

# The Deep Energy Retrofit Initiative: The ABCs of D.E.R.

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Credits: 1 AIA LU

AIA Course Number: TRS 099

## Outline of Presentation

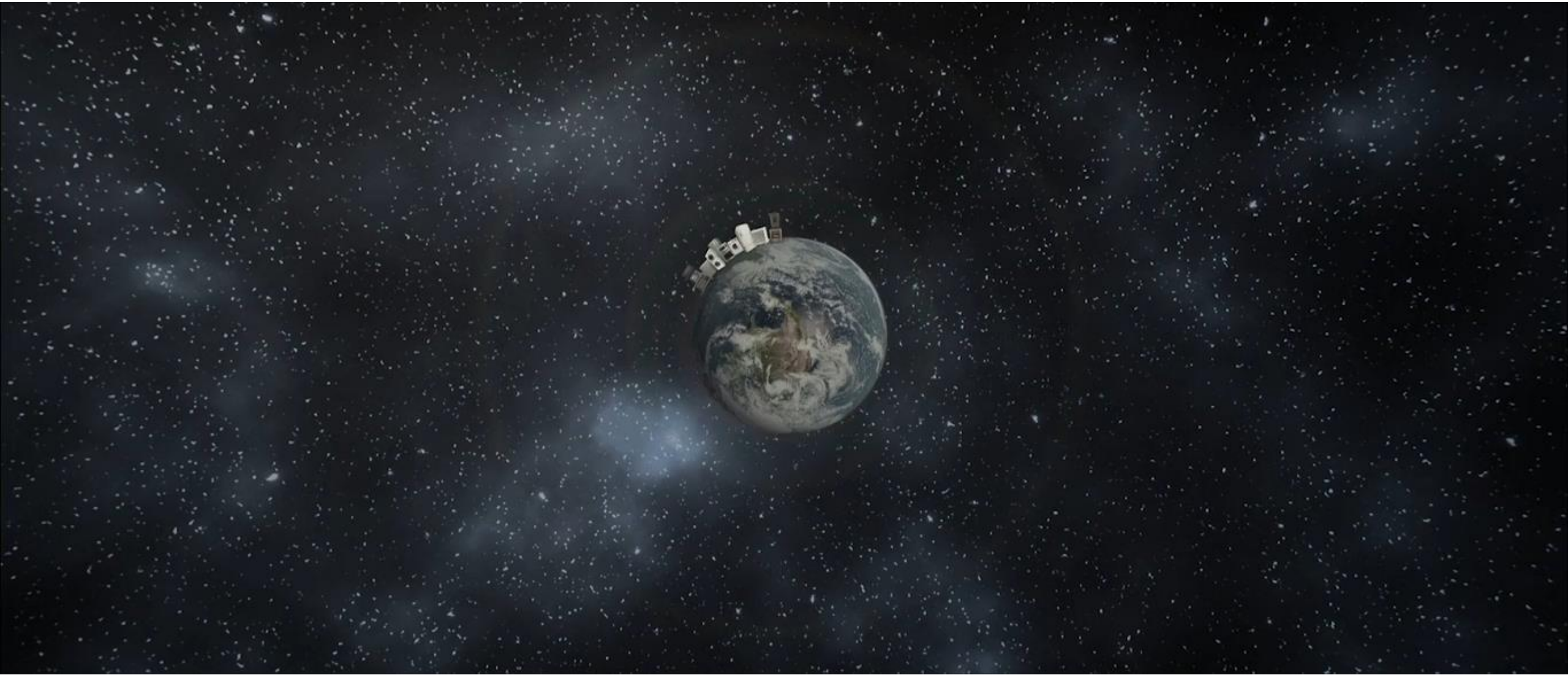
- AIA Provider Credentials
- Learning Objectives
- Content
- Questions

## Learning Objectives

By the end of this course, attendees should be able to:

- Define the necessary improvements to a structure to influence the operational costs and to do so in a sustainable and repeatable manner
- Discuss the impact of local laws and state laws that are changing, like the climate mobilization act which will introduce fines associated with overuse of energy in these existing buildings.
- Compare existing energy consumption of the large stock of existing buildings, and identify holistic opportunities, including the mechanicals and the entirety of the façade.
- The cities and their buildings can have the greatest effect on climate change, this will be demonstrated in the review of existing retrofitted buildings.

**Deep Energy Retrofit (RMI)**- A deep energy retrofit is a whole-building analysis and construction process that achieves much larger energy cost savings—sometimes more than **50% reduction**—than those of simpler energy retrofits and fundamentally enhances the building value.



## POINT 1: NEEDS VS WANTS



“Great achievement is usually born of great sacrifice, and is never the result of selfishness” ~ Napoleon Hill

# Integrated Physical Needs Assessment (IPNA) NYC- IPNA Template

## INSPECTION - PHYSICAL NEEDS

Site Inspection	Material	Condition	Site Inspection Narrative / Recommendations
Sidewalk			
Curbs			
Yard / Courtyard Concrete			
Area / Yard Drains			
Ramps			
Stoop and Stairs			
Areaway / Sidewalk Grates			
Fire Passages			
Wrought Iron Fence/Gates			
Chain Link Fences			
Debris			
Exterior Stairs			
Trash Enclosures			
Landscaping / Vegetation			
Open Space / Playground			

(All values are total annual values)	Existing Annual Energy Use and Cost								
	Electricity (kwh/yr)	Natural Gas (therms/yr)	Oil #2 (gal/yr)	Oil #4 (gal/yr)	Oil #6 (gal/yr)	District Stream (Mlbs/ yr)	Water (gal/yr)	Other (note units)	Total Site Energy Use (kBtu/yr)
Owner-Paid Consumption									0
Aggregated Resident Consumption									0
Whole Building Consumption	0	0	0	0	0	0	0	0	0

## OPERATION AND MAINTENANCE MEASURES

General Recommended O&M Interventions	Intervention Type	Why Do It	Frequency	Impact / Cost	Notes

## INSPECTION - ENERGY AND WATER

### Building Envelope

General Building/Envelope Description	Construction Description				Estimated Total R-Value
Envelope Components					
Above Grade Exterior Walls					
Floor Perimeter/ Rim Joists					
Below Grade Walls					
Floor Above Unconditioned Space					
Slab On/Below Grade					
Roof					
Ceilings to Unconditioned Attics					
Wall to Unconditioned Space					
Windows	Location	Operation Type	Framing Material	Thermal Break	# of Panes
Window Type 1	In-Unit				
Window Type 2	Common Area				
Window Type 3	Bulkhead				
Window Type 4					
Window Type 5					

# Integrated Physical Needs Assessment (IPNA) NYC- IPNA Template

Integrated Physical Needs Assessment (IPNA)



Improvement	Estimated Replacement Cost (\$)	Estimated Annual Utility Cost Savings (\$/yr)	Potential Health Benefit (yes/no)	Urgency	
				A: Critical	B: Short Term (<12 months) C: Long term (1 to 15 years)
<b>INTERIOR COMMON SPACE</b>					
Replace emergency lighting packs	\$ 1,800	\$ -	Yes		C
Repaint interior common areas incl stairwell and doors (after first application, becomes maintenance)	\$ 96,300	\$ -	No		C
Replace 1"x1" wall tile with another material	\$ 32,000	\$ -	No		C
Replace 1st floor corridor and lobby flooring including	\$ 197,928	\$ -	No		C
Replace flooring on 2-6 floors	\$ 17,340	\$ -	No		C
Upgrade office finishes incl ceiling and bathroom	\$ 5,500	\$ -	No		C
Improve lobby features. Refer to DOHMH Healthy Homes Active Design Guidelines	\$ 7,000	\$ -	No		C
Improve visual access to stairs. Refer to DOHMH Healthy Homes Active Design Guidelines	\$ 5,000	\$ -	Yes		C
Upgrade interior lighting to LED	\$ 10,575	\$ 5,026	No		B
Upgrade interior lighting to LED	\$ 60,000	\$ -	No		C
<b>APARTMENTS</b>					
Upgrade kitchen cabinets, counters, and sinks	\$ 315,000	\$ -	No		C
Upgrade kitchen counter and sink	\$ 465,251	\$ -	No		C
Replace apt VCT flooring	\$ 603,000	\$ -	No		C
Replace ranges and range hoods	\$ 72,000	\$ -	No		C
Replace bathroom vanity and faucet	\$ 33,750	\$ -	No		C
Replace bathroom wall tiles. Add new bathroom accessories. Tile in soap holder in bathtub.	\$ 162,000	\$ -	No		C
Replace and grout bathroom floor tile	\$ 37,800	\$ -	No		C
Replace hollow core doors	\$ 99,833	\$ -	No		C
Interior painting (at least upgrades)	\$ 15,000	\$ -	No		C
Upgrade interior lighting to LED	\$ 26,925	\$ 651	No		C
Upgrade lighting to LED	\$ 60,000	\$ -	No		C
Replace bathroom aerators with 1.0 GPM (Becomes maintenance)	\$ 150	\$ 150	No		B
Replace kitchen aerators with 1.5 GPM (Becomes maintenance)	\$ 450	\$ 901	No		B
Replace kitchen aerators with 1.5 GPM (Becomes maintenance)	\$ 900	\$ 499	No		B
Replace toilets with 1.1 GPF	\$ 9,200	\$ -	No		C
Upgrade interior LED lights to current technology	\$ 53,850	\$ 651	No		C
Replace bathtub and shower surround	\$ 83,250	\$ -	No		C
Replace apartment entry doors & hardware	\$ 67,500	\$ -	No		C

## BUILDING ENVELOPE

	Construction Description	
Wall Insulation	3 1/2' Fiberglass batt	Not observed
Roof Insulation	6' Fiberglass batt	Not observed

**Insulation Narrative / Recommendations**

Insulation level and condition could not be verified at time of site inspection. Levels were taken from drawings. At time of roof replacement, recommend inspection to be completed to ensure insulation in good condition. If replacement is needed, add as needed to meet minimum R-38.

Improvement	R.O.I.	Life Expectancy	Should we proceed?
Replace kitchen aerator	6 months	15 – 20 years	Yes
Upgrade Interior lighting to LED in Apartments	41 years 4 months	20 years	Probably not....
Upgrade Interior lighting to LED in Common Space	2 years	20 years	Yes



# The MoSCoW Approach (Must, Should, Could, Won't/Would)

## MUST

- Structurally sound façade
- Functioning ingress/egress
- Functioning fire suppression and other life safety measures
- Defective/missing items from compliance with laws or funding

## SHOULD

- Mechanical systems that are efficient
- Well functioning building envelope
  - Windows (Double Glazed)
  - Thermal (Min. Code)
  - Water Resistant
  - Min. Air Leakage
  - Min. Maintenance

## COULD

- Replace non-efficient equipment (fridge, range, washer/dryer)
- Replace incandescent lights with LED

## WON'T

- Replacement/Upgrade of subjective interior finishes (paint, tile, carpet, etc.)

# Sustainable and Repeatable



- Light Bulb Replacement
- Mechanical System Replacement
- Resolve Compliance Issues
- Fix Water Ingress Issues



- New Windows
- New Façade with additional insulation
- Air Sealing

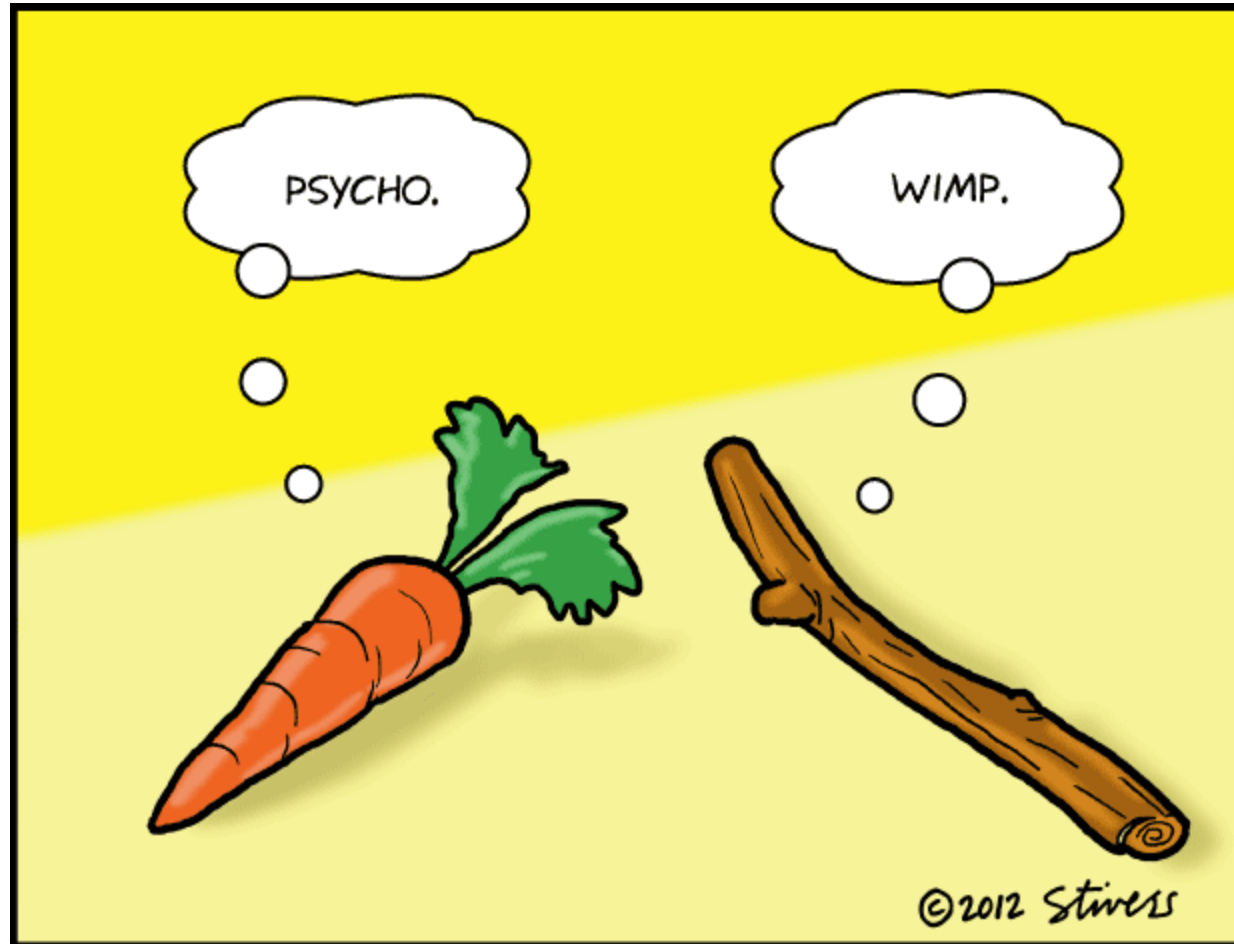


- Adding non-client specific amenities
- Replacing “new-ish” appliances
- Prioritizing aesthetics over function



- New interior finishes
- Repurposing/renovating common area space
- Green Energy (pending location)

## POINT 2: FINANCING AND FINES



“There are only two ways to influence human behavior; you can manipulate it or you can inspire it”  
~ Simon Sinek



### Project Costs

$\$25,000,000 \div \$34,815 =$

718-year payback on today's energy costs

Budget Overview				
Cost Per Unit Estimate	"BAU"	REALIZE		
	11/14/19	10/28/21	1/3/22	6/21/2022*
<b>Non-Energy Costs</b>	\$ 58,085.23	\$ 89,952.49	\$ 77,725.75	\$ 101,806.87
<b>Envelope</b>	\$ 17,620.00	\$ 56,464.00	\$ 61,003.77	\$ 72,081.13
<b>Mechanical</b>	\$ 19,561.76	\$ 38,086.79	\$ 39,320.75	\$ 49,537.26
<b>Electrical</b>	\$ 9,310.03	\$ 12,421.91	\$ 24,445.38	\$ 32,032.08
<b>Plumbing</b>	\$ 8,428.88	\$ 13,181.13	\$ 15,339.85	\$ 21,899.25
<b>Total CPU</b>	\$ 113,005.90	\$ 210,106.32	\$ 217,835.51	\$ 277,356.58
<b>Target Construction Cost:</b>	~\$25m (approx. \$245k/unit)		<b>85%</b>	<b>93%</b>
<b>Target Total Dev Cost:</b>	~\$40m			<b>145%</b>
<b>Project Sources:</b>				
4% LIHTC				
HUD RAD Conversion, Section 18 Blending (80% Section 18/20% RAD blend)				
MassSave Grant				
Soft State Subsidies				
Owner Equity				
<i>*Still in progress and under review.</i>				

# Investing



- “For me it was never about money, but solving problems for the future of humanity” ~ Elon Musk
- “I heard Jeff Bezos say one time that he makes his investments based on if it’s going to change people’s lives. Once I started doing that, I think I probably quadrupled what I’m worth” ~ Shaquille O’Neal
- “We are going to make historic investment in affordable housing, increasing and improving the housing supply by building and rehabilitating more than 2 million homes, especially in places that need more housing” ~ President Biden

# Investing – Federal Level



## Inflation Reduction Act of 2022

- Lower Consumer Energy Costs
  - \$9 Billion – Consumer home energy rebate programs
    - Focused on low-income consumers, to electrify home appliances and for energy efficient retrofits.
  - 10 years of consumer tax credits to make homes energy efficient and run on clean energy, making heat pumps, rooftop solar, electric HVAC and water heaters more affordable.
  - \$1 Billion - Grant program to make affordable housing more energy efficient.
- American Energy Security and Domestic Manufacturing
  - \$30 Billion - Production tax credits to accelerate U.S. manufacturing of solar panels, wind turbines, batteries, and critical minerals processing
  - \$10 Billion - Tax credit to build clean technology manufacturing facilities, like facilities that make electric vehicles, wind turbines and solar panels
  - \$500 Million - Defense Production Act for heat pumps and critical minerals processing
  - \$2 billion - Grants to retool existing auto manufacturing facilities to manufacture clean vehicles, ensuring that auto manufacturing jobs stay in the communities that depend on them.
- Infrastructure Investment and Jobs Act
  - \$225 Million – DOE will utilize to support energy code adoption, enforcement, training and technical assistance.

# Investing – Federal Level



Just some of the other **1,035 bills** that have been Introduced with the keyword “retrofit”

- S.4422 – Energy Efficiency for Affordable Housing Act
- S.2361 – Green Retrofits Act
- S.1218 - Green New Deal for Public Housing Act
- S.1925 - Buy Green Act of 2021
- S.2066 - INSULATE Buildings Act of 2021
- S.4422 – Energy Efficiency for Affordable Housing Act
- S.227 – Renewable Fuel Infrastructure Investment and Market Expansion Act of 2021
- S.442 – BRIGHT Act
- H.R.4155 – Green Neighborhoods Act of 2021
- H.R. 5689 – Resilient AMERICA Act
- H.R. 5181 – Energy Efficient Commercial Buildings Act of 2021

# Investing – State Level



**CALIFORNIA**  
**ENERGY COMMISSION**







# Climate Mobilization Act

April 18<sup>th</sup>, 2019

- New Government Regulatory Body
  - Office of Building Energy and Emissions Performance
- Introductory Compliance by 2029
- Secondary Compliance by 2034
  - 40% reduction by 2030 (by law)
- Tertiary Compliance by 2050
  - 80% reduction by 2050

# Climate Mobilization Act

- Local Law 92
  - Effective Nov. 15, 2019
  - Green Roof or Solar Panels
- Local Law 94
  - Effective Nov 15, 2019
  - White Roof
    - Minimum SRI of 82, per ASTM E1980

Trigger: Any new construction or project that requires replacement of the entire roof assembly or decking.



# Climate Mobilization Act

## Local Law 95

- Effective April 18<sup>th</sup>, 2019
- All buildings over 25,000 GSF
- Energy score posted on front door

Energy Grade	Energy Star Score
A	85-100
B	70-84
C	55-69
D	1-54
F	Non-Compliant
N	No ES Score or Exempt



# Climate Mobilization Act

## Local Law 96

- Effective April 1, 2020
- PACE (Property Assessed Clean Energy) Financing
  - 100% Financing
  - 20 – 30-year financing terms



# Climate Mobilization Act

## Local Law 97

- Effective Jan 1 2024
- Buildings over 25,000 GSF
  - 50,000 buildings in NYC



	2024-29 limit (kg of CO <sub>2</sub> e per SF)	2030-34 limit (kg of CO <sub>2</sub> e per SF)
Occupancy Group <b>R-2</b> (includes apartments)	6.75	4.07
Occupancy Group <b>B</b> (includes offices)	8.46	4.53
Occupancy Group <b>R-1</b> (includes hotels)	9.87	5.26

Violation Type	Maximum Fine
Failure to file a report	\$0.50 per building square foot, per month
Exceeding emissions limit	\$268 for each metric ton over the building's limit
False statement (misdemeanor)	\$500,000

For example, a 1,587,872 square-foot commercial office building emitting 14,550 metric tons of carbon would be 1,016 metric tons over its 2024-2029 limit and pay a fine of approximately **\$272,288 annually**.

# Capital Stack

 Grants/Rebates

 Loans

 Penalty Avoidance

Funding Source	Funding Category	Incentive	Requirements
NYS Homes and Community Renewal	Clean Energy	\$12,500/unit	<ul style="list-style-type: none"> <li>HCR's Stretch Sustainability Standards</li> </ul>
NYSERDA	RetrofitNY	\$40,000/unit	<ul style="list-style-type: none"> <li>Utilize heat pump-based technology</li> <li>Utilize energy and heat recovery ventilation technology</li> <li>Demonstrate it will not exceed a site Energy Use Intensity of 30 kBtu/ft<sup>2</sup>/year and an air tightness of 2.0 ACH50</li> </ul>
Various Utility Providers	Electric Incentives and Rebates	<ul style="list-style-type: none"> <li>Partial Load Air Source Heat Pump: \$600/outdoor condenser unit</li> <li>Full Load Air Source Heat Pump: \$1,200/10,000 BTUH</li> <li>Full Load Ground Source Heat Pump: \$1,500/10,000 BTUH</li> <li>Electric Heat Pump Water Heater: \$700/Unit</li> <li>WiFi Enabled Thermostats: \$75/each</li> </ul>	<ul style="list-style-type: none"> <li>Each air source unit must meet Northeast Energy Efficiency Partnership Product Specification List</li> <li>Each ground source unit must meet or exceed ENERGY STAR Tier 3 Product Criteria</li> <li>ENERGY STAR Certified HPWH</li> </ul>
Various Utility Providers	Natural Gas Incentives and Rebates	<ul style="list-style-type: none"> <li>Condensing Boiler: \$400</li> <li>Hot Water Boiler: \$200</li> <li>Steam Boiler with Electronic Ignition: \$200</li> <li>Furnace: \$150 - \$450</li> <li>Water Heater: \$50 - \$250</li> <li>WiFi Enabled Thermostats: \$75/each</li> </ul>	<ul style="list-style-type: none"> <li>Annual Fuel Utilization Efficiency Rating ≥ 90%</li> <li>Annual Fuel Utilization Efficiency Rating ≥ 85%</li> <li>Annual Fuel Utilization Efficiency Rating ≥ 82%</li> <li>Annual Fuel Utilization Efficiency Rating ≥ 90% (more money for higher efficiency rated equipment)</li> </ul>
New York City Energy Efficiency Corporation (NYCEEC)	C-PACE	<ul style="list-style-type: none"> <li>\$200,000, up to 90% of project costs (100% for affordable multifamily)</li> <li>\$150,000, up to 100% of project cost</li> <li>\$400,000, up to 80% of project cost (20% developer equity)</li> <li>&gt; \$400,000, up to 80% of project costs (20% developer equity)</li> <li>\$300,000, up to 90% of project costs (100% for affordable multifamily)</li> <li>\$200,000, up to 90% of project costs (100% for affordable multifamily)</li> </ul>	<ul style="list-style-type: none"> <li>Equipment Loan</li> <li>PACE Loan</li> <li>Energy Services Agreement (ESA) Loan</li> <li>Power Purchase Agreement (PPA) Loan</li> <li>Green Construction Loan</li> <li>Multifamily Service Loan</li> </ul>
Costs and Fine Avoidance	Building Owner	<ul style="list-style-type: none"> <li>\$268/year/metric ton of CO<sub>2</sub> <ul style="list-style-type: none"> <li>\$0.50/sq.ft./month (missing report)</li> <li>\$500,000 and up to 30 days of imprisonment (false report)</li> </ul> </li> <li>&gt; \$25,000/5-year inspection           <ul style="list-style-type: none"> <li>\$1,000/month (late filing)</li> <li>\$5,000/year (failure to file)</li> <li>\$1,00/month base + \$10 - 40/month based on number of years for unsafe condition</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Comply with requirements of Local Law 97</li> <li>Comply with requirements of Local Law 11</li> </ul>

# Capital Stack

 Grants/Rebates

 Loans

 Penalty Avoidance

Funding Source	Funding Category	Amount
NYS Homes and Community Renewal	Low Income Housing Tax Credit (LIHTC)	\$1,122,000
NYS Homes and Community Renewal	State Low Income Housing Credit (SLIHC)	\$332,000
NYS Homes and Community Renewal	Low Income Community Investment Fund (CIF)	\$130,000
NYS Homes and Community Renewal	Senior Housing Program (SENR)	\$5,000,000
NYSERDA	RetrofitNY Pilot Funding	\$2,400,000
ConEdison	Air-Source Heat Pump Incentive	\$60,000
ConEdison	Air-Source Heat Pump Water Heater (< 120 Gal)	\$60,000
NYCEEC	Multifamily Solar Loan	\$275,000
NYCEEC	Green Construction Loan	\$3,500,000
NYC Department of Buildings	Building Owner	<ul style="list-style-type: none"> <li>• (\$27,872)/ year – Local Law 97 Excessive Carbon use penalty</li> <li>• (\$25,000)/ 5 years – Local Law 11 Inspection costs</li> </ul>

Total Capital Stack: **\$13,536,440**

- Grants, Rebates and Other Incentives: \$9,104,000
- C-PACE Loans: \$3,775,000
- C.M.A. Cost and Fine Avoidance: \$657,440 (over 20 yrs)

Other “Soft” Financial Benefits:

- Reduction in O&M costs
  - Higher Occupancy Rate
  - Greater Occupant Satisfaction
  - Lower Turnover costs (paint, carpet, marketing, realtor fees, etc.)
- Reduction in Insurance Premiums
- Elimination of Deferred Maintenance Line Items
- Increase the future market value of the asset

# Capital Stack Impact on Design – Lessons Learned

- *Know where every dollar comes from, and what strings are tied to them.*
- **Grants/Rebates**
  - Can only be used for specific items, performance driven usually
  - Typically has a “spend by date”
  - Requires periodic monitoring/performance verification
- **Loans**
  - If C-PACE: Can only be used for specific items, performance driven usually
- **Penalty Avoidance**
  - Pressure could be increased/diluted with political landscape
  - Requires Owner being “honest broker” or enforcement
- **Soft Costs Optimization**
  - Ample opportunity for identifying additional cash flows
  - Hard to qualify cashflows broadly today. Requires a great deal of owner’s financial transparency into operating costs.





## POINT 3: THE IMPACT OF INTEGRATED DESIGN



“Pull a thread here and you’ll find it is attached to the rest of the world” ~ Nadeem Aslam

# The Pilot Project

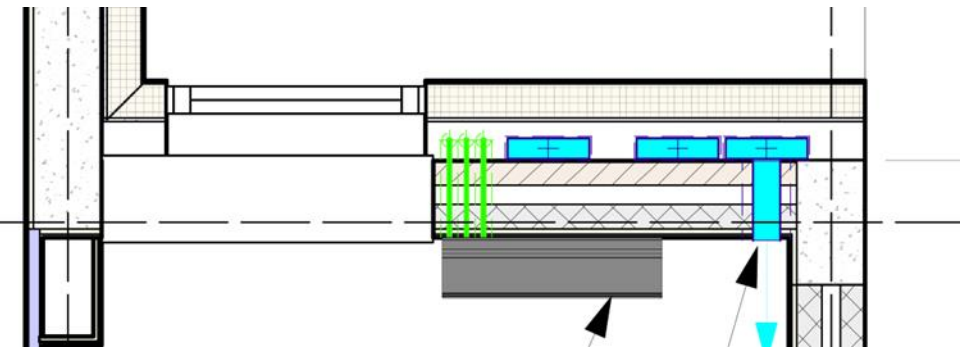
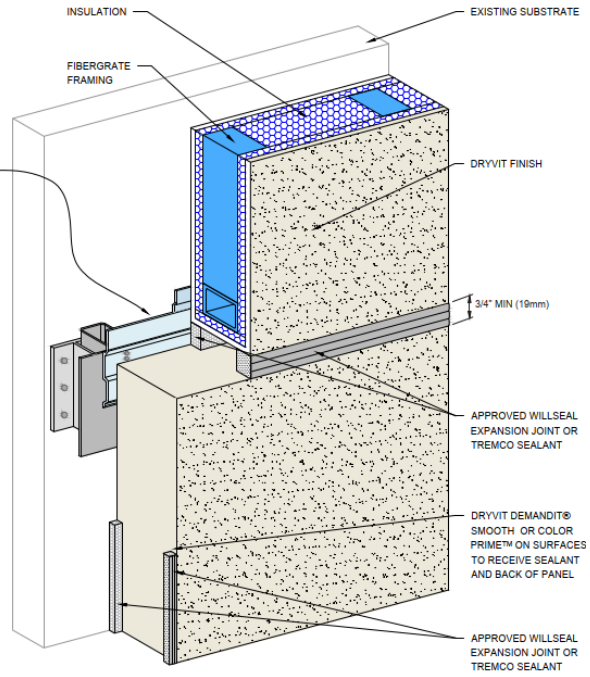


Built 1960s  
R-1 Wall Assembly  
Single Glazed Windows  
Rent Controlled Multi-Family  
Significant Elderly Population

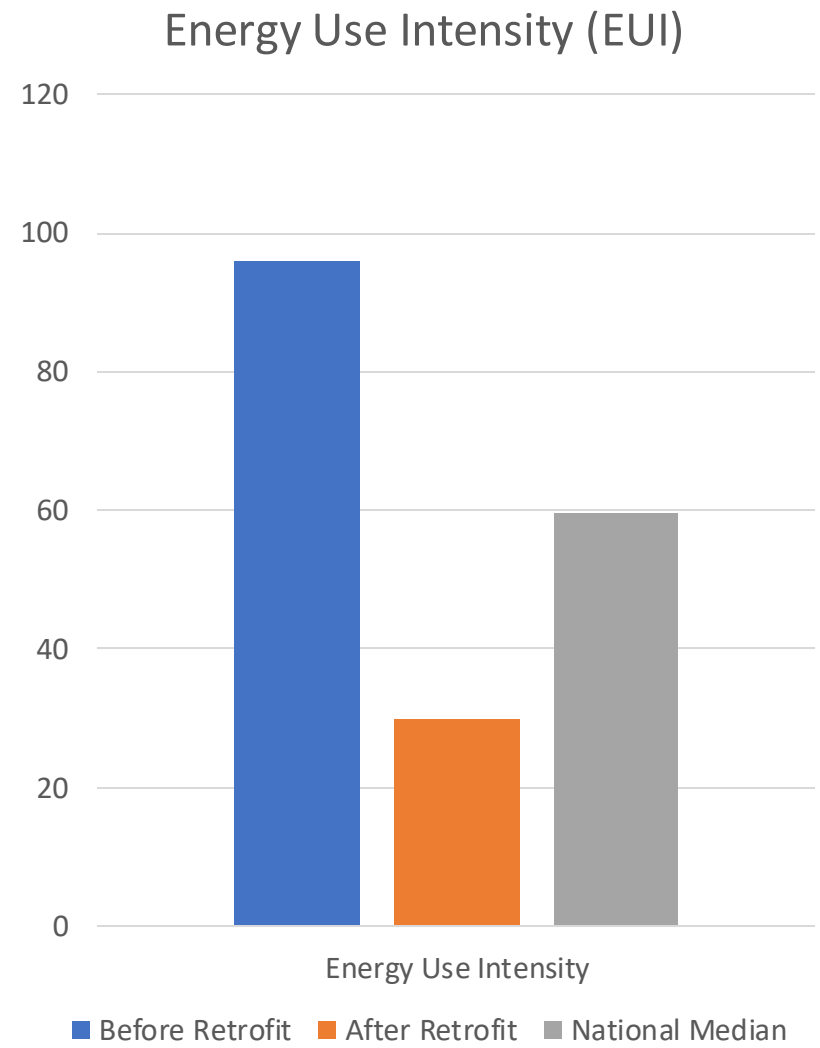
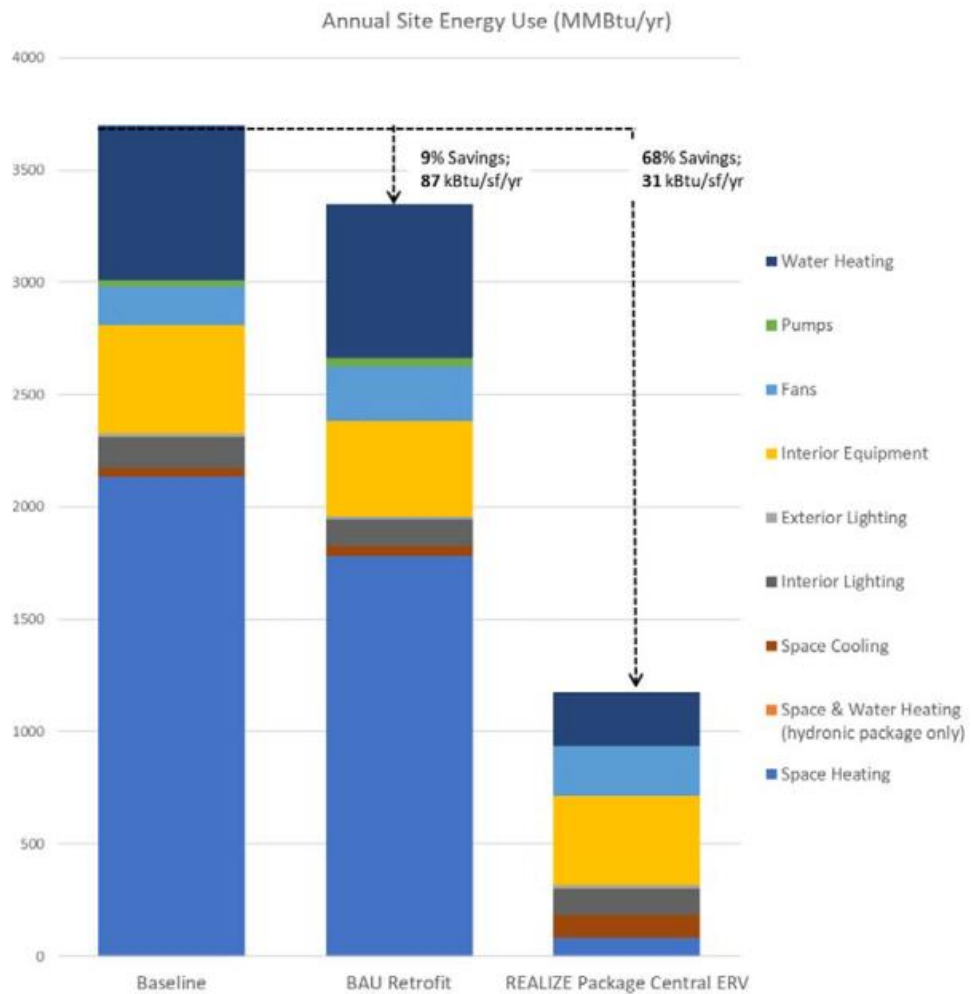
Goal:  
R-30 Wall Assembly  
U-0.12 Window System  
Window in Wall Panel  
New Roof Top VFD and duct work  
No Tenant Displacement, Minimum Disruption



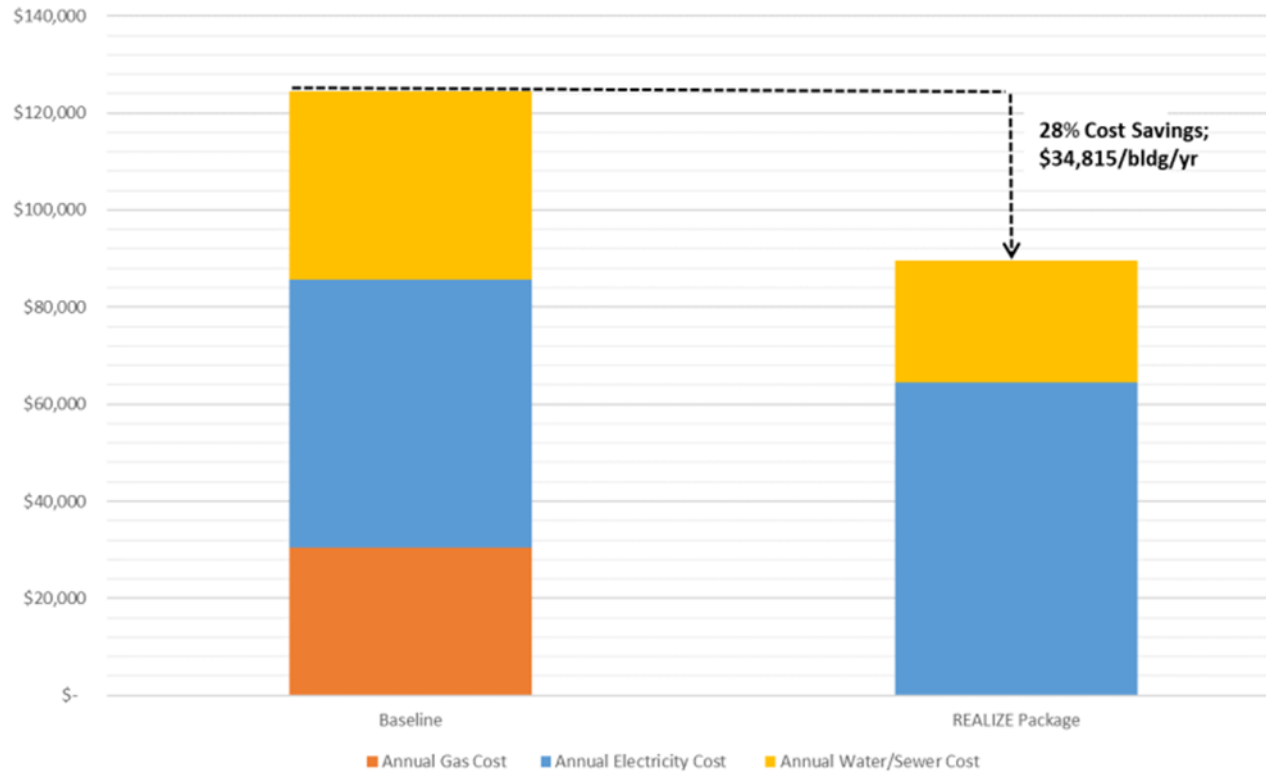
# Integrated Design







Annual Utility Costs (\$/yr)



## POINT 3: THE NECESSITY FOR CHANGE



Sydney, Australia



Lake Oroville, California



Tewkesbury, England

“The good thing about science is that it’s true whether or not you believe it” ~ Neil DeGrasse Tyson



Goleta, California (100 miles north of L.A.)



Suesca, Colombia



Lake Mead, Nevada

“A society grows great when old men plant trees whose shade they know they shall never sit in” ~ Greek Proverb





Over the next 35 years,

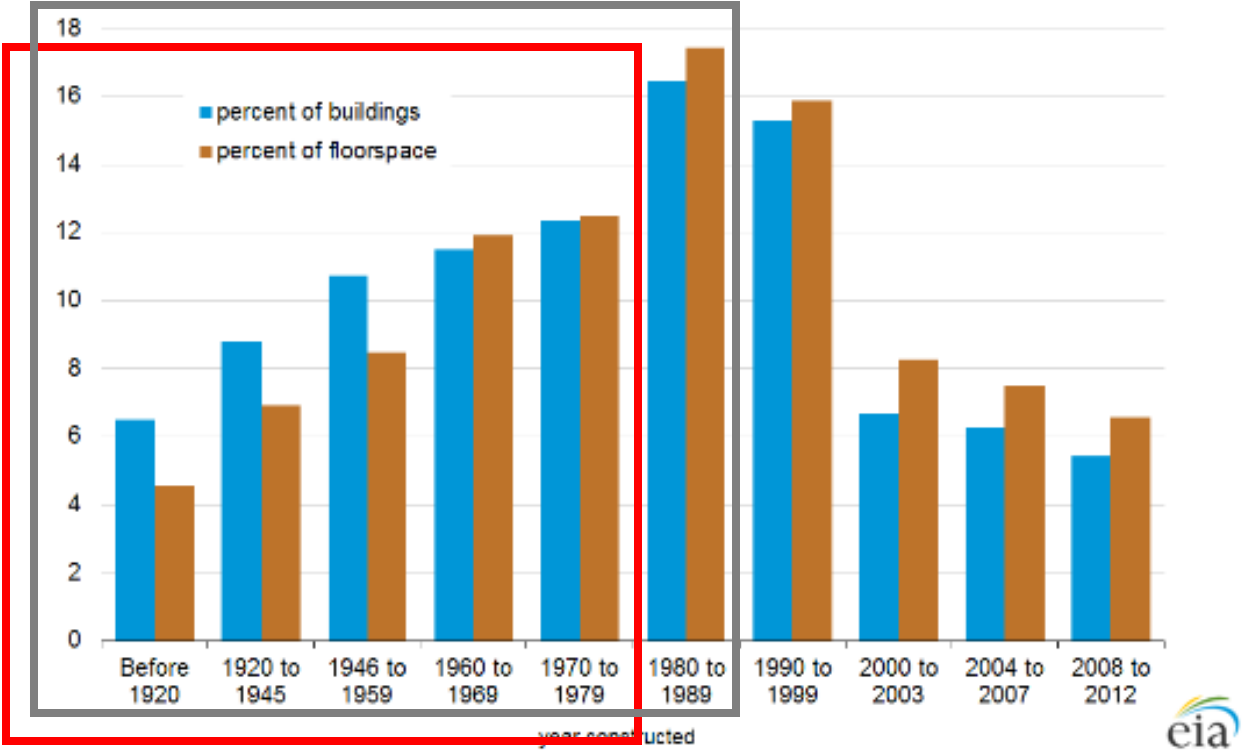
**2.5 trillion ft<sup>2</sup>**

of buildings will be constructed or renovated in cities worldwide.

# Opportunity

## Existing Building Stock

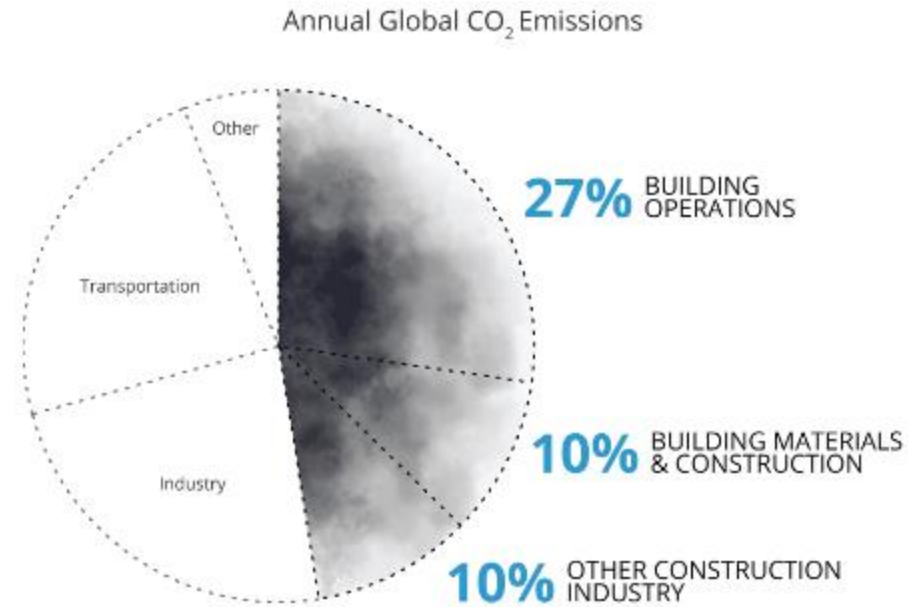
80% of buildings we see today will be here in 2050



Source: U.S. Energy Information Administration, 2012 Commercial Buildings Energy Consumption Survey



## THE BUILT ENVIRONMENT



**The built environment generates nearly 50% of annual global CO<sub>2</sub> emissions.**

Of those total emissions, building operations are responsible for 27% annually, while building materials and construction (typically referred to as embodied carbon) are responsible for an additional 20% annually.

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Data Sources: Global ABC Global Status Report 2021, EIA

# The Carbon Impact

- 27,000 therms of natural gas reduction per year.  
Equivalent to:
  - 353,826 miles driven by a car
  - 16,040 gallons of gas consumed
  - 157,713 pound of coal burned
  - 27 homes' electricity use for one year
  - 330 barrels of oil consumed
  - 6,170 trash bags of waste recycled instead of landfill
  - 5,403 incandescent lamps switched to LEDs
  - 169 acres of U.S. forests





**QUESTIONS?**

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*Construction Products Group*

