

# Advancing Passive House Policy

## NAPHN 2016 policy session 1

### presentations

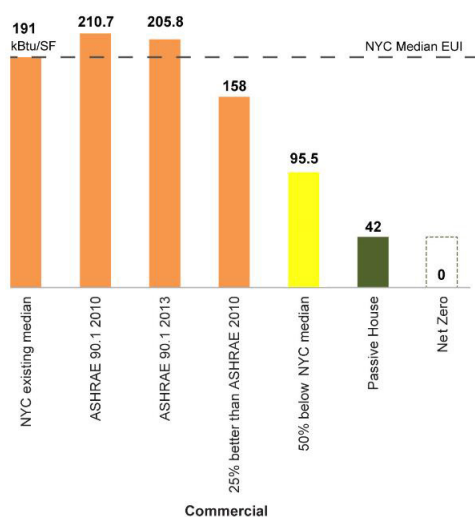
*“The building sector offers the largest low-cost potential in world regions to lower emissions.”*

*- Dr. Diana Urge-Vorsatz, Vice Chair,  
Intergovernmental Panel on Climate Change (IPCC)*

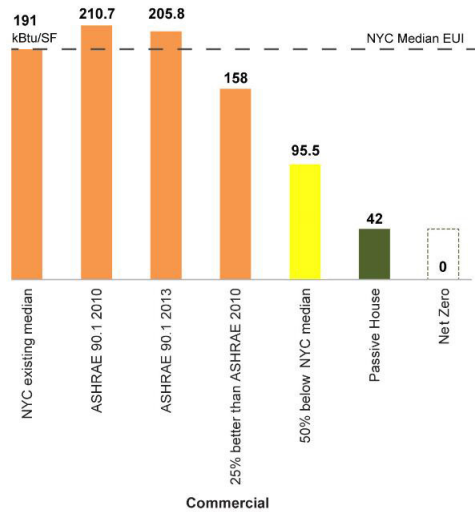
## appendix c: session 1 presentations

John Lee

NYC Mayor's Office of Sustainability



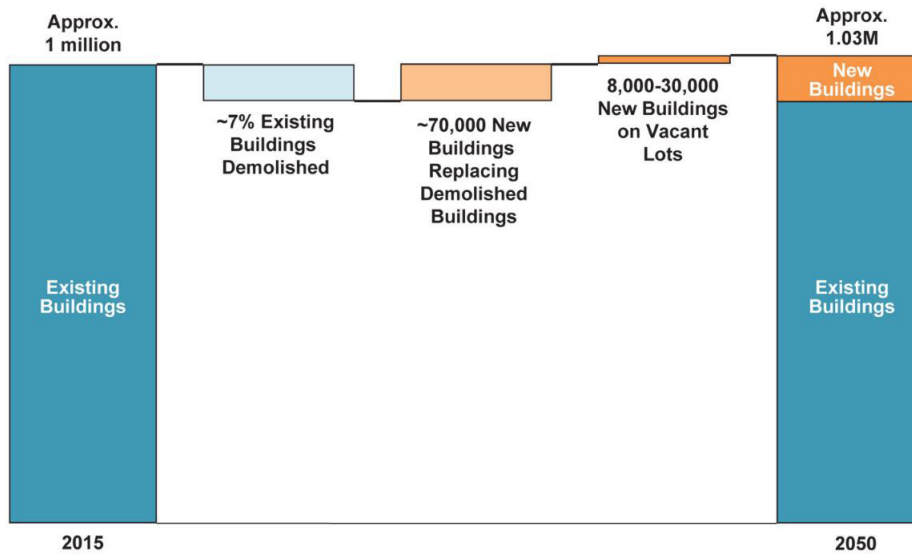
Starting in 2017, all City-owned new buildings and major renovations must meet a very-low-energy design target, at least 50% below comparable buildings

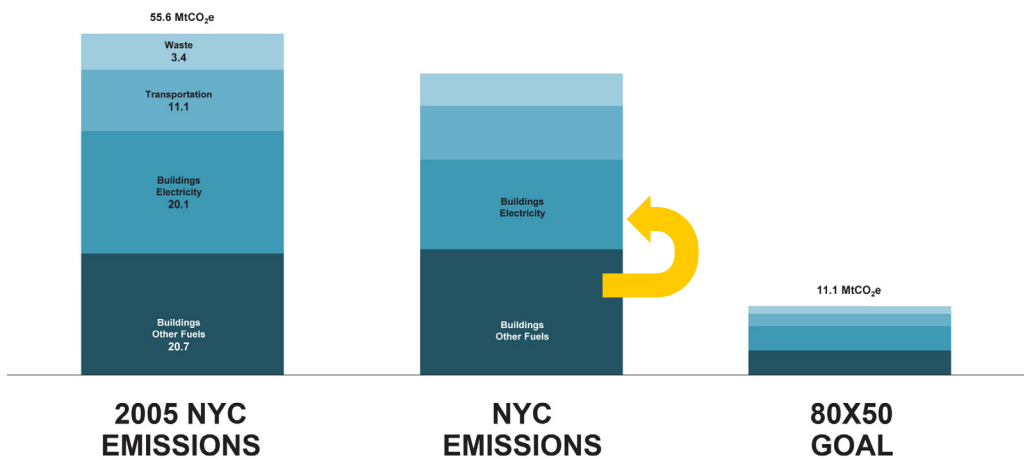
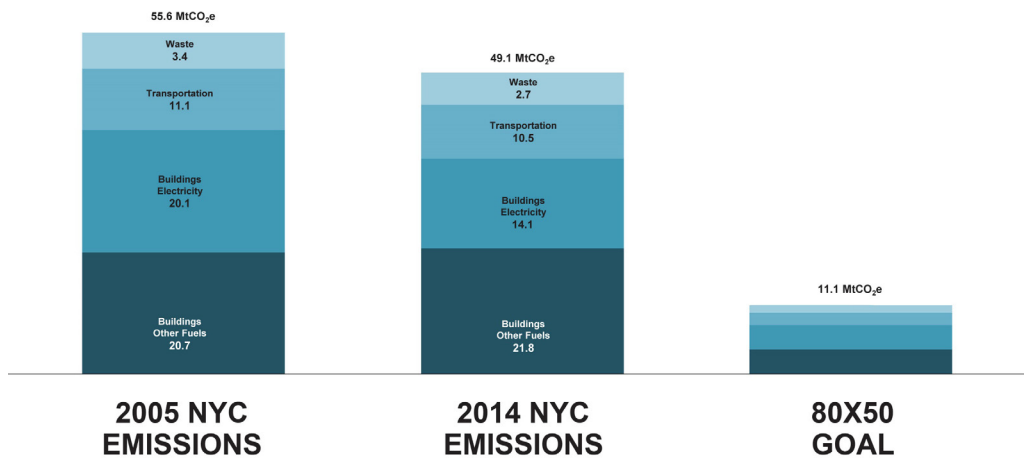


For private sector new buildings:

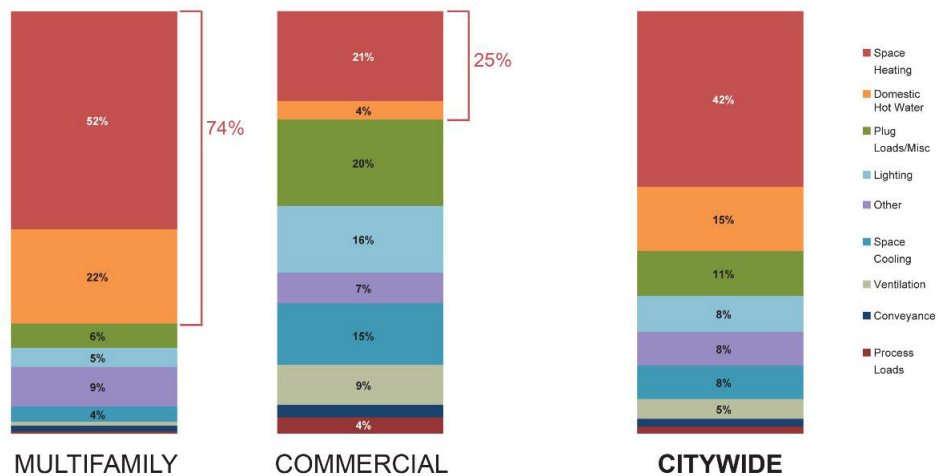
**2019:** Report on an energy performance metric

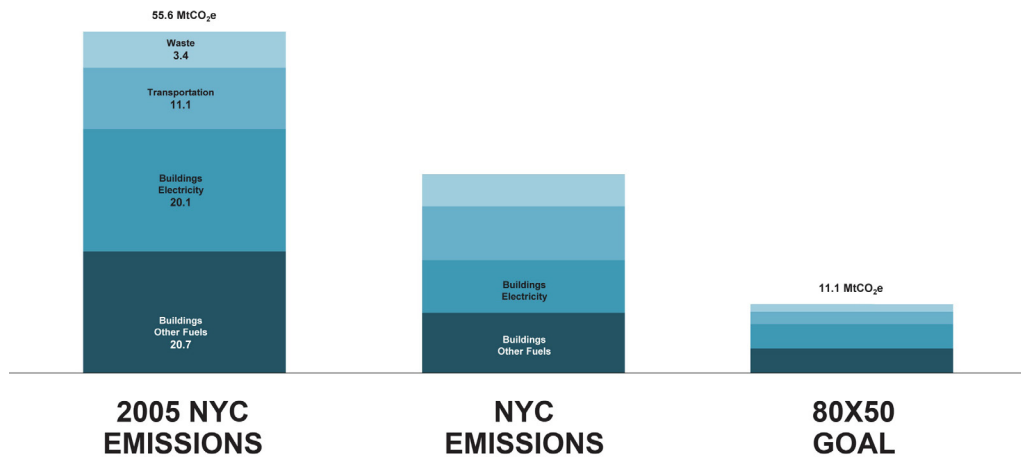
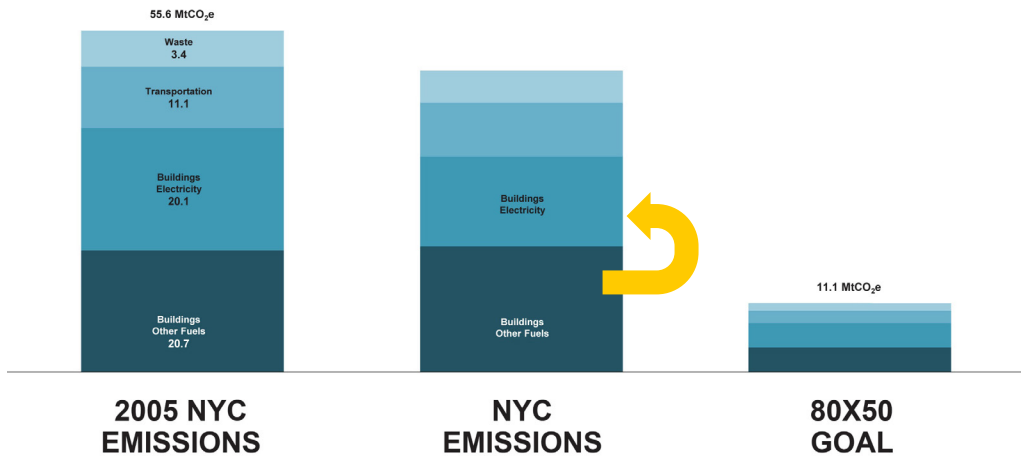
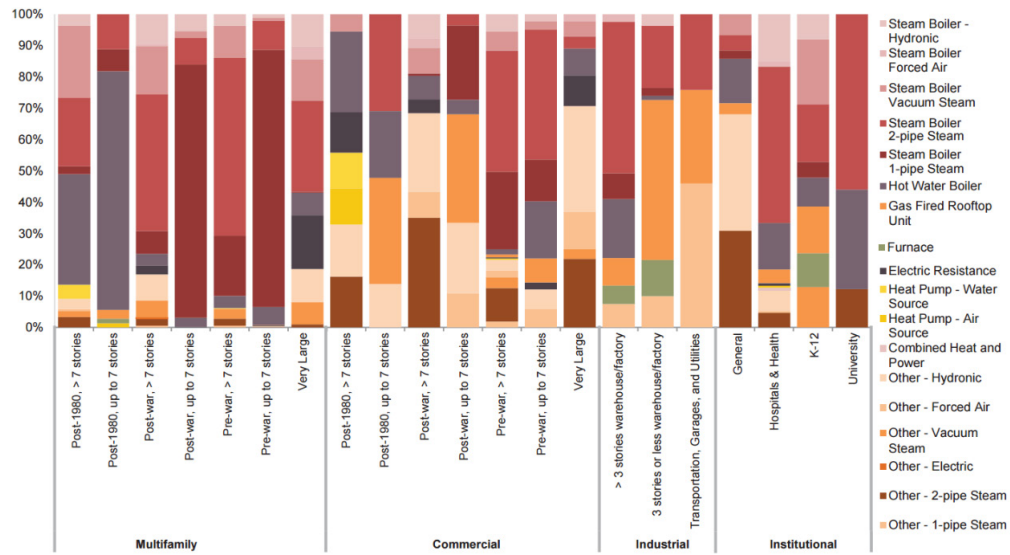
**2022:** Meet a whole building energy performance design target

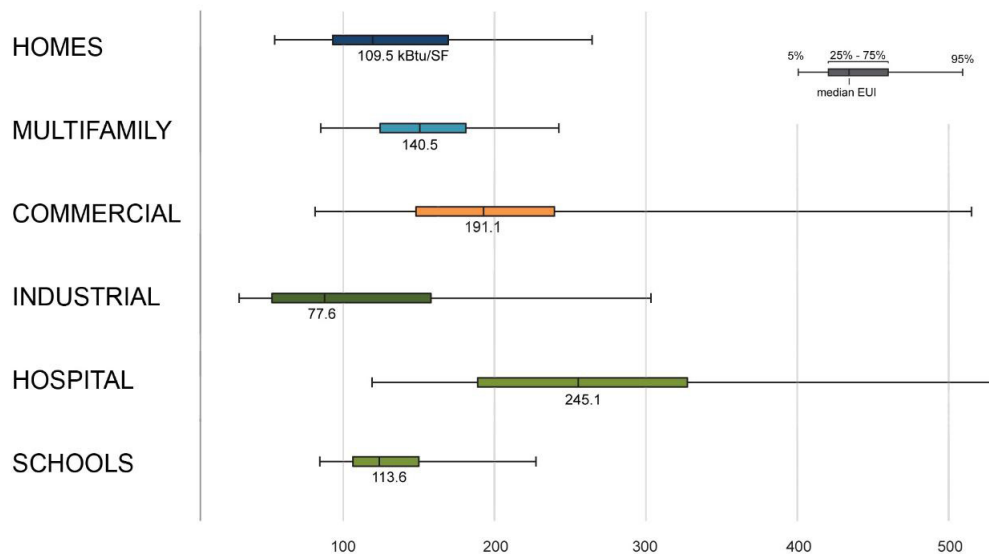
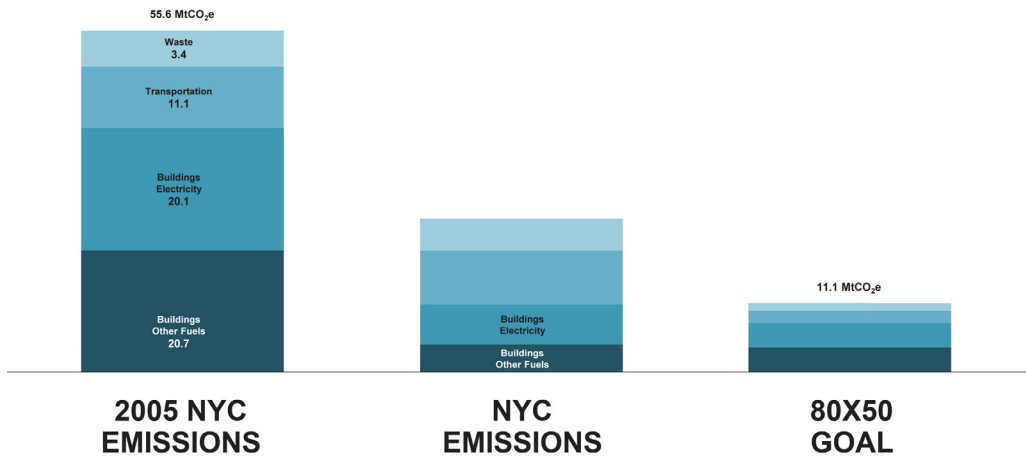
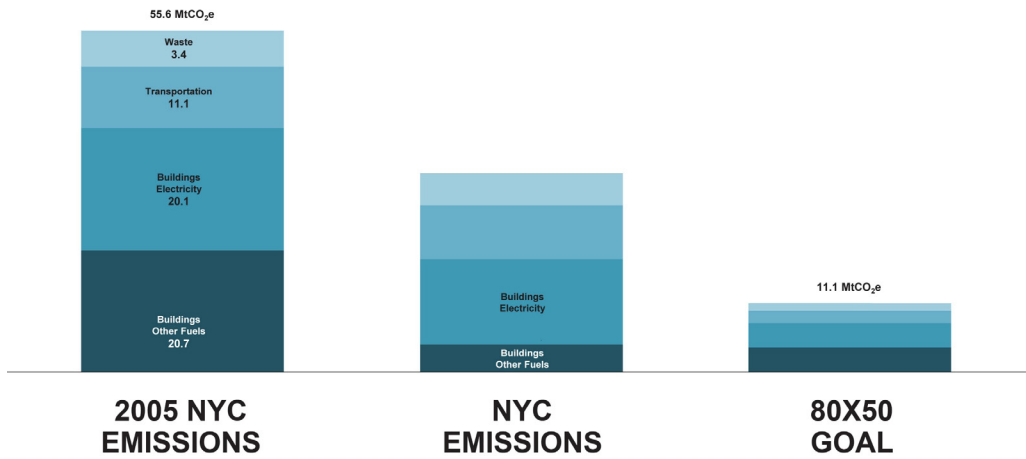




### GHG EMISSIONS FROM LARGE BUILDINGS IN NEW YORK CITY









## HOMES



## MULTIFAMILY



## COMMERCIAL



## INDUSTRIAL



## HOSPITAL



## SCHOOLS



### ONE- TO FOUR-FAMILY HOMES

This typology includes both one- to four-family freestanding homes and row homes, which covers both the greatest absolute number of buildings and the most square footage of the City's 21 building typologies. The baseline building includes a steam boiler with one-pipe steam distribution for heating, window air conditioning units for cooling that cause air leakage, and exhibits a high air infiltration rate that is typical of these buildings.



Size 3,000 SF  
Height 3 Stories + 1 Below-grade

#### Baseline Conditions

Wall Construction: Mass wall with infiltration (R-5)  
Roof: Modified shingles roof on wood rafters, crawl space (R-15)  
Windows and Glazing: Double-pane windows, vinyl frame  
Lighting: 0.50 Watts/SF  
Plug Loads: 0.57 Watts/SF  
Heating System: Gas boiler, 1-pipe steam, radiators  
Cooling System: Window A/C  
DHW System: Direct-fired storage tank, natural gas

#### Efficiency Measures Applied to All Paths

- Lighting: Reduce LPD
- Plug loads: Replace appliances: Master switching: Smart plugs
- Ventilation: Reduce over-ventilation: Upgrade fans
- Envelope: Maximize roof insulation: Air Sealing
- DHW: Install low flow fixtures: On-demand gas hot water heater
- Renewables: Solar PV on 20% of the roof

#### Path 1

##### Efficient Systems

- Optimized best-in-class natural gas steam boiler and steam distribution
- ENERGY STAR A/C
- Solar PV on 25% of the roof

#### Path 2

##### Hydronic Conversion

- Remove window A/C
- Re-clad 100% of facade
- Remove Through-wall A/C
- Variable Refrigerate Flow for heating and cooling
- Solar thermal for 50% of the DHW load

#### Path 3

##### Electrification

- Remove window A/C
- Re-clad 100% of facade
- Remove Through-wall A/C
- Variable Refrigerate Flow for heating and cooling
- Solar thermal for 50% of the DHW load

#### Path 4

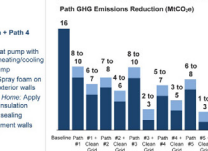
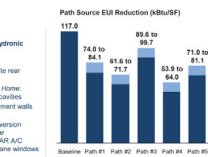
##### Electrification + Re-cladding

- Remove window A/C
- Re-clad 100% of facade
- Remove Through-wall A/C
- Variable Refrigerate Flow for heating and cooling
- Solar thermal for 50% of the DHW load

#### Path 5

##### Electrification + Path 4 Envelope

- Air source heat pump with mini-split for heating/cooling
- Freestanding Home: Apply rigid exterior insulation
- Extensive air sealing
- Freestanding Home: Apply rigid exterior insulation
- Extensive air sealing
- Insulate basement walls
- Hydronic conversion
- Upgrade boiler
- Install ERVs
- Multi-split A/C



### MULTIFAMILY, PRE-WAR UP TO 7 STORIES

This typology includes the most square footage in New York City after one- to four-family homes. These buildings typically include one-pipe steam distribution systems with limited or no controls to provide space heating. Window air conditioners provide summertime cooling and create window or wall penetrations and lead to air leakage year-round and a high air infiltration rate.



Size 12,800 SF  
Height 4 Stories + 1 Below-grade

#### Baseline Conditions

Wall Construction: Mass wall (R-5)  
Roof: Insulation above deck (R-12)  
Lighting: 0.40 Watts/SF  
Plug Loads: 0.55 Watts/SF  
Heating System: Dual fuel boiler, 1-pipe Steam  
Cooling System: Window A/C  
DHW System: Indirect coil in steam boiler

#### Efficiency Measures Applied to All Paths

- Lighting: Reduce LPD
- Plug loads: Master switching: Smart plugs: Replace appliances
- DHW: Install low flow fixtures: Condensing gas boiler
- BMS/EMS: Controls to provide indoor feedback and implement set-backs
- Ventilation: Unbalanced through-wall exhaust ventilation
- Envelope: Replace windows with double-pane, low-e windows, maximize roof insulation and air-sealing
- Solar PV on 25% of the roof

#### Path 1

##### Efficient Systems

- Optimized best-in-class natural gas steam boiler and steam distribution
- ENERGY STAR A/C
- Solar PV on 25% of the roof

#### Path 2

##### Hydronic Conversion

- Remove window A/C
- Re-clad 100% of facade
- Remove window A/C
- Air source heat pump with mini-split for heating/cooling
- Solar thermal for 50% of the DHW load

#### Path 3

##### Electrification

- Remove window A/C
- Re-clad 100% of facade
- Remove window A/C
- Air source heat pump with mini-split for heating/cooling
- Solar thermal for 50% of the DHW load

#### Path 4

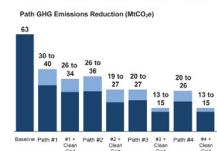
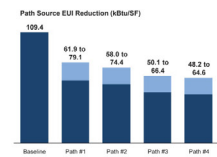
##### Electrification + Re-cladding

- Remove window A/C
- Re-clad 100% of facade
- Remove window A/C
- Air source heat pump with mini-split for heating/cooling
- Solar thermal for 50% of the DHW load

#### Path 5

##### Electrification

- Remove window A/C
- Re-clad 100% of facade
- Remove window A/C
- Air source heat pump with mini-split for heating/cooling
- Solar thermal for 50% of the DHW load



### MULTIFAMILY, POST-WAR GREATER THAN 7 STORIES

This building typology includes taller buildings that were constructed in the post-war period but before the first Energy Code was enacted in New York City. The baseline building includes a two-pipe steam heating system with a steam boiler and limited heating system controls. In addition, this building uses through-wall sleeve air conditioners for cooling, which result in the potential for air leakage at wall penetrations.



Size 185,600 SF  
Height 16 Stories + 1 Below-grade

#### Baseline Conditions

Wall Construction: Mass wall (R-5)  
Roof: Insulation above deck (R-12)  
Lighting: 0.50 Watts/SF  
Plug Loads: 0.65 Watts/SF  
Heating System: Natural gas boiler, 2-Pipe Steam  
Cooling System: Through-wall A/C  
DHW System: Indirect coil in steam boiler

#### Efficiency Measures Applied to All Paths

- Lighting: Reduce LPD
- Plug loads: Master switching: Smart plugs: Replace appliances: Replace old elevators
- DHW: Install low flow fixtures: Condensing gas boiler
- BMS/EMS: Controls to provide indoor feedback and implement set-backs
- Ventilation: Seal and balance kitchen and toilet risers: Upgrade fans
- Envelope: Replace windows: Maximize roof insulation: Air Sealing

#### Path 1

##### Efficient Systems

- Optimized best-in-class natural gas steam boiler and steam distribution
- Solar PV on 23% of the roof

#### Path 2

##### Hydronic Conversion

- Remove Through-wall A/C
- Water source heat pump with gas boiler and cooling tower for heating and cooling
- Solar thermal for 50% of the DHW load

#### Path 3

##### Electrification

- Remove Through-wall A/C
- Re-clad 100% of facade
- Remove Through-wall A/C
- Variable Refrigerate Flow for heating and cooling
- Solar thermal for 50% of the DHW load

#### Path 4

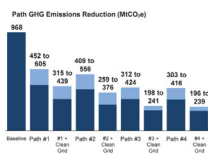
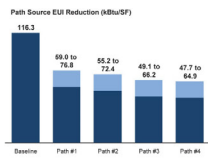
##### Electrification + Re-cladding

- Remove Through-wall A/C
- Re-clad 100% of facade
- Remove Through-wall A/C
- Variable Refrigerate Flow for heating and cooling
- Solar thermal for 50% of the DHW load

#### Path 5

##### Electrification

- Remove Through-wall A/C
- Re-clad 100% of facade
- Remove Through-wall A/C
- Variable Refrigerate Flow for heating and cooling
- Solar thermal for 50% of the DHW load



### MULTIFAMILY, POST-1980 GREATER THAN 7 STORIES

This building typology includes taller buildings that were constructed after the first Energy Code was enacted in New York City. The baseline building for this typology includes a hydronic heating system, PTACs for cooling, and steel framed window-wall construction.



Size 78,000 SF  
Height 11 Stories + 1 Below-grade

#### Baseline Conditions

Wall Construction: Steel framed window wall with some insulation (R-6)  
Roof: Insulation above deck (R-19)  
Lighting: 0.50 Watts/SF  
Plug Loads: 0.67 Watts/SF  
Heating System: Natural gas boiler, Hydronic with PTACs  
Cooling System: PTACs  
DHW System: Indirect storage tank, natural gas boiler

#### Efficiency Measures Applied to All Paths

- Lighting: Reduce LPD
- Plug loads: Master switching: Smart plugs: Replace appliances: Replace old elevators
- DHW: Install low flow fixtures: Condensing gas boiler
- BMS/EMS: Controls to provide indoor feedback and implement set-backs
- Ventilation: Seal and balance kitchen and toilet risers: Upgrade fans
- Envelope: Replace windows: Maximize roof insulation: Air Sealing

#### Path 1

##### Efficient Systems

- Optimized best-in-class natural gas hot water boiler and hydronic distribution
- Upgrade PTACs
- Solar PV on 15% of the roof

#### Path 2

##### Water Source Heat Pump Upgrade

- Remove PTACs
- Water source heat pump with gas boiler and cooling tower for heating and cooling
- Solar thermal for 50% of the DHW load

#### Path 3

##### Electrification

- Remove PTACs
- Re-clad 100% of facade
- Remove PTACs
- Variable Refrigerate Flow for heating and cooling
- Solar thermal for 50% of the DHW load

#### Path 4

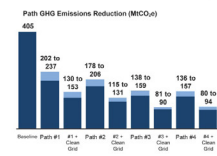
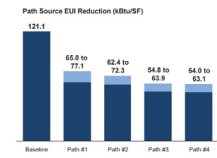
##### Electrification + Re-cladding

- Remove PTACs
- Re-clad 100% of facade
- Remove PTACs
- Variable Refrigerate Flow for heating and cooling
- Solar thermal for 50% of the DHW load

#### Path 5

##### Electrification

- Remove PTACs
- Re-clad 100% of facade
- Remove PTACs
- Variable Refrigerate Flow for heating and cooling
- Solar thermal for 50% of the DHW load



## COMMERCIAL, PRE-WAR UP TO 7 STORIES

This building typology includes relatively simple low-rise commercial buildings with many building systems that may not have been recently replaced. The baseline building includes mass wall construction with a one-pipe steam heating system and window air conditioners for cooling. The building is also modeled as an office building with corresponding tenant energy use.



Size 12,500 SF  
Height 4 Stories + 1 Below-grade

### Baseline Conditions

Wall Construction: Mass wall (R-3)  
Roof: Insulation entirely above deck (R-15)  
Windows and Glazing: Double pane, aluminum frame, no glass coating  
Lighting: 1.75 Watts/SF  
Plug Loads: 1.75 Watts/SF  
Heating System: Natural Gas Steam Boiler, 1-Pipe Steam  
Cooling System: Window A/Cs  
DHW System: Cold Feed Storage Tank, Natural Gas

### Efficiency Measures Applied to All Paths

Lighting: Reduce LPD and install sensors  
Plug loads: Master switching, Smart plugs  
Envelope: Replace windows, Maximize roof insulation, Air Sealing, Cool Roofs  
DHW: Install low flow fixtures  
BMS: Controls to provide indoor feedback and implement set-backs  
Renewables: Solar PV on 15% of the roof  
Tenant Measures: Replace appliances, Address supplemental heating and cooling

### Path 1 Steam System Upgrade

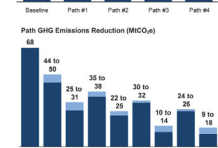
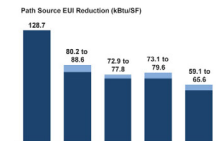
•Optimized best in class natural gas steam boiler and steam distribution  
•Upgrade boiler  
•ENERGY STAR A/C  
•ENERGY STAR A/C  
•Condensing gas tankless DHW

### Path 3 Electrification

•Air source heat pump with mini-split for heating and cooling  
•Install ERVs  
•Electric tankless DHW at point of use  
•Remove Window A/C

### Path 4 Electrification + Re-cladding

•Re-clad 50% of facade  
•Air source heat pump with mini-split for heating and cooling  
•Install ERVs  
•Electric tankless DHW at point of use  
•Remove Window A/C



## COMMERCIAL, PRE-WAR GREATER THAN 7 STORIES

This building typology also tends to have many building systems that have not been recently replaced. The baseline building is modeled with mass wall construction, a two-pipe steam distribution system for space heating, and a mix of air-cooled DX units and window air conditioning units for cooling.



Size 62,700 SF  
Height 12 Stories + 1 Below-grade

### Baseline Conditions

Wall Construction: Mass wall (R-5)  
Roof: Insulation entirely above deck (R-15)  
Windows and Glazing: Double pane, aluminum frame, no glass coating  
Lighting: 1.25 Watts/SF  
Plug Loads: 1.25 Watts/SF  
Heating System: Natural Gas Steam Boiler, 2-Pipe Steam  
Cooling System: Air-cooled DX Units  
DHW System: Indirect coil in steam boiler

### Efficiency Measures Applied to All Paths

Lighting: Reduce LPD and install sensors  
Plug loads: Master switching, Smart plugs  
Envelope: Replace windows, Maximize roof insulation, Air sealing, Cool Roofs  
DHW: Install low flow fixtures  
BMS: Upgrade to DDC system, with resets  
Renewables: Solar PV on 8% of the roof  
Tenant Measures: Replace appliances, Address supplemental heating and cooling, Improve data center efficiency  
Ventilation/Phenomena: Demand control ventilation with ERVs, Install pumps with premium efficiency motors with VFD

### Path 1 Cooling System Upgrade

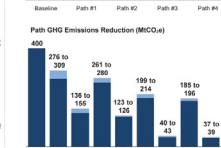
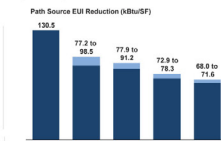
•High efficiency Air Cooled DX Units  
•Hydronic conversion  
•Upgrade boiler  
•High efficiency Water Cooled DX Units with cooling tower

### Path 3 Electrification

•Variable Refrigerant Flow and Air Source Heat Pump for heating, cooling, and ventilation  
•Electric tankless DHW at point of use

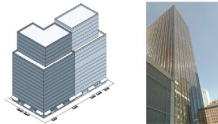
### Path 4 Electrification + Re-cladding

•Re-clad 50% of facade  
•Variable Refrigerant Flow and Air Source Heat Pump for heating, cooling, and ventilation  
•Electric tankless DHW at point of use



## COMMERCIAL, POST-WAR GREATER THAN 7 STORIES (EARLY CURTAIN WALL)

This building typology is typical of many large commercial buildings that were built during the post-war construction boom but before the first Energy Code was enacted in New York City. The baseline building has an early curtain wall design with little insulation and issues with thermal bridging. The building is served by New York City's district steam system for space heating and cooling, with a two-pipe steam distribution system.



Size 160,000 SF  
Height 18 Stories + 1 Below-grade

### Baseline Conditions

Wall Construction: Single pane curtain wall construction, Steel framed wall with some insulation (R-2)  
Roof: Uninsulated roof construction (R-5)  
Lighting: 1.2 Watts/SF  
Plug Loads: 1.3 Watts/SF (receptacle equipment), 0.21 Watts/SF (Servers, process loads)  
Heating System: District Steam, 2-Pipe Steam  
Cooling System: Packaged water cooled DX units  
DHW System: Indirect heat exchanger from boiler

### Efficiency Measures Applied to All Paths

Lighting: Reduce LPD and install sensors  
Plug loads: Master switching, Smart plugs  
Envelope: Maximize roof insulation, Cool Roofs  
DHW: Install low flow fixtures  
BMS: Upgrade to DDC system, with resets  
Renewables: Solar PV on 7% of the roof  
Tenant Measures: Replace appliances, Address supplemental heating and cooling, Improve data center efficiency  
Ventilation/Phenomena: Demand control ventilation with ERVs, Install pumps with premium efficiency motors with VFD

### Path 1 Steam System and Envelope Upgrades

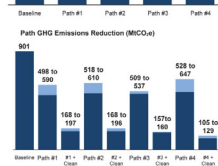
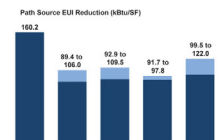
•Upgrade IGU and insulate behind spandrel  
•Optimized steam distribution  
•High efficiency Water Cooled DX Units  
•Condensing gas tankless DHW

### Path 3 Re-cladding

•Re-clad 50% facade and insulate behind spandrel  
•Hydronic conversion  
•Install natural gas boiler  
•High efficiency Water Cooled DX Units  
•Electric tankless DHW at point of use

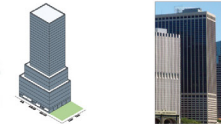
### Path 4 Electrification + Re-cladding

•Re-clad 50% facade and insulate behind spandrel  
•Hydronic conversion  
•Install natural gas boiler  
•High efficiency Water Cooled DX Units  
•Electric tankless DHW at point of use



## COMMERCIAL, VERY LARGE

This typology includes commercial buildings over 500,000 square feet in floor area. This includes a relatively small absolute number of buildings in New York City, but accounts for six percent of the built square footage and a significant portion of GHG emissions. The baseline building is served by a central chiller plant for space cooling and a hydronic distribution system supplied by district steam for space heating and using perimeter induction units. The building includes a glass curtain wall construction and relatively high process loads from tenants in the building, which is typical of large commercial office buildings.



Size 773,000 SF  
Height 32 Stories + 1 Below-grade

### Baseline Conditions

Wall Construction: Double pane curtain wall construction, Steel framed wall with some insulation (R-4)  
Roof: Insulation above deck (R-15)  
Lighting: 1 Watts/SF  
Plug Loads: 1.5 Watts/SF (receptacle equipment), 0.5 Watts/SF (Servers, process loads)  
Heating System: District steam, hydronic distribution with induction units  
Cooling System: Water-cooled centrifugal chiller  
DHW System: Storage tank with district steam heat exchanger

### Efficiency Measures Applied to All Paths

Lighting: Reduce LPD and install sensors  
Plug loads: Master switching, Smart plugs  
Envelope: Maximize roof insulation, Cool Roofs  
DHW: Install low flow fixtures  
BMS: Upgrade to DDC system, with resets  
Renewables: Solar PV on 1% of the roof  
Tenant Measures: Replace appliances, Address supplemental heating and cooling, Improve data center efficiency  
Ventilation/Phenomena: Demand control ventilation with ERVs, Install pumps with premium efficiency motors with VFD

### Path 1 Steam System and Envelope Upgrades

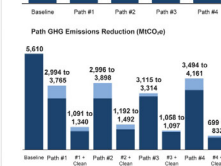
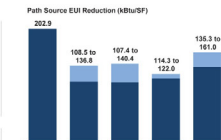
•Upgrade IGU and insulate behind spandrel  
•High efficiency chiller with VFDs  
•High efficiency chiller with VFDs

### Path 3 Re-cladding

•Re-clad facade and insulate behind spandrel  
•Install Dedicated Outdoor Air System  
•Upgrade IGU and insulate behind spandrel  
•Condensing gas boiler  
•High efficiency chiller with VFDs  
•High efficiency chiller with VFDs  
•Remove induction units

### Path 4 Electrification

•Re-clad facade and insulate behind spandrel  
•Install electric boiler  
•Electric tankless DHW at point of use  
•Upgrade IGU and insulate behind spandrel  
•High efficiency Water Cooled DX Units  
•High efficiency chiller with VFDs



# New York City's 80X50 strategies for buildings

1 Upgrade existing buildings to increase energy efficiency

2 Help owners, tenants, and residents understand and invest in energy efficiency

3 Ensure exceptional energy performance in new buildings

4 Prepare the workforce to deliver high performance buildings

5 Become a global hub for clean energy and energy efficiency technology





**NYC Retrofit Accelerator**  
Buildings That Make a Difference

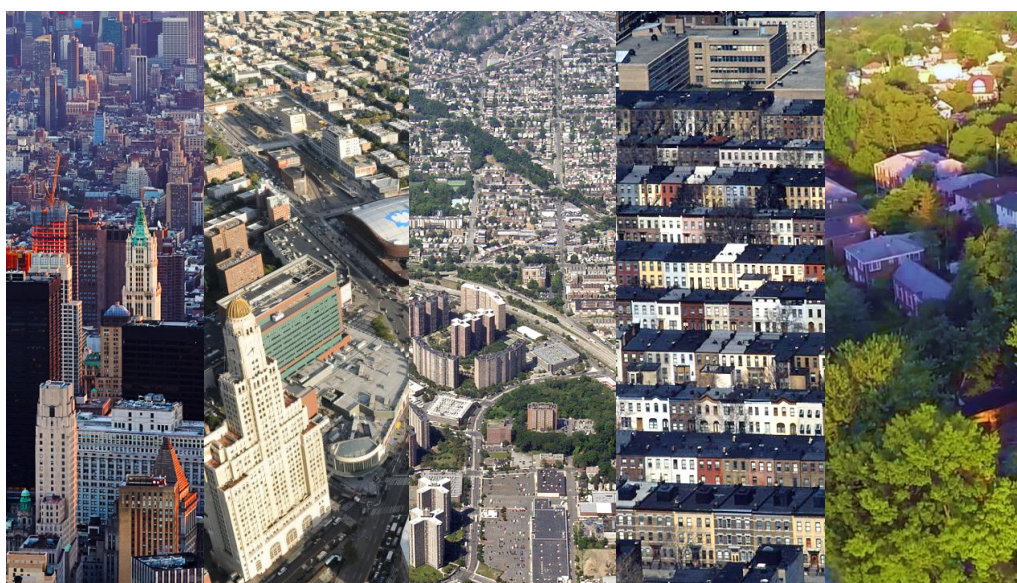
HOME ABOUT RESOURCES FAQs CONTACT

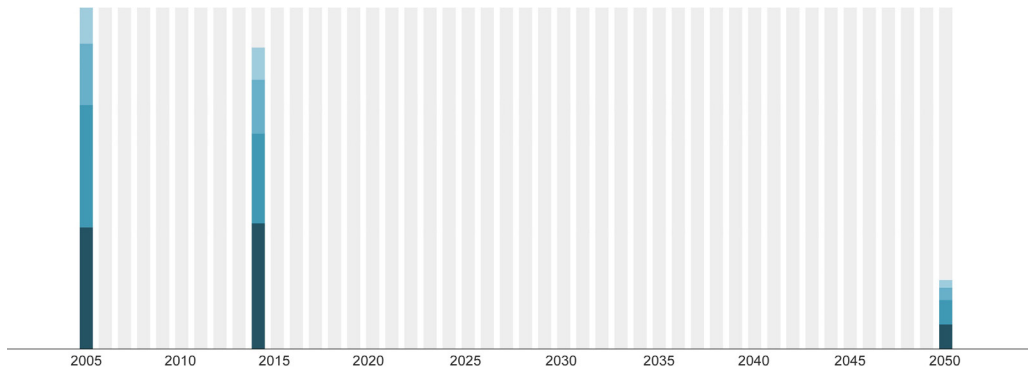
## Buildings that Make a Difference

We work with you every step of the way to make energy efficiency upgrades that can help your building. Click [here](#) to get started.

The NYC Retrofit Accelerator is a one-stop resource provided by the City of New York to help owners and operators of privately owned buildings reduce operating costs and increase the sustainability of their properties through energy and water upgrades.

The screenshot shows the homepage of the NYC Retrofit Accelerator website. At the top, there is a navigation bar with the logo 'NYC Retrofit Accelerator' and the tagline 'Buildings That Make a Difference'. Below the navigation bar are links for HOME, ABOUT, RESOURCES, FAQs, and CONTACT. The main content area features a large banner with the title 'Buildings that Make a Difference' and a sub-headline 'We work with you every step of the way to make energy efficiency upgrades that can help your building. Click here to get started.' Below the banner is a section with a photo of a woman and a text box stating: 'The NYC Retrofit Accelerator is a one-stop resource provided by the City of New York to help owners and operators of privately owned buildings reduce operating costs and increase the sustainability of their properties through energy and water upgrades.'





**The Building Energy Exchange connects the Manhattan real estate communities to energy and lighting efficiency solutions through exhibitions, education, technology demonstrations, and research. We identify opportunities, navigate barriers to adoption, broker relationships, and showcase best practices at our resource center in the Surrogate's Courthouse in Manhattan.**

**[be-exchange.org](http://be-exchange.org)**