TRANSFORMING NYC’S BUILDINGS FOR A CHANGING CLIMATE
NYC’S BUILDINGS MUST TRANSFORM OVER THE NEXT 30 YEARS:

>>> Consume less energy

>>> Emit less greenhouse gas

>>> Resilient to a changing climate
- Buildings & Land Use
- Infrastructure & Energy
- Waterfront
- Social Resiliency
AGENDA

I. What is the scale of NYC’s building stock?

II. What climate risks threaten NYC’s buildings?

III. What are the challenges facing climate retrofits in NYC?

IV. DISCUSSION: What are potential roles of the parametric insurance industry in protecting New Yorkers from climate shocks and stresses?
8.6 million residents in 300 sq miles
9.2 million by 2050

Population distribution:
- Manhattan: 8%
- The Bronx: 17%
- Queens: 27%
- Brooklyn: 31%
- Staten Island: 6%

Land area:
- Manhattan: 8%
- The Bronx: 14%
- Queens: 36%
- Brooklyn: 23%
- Staten Island: 19%

Source: Department of City Planning, 2018
~1 million+ buildings

Building type
- 1-4 family: 83%
- 5+ family: 9%
- Commercial: 3%
- Industrial: 2%
- Institutional: 1%

Floor area by building type
- 1-4 family: 27%
- 5+ family: 41%
- Commercial: 15%
- Industrial: 6%
- Institutional: 11%

Source: One City Built to Last, 2016
Median building age is 90 years

Many predate the city’s first building code in 1938 (major code updates in 1968, 2008 and 2014)

Buildings by year built or significant alteration

Sources: https://www.renthop.com/studies/nyc/building-age-and-rents-in-new-york
One City Built to Last Technical Working Group Report, 2016
91,000 building permits issued 2013-2018
= 316 million sq ft of floor area
= 445,000 new dwelling units

Borough share of building permits

Source: NYC Department of Buildings, Building permits for new construction and major alterations only
91,000 building permits issued 2013-2018
= Average of 52.7 million square feet/year
= Average of 74,150 dwelling units/year

Source: NYC Department of Buildings, Building permits for new construction and major alterations only
New York City has 520 miles of coastline
More than Miami, Boston, San Francisco, Los Angeles combined
10.29.2012
SANDY CAUSED UNPRECEDENTED DAMAGE

51 square miles flooded (17% of NYC)

88,700 buildings inundated

44 lives lost

$19 billion in damage and lost economic activity

2 million New Yorkers left without power for several weeks

Thousands displaced from their homes
THE INTENSITY AND IMPACTS OF MAJOR STORMS WILL INCREASE

By the 2050s, a Sandy-like storm could cause $90 billion in damage and lost economic activity – nearly five times Sandy’s impact.

Source: SIRR, 2013
Underwater
Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate

Are waterfront hotels ready for climate change?

On the front lines of rising seas and extreme weather, the hospitality and tourism industry recalculates real estate and insurance risks

By Patrick Sisson | May 20, 2019, 1:01 pm EDT

May 2019
NYC MUST PREPARE FOR SEVERAL CLIMATE HAZARDS

- **COASTAL STORMS**: +50% more intense storms by 2100
- **SEA LEVEL RISE**: ~30 in sea level rise by 2050s
- **PRECIPITATION**: Up to 1.5x rain days > 1” by 2080s
- **TEMPERATURE**: 3x # of days above 90°F by 2050s

- **WIND STORM SURGE**
- **TIDAL FLOODING**
- **GROUND WATER TABLE RISE**
- **INLAND FLOODING**
- **HOT SUMMERS LIKE BIRMINGHAM, ALABAMA**

Source: New York City Panel on Climate Change
SHOCKS

Hurricane/coastal storm*
Torrential rain*
Heat wave
Winter blizzard

STRESSES

Tidal flooding*

*Sea level rise is making these worse
1. Twice Monthly High Tides & Tidal Floods

- Average tidal conditions
- King tide/sea level rise
- Tidal flooding during twice-monthly high tides

- Gravitational pull of the Sun
- Gravitational pull of the Moon
- High Tide
- Low Tide

Tidal flooding during twice-monthly high tides

© timeanddate.com
2. Storm Surge

Storm Surge onto the 100-Year Floodplain
Global warming is the primary cause of current sea level rise.

- Temperature is rising
- Ice is melting
- Oceans are warming

Contributions to global sea level rise (1972-2008):
- Melting land ice: 52%
- Warmer oceans: 38%
- Other: 10%
2.5 million New Yorkers live in the potential storm inundation zone

71,500 buildings stand in the 2013 floodplain; and 34,000 dwelling units have been built in the 2013 floodplain since Sandy

3,900 retail businesses, employing 67,000 people, are in the 2013 floodplain
Tidal flooding in Edgemere, Queens 2018

Tidal flooding in Edgemere, Queens 2018

Source: Giles Ashford, 2016, Edgemere
Tidal flooding in Hamilton Beach, Queens 2018

Source: Science & Resilience Institute of Jamaica Bay
Flood Watch, April 2018.
EXTREME PRECIPITATION IS A YEAR-ROUND THREAT

Cloudbursts can overload storm drain systems, causing inland flooding.

Islip, NY 2014 after two hours of intense rain
EXTREME HEAT IS NYC’s DEADLIEST CLIMATE HAZARD

- Cities are up to 22°F hotter than surrounding areas, and indoor temperatures can be 20°F hotter than outdoors
- In an average year, extreme heat in NYC causes...
  - 13 heat stroke deaths
  - 450 heat-related ER visits
  - 115 excess deaths from natural causes worsened by heat exposure

Sources: Cool Neighborhoods NYC
NY Daily News/Marcus Santos, 2011
HEAT VULNERABILITY IS NOT EQUAL

Poverty, neighborhood conditions and poor housing quality amplify vulnerability to heat.
HEAT WAVES ARE RISKIEST FOR THE ELDERLY

Extreme heat impacts our most vulnerable residents, especially older adults and those with mental and chronic health conditions.
NYC’S BUILDINGS MUST TRANSFORM TO BECOME RESILIENT TO CLIMATE HAZARDS
New construction with climate resilience and sustainability features

Beach Green Dunes

- 100 apartments for low- and middle-income households, plus retail
- Opened December 2017
- Seven stories
- $27.6 million construction cost
Beach Green Dunes is a certified "**Passive House**"

- **Resilient** to extreme heat and cold by stabilizing interior temperatures, even during power loss
- **Sustainable** with very low energy consumption
Elevated ground floor and patio for floods

Parking lot with permeable pavement to absorb rain
Flood vents (i.e. “wet floodproofing”) allows water to move in and out of the building.
Bioswale to store almost 100% of on-site storm water
Daylighted corridors and staircases encourage active mobility and allow for circulation even during periods without power.

Elevator and building mechanicals elevated above flood risk.

Mold-resistant materials to withstand floods.
129.5 kWh solar photovoltaic array and the 10kW cogeneration unit power common areas and back-up power during system failures.
Low energy heat pump HVAC systems reduce energy costs for residents.
Approximately 1 million buildings

~7% existing buildings demolished

~70,000 new buildings replacing demolished buildings

~8,000-30,000 new buildings on vacant lots

~930,000 existing buildings remain in 2050

~5.4 billion ft²

~78,000-100,000 new buildings between 2015 and 2050 (+460 million square feet)

2015

2050

~5.8 billion ft²

Source: One City Built to Last, 2016
CHALLENGES FACING CLIMATE RESILIENCE RETROFITS
Retrofits for climate resilience yield **avoided cost** savings by preventing building damage that would otherwise occur because of weather events.

**Avoided costs** are difficult to quantify and usually don’t payoff immediately (like investments in energy efficiency).

National Institute of Building Sciences reports that society gains $11 of benefit for every $1 invested in climate resilience retrofits.

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**1. MOST CLIMATE RESILIENCE RETROFITS LACK IMMEDIATE FINANCIAL INCENTIVE**

- Retrofits for climate resilience yield avoided cost savings by preventing building damage that would otherwise occur because of weather events.
- **Avoided costs** are difficult to quantify and usually don’t payoff immediately (like investments in energy efficiency).

Retrofits that achieve sustainability and resilience co-benefits may maximize returns on investment.

2. MANY OWNER-OCCUPIED HOUSEHOLDS IN THE FLOODPLAIN FACE FINANCIAL BURDENS

- Many NYC homeowners have limited ability to undertake major resilience retrofits or pay for flood insurance
- Urban heat increases air conditioner use and exacerbates financial burdens with higher energy costs

Source: Flood Insurance in New York City Following Hurricane Sandy, RAND, 2013
One City Built to Last

Annual median income for households in owner-occupied homes in the floodplain

- 37% earn <$75K
- $75K to 100K: 13%
- $100K to 150K: 19%
- $50K to 75K: 14%
- $25K to 50K: 16%
- >= $150K: 31%

Median monthly utility costs per household

- 2002: $94
- 2012: $114
- 2016: $120
3. INSUFFICIENT AWARENESS OF CLIMATE HAZARDS AND SOLUTIONS

Supply side: Designers, Contractors, Subcontractors
1. General **knowledge gaps** regarding climate hazards and implications on building design and construction
2. **Silos** between designers, contractors and subcontractors prevent information sharing

Demand side: Owners, Renters, Insurance Industry
1. Many homeowners remain uninformed about present or future climate hazards and **don’t invest in retrofits or purchase flood insurance**
2. Insurance premium credits **don’t effectively offset retrofit costs or reflect avoided losses** enabled by resilience retrofits
3. Property sellers **lack incentives to disclose** climate risks to buyers
4. DIFFERENT HAZARDS REQUIRE DIFFERENT RETROFITS

Coastal Storms: Surge + Wind

Sea Level Rise: Tidal Flooding

Cloudburst Storms: Inland Flooding

Extreme Temperatures: Heat Waves + Cold Snaps

Source: New York City Panel on Climate Change
4. DIFFERENT HAZARDS REQUIRE DIFFERENT RETROFITS
5. DIFFERENT TYPOLOGIES REQUIRE DIFFERENT RETROFITS

One- to four-family

1. One-to-four family detached, semi-attached and attached

Multifamily, 5+ units

2. Multifamily, Pre-War, ≤7 stories

3. Multifamily, Post-war, >7 stories

4. Multifamily, Post-war, >7 stories

Commercial/mixed use

5. Commercial, Pre-War, ≤7 stories

6. Commercial, Pre-War, >7 stories

7. Commercial, Post-War, >7 stories

8. Commercial tower

Multifamily, 5+ units

Multifamily, 5+ units

Commercial/mixed use

Commercial/mixed use
37% of buildings in the floodplain are **1-4 family detached buildings** on lots wider than 20 feet.

Generally these can benefit from flood insurance credits for:

1. Installing food vents/wet flood proofing
2. Raising machinery and equipment
3. Infilling basement
4. Elevating structure

Generally accommodate **sustainability retrofits** like increased insulation, air sealing, and heat pump conversions
Flood retrofits for the remaining ~ 63% of buildings in the floodplain are generally not eligible for flood insurance credits.

Heat and sustainability retrofits are also complicated because of zero lot lines and limited space for system retrofits, additional façade insulation, and footprint for solar PV.
OPPORTUNITIES FOR CLIMATE RESILIENCE

1. NYC’s regulatory framework
2. FloodHelpNY.org
1. NYC’s REGULATORY FRAMEWORK

**Flood Insurance Rate Maps** determine where floodplain regulations apply.

**National Flood Insurance Program** sets insurance rates depending on building elevation and other requirements.

**Construction Standards (ASCE 24)** mandate special requirements for flood hazard areas.

**Building Code** requires new buildings and substantial improvements to meet FEMA standards.

**Zoning** accommodates these regulations and improves neighborhood character.

**Energy Code** defines base level energy performance in buildings.
1. NYC’s REGULATORY FRAMEWORK

NYC-specific guidance for climate resilient design in new city capital projects, including buildings, infrastructure, and landscapes

- HISTORIC CLIMATE DATA
- FUTURE-LOOKING CLIMATE DATA
- Building Code and Engineering Standards
- Climate Resiliency Design Guidelines
- City agency design process

www.nyc.gov
2. FloodHelpNY.org

- Flood risk information with **address search tool** that locates properties on the flood insurance map. **Launched Oct 2016.**

- Portal for a **Home Resiliency Audit** which offers eligible owners a free on-site engineering consultation, a customized menu of resilience retrofit options, and flood insurance counseling.
2. FloodHelpNY.org

Hey New York, are you flood-ready?

See what the flood zones mean for you.

Enter your address, find your zone

Search for your address

Get Started
2. FloodHelpNY.org


- 57 percent of 2018 policies are in the “X zone” (the 500-year floodplain without flood insurance requirements), indicating that **awareness is spreading with ongoing communications**.
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