The Empire Building Challenge

Partner Case Study
Empire Building Challenge

A $50 million NYSERDA investment to:

1. Accelerate private sector commitment and investment in carbon reduction, working with large portfolio owners.
2. Enable replication and scale across NY’s existing large commercial/multifamily building stock.
3. Make NY a global hub for low carbon retrofits.
4. Drive innovation to meet the needs of NY’s large commercial/multifamily building stock.
Low Carbon Retrofits Unlock Climate Progress

NYC: 3 billion square feet of existing office, multifamily buildings

~70% of today’s buildings constructed prior to energy code

~90% of today’s buildings will still be in operation in 2050

Buildings account for ~45% of NYS energy-related greenhouse gas emissions

Source: Urban Green Council, Retrofit Market Analysis 2019
Low Carbon Playbooks

In 2020, Vornado, The Durst Organization, Hines and Empire State Realty Trust partnered with NYSERDA to conduct in-depth analysis of their buildings.

The animating question is: **What are the retrofit pathways that transition this building to carbon neutrality and are economically and technically viable?**

What follows is the answer from the Hines team.
Playbook Partner
Established in 2015, Hudson Square Properties (HSP) is a joint venture of Trinity Church Wall Street, Norges Bank Investment Management and Hines. Together, Hudson Square Properties owns and manages a 12-building portfolio of approximately 6 million square feet in lower Manhattan.

Hines is a privately owned global real estate investment firm founded in 1957 with a presence in 285 cities in 28 countries. Hines oversees investment assets under management totaling approximately $90.3 billion¹. In addition, Hines provides third-party property-level services to 373 properties totaling 114.2 million square feet. Historically, Hines has developed, redeveloped or acquired approximately 1,530 properties, totaling over 511 million square feet. The firm currently has more than 198 developments underway around the world. With extensive experience in investments across the risk spectrum and all property types, and a foundational commitment to ESG, Hines is one of the largest and most-respected real estate organizations in the world. Visit http://www.hines.com for more information.

¹ Includes both the global Hines organization as well as RIA AUM as of December 31, 2021
Commitment to Carbon Neutrality

- Carbon neutrality elements are currently implemented in the firm's portfolio, most notably at 555 Greenwich, which is forecasted to achieve carbon emissions reductions 45% lower than New York City’s 2030 targets for office buildings. The project is also designed to align with a 1.5°C pathway while meeting the state’s 2050 carbon neutral targets. It is expected to be one of the most sustainable buildings in the city and is one of Hines’ pilot projects in the firm's formative embodied carbon reduction initiative.

- **Hudson Square Properties** has pledged one of its buildings – 345 Hudson – to reach carbon neutrality by 2032.
  - The building will reduce its site Energy Use Intensity (EUI) by 69% from 2010 EUI level by 2032. The EUI of the building in 2010 was 126 kbtu/SF, and by 2032, Hines commits to reduce the EUI to 40 kbtu/SF.

- In 2021, Hines promoted Mike Izzo to Vice President-Carbon Strategy to lead the firm in assessing its global carbon emissions and develop the strategy to set and achieve the firm’s science-based targets.
The Team
Mike Izzo, Vice President Carbon Strategy in Hines' New York office led the study. He assembled a team comprising experts from:

**URBS | Urban Systems**, a Stockholm, Sweden-based mechanical engineering firm that focuses on sustainable HVAC design

**van Zelm Heywood & Shadford** of Hartford, Connecticut, which specializes in water-based HVAC solutions

**Thornton Tomasetti**, a multi-disciplinary engineering firm known for its advanced building simulation techniques
Hines' Sustainability Team

ESG Senior Leadership Council
- SMO, Global Head of ESG
  - Peter Empring
- VP, Global ESG
  - Adam Stainman
- ESG, Associate
  - Jorge Lopez
- ESG Communications
  - Cara Martin
- Senior Associate, Strategic Projects

Environmental
- Global Sustainability Officer
  - and SVP COES
  - Clayton Bingham

Social
- SVP, Chief People Officer
  - Stephen Bierbaum
- VP, Talent Strategy
  - Crystal Castell-Cromartey
- DEI & Community Team
  - Danielle Jones
- Community Outreach & Engagement Lead
  - Michael Hoag

Governance
- SVP, Head of Legal, Compliance & Risk
  - Richard Noonan
- SVP, Global Head of Compliance
  - Fiona Hopkins

Regional ESG Leaders
- Asia Pacific & Mexico
  - Ricardo Gonzalez
  - Jihye Thakral
- Europe
  - Daniel Chang
- U.S. Southwest Region
  - Chris Rector
- U.S. Midwest Southeast, Canada & Brazil
  - Alexandra Krassam
- U.S. Midwest Southwest, Canada & Brazil
  - Brad Soderwall
- U.S. West Region
  - Denny Dorton
- U.S. East Region
  - Ben Rodney

1. Central Operations and Engineering Services

NEW YORK STATE OF OPPORTUNITY
NYSERDA
The Building
100 AoA Overview

Built in 1930, the 17-story masonry building structure is representative of many of New York City’s commercial buildings.

It has an uninsulated façade, double-pane windows and inefficient heating, cooling and ventilation systems that are prime for replacement.
100 AoA Energy Attributes

**COOLING**
Most floors are cooled by two 30-ton A/C units at a COP of 2.5. Modern units use 20%-60% less energy to provide the same amount of cooling.

**HEATING**
Steam radiators are fed by two 12,00 MBH boilers. These 35 year old units now operate at 65% efficiency, compares to a heat pump which acheives 300% efficiency.

**FAÇADE**
Uninsulated masonry façade with 10-year old double-pane windows.
What is the plan to reach carbon neutrality?

Follow these simple design principles

1. Understanding the needs of the building
2. Electrify heating with high COP equipment, heat pumps
3. Use only the temperature water required to satisfy the indoor comfort and conditions, not any hotter or any colder
4. Capture the heat that is already being discarded within a building
5. Store the excess heat for use at a later time when needed
What is the plan to reach carbon neutrality?
The Analysis
Proving that electric-based approaches can work

Until recently the technology to efficiently electrify heating systems hadn’t been readily available in the U.S. Using 100 AoA as the test bed, the team set out to prove that electric-based approaches could work.

Three primary solutions were studied:

- Active chilled beams with a heat pump
- Active chilled beams, heat pump and radiant floor system
- A hybrid variable refrigerant flow.

The first two can be built with off-the-shelf parts, while the third, which has been in use in Scandinavia and Japan for more than a decade, will be available in the U.S. within the next year.
New systems can be phased in over time

Rather than retrofitting the entire building, work can be done on a floor-by-floor basis, which is easier on the budget, allows for greater scheduling flexibility and is less disruptive to existing tenants.

It is estimated that full-floor tenants vacate spaces every 10 to 15 years, providing ample opportunities for upgrades before the city’s 2050 deadline.
All three methods rely on a single central heating/cooling machine that can transfer energy between returning hot and cold water streams simultaneously. The machines use a vapor-compression cycle, like that of a residential air conditioning unit, which runs in reverse.

Rather than cooling a space by pushing heat outdoors, it transfers the heat into another area of the building.
A more circular approach

Leverage heat recovery ventilation to reduce conditioning loads.

Recycle existing sources of heat within the building during the cold weather rather than rejecting it to the atmosphere.

Utilize heat pumps to satisfy remaining heating loads in buildings and fully eliminate the use of fossil fuel combustion.
FEB 16 24-HR THERMAL LOADS
RESULTS

Baseline (Existing) 61 kBtu/ft²y

18% NYCECC Code Renovation

44% Hybrid VRF

51% 4-Pipe ASHP

58% 2-Pipe ASHP + TAS
FIRST COST COMPARISON

HVAC Components ($/sf)

2-Pipe ASHP + TAS

4-Pipe ASHP

Hybrid VRF

NYCECC Code Renovation

Legend:
- Other
- Distribution (Air/Hydronic)
- Equipment
The ambient loop is used as a primary water circulation energy carrier using low temperature variations to keep steady state enthalpy to the sub-sources; heat pumps and chillers.
ELIMINATE FOSSIL FUELS + LOWER EUI

CURRENT PRACTICE

CURRENT OPPORTUNITY

Moving heat from core zones to perimeter zones can eliminate the need for heating during most of the year.

Eliminate gas supply
Additional Technical Information
Bring experts together from the largest geographical and knowledge area to provide diverse holistic solutions

Identify financial and physical constraints to provide most efficient solutions

Narrow down options to provide best solutions for the particular problem

Provide a strategy that matches the financial plan for the building to phase out at the end of its useful life the fossil fuel equipment within the building
Analysis Process: 100 AoA

- Established decarbonization goals and timeline
- Assessed existing conditions
- Developed calibrated energy model
- Aligned on objectives
- Designed & iterated
- Prioritized measures/packages
- Conducted financial analysis
- Re-prioritization
- Further analysis plus refinement . . . Iterate.
DESIGN PROCESS

5 HVAC CHARETTES

Full Design Simulation Pricing

OF

9 Plant options
9 Distribution options
3 ventilation schemes
3 dehumidification options
Building systems and system architecture shall exploit part load design, not peak design

- **Peak heating** (0°F – 29°F) – 6.5% (5°F - 36 hours, 10°F 143 hours, 15°F 343 hours out of 108,120)
- **Heating + Cooling** (30°F – 59°F) – 48%
- **Moderate Cooling** (60°F – 79°F) – 37.5%
- **Cooling** (80°F – 100°F) – 8%

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**2010 - 2021 NYC Weather Data**

2010-2020 NYC Temperature

- 2010-2021 NYC Weather Data
PARAMETRIC STUDIES
ANNUAL ENERGY USE BREAKDOWN

30 kBtu/sf/yr

100 AoA ENERGY END-USE

- Cooling
- Heating
- Service Hot Water
- Fans
- Pumps
- Equipment
- Lights
Heating accounts for 13% of annual energy use.

The majority of heating needs come from the introduction of fresh air.
A simple heat recovery wheel can reduce fresh air loads by 85%.

Adding wall insulation has little benefit because it accounts for a fraction of the remaining heating load.
How did the team conduct this analysis?

FOCUS ON ENERGY FLOWS.

The fundamental principle of this project was a deep examination into the energy flows within commercial office spaces. While lights provide illuminance, they also give off heat. Office equipment and occupants behave much in the same way - they are essential dynamic components within the building program and have a thermal signature that a building’s heating and cooling systems must respond to. The analysis was based on examining opportunities to reuse/recycle/balance these flows via hydronic-based HVAC retrofits at multiple scales of renovation.