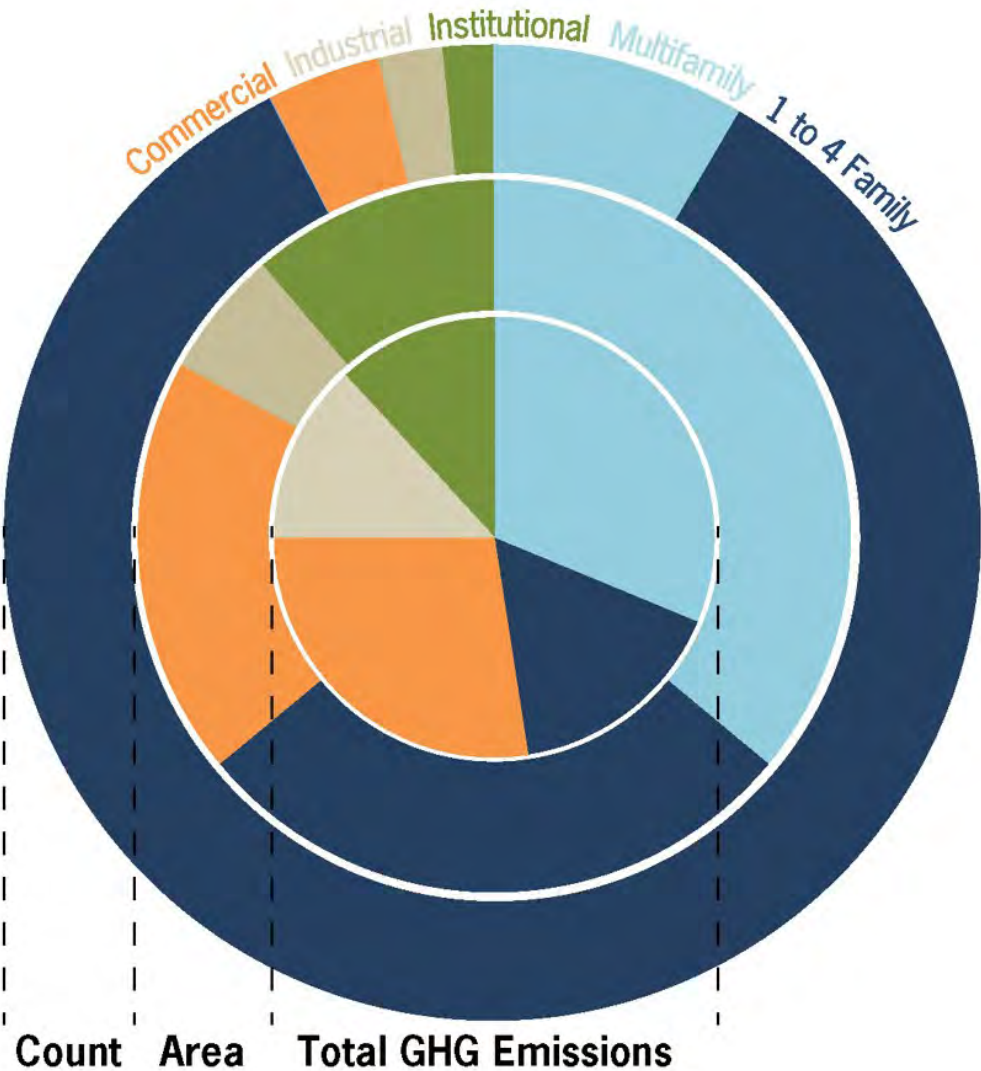
80X50

New York's GHG Mitigation Action Plan

NEWLY AVAILABLE DATA  
SOURCES  
NYC'S BENCHMARKING LAWS

Most of GHG emissions covered by  
15,000 buildings covered by LL84.  
But, small buildings, which, by count,  
is

85% of the  
buildings, aren't  
covered.



SOURCE: PLUTO14V2 AND MOS GHG INVENTORY



- 1 Lead by example.** The City will pave the way by implementing innovative technologies and strategies in City-owned buildings that will set the example for achieving deep carbon reductions. This also means working with the federal government on new strategies to reduce energy use in public housing and mobilizing business leaders and communities in our effort to tackle climate change.
- 2 Empower New Yorkers to take action.** The City will create programs and policies to reduce the risks and complexities of retrofitting buildings and empower New Yorkers to act. This includes providing educational resources and expanding financial resources to help cover the costs of projects. The City can also research local applicability of emerging technologies and help bring them to market, particularly where they promote deep energy retrofit projects.
- 3 Hold New York City's buildings to the highest energy performance standards.** The City will ensure our buildings meet the highest standards. This includes improving compliance with existing laws, raising standards for energy performance on new construction and renovations, and promoting resiliency improvements during efficiency upgrades.
- 4 Ensure benefits are shared by New Yorkers in every neighborhood.** The City will promote energy efficiency and renewable energy across more communities and building sectors, including affordable housing and small and mid-sized buildings. The City will also create new programs so local workers benefit from the job growth and economic activity that result from efficiency investments.
- 5 Use data, analysis, and stakeholder feedback to drive the approach.** As initiatives are implemented, the City will take a data-driven approach based on energy use information, real estate market data, engineering analysis, and other sources. We will collaborate with stakeholders along the way, particularly when shaping the approach for specific building sectors and communities. We will hold ourselves accountable by closely tracking and reporting our progress to the public.

SOURCE: PAGE FROM ONE CITY, BUILT TO LAST

