



# Green Building, Energy, and GHG Emissions

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Vice President Research  
U.S. Green Building Council

# Past

**Green building** started with a **curve** and a **simple idea...**

Regulations

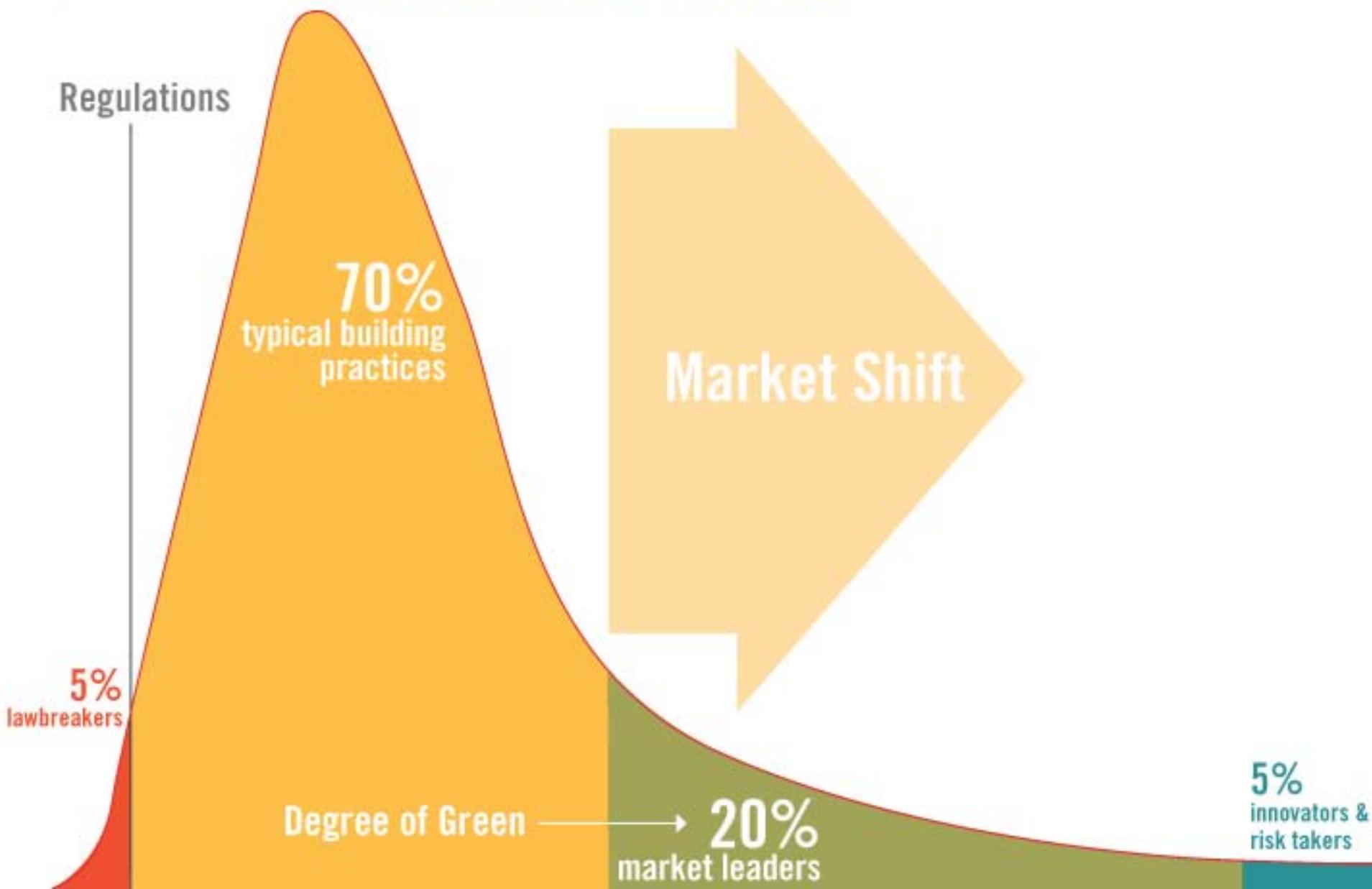
70%  
typical building  
practices

Market Shift

5%  
lawbreakers

Degree of Green → 20%  
market leaders

5%  
innovators &  
risk takers



# Moving the Curve

- **Professionals** with a common technical vocabulary
- **Tools** to identify strategies and define high performance
- **Processes** to document, verify, and reward leaders





**Legend**

**USGBC Green Buildings**

Green Buildings

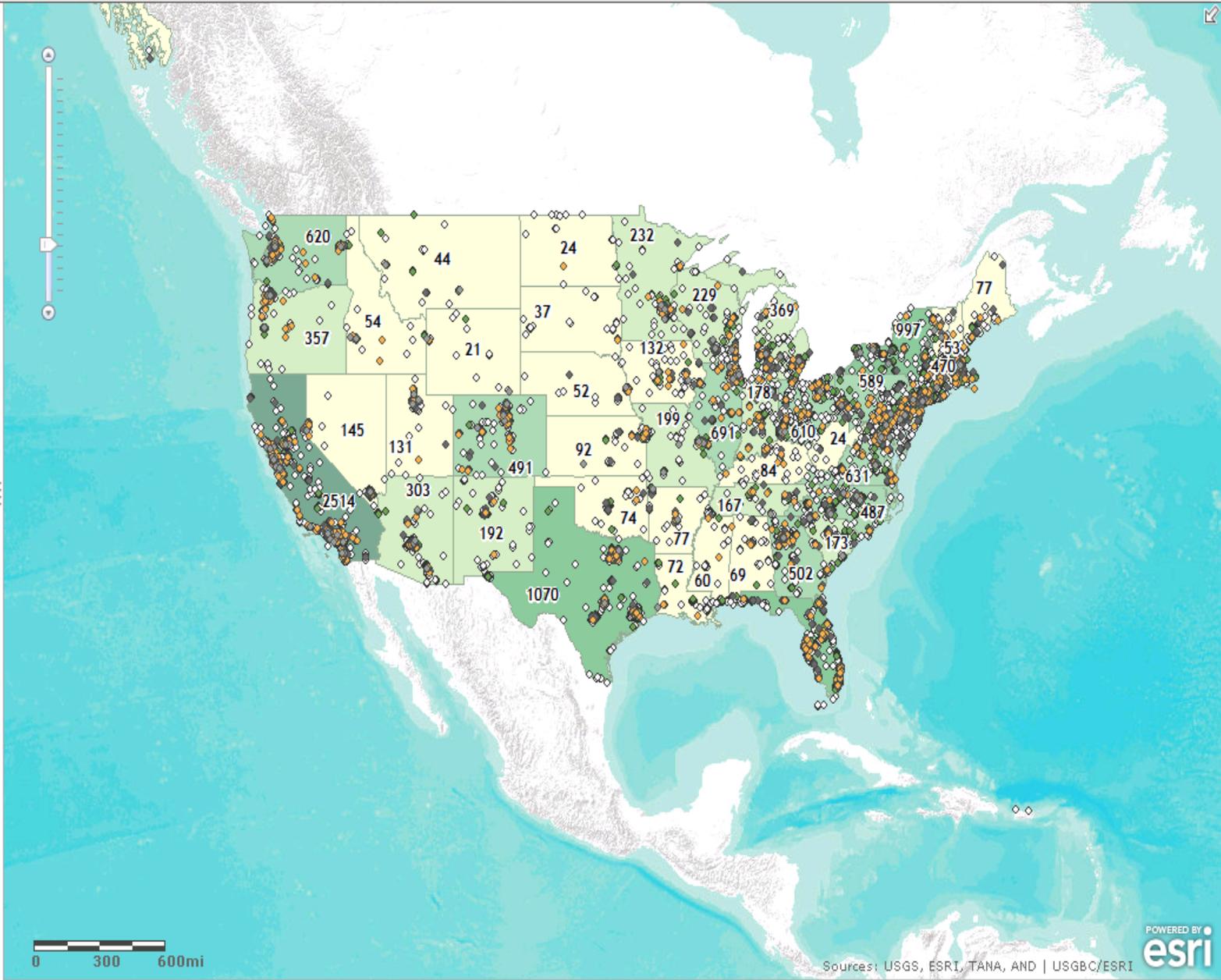
LEED Data (large scales)

LEED Data

- Certified - Platinum 
- Certified - Gold 
- Certified - Silver 
- Certified 
- Registered Only 

LEED Data-Project Labels

- Certified - Platinum
- Certified - Gold
- Certified - Silver



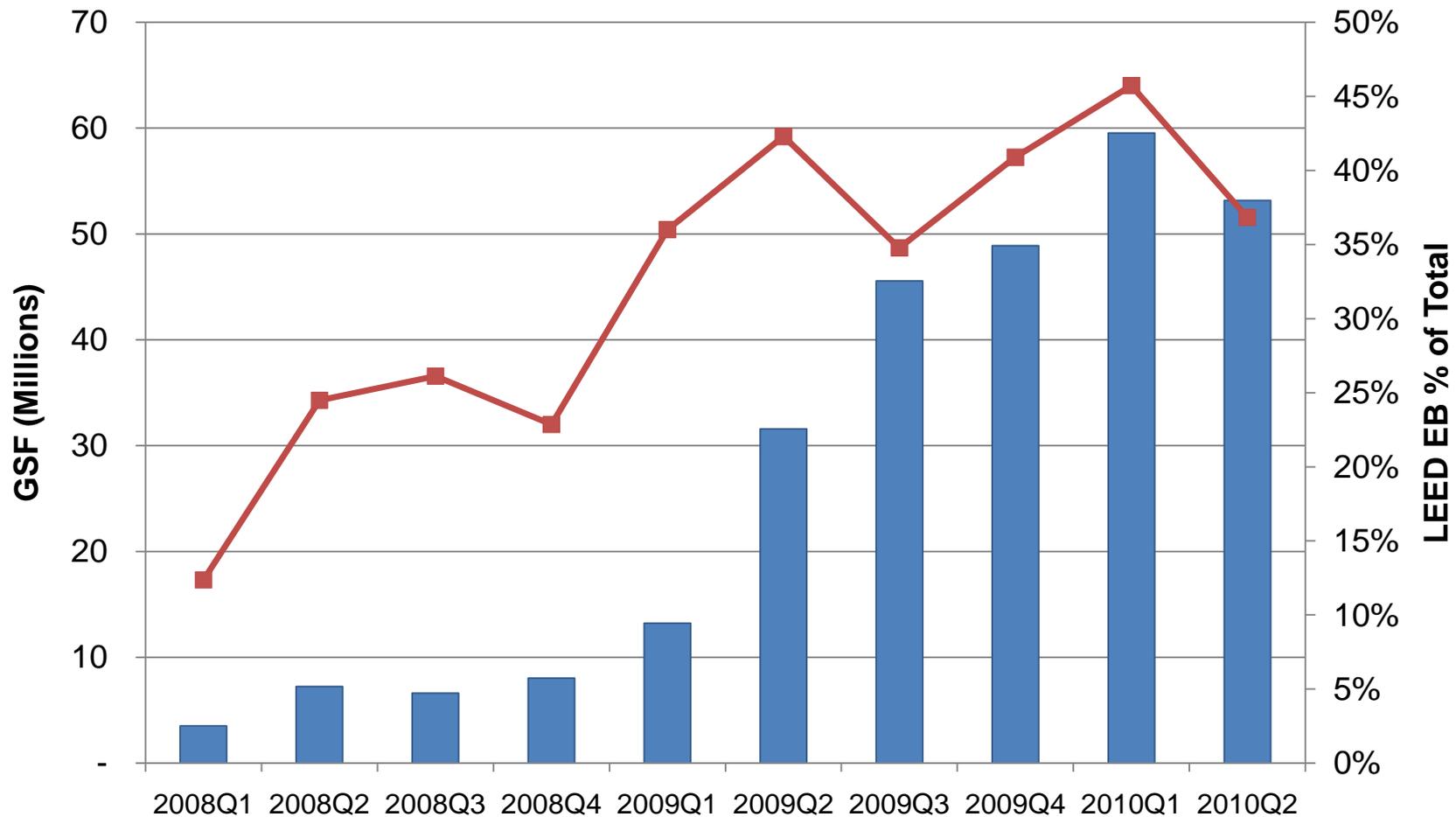


# Present

**Impact-driven  
priorities** across the  
**lifecycle** of buildings  
and communities

# Rise of Existing Buildings

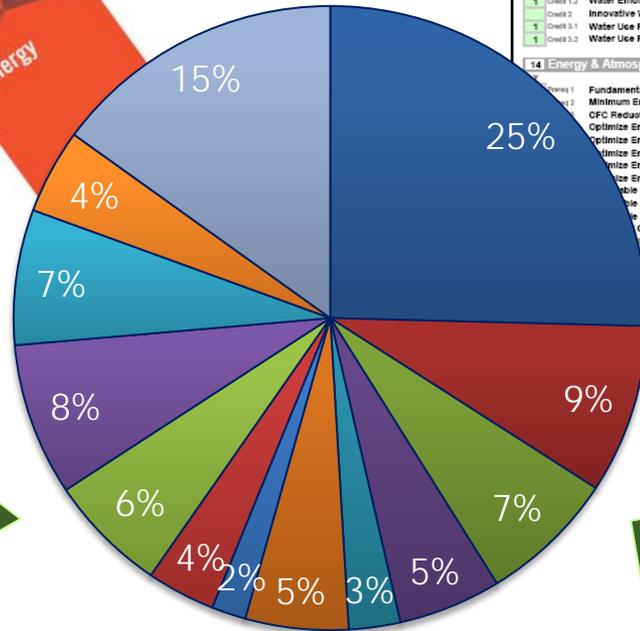
**LEED EB: Certified GSF  
(2008-9/2010)**



# Analytically-Driven Tools

Strategies

LEED



Center for Neighborhood Technology  
LEED® Project # 0142  
LEED Version 2 Certification Level: PLATINUM  
22 November 2005

LEED-NC

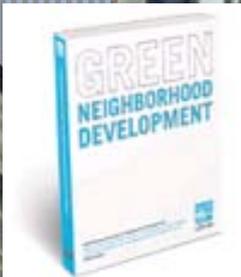
52 Points Achieved  
Certified 26 to 32 points Silver 33 to 38 points Gold 39 to 51 points Platinum 52 or more points Possible Points: 69

Prereq	Y/N	Points	Prereq	Y/N	Points
111 Sustainable Sites	Y	14	8 Materials & Resources	Y	13
111.1 Erosion & Sedimentation Control	Y	1	8.1 Storage & Collection of Recyclables	Y	1
111.2 Site Selection	Y	1	8.1.1 Building Reuse, Maintain 75% of Existing Shell	Y	1
111.3 Urban Redevelopment	Y	1	8.1.2 Building Reuse, Maintain 100% of Existing Shell	Y	1
111.4 Brownfield Redevelopment	Y	1	8.1.3 Building Reuse, Maintain 100% Shell & 50% Non-Shell	Y	1
111.5 Alternative Transportation, Public Transportation Access	Y	1	8.2 Construction Waste Management, Divert 50%	Y	1
111.6 Alternative Transportation, Bicycle Storage & Changing Rooms	Y	1	8.2.1 Construction Waste Management, Divert 50%	Y	1
111.7 Alternative Transportation, Alternative Fuel Refueling Stations	Y	1	8.2.2 Construction Waste Management, Divert 70%	Y	1
111.8 Alternative Transportation, Parking Capacity	Y	1	8.3 Resource Reuse, Specify 5%	Y	1
111.9 Reduced Site Disturbance, Protect or Restore Open Space	Y	1	8.3.1 Resource Reuse, Specify 10%	Y	1
111.10 Reduced Site Disturbance, Development Footprint	Y	1	8.4 Recycled Content	Y	1
111.11 Stormwater Management, Rate and Quantity	Y	1	8.4.1 Recycled Content	Y	1
111.12 Stormwater Management, Treatment	Y	1	8.4.2 Recycled Content	Y	1
111.13 Landscape & Exterior Design to Reduce Heat Islands, Non-Roof	Y	1	8.5 Local/Regional Materials, 20% Manufactured Locally	Y	1
111.14 Landscape & Exterior Design to Reduce Heat Islands, Roof	Y	1	8.5.1 Local/Regional Materials, of 20% Above, 50% Harvested Locally	Y	1
111.15 Light Pollution Reduction	Y	1	8.5.2 Local/Regional Materials, of 20% Above, 50% Harvested Locally	Y	1
			8.6 Rapidly Renewable Material	Y	1
			8.6.1 Certified Wood	Y	1
4 Water Efficiency	Y	5	10 Indoor Environmental Quality	Y	15
4.1 Water Efficient Landscaping, Reduce by 50%	Y	1	10.1 Minimum IAQ Performance	Y	1
4.2 Water Efficient Landscaping, No Potable Use or No Irrigation	Y	1	10.1.1 Environmental Tobacco Smoke (ETS) Control	Y	1
4.3 Water Use Reduction, 20% Reduction	Y	1	10.1.2 Carbon Dioxide (CO <sub>2</sub> ) Monitoring	Y	1
4.3.1 Water Use Reduction, 30% Reduction	Y	1	10.2 Increase Ventilation Effectiveness	Y	1
4.3.2 Water Use Reduction, 30% Reduction	Y	1	10.2.1 Construction IAQ Management Plan, During Construction	Y	1
			10.2.2 Construction IAQ Management Plan, Before Occupancy	Y	1
14 Energy & Atmosphere	Y	17	10.2.3 Low-Emitting Materials, Adhesives & Sealants	Y	1
14.1 Fundamental Building Systems Commissioning	Y	1	10.2.4 Low-Emitting Materials, Paint	Y	1
14.1.1 Minimum Energy Performance	Y	1	10.2.5 Low-Emitting Materials, Carpet	Y	1
14.1.2 OPC Reduction in HVAC/R Equipment	Y	1	10.2.6 Low-Emitting Materials, Composite Wood	Y	1
14.1.3 Optimize Energy Performance, 20% New / 10% Existing	Y	2	10.2.7 Indoor Chemical & Pollutant Source Control	Y	1
14.1.4 Optimize Energy Performance, 40% New / 30% Existing	Y	2	10.2.8 Controllability of Systems, Parametric	Y	1
14.1.5 Optimize Energy Performance, 50% New / 40% Existing	Y	2	10.2.9 Controllability of Systems, Non-Parametric	Y	1
14.1.6 Optimize Energy Performance, 60% New / 50% Existing	Y	2	10.2.10 Thermal Comfort, Comply with ASHRAE 55-1992	Y	1
14.1.7 Sustainable Energy, 5%	Y	1	10.2.11 Thermal Comfort, Permanent Monitoring Systems	Y	1
14.1.8 Sustainable Energy, 10%	Y	1	10.2.12 Daylight & Views, Daylight 75% of Spaces	Y	1
14.1.9 Sustainable Energy, 20%	Y	1	10.2.13 Daylight & Views, Views for 50% of Spaces	Y	1
14.1.10 Sustainable Energy, Commissioning	Y	1			
14.1.11 Sustainable Energy, Verification	Y	1	6 Innovation & Design Process	Y	5
			6.1 Innovation in Design, Public & Staff Education / Training	Y	1
			6.1.1 Innovation in Design, Exemplary Performance IAQs	Y	1
			6.1.2 Innovation in Design, Exemplary Performance IAQs	Y	1
			6.1.3 Innovation in Design, Enhanced Regularly Renewable Materials - 10% of TC	Y	1
			6.1.4 Innovation in Design, Exemplary Performance (EnPI)	Y	1
			6.2 LEED® Accredited Professional	Y	1

Scorecards

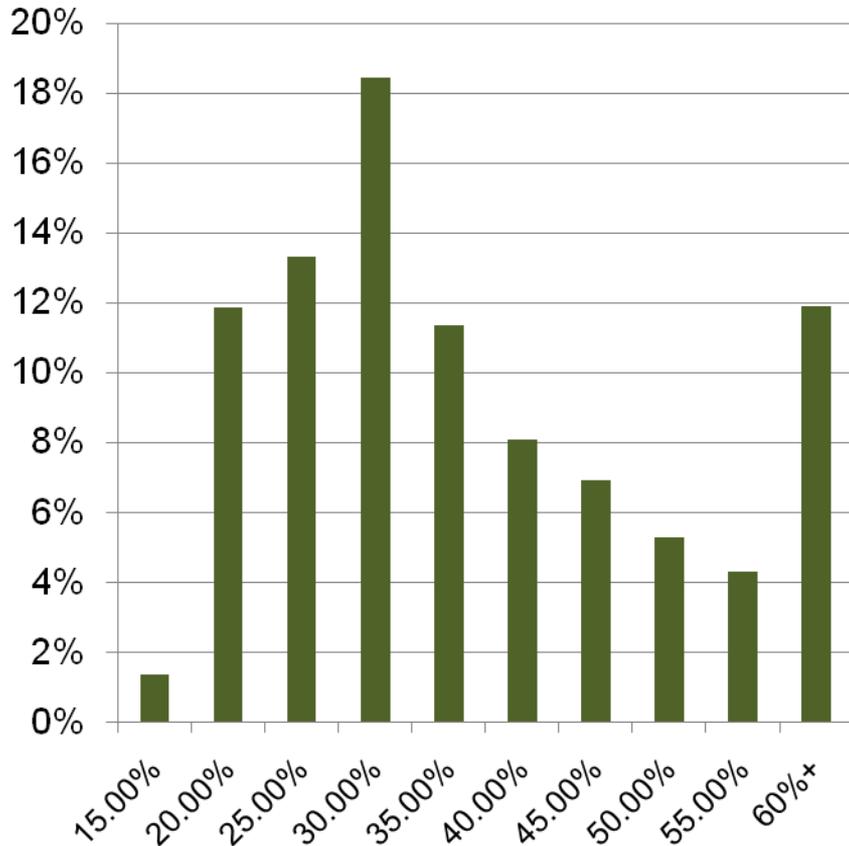
Prioritized Impact Categories

# Across Lifecycle



## Building Design & Construction

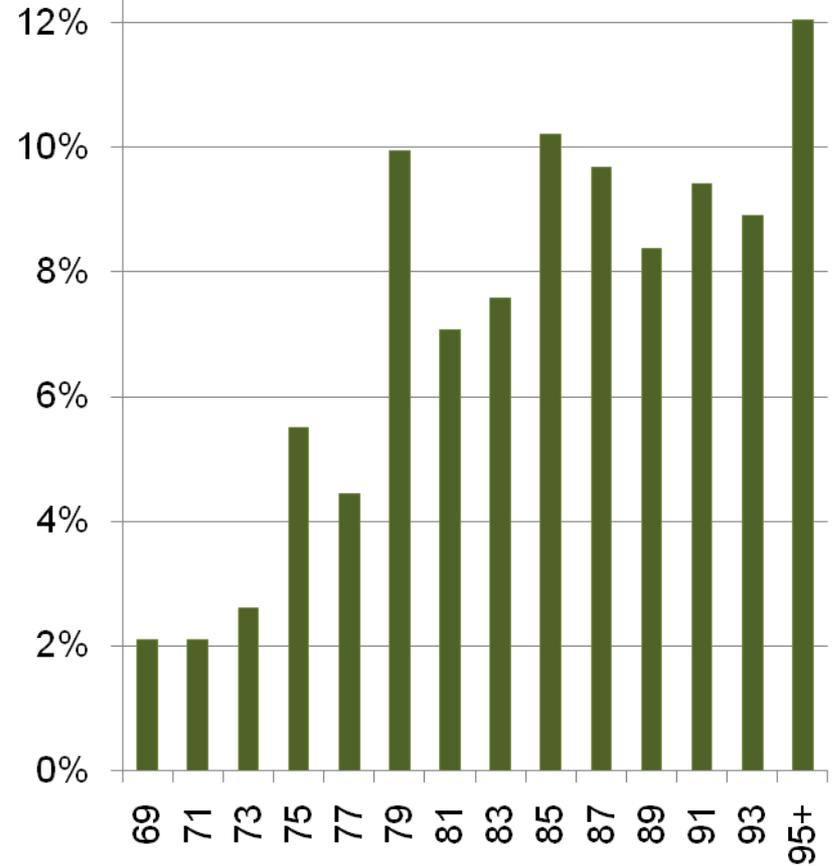
**NC 2.2 - % Improvement Over  
ASHRAE/IESNA Standard 90.1-  
2004**



**High-performance design**

## Operation & Maintenance

**EB O&M Energy Star Scores  
Average = 86**



**Efficient operations**

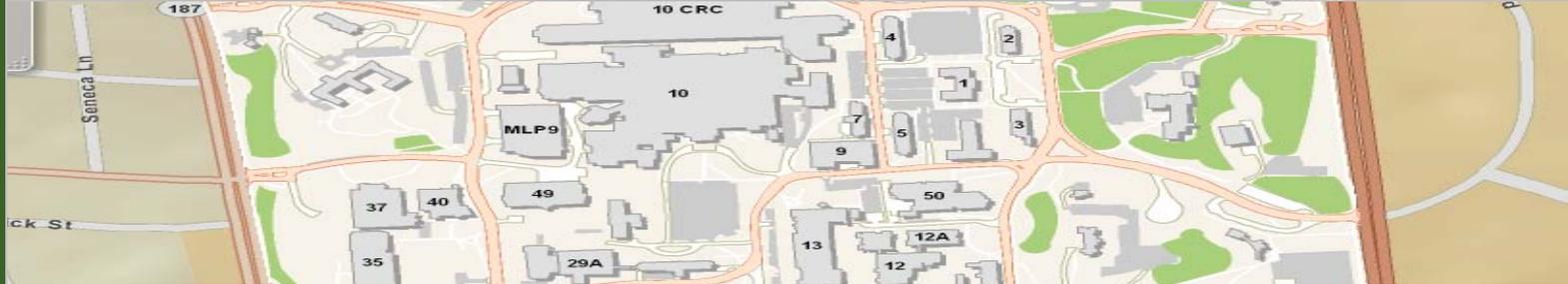
# Mandate & Mission



# Nation



# Installation



# Building

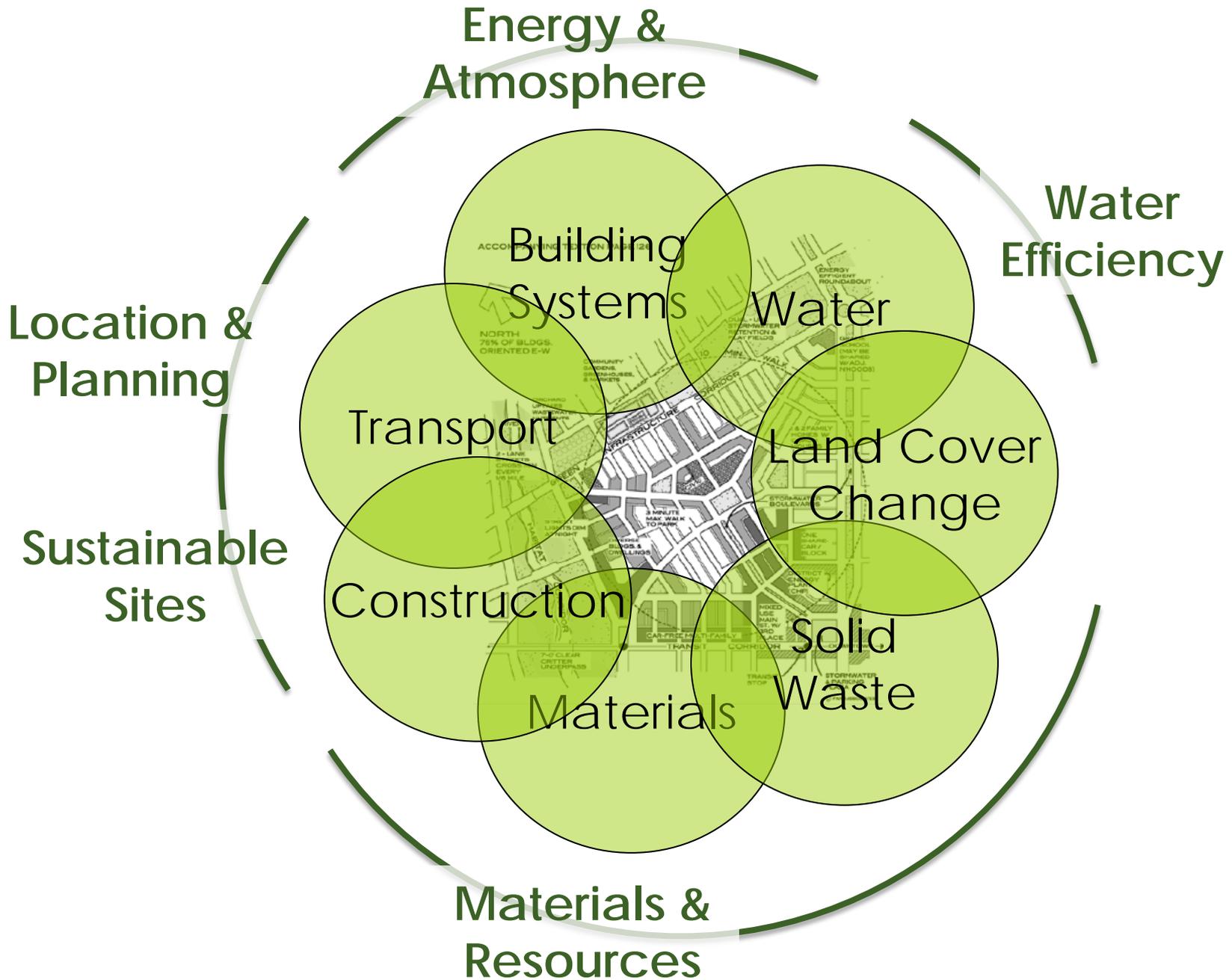


# Interior



# Energy & GHGs

Green building **tools** and **processes** can target **energy efficiency** and **GHG reduction**.



# Three Common Requirements

1. **Quantify and report** greenhouse gas emissions
2. **Identify and prioritize** emission reduction strategies
3. **Compare and benchmark** performance

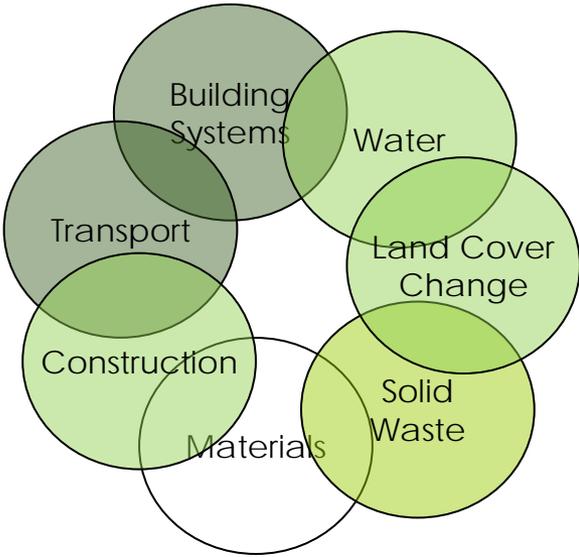
# #1. Quantify & Report

**Driven by rules. Which rules apply?**

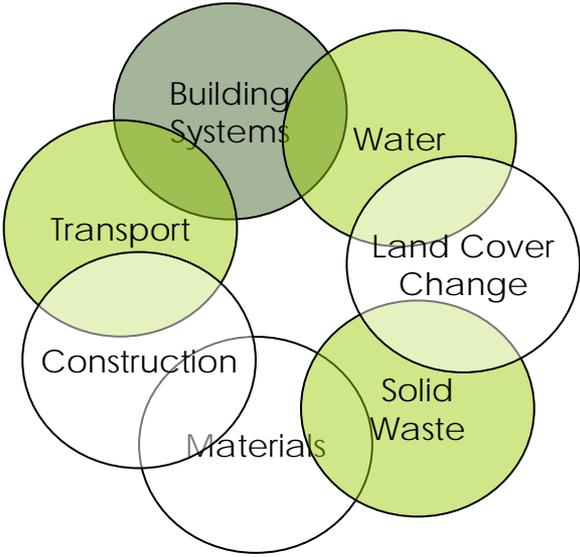
- World Resources Institute
- Carbon Disclosure Project
- E.O. 130514
- NEPA/CEQA
- ISO 14064/14065
- CEN/TC 350
- Many others...

# Scope & Methods

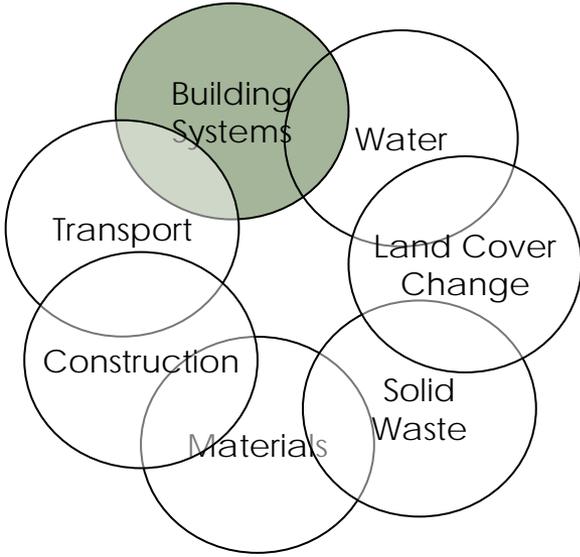
CEQA



E.O.13514



CDP



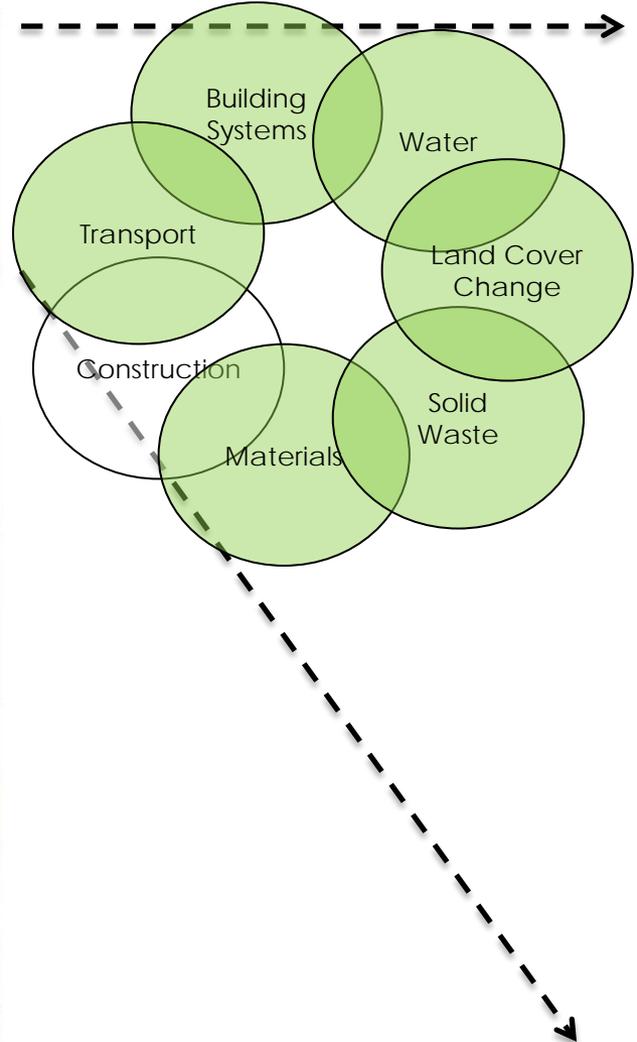
# #2. Identify and Prioritize

- Climate change is the **most important of 13 “impact categories”** used to assign points to LEED 2009 credits.
- A **GHG index** provides an indicator of the relative value of strategies for greenhouse gas emissions reduction.



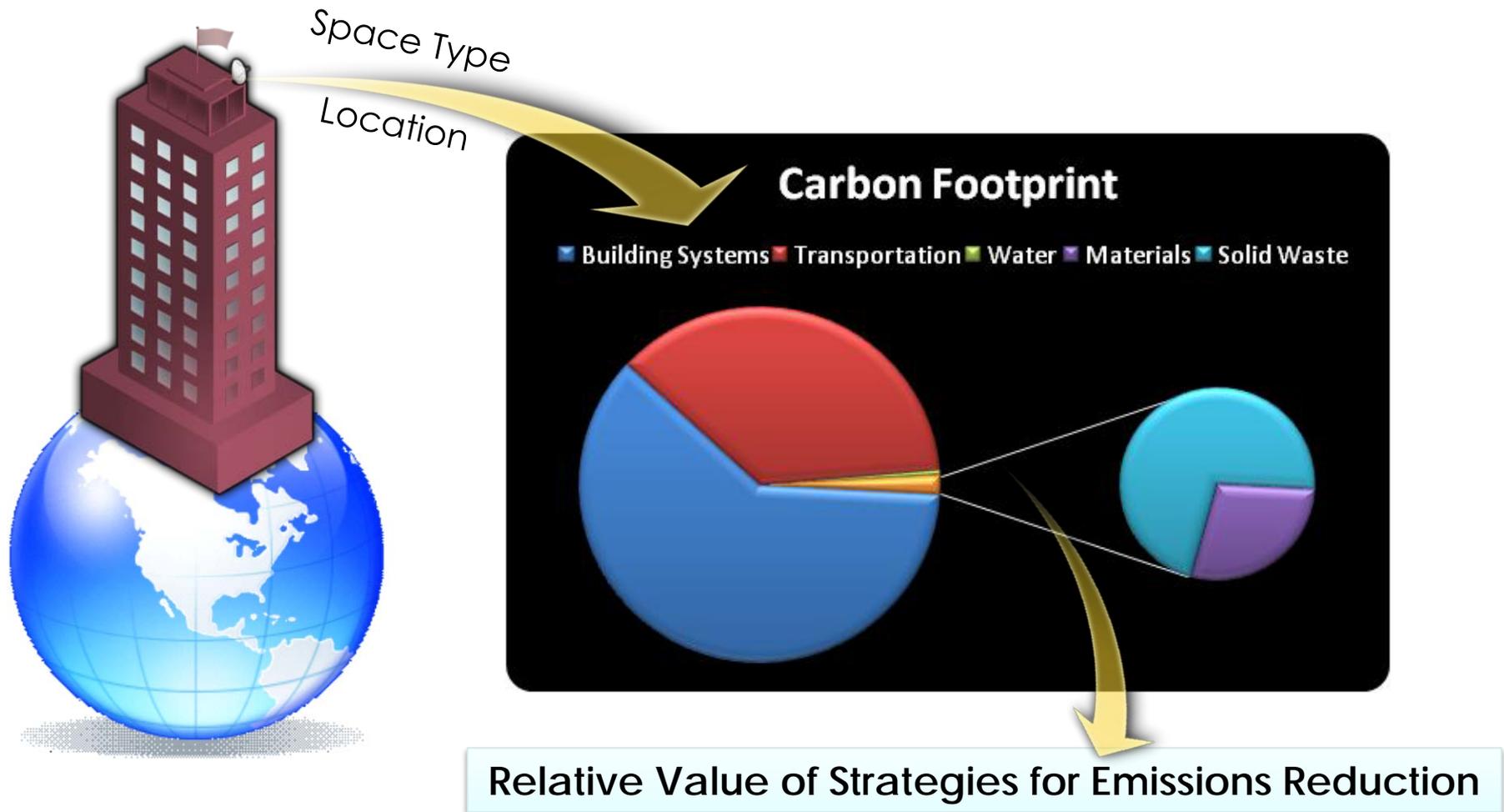
# Focus on GHG Reduction

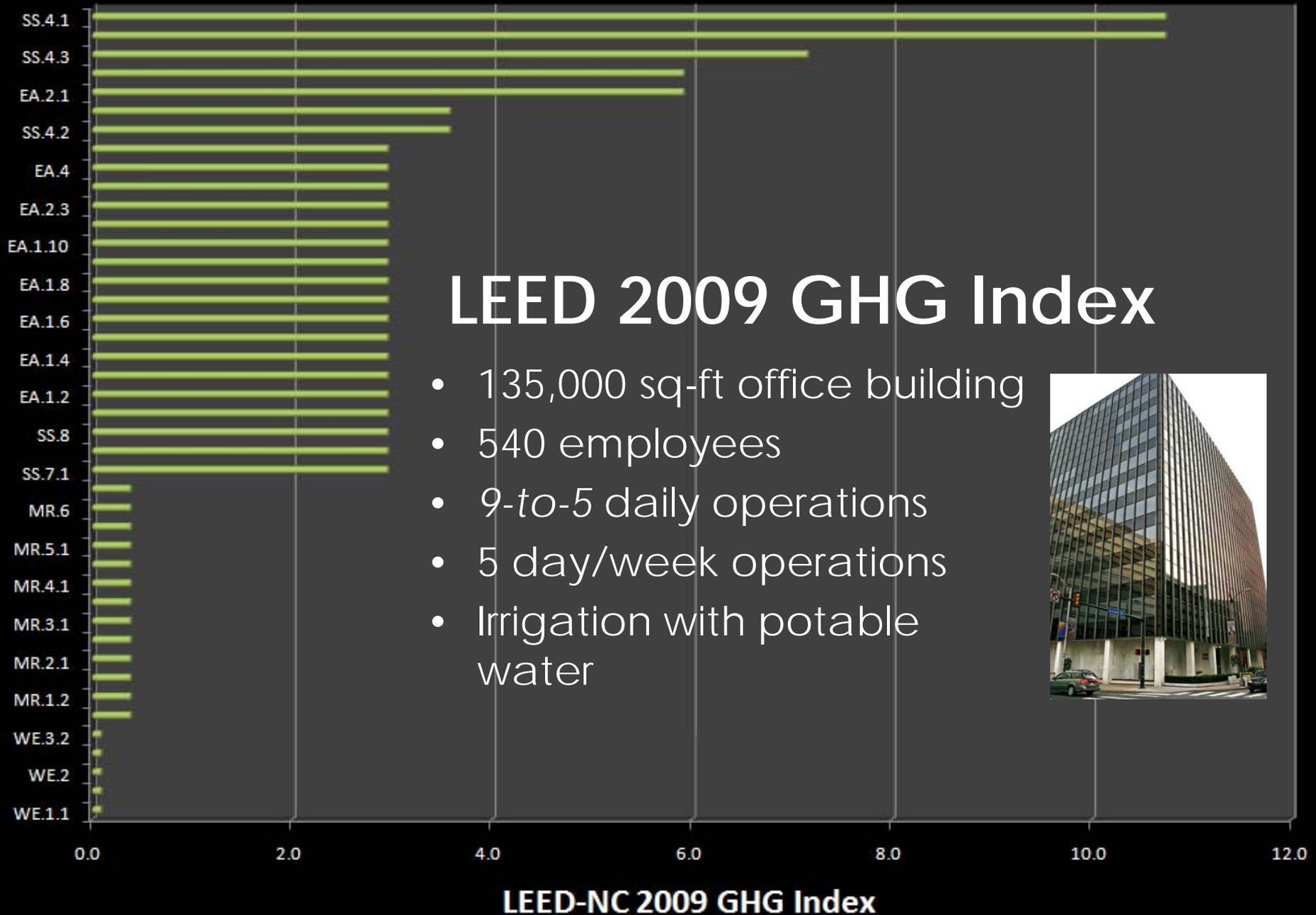
- CLIMATE CHANGE
- INDOOR ENVIRONMENTAL QUALITY
- RESOURCE DEPLETION
- HUMAN HEALTH CRITERIA
- WATER INTAKE
- HUMAN HEALTH-CANCEROUS
- ECOTOXICITY
- EUTROPHICATION
- HABITAT ALTERATION
- HUMAN HEALTH-NONCANCEROUS
- SMOG FORMATION
- OZONE DEPLETION



**Greenhouse Gas Emissions**

# Prioritizing Strategies





# LEED 2009 GHG Index

- 135,000 sq-ft office building
- 540 employees
- 9-to-5 daily operations
- 5 day/week operations
- Irrigation with potable water



LEED-NC 2009 GHG Index

# Advanced LEED GHG Index

Emissions reduction potential is based on multiple factors, such as:

- **Magnitude:** fraction of emissions addressed
- **Duration:** performance period
- **Control:** certainty of outcome
- **Rigor:** fraction of potential realized

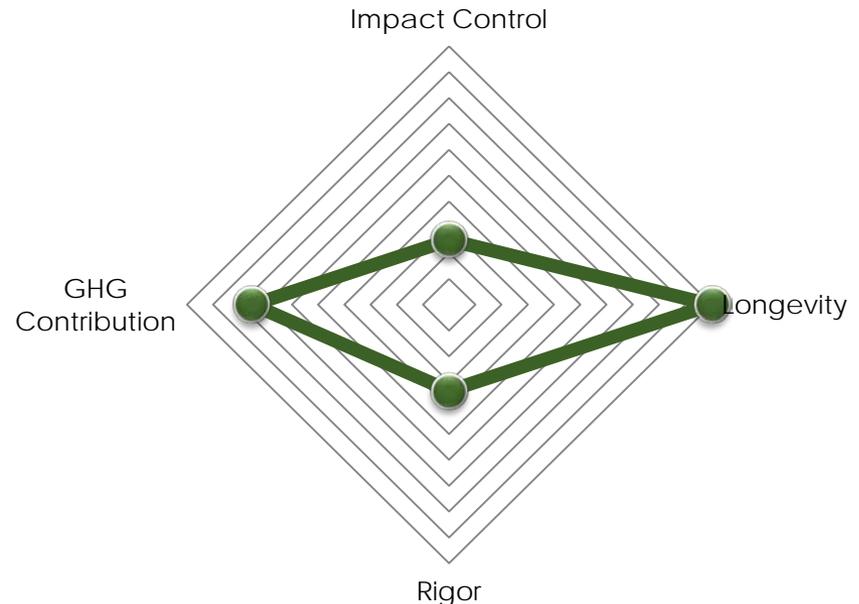
Applicable to any system with a points and credit structure.

# BIKE STORAGE & CHANGING ROOMS

- Reducing Large Regional End-Uses
- Great Longevity
- Weak Control
- Weak Rigor
- GHG Index 6.4

## GHG Index

Alternative Transportation: Bicycle Storage & Changing Rooms

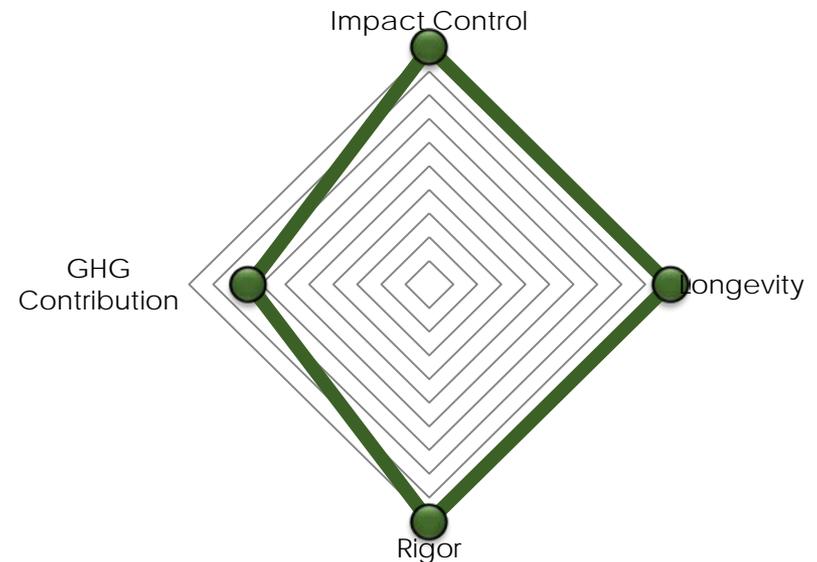


# DEVELOPMENT DENSITY & CONNECTIVITY

- Reducing Large Regional End-Uses
- Strong Reduction Rigor
- Great Longevity
- Strong Control
- GHG Index 77

## GHG Index

—●— Development Density & Community Connectivity

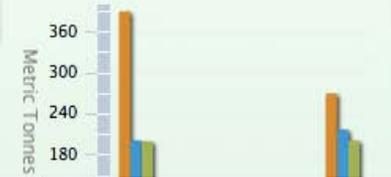


### Carbon Emissions



## Place Data Chicago

### Carbon Emissions



### General

- Desc
- Jurisd
- Govt
- Require
- Eco-F
- Doe Climate
- Vegetation

## Target Building Data Med Office - Rural (Office - Commercial)

### General

Building

Building

Construction

Landsc

### Base Carbon

- Energy
- Water
- Waste
- Materials
- Transport
- Other

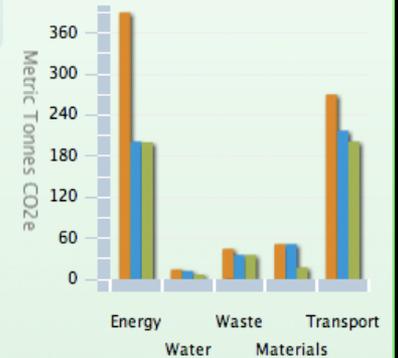
## Scorecard

Custom

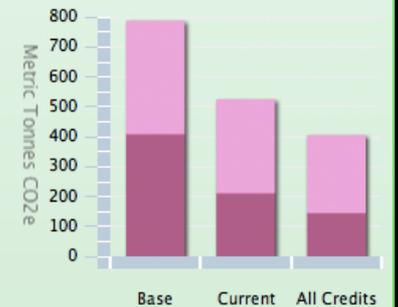
Show results as: % of base

Credit & Points	Emissions					
	TOTAL	Energy	Water	Waste	Materials	Transp.
P Minimum Energy Performance (only option 1 is applicable ???) 3 EA Prerequisite 2.0 3 EA ... 0	94.6 %	90 %	-	-	-	-
P Fundamental Commissioning of Building Energy Systems 0	94.6 %	89 %	-	-	-	-
P Storage and Collection of Recyclables 0	93.5 %	-	-	79 %	-	-
✓ Enhanced Refrigerant Management (???) 3 EA Credit 4.0 3 EA Credit... 2	93.5 %	-	-	-	-	-
✓ Optimize Energy Performance (only option 1 is applicable ???) (tier) 3 EA Credit 1.0 3 EA Credit... 19 19: 0.48 [%] ...	73.8 %	51 %	-	-	-	-
✓ Enhanced Commissioning 2	73.8 %	51 %	-	-	-	-
✓ Alternative Transportation- Public Transportation Access 1 SS Credit 4.1 1 SS Credit ... 6	67.1 %	-	-	-	-	80 %

### Carbon Emissions



Base Current All Credits



Scope 1 & 2 Scope 3

# #3. Compare and Benchmark

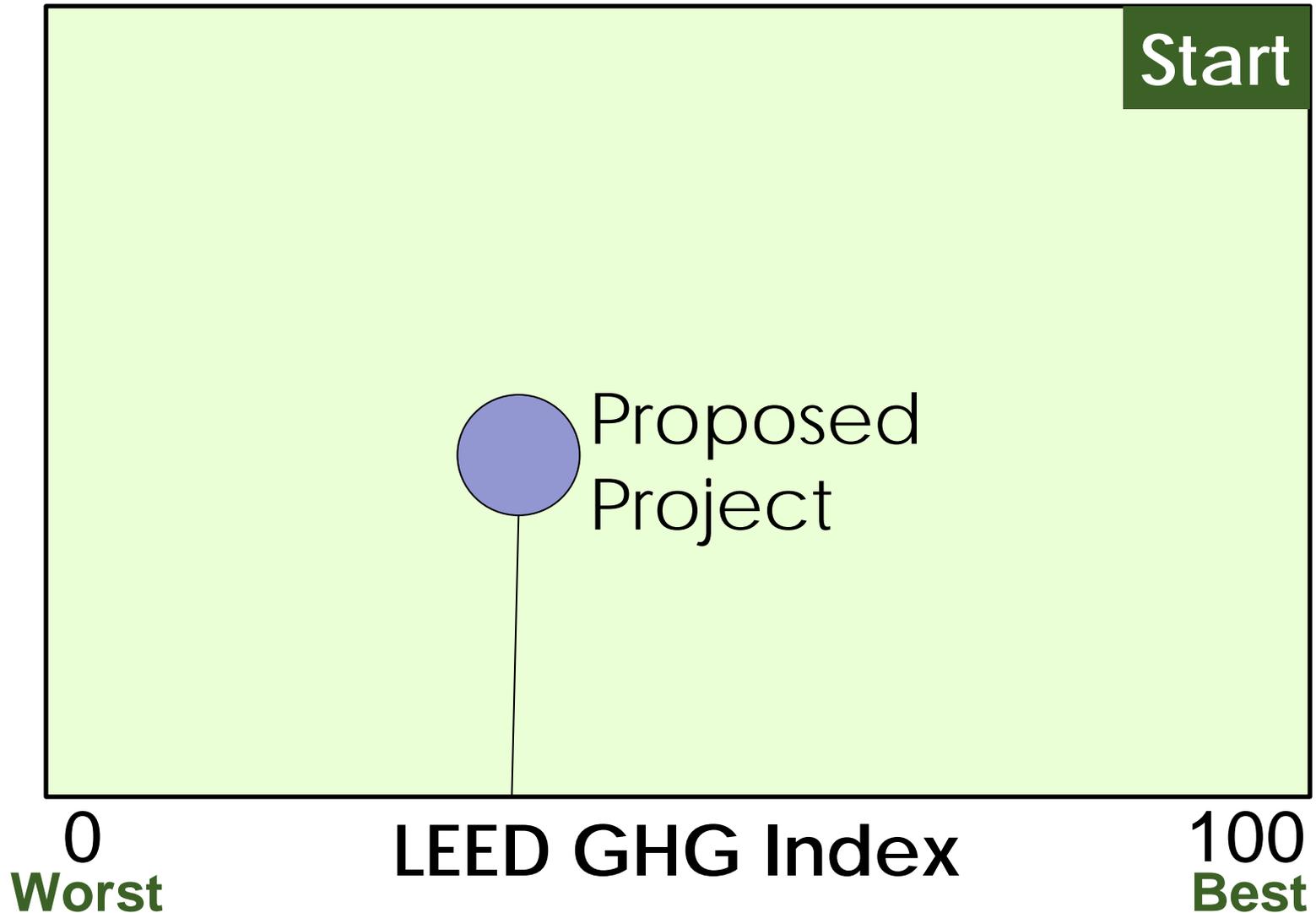
Any index or emissions estimate can be benchmarked against other projects, including:

- Comparison to **absolute metric**
- Comparison to **market**
- Comparison to **projects or portfolios**
- Comparison by **geographic location**
- Comparison by **attributes**

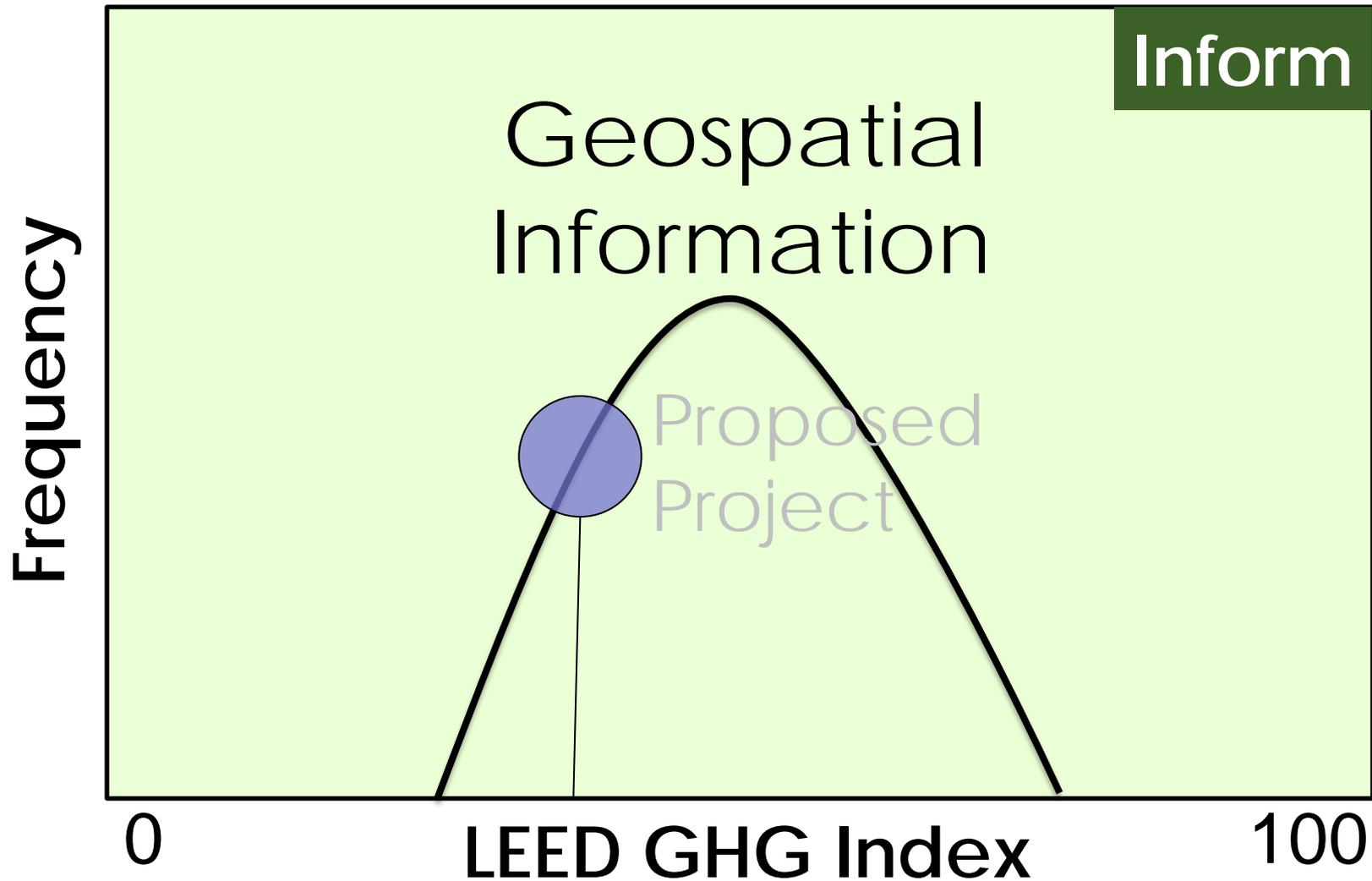


Source: ArcScene

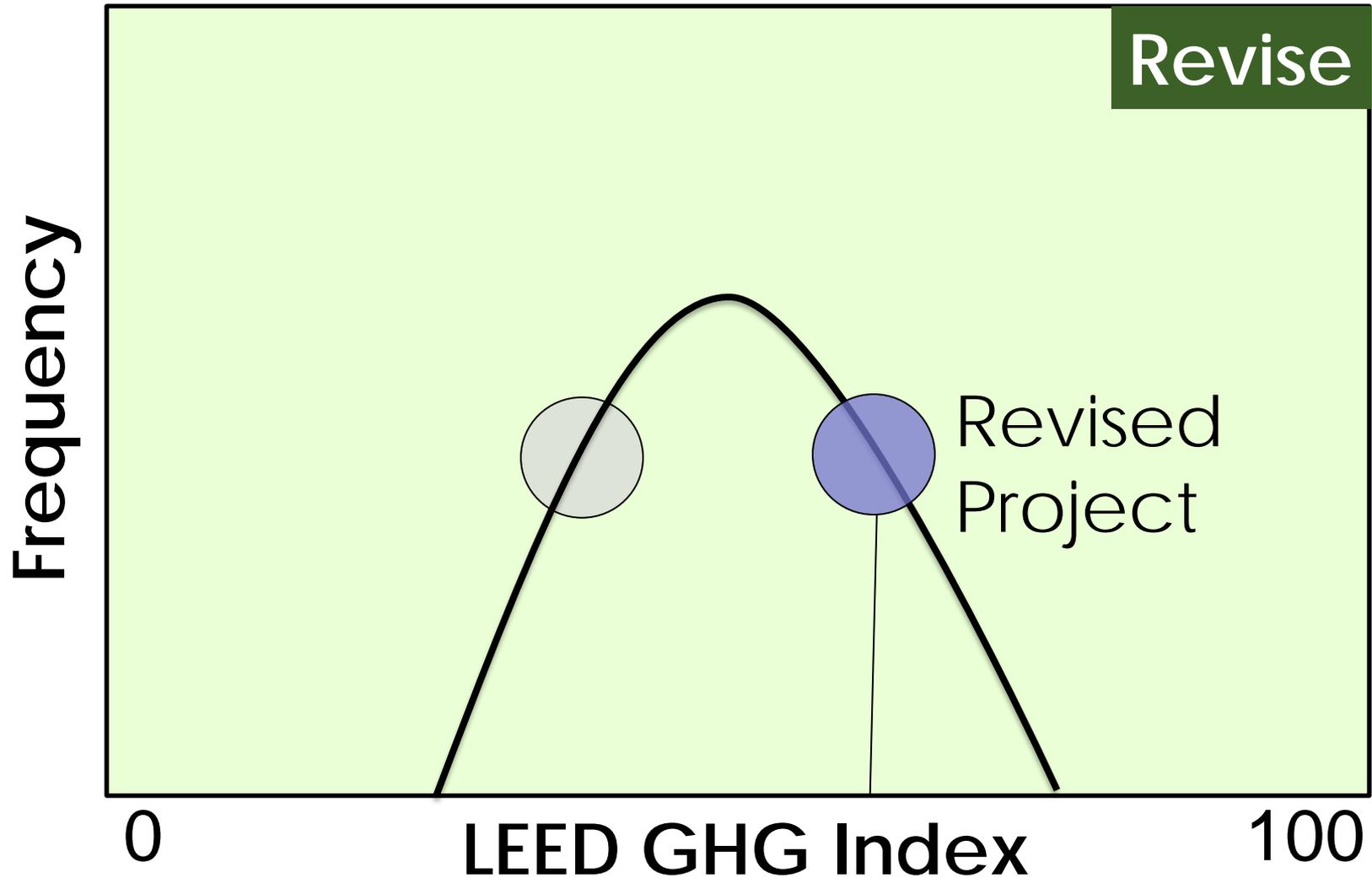
# Achievement of GHG Strategies



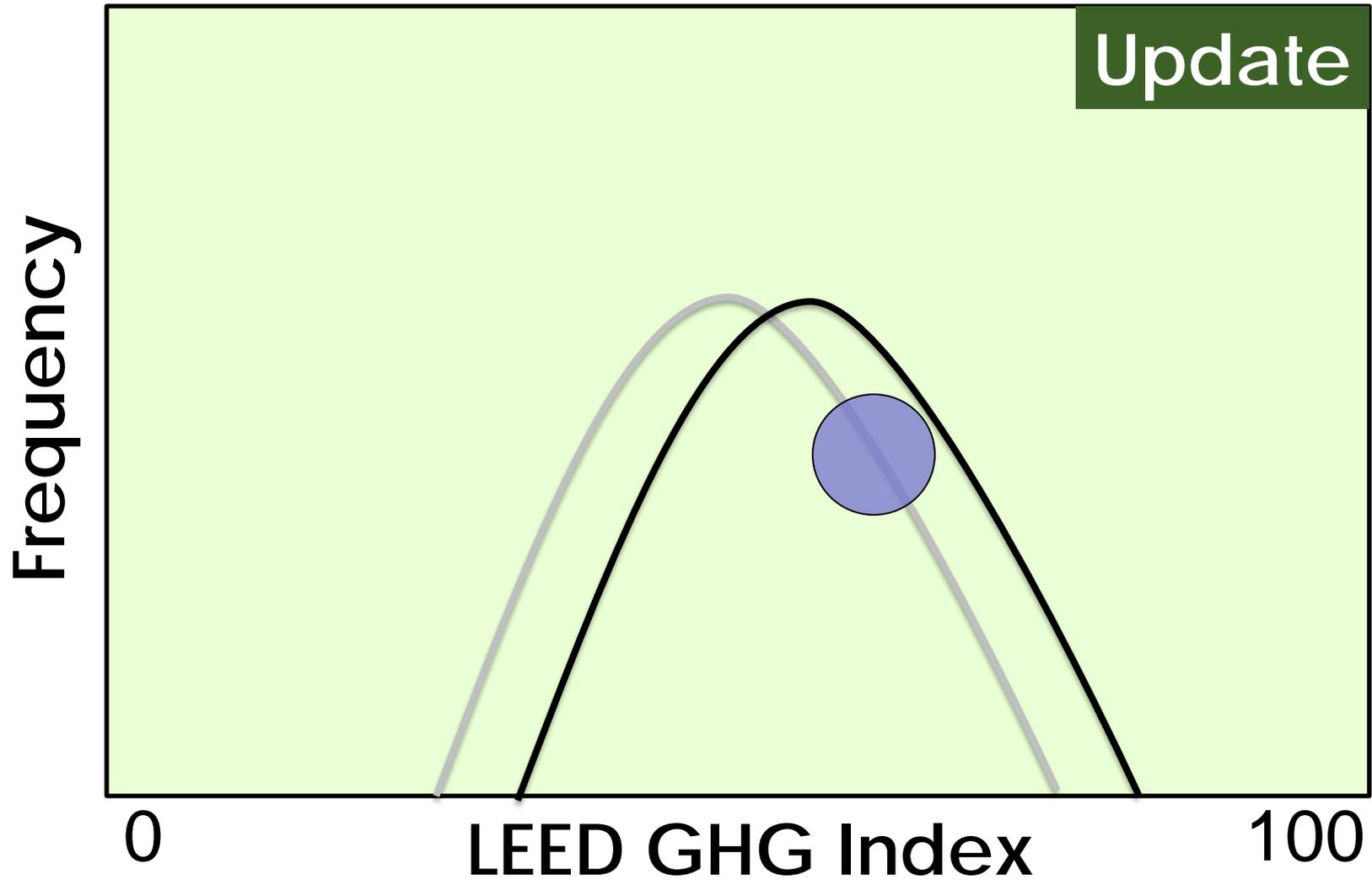
# Achievement of GHG Strategies



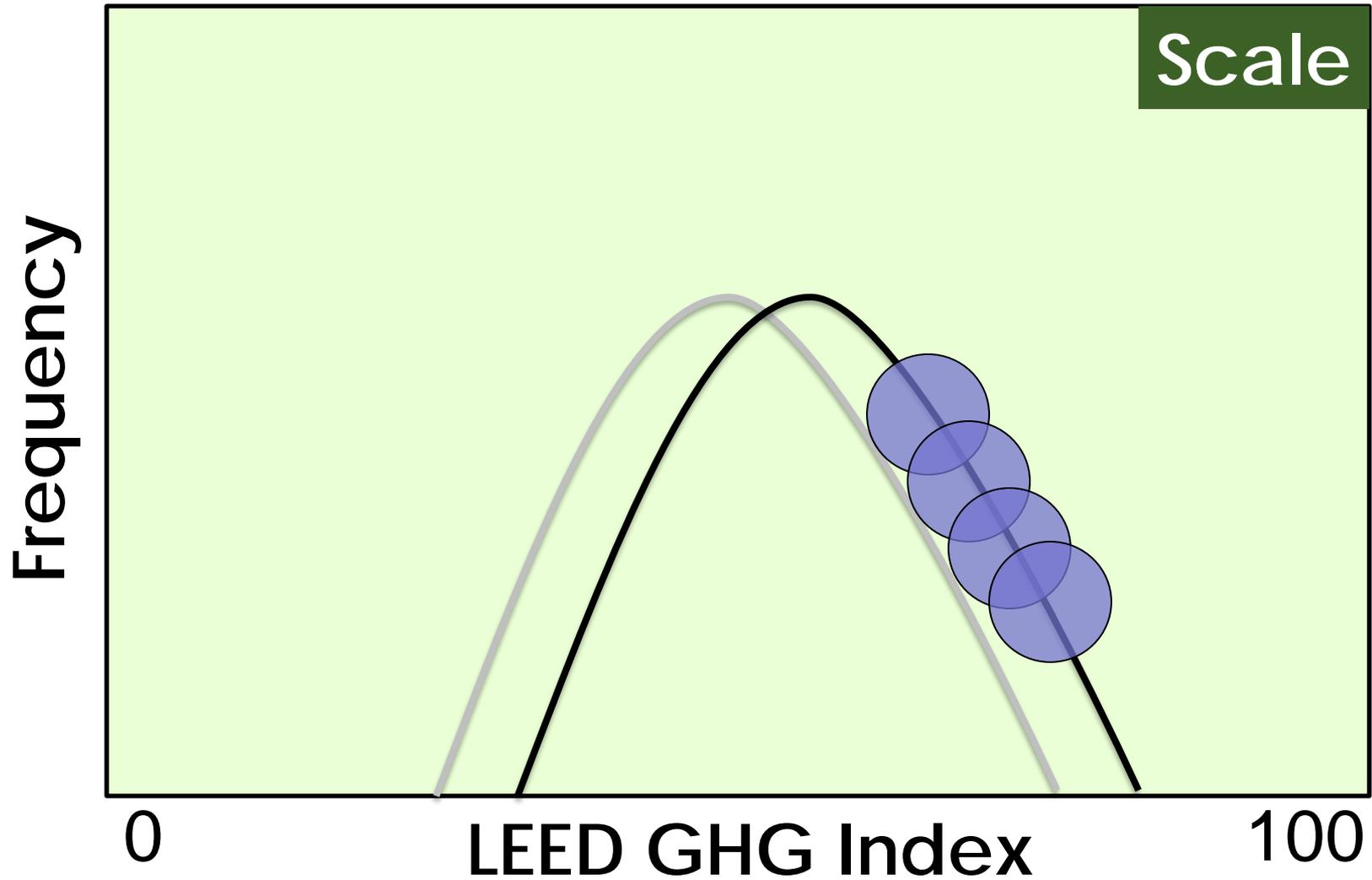
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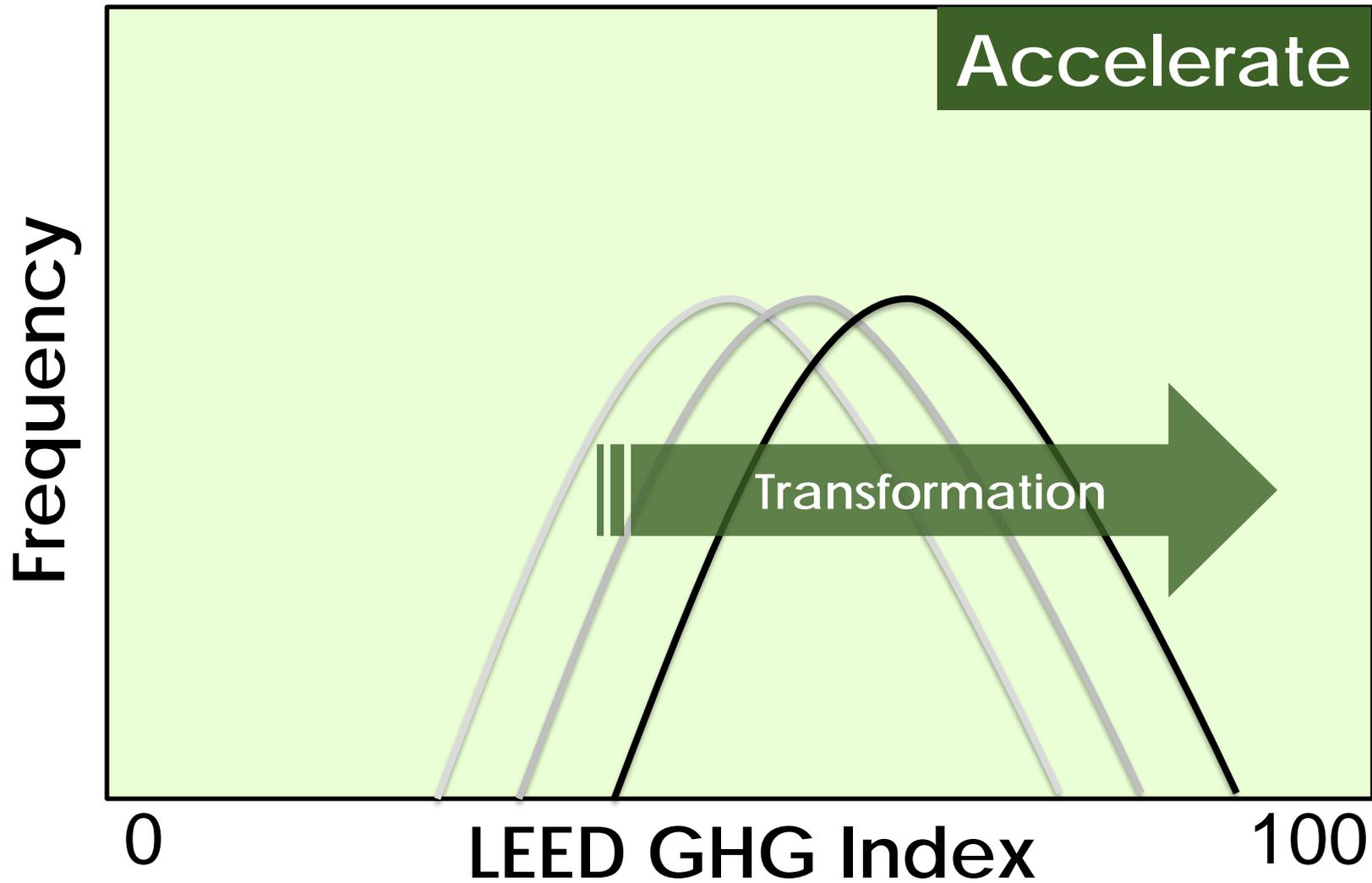
# Achievement of GHG Strategies



# Achievement of GHG Strategies



# Achievement of GHG Strategies



Demonstration

**GBIG**

Green Building Analytics

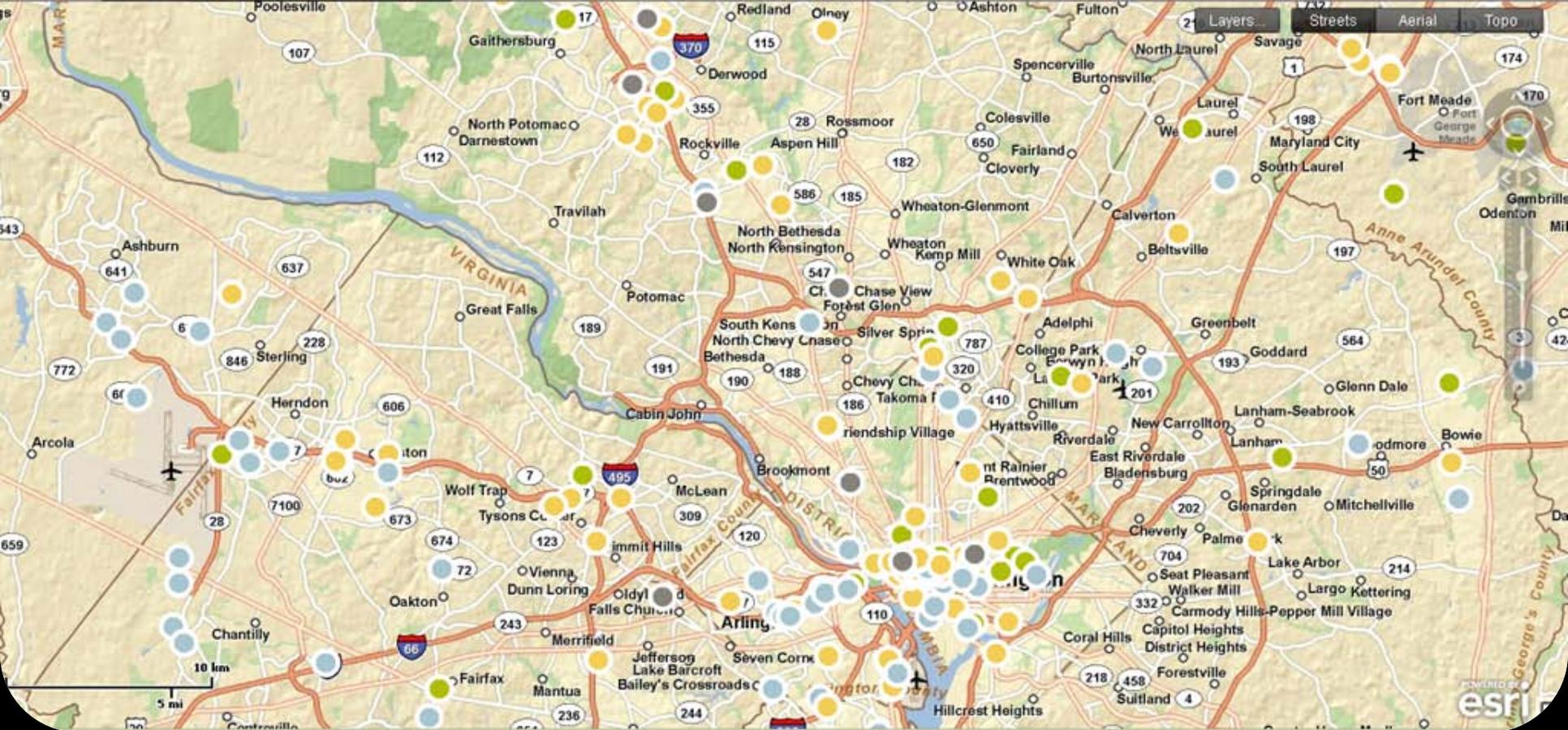
[www.gbig.org](http://www.gbig.org)



# GBIG: Green Building Information Gateway – DC Regional Pilot

Select Compare Trends About

Legend Feedback





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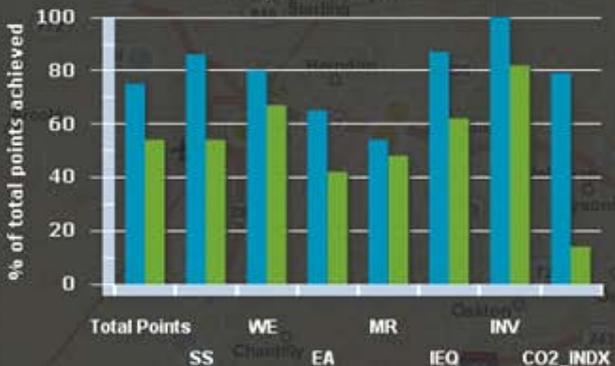
## Compare

Zoom to the project

Refine selection

Credit category	Gaithersburg Olde Towne Youth Center	All projects average	Click to Benchmark
Total Points	75%	54%	
SS	86%	54%	
WE	80%	67%	
EA	65%	42%	
MR	54%	48%	
IEQ	87%	62%	

Comparison Chart

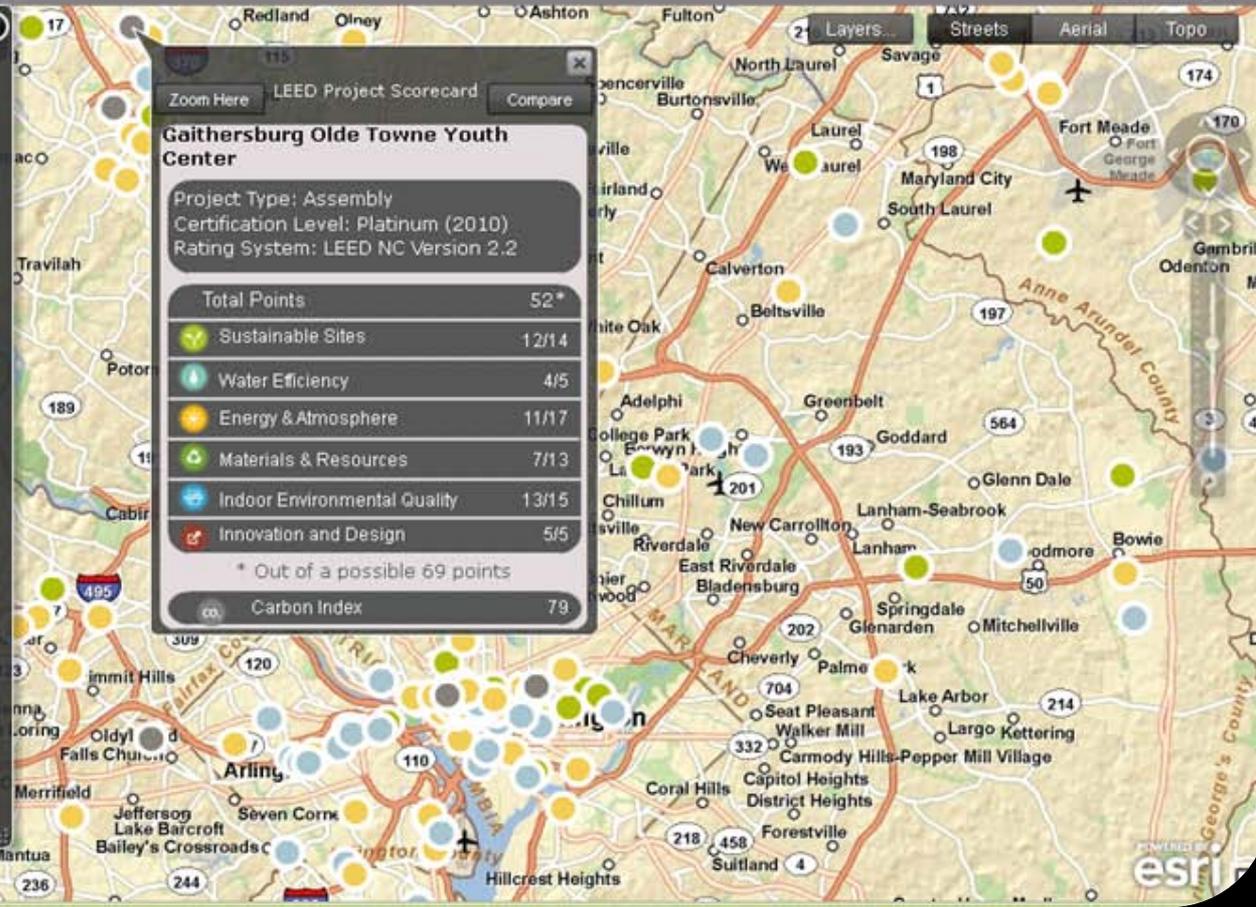


Zoom Here LEED Project Scorecard Compare

### Gaithersburg Olde Towne Youth Center

Project Type: Assembly  
 Certification Level: Platinum (2010)  
 Rating System: LEED NC Version 2.2

Total Points	52*
Sustainable Sites	12/14
Water Efficiency	4/5
Energy & Atmosphere	11/17
Materials & Resources	7/13
Indoor Environmental Quality	13/15
Innovation and Design	5/5
* Out of a possible 69 points	
Carbon Index	79





# GBIG: Green Building Information Gateway – DC Regional Pilot

Select Compare Trends About

Legend Feedback

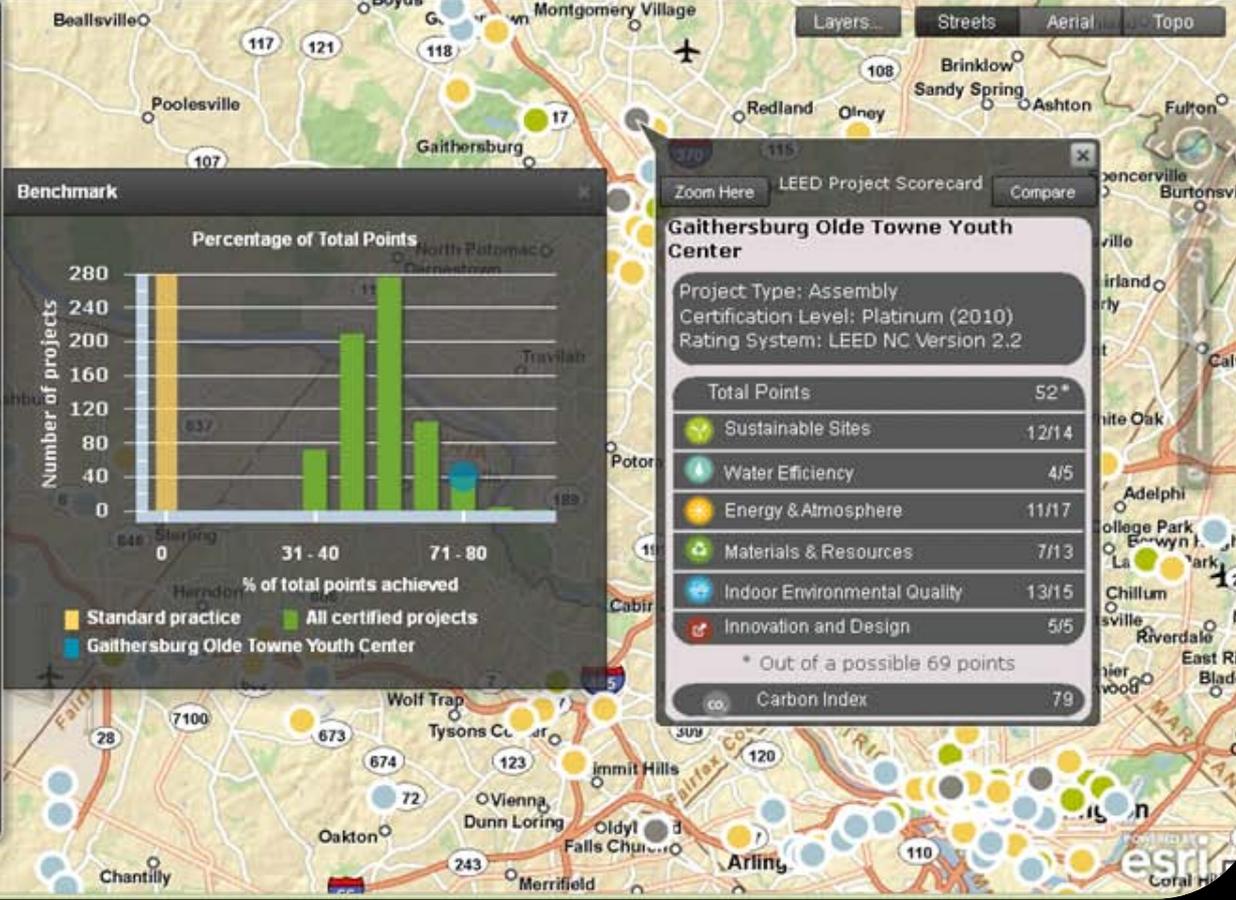
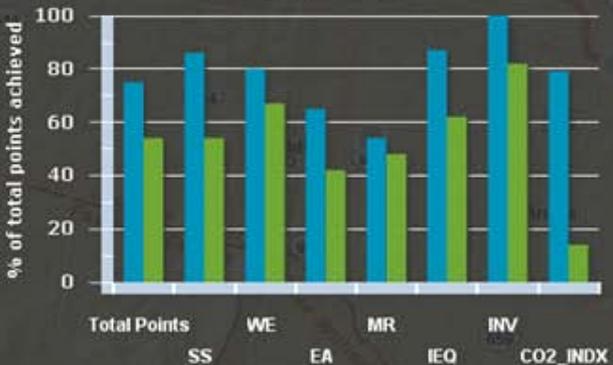
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IEQ	87%	62%	

### Comparison Chart



### Gaithersburg Olde Towne Youth Center

Project Type: Assembly  
 Certification Level: Platinum (2010)  
 Rating System: LEED NC Version 2.2

Category	Score	Out of
Total Points	52*	69
Sustainable Sites	12/14	
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\* Out of a possible 69 points



# GBIG: Green Building Information Gateway – DC Regional Pilot

Select Compare Trends About

Legend Feedback

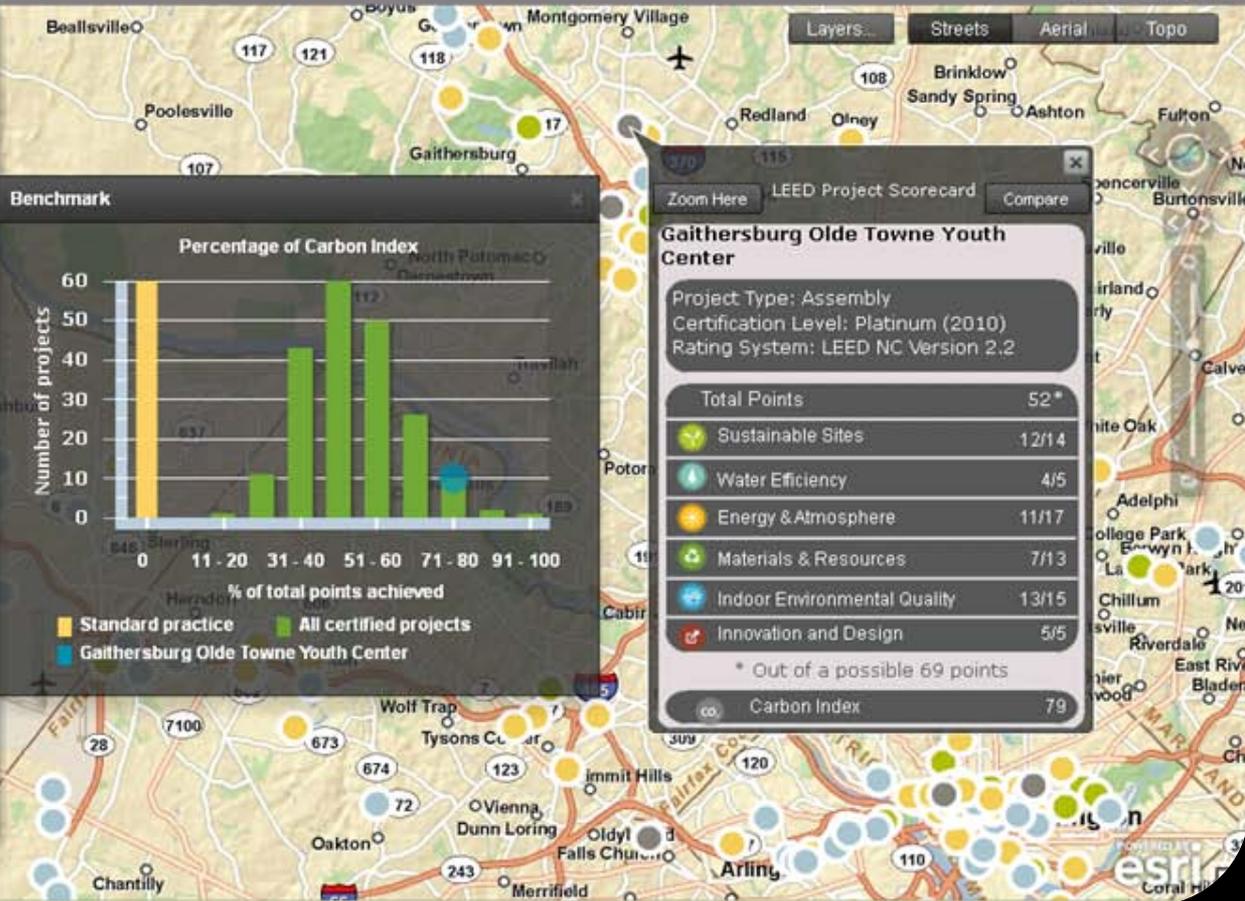
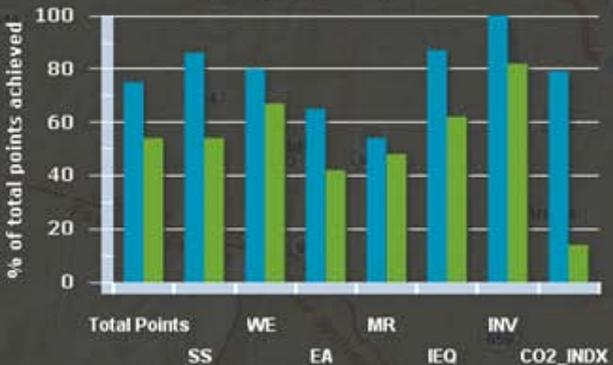
## Compare

Zoom to the project

Refine selection

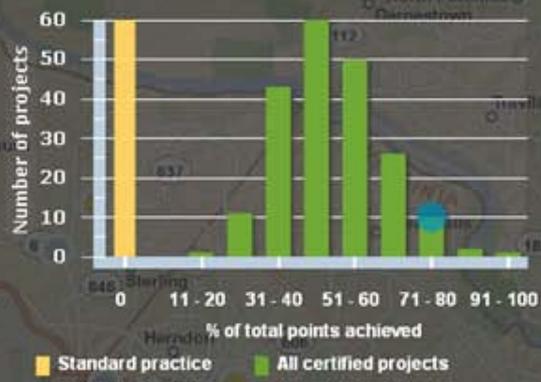
Credit category	Gaithersburg Olde Towne Youth Center	All projects average	Click to Benchmark
WE	80%	67%	
EA	65%	42%	
MR	54%	48%	
IEQ	87%	62%	
INV	100%	82%	
CO2_INDX	79%	14%	

Comparison Chart



## Benchmark

Percentage of Carbon Index



**Gaithersburg Olde Towne Youth Center**

Project Type: Assembly  
 Certification Level: Platinum (2010)  
 Rating System: LEED NC Version 2.2

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Total Points: 52\*  
 Sustainable Sites: 12/14  
 Water Efficiency: 4/5  
 Energy & Atmosphere: 11/17  
 Materials & Resources: 7/13  
 Indoor Environmental Quality: 13/15  
 Innovation and Design: 5/5

\* Out of a possible 69 points

Carbon Index: 79

# Take Home Messages

- Green building** tools and processes can be applied to advance energy and GHG emissions through:
- **Quantification and reporting** based on third-party standards
  - **Priority setting tools** identify high value strategies
  - **Comparison and benchmarking** put performance into context

# More

<b>Explore</b>	<a href="http://www.gbig.org">www.gbig.org</a> <a href="http://www.usgbc.org/research">www.usgbc.org/research</a>
<b>Search</b>	Apple App Store
<b>Find</b>	GBIG Analyst
<b>Demos</b>	<i>Government Summit</i> 5/10: Indices & Metrics 5/11: GBIG Explorer:Place
<b>Email</b>	<a href="mailto:cpyke@usgbc.org">cpyke@usgbc.org</a>

# Questions

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