NEW YORK STATE OF OPPORTUNITY. | Empire Building Challenge

High Rise/ Low Carbon

Reimagining Heat

partner profile

345 Hudson

HUDSON SQUARE PROPERTIES

be ex building energy exchange

A New Direction for Commercial Office Buildings

With a bold plan that imports expertise from a highly efficient Nordic model, Hudson Square Properties (HSP) is looking to fully decarbonize their commercial building portfolio. The plan is efficient with capital as well as energy, relying on phasing tied to traditional leasing cycles and limiting cost increases. While novel for the U.S. market, the HSP roadmap utilizes systems and technologies vetted across decades in other regions. Rather than rely on the innovation of new technologies, this approach innovates through design.
In effect, the HSP innovation is in *how they look at building systems*—using familiar parts to create a unique, inexpensive, and highly efficient system to deliver the high-quality office environments that today's tenants demand.

Dramatic energy use reductions in large commercial office buildings have long been elusive. An industry largely focused on individual equipment efficiency has long felt like a structural barrier to the deep reductions and full electrification that will be necessary to meet climate goals. The foundational innovation in the HSP model is to see heat not as something to be ejected in summer and supplied in winter, but as a resource to be shared among different spaces year-round. For large portions of a typical year, many offices are heating some spaces while simultaneously cooling others, with separate heating and cooling systems working independently to add heat to the former and remove heat from the latter. The HSP model provides an integrated system that allows these spaces to share that heat—not just within an individual floor, but between different floors in the same building, and even opens the possibility of sharing heat between otherwise separate buildings, dramatically improving overall building efficiency.

The benefits of such an approach are multiple—including whole building energy savings on the order of 50%. Commercial building energy savings of this magnitude would normally only be feasible through full scale renovations, requiring a massive influx of capital and only on the rare occasion of the building being vacant. The HSP approach can be applied in phases on a floor-by-floor or tenant-by-tenant basis, working *with* rather than against the natural lease turnover cycle.

As the first set of floors are retrofitted to this new model, the industry will be provided a clear showcase for how brown assets—buildings that are at risk of future carbon costs—can be converted into green assets that are fully prepared for an all-electric, low-carbon energy future.

Introduction: Motivations

For Hudson Square Properties (HSP), a joint venture of Hines, Trinity Church Wall Street, and Norges Bank, the 345 Hudson retrofit project balances strategic repositioning, regulatory compliance, and firm dedication to sustainability.

This forward-thinking team recognizes that an aggressive policy landscape shaped by New York City's carbon emission limits for large buildings (Local Law 97 of 2019) has increased the urgency for real estate actors to improve the performance of their building portfolios to avoid financial penalties. Building electrification initiatives and renewable energy targets at both the City and State level provide a path to a carbon-neutral building stock, while Environmental, Social, and Corporate Governance (ESG) commitments, echoing science-based targets established by leading international bodies, have increased demand for high-performance, low-carbon buildings.

Rather than a regulatory approach, HSP takes a science-based approach. Their low-carbon retrofit internalizes companywide ESG commitments to meet urgent global climate objectives in line with a 1.5°C pathway, reduces carbon emissions well within the limits set by New York City's Local Law 97 by targeting full building electrification, and takes advantage of New York State commitments to supplant fossil fuel-based electricity generation with renewable sources. "Follow the science, not local laws," said Mike Izzo, vice president of carbon strategy at Hines, and leading force behind the 345 Hudson project. This guiding principle informed a retrofit strategy that meets Local Law 97's 2050 limits—by 2030—ensuring for a *green asset*, or a high-efficiency, low-carbon building with low (or, no) regulatory risk and high marketability. Moreover, it informed a phased approach that was scalable—floor by floor, building by building—across the HSP portfolio, and throughout the New York market.

The Empire Building Challenge

HSP is among the first cohort of real estate partners convened by New York State Energy & Research Development Agency (NYSERDA) for their Empire Building Challenge, a public-private partnership with leading real estate groups to decarbonize New York's existing building stock by designing and implementing innovative tall-building cold-climate retrofits, tackling systemic market barriers, and attracting the world's top solutions providers to the New York market.

The challenge's first cohort of partners collectively represent more than 130 million square feet of New York real estate, and a massive influence over regional energy demand. If fully retrofitted to HSP's level of peak load reduction, the combined impact would enable New York City to shut down the Astoria 5 coal power plant.[1]

In January of 2022, New York State Governor Kathy Hochul announced the awarding of $20 million to HSP and three other real estate partners for their innovative proposals for tall-building low-carbon retrofits.[2] This profile explores how the 345 Hudson project meets the Empire Building Challenge's key objectives: significantly reducing building Energy Use Intensity (EUI), removing on-site fossil fuel combustion, producing a low-cost, high-value, replicable solution, engaging leading international solutions providers, and eliminating market barriers.

Challenges & Market Barriers

New York State's Climate Leadership and Community Protection Act (CLCPA 2019) commits the state to emissions-free electricity generation by 2040 and provides a path forward for building owners seeking compliance with Local Law 97: building electrification. The electrification movement, most recently endorsed by New York City's landmark decision to phase out fossil fuel combustion in buildings starting in 2023, has become the centerpiece of building decarbonization strategies proposed by policymakers, research communities, and environmental advocates.

Yet, New York's building sector, representing an expansive and widely diverse existing building stock, faces significant barriers to building electrification, both perceived, and real. The sheer number of building industry stakeholders—engineers, architects, building owners, financers, insurers, policymakers, community activists, real estate developers, each with varying areas of expertise, priorities, and analytical frameworks—poses real challenges to adopting novel approaches to building decarbonization. For uninitiated building engineers, the perceived risk of adopting all-electric building systems is high. Concerns over utilizing heat pumps in cold climates, or for large scale hot water systems, persist, despite these challenges having been surmounted in other regions many years ago. For financers, ambitious whole-building retrofits seem untenable, posing significant financial costs and tenant disruption risks. Conventional return-on-investment calculations for individual equipment or specific systems, don't accurately capture the benefit of holistic design approaches where whole-system synergies generate deep overall savings. This status quo inertia, fueled by legacy misinformation and risk aversion, impedes the uptake of novel technologies or design concepts, in favor of like-for-like replacements, particularly when each stakeholder group is siloed.

The 345 Hudson project seeks to break through these market barriers and dispel doubts across all stakeholders, showcasing to ownership, engineering, and design communities the feasibility of adopting approaches successfully applied in other cold climates to the New York market—catalyzing adoption across the HSP Portfolio, and the New York market at large.

Defining the Problem

Key to HSP's strategy was understanding how to meet aggressive climate targets while addressing the practical objectives of their tenants—stable temperatures, fresh air, and reliable equipment—without placing too much onus on tenants to devise their own solutions or diligently manage their own consumption. To devise this approach, HSP divided building systems into three distinct spheres of ownership and influence. The first sphere encompasses the heating, cooling, and air distribution equipment under tenant control (e.g., radiators, fan coil units, and chilled beams). The second sphere includes equipment commonly installed and maintained by the landlord, but controlled by the tenant (e.g., air conditioning units). The third sphere covers the core building infrastructure, under full control of the landlord, like cooling towers, boiler plants, and primary air handling units.

This framework identified a major opportunity area in which to address carbon and energy goals: equipment supplied by the landlord but controlled by the tenant. Given this, the core objective was to create a scenario in which the landlord provides the solid grounding—such as the thermal network described later—for tenants to condition their spaces most efficiently. With this core functionality in place, tenants are afforded efficient systems performance simply by occupying the space and tapping into the building infrastructure.

Reimagining Heat

HSP's retrofit strategy hinges on the reimagining of heat as a resource—part of the building infrastructure—rather than a linear input. For 345 Hudson, a water-based thermal network runs throughout the building, between and within floors, enabling heat transfer between floors. The thermal network allows for heat transfer between floors, and to and from rooftop thermal storage. Heating and cooling energy, once provided in a linear fashion (e.g., gas boiler to steam radiators; air handling unit to packaged air terminals), will be recovered, stored, and recycled, via heat pumps, connected to a thermal spine—a hydronic water loop running the full height of the building.

This design approach, dubbed the "Nordic model," follows a *circular systems* philosophy, challenging designers to consider the full-picture perspective of building systems, rather than individual elements, and identify opportunities to incorporate circular, regenerative, and resource-efficient processes. Commonly cited in design practices that emphasize material recyclability, like Cradle-to-Cradle design, the philosophy is here extended to engineering measures that capture, store, and reuse energy. The strategy is common in Sweden, Norway, and other Nordic countries, gaining traction through aggressive climate policy, high shares of renewable electricity generation, and deep market penetration of heat pump technology.[3] As such, Nordic building sector carbon emissions have fallen 70% since 1990.[4]

1 Hudson Square Properties, *Pioneering the Future: Carbon Neutrality Roadmap*, 26
2 learn more online at https://be-exchange.org/high-rise-low-carbon-series/
3 Nordic Council of Ministers, *Nordic Heating and Cooling*, 2017, 21
4 Nordic Energy Research, *Tracking Nordic Clean Energy Progress*, 2020, 8

The Nordic model reduces heating demand by recovering and redistributing heat from high-energy areas to low-energy areas, rather than simultaneously cooling and heating different zones and rejecting heat into the atmosphere. Heat is moved to or from different floors, and only then is energy introduced to the system via water-source heat pumps that serve each floor.

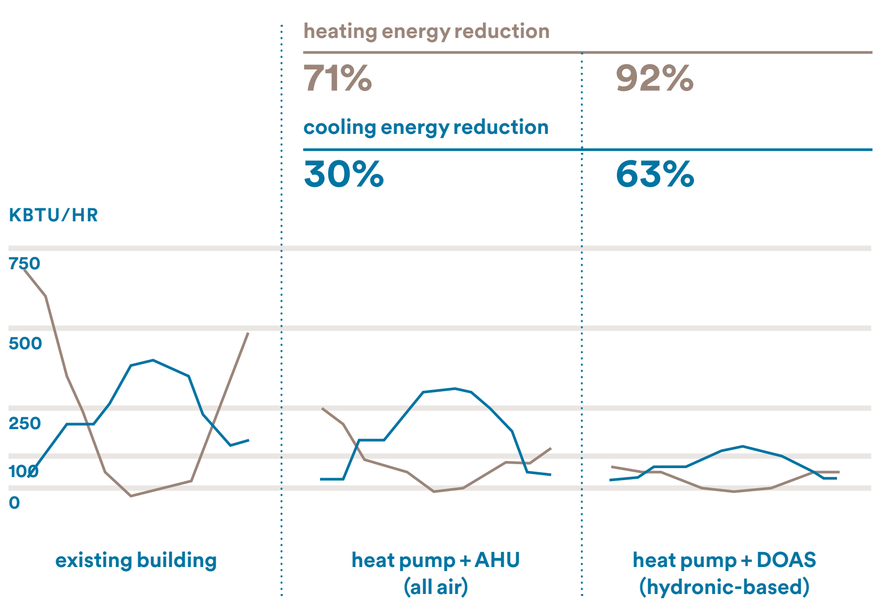
The Nordic approach can be applied to a range of building typologies and uses. For instance, whole-floor data centers, often seen as a substantial energy use liability, could effectively become the primary heating source for a whole building, as waste heat is captured and redistributed towards floors in need of heating. This thermal network approach takes advantage of the natural variability in heat across the different spaces of a building.

Energy & Carbon Outcomes

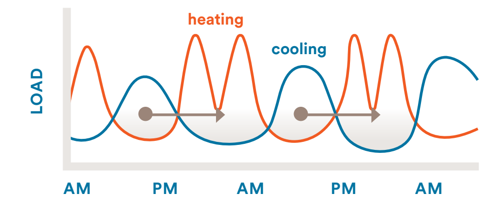
As floors are phased in and more tenants take advantage of the thermal network, the amount of energy recycled across the building increases, incrementally improving the efficiency of 345 Hudson. By 2032, once fully implemented, whole-building energy use would be expected to drop by more than 50%, from 83 to about 38 kBtu/sf—80% lower than an average large New York City office building.[5] Peak demand would fall by 80%, from 13.5 MW to 2.7 MW. Total building carbon emissions would fall 85%, compared to a pre-retrofit baseline, with reductions increasing towards 100% as New York's electric grid becomes fully renewable. These reductions reflect both emissions avoided by capturing 11GWh of energy currently rejected by the building (e.g., via cooling towers), and via the application of high-efficiency heat pumps. With a fully deployed thermal network and energy recovery ventilation, modeling reflects a scenario in which only 4 GWh of energy would be rejected.

Notably, post-retrofit peak heating and cooling loads would fall dramatically—by 92 and 63% respectively—reflecting the significant benefits of capturing, sharing, and recycling heat across floors. The thermal network is key to electrifying buildings via heat pumps, as it reduces floor-level energy demand, allowing for smaller capacity heat pump systems.

Compared to the existing building systems, an air handling unit with air-source heat pumps represents a sizable system efficiency gain. The proposed solution, incorporating water-source heat pumps, a Dedicated Outdoor Air System (DOAS), and thermal network, performs even better, nearly eliminating heating demand by storing and recycling heat.



5 Office category has an average 186 kBtu/sf EUI, Energy & Water Data Disclosure for Local Law 84 2019



Rather than reject heat during cooling periods, thermal networking and storage can capture, store, and recycle heat across space (between floors) or time (heating & cooling cycles), decreasing peak loads and increasing efficiency.

To provide fresh air to the tenants, a key feature of the Nordic model is separating ventilation from heating and cooling systems. This model utilizes a Dedicated Outdoor Air System (DOAS) which provides 100% fresh air to tenant spaces, meeting indoor air quality standards widely adopted in response to the COVID-19 pandemic. Critically, the DOAS uses a heat recovery system with an efficiency of nearly 90%, capturing otherwise wasted energy to temper incoming fresh air.

The impact of these collective systems is a building that delivers an improved tenant experience while using massively less energy. Meanwhile, HSP meets key internal goals: energy efficiency, carbon emissions reductions meeting both local and global objectives, and a healthful indoor environment with 100% fresh air and limited recirculation to mitigate the spread of bacteria and viruses.

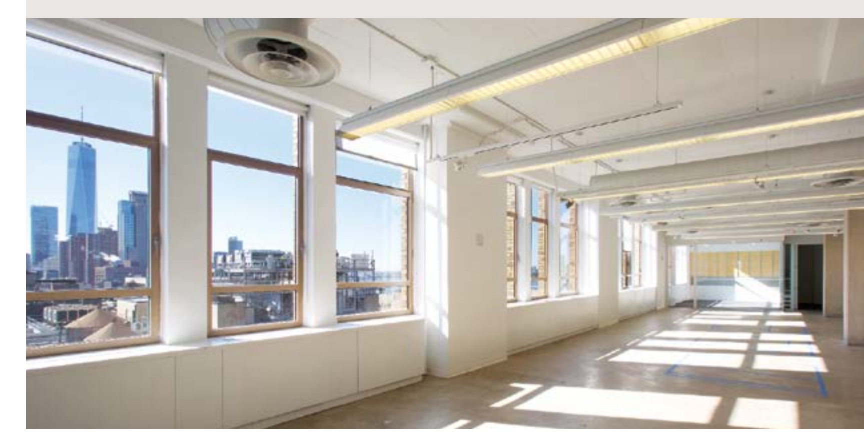
Financial Considerations

Using a phased approach, HSP spreads costs across the term of their decarbonization project, incorporating key milestones like equipment end-of-life and tenant turnover to take advantage of previously planned capital expenditures. HSP's phased approach was informed by the Strategic Decarbonization Assessment (SDA) tool,[6] a long-term financial planning tool for building owners to manage emissions and energy use. Developed for NYSERDA, the SDA tool has been piloted by the first EBC cohort and will be continually revised based on feedback from these partners, producing a resource that will help the broader real estate investment community compare business-as-usual pathways to proposed improvements over time, and develop a detailed Discounted Cash Flow (DCF) model of different investment scenarios. The SDA tool is designed to help owners move away from reactive decision-making and towards proactive planning to simultaneously optimize for operational expenses, net operating income, and emissions reductions.

The phased retrofit plan provides long-term financial value to Hudson Square Partners, transforming 345 Hudson into a green asset—a class-A building with no legislative risk and very little tenant disruption risk. The hydronic heating infrastructure allows HSP to meet Local Law 97's building emissions targets, saving an estimated $440,000 each year starting in 2030. In the near-term, these low carbon systems deliver health and comfort benefits and act as a key differentiator for prospective tenants in a commercial market still rebounding from the devastating impacts of COVID-19.

A Post-Pandemic Direction for Commercial Offices

In the fallout of the COVID-19 pandemic, commercial tenants are demanding healthful and efficient workspaces with verifiable performance to assuage health and safety concerns, meet corporate climate commitments,[7] and address strict environmental disclosure requirements on the horizon.[8] The Empire Building Challenge partners are presenting new models in a hypercompetitive market with a growing appetite for healthful, low-carbon buildings.



6 The Strategic Decarbonization Assessment Tool is available at https://knowledge.nyserda.ny.gov/pages/viewpage.action?pageId=99877032
7 New York Tines, *As Risks of Climate Change Rise, Investors Seek Greener Buildings*, 2021
8 U.S. Securities and Exchange Commission, *SEC Response to Climate and ESG Risks and Opportunities*, 2022

the building

17 floors, roughly 978,000 RSF

- **Floor plates:** up to 62,000 RSF, 12'-6" ceiling heights
- **Heating:** 1-pipe steam from natural gas steam boiler, cast-iron radiators
- **Cooling:** rooftop cooling towers for condenser water system and DX units on each floor
- **Hot water:** natural gas hot water boilers

A 1931 masonry office building occupying the entire block between King and Charlton Streets in New York's former Printing District

Owned and operated by Hudson Square Properties (HSP), 345 Hudson is an ideal case study for low-carbon retrofits in the New York market. Occupying the entire block between King and Charlton Streets in New York's former Printing District, the 1931-constructed building covers over 850,000 square feet across 17 stories. Typical of New York's commercial building stock, the building uses relatively inefficient fossil-fuel based systems. The building is fully occupied, with seven tenants. Notably, it is the most carbon intensive building in the HSP portfolio, with a 2019 EUI of 83 kBtu/sf, and with potential Local Law 97 exposure up to $440,000 per year starting in 2030. These current conditions reflect a set of common challenges faced by a wide swath of New York's commercial building sector.

345 Hudson neighbors a new HSP commercial development, 555 Greenwich, which will meet similarly ambitious carbon and efficiency targets with a similar set of building systems. Once fully constructed, 555 Greenwich will provide key insight into the ability of ostensibly separate buildings to share thermal network infrastructure—strengthening the case for thermal networking at both the building and block scale. 555 Greenwich will also shed light on the relative performance of new construction and retrofits within their portfolio, given the similarity in design approaches, siting, prospective tenants, and programming.

Process

The innovative direction of the 345 Hudson project was born out of a partnership between Stockholm, Sweden-based consulting engineer Urbs | Urban Systems and Hines, who by deep collaboration and multi-stakeholder engagement, proved the case for the application of the Nordic model to HSP partners. A chief objective for Urbs, led by Will Sibia, was to export the Nordic model to the New York market—seen as a great fit given the regulatory drive in New York as well as the sheer scale of the building sector. In early 2019, Sibia presented the Nordic model to HSP partners, who agreed to a concept study that applied the model to a new development in their portfolio. Hines' Mike Izzo, convinced of the applicability and potential carbon impact of the strategy, pushed forward, engaging Sibia to learn more.

Over the following year, Izzo and Sibia traveled to Sweden and Norway, coordinating technical roundtables with the Nordic engineering community, amassing a compelling case for HSP to adopt the Nordic model here in the U.S. Through Urbs, Hines connected with Nordic trade organizations, tapping into the regional market and developing partnerships with key solutions providers.

Returning with a newfound understanding of the Nordic model, Izzo and Sibia presented their strategies to colleagues from HSP, alongside building science experts from UC Berkeley, to dispel doubts around the novel strategy—including a lack of familiarity with thermal networking, and legacy misinformation around the efficacy of equipment like cold-climate heat pumps. This multi-stakeholder process, championed by Izzo and Sibia, and ultimately approved by independent experts, was key to unanimous approval of the Nordic model by HSP. The approach, first greenlit for HSP's 555 Greenwich new construction project, was then incorporated into the retrofit measures for the neighboring 345 Hudson building.

With the project greenlit, HSP and Urbs established an international network of project partners, capitalizing on newfound ties to Nordic trade organizations, engineering experts, and solutions providers. Along with project engineer Jaros, Baum & Bolles, HSP tapped thermal networking consultants Noda and heat pump manufacturer Energy Machines, to support project development and delivery of the 345 Hudson retrofit.

The 345 Hudson Team

Owner/Operator: Hudson Square Properties (Norges Bank, Trinity Church Wall Street, Hines)

Consulting Engineer: Urbs | Urban Systems

Heat Pump Manufacturer and System Control: Energy Machines

Engineer of Record: Jaros, Baum & Bolles

Thermal AI Integration: Noda

Transition Risk Insurance: Willis Towers Watson

Control Software: Modio

Energy Storage Analyst: Blueprint Power

Carbon Reduction Certification: International Finance Corporation

Global Problem, Global Solutions

A key ambition of the Empire Building Challenge is to broaden supply-side partnerships with foreign solutions providers, importing best-in-class climate solutions to the New York market, and attracting local investment by amplifying New York's business case: unprecedented demand. In New York City alone, over 26,000 buildings, representing 1.3 billion square feet of residential real estate, and 335 million square feet of commercial space, must complete low-carbon retrofits to meet City and State climate action policies.

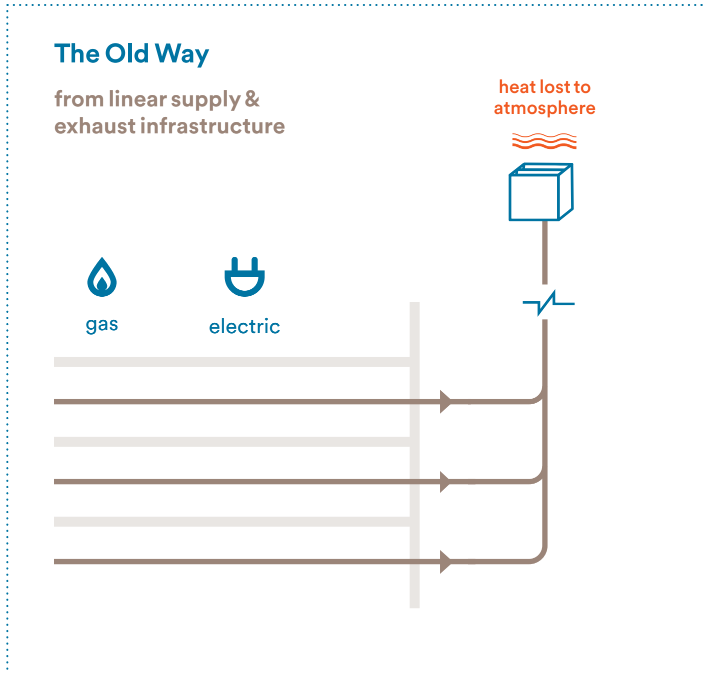
As an Empire Building Challenge Partner, HSP is dedicated to establishing new supply chain links with international providers, like Energy Machines and Noda and expand New York's market for energy innovation—a key barrier for largescale adoption of low-carbon retrofit solutions. As a result, these Nordic companies have committed to setting up operations in New York to meet the growing local demand.

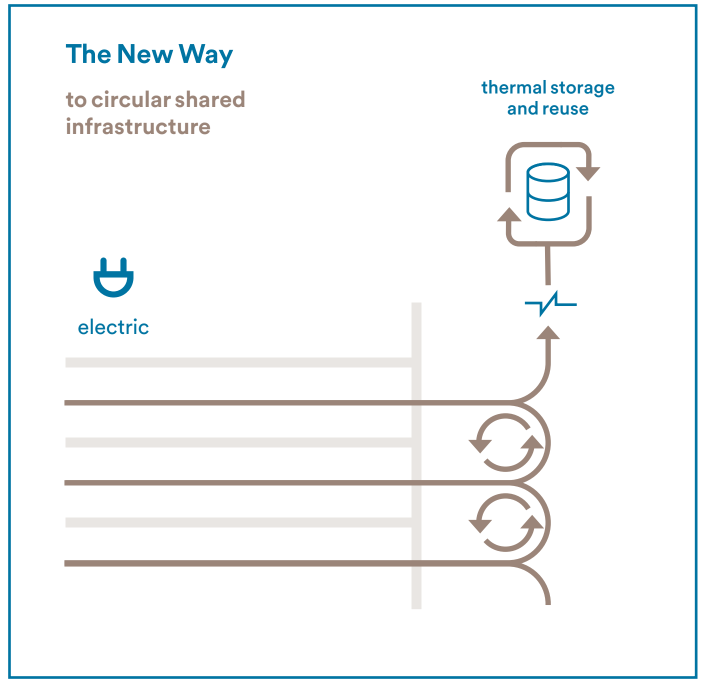
Mike Izzo

Mike Izzo, vice president of carbon strategy at Hines, focuses on achieving carbon reductions in line with science-based targets for the 345 Hudson retrofit, and across Hines' portfolio.

Will Sibia

Will Sibia is founder and CEO of Urbs | Urban Systems, a Stockholm-based consulting group that delivers sustainable solutions for real estate and infrastructure projects.





Thermal Network

The 345 Hudson project employs a circular systems approach to heating, cooling, and ventilation, recycling energy naturally via a passive thermal network that distributes heat within and between tenant spaces. This highly efficient system, inspired by the Nordic model, relies primarily on a hydronic energy distribution and storage network to capture, store, and distribute heat energy towards a natural equilibrium. Energy is only really introduced into the system via high-efficiency water source heat pumps on individual levels, and only when additional space conditioning is needed.

The thermal network consists of a repurposed condenser water loop, a thermal spine running vertically from floor to floor. From this thermal spine, hydronic loops run outwards within each floor, allowing for efficient local energy exchanges between zones, with water as the medium. If space is available, the thermal network will connect to a rooftop water tank, acting as a thermal battery. The result is a highly efficient, self-regulating network designed to reach a temperature close to the desired operative level by capitalizing on the natural variability in temperatures across zones and floors.

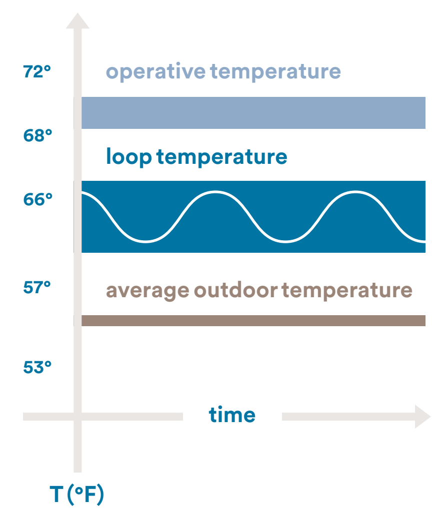
The thermal network provides a simple solution to a common problem—an overheated building core, and underheated building perimeter. The hydronic loop at each floor provides a self-acting system in which heat energy redistributes naturally, towards a balanced state. In other words, heat travels from the hotter building core, towards the colder building perimeter, with very little additional energy.

The same process can also occur at an inter-floor level by use of the thermal spine. Rather than exhausting heat on one floor, and generating it on another, the system will redistribute excess heat from one floor to another—a critical feature for a building like 345 Hudson, where tenant spaces require simultaneous heating and cooling 44% of the time. By redistribution, the need for traditional linear energy supply to condition spaces is drastically reduced.

> "You create an inherently smart system by following nature's principles... then you add heat pumps." — Will Sibia

Heat Pumps

From this balanced state, small interjections of energy via water-source heat pumps on individual levels allow for additional conditioning, whenever necessary. Water-to-water heat pumps, connected to the thermal spine and the hydronic loops on each floor, produce heating and cooling on demand, at critical junctures closest to the receiving zones. As floors are phased in, these high-efficiency electric heat pumps will replace preexisting AC units, while steam radiators connected to natural gas boilers will be eliminated.



The hydronic loop provides water at a stable temperature range, providing optimal conditions for water-source heat pumps to run. Air-source heat pumps, in contrast, suffer efficiency losses during the coldest days of the year, particularly in cold climates like NYC.

The hydronic loop, which supplies a stable temperature range—hovering between 57 and 66 °F for much of the year—provides optimal conditions for heat pumps to operate most efficiently. Given that heat pumps realize efficiency losses as outside temperature decreases, a stable hydronic loop levels the playing field, providing a solid foundation for optimal operating conditions, relative highly fluctuating outdoor temperatures.

Heating & Cooling

High temperature chilled water and low temperature hot water, supplied from on floor water-source heat pumps, will be provided at each floor. Low temperature hydronic radiators at the perimeter will be used for heating. Ideally, high-temperature active chilled beams, ceiling-mounted heating/cooling coils supplied with water from the hydronic network, will be used for cooling and to remove heat from the space supplying it back to the ambient loop. Both chilled beams and hydronic radiators provide market-friendly solutions, resembling options close to business as usual for prospective tenants, while maximizing benefits of the thermal network infrastructure.

Ventilation

At 345 Hudson, the central primary air handling unit will be replaced with a highly efficient energy recovery Dedicated Outdoor Air System (DOAS). By decoupling space conditioning from ventilation and installing a DOAS, the size of air distribution tenant infrastructure will be significantly reduced. By reducing airside infrastructure, energy recovery is greatly improved, with the Energy Recovery Ventilator (ERV) capturing nearly 90% of the energy from exhaust air.

Domestic Hot Water

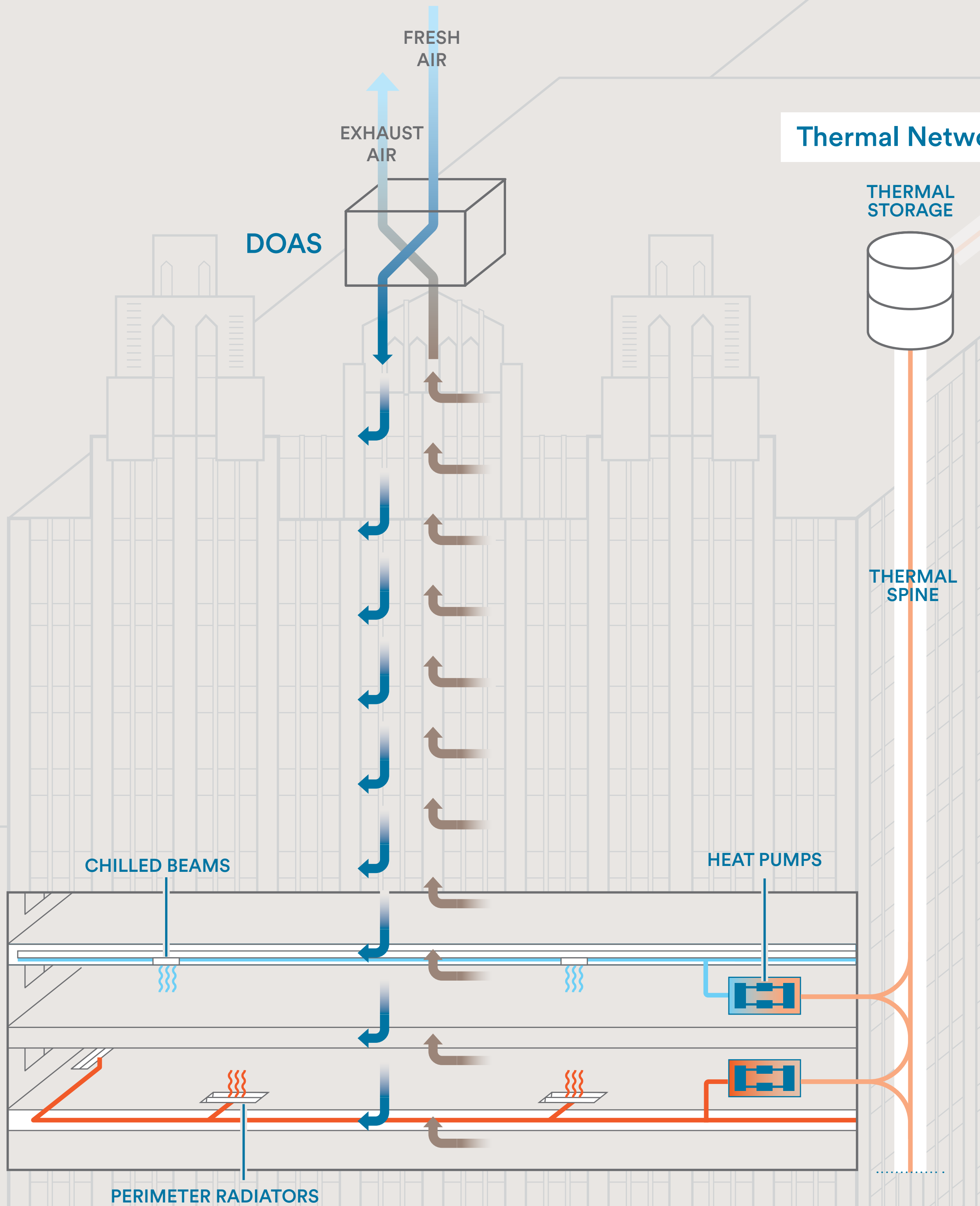
To supply domestic hot water, HSP is exploring water-source heat pumps, connected to the thermal network's hydronic loops. While still a rapidly developing technology, heat pump water heaters are sufficient in meeting the relatively low demand for hot water in the commercial building sector and eliminating the need for gas-fueled hot water generation.

Controls

For 345 Hudson, building controls will be integrated within the heat pumps and DOAS to maximize equipment efficiency. Advanced control systems will take advantage of the system's efficiency, born out of integrated, self-balancing engineering.

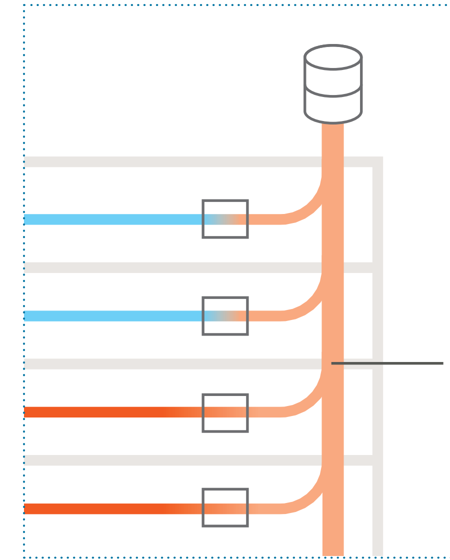
Additional Measures

Hydronic networks can accommodate an array of heating and cooling options, from chilled beams to radiant flooring. Scheduling, structural, and cost constraints, may pose issues for radiant flooring in retrofits, particularly for buildings like 345 Hudson with large floor plates. In contrast, HSP's 555 Greenwich will use radiant flooring. For new construction or small residential retrofits, radiant flooring should be strongly considered in tandem with a whole building thermal network.

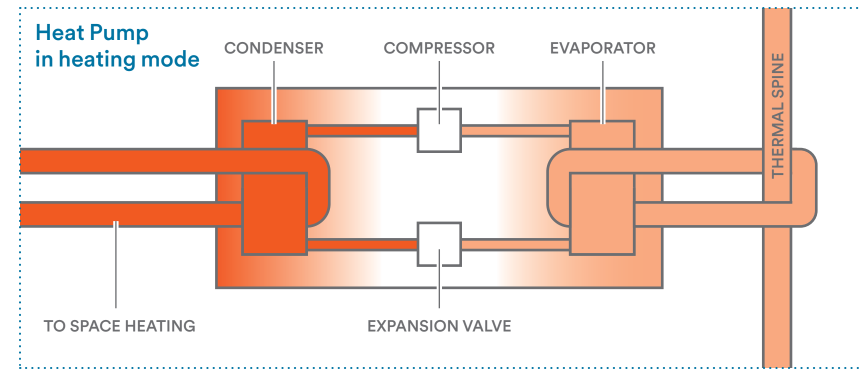


Thermal Network

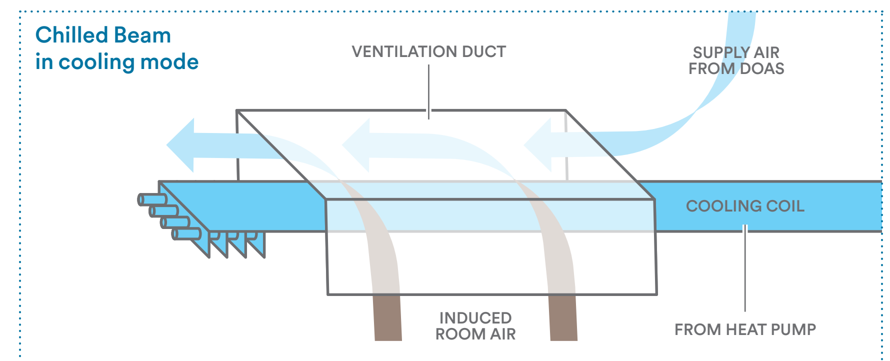
A repurposed condenser water loop makes up the thermal spine, running vertically between floors and to a thermal storage tank on the roof. Hydronic loops run outwards within each floor, connected to tenant heating and cooling equipment.



The thermal network uses water to absorb and transport energy throughout the building, creating an efficient, self-regulating network that takes advantage of the natural variability in temperatures across zones and floors, redistributing energy towards an equilibrium close to the desired operative level.



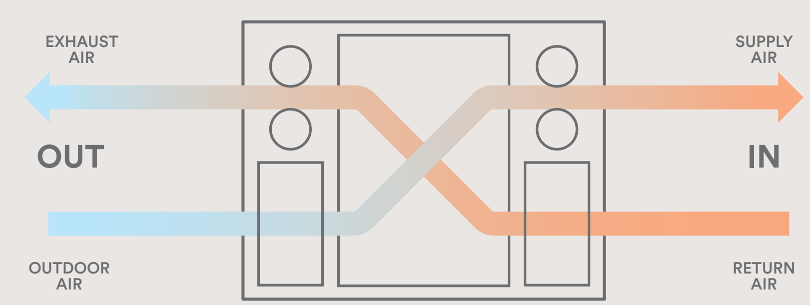
From this balanced state, floor-level water-source heat pumps, connected to the thermal spine, cool or heat on demand, at critical junctures closest to the receiving zones. The thermal network's stable temperature range levels the playing field, providing a solid foundation for optimal heat pump operating conditions, relative highly fluctuating outdoor temperatures.



Water will then be run through high-temperature active chilled beams, ceiling mounted heating/ cooling coils supplied with water from the thermal network. Floors are conditioned as air flows across the coils. Low-temperature hydronic radiators connected to the thermal network provide additional heating and cooling capacity at the perimeters of each floor.

DOAS

A high energy recovery Dedicated Outdoor Air System (DOAS) on the rooftop provides fresh air to the chilled beams, which induces additional airflow across the coils. Nearly 90% of the energy from the exhaust air is recaptured and used to temper incoming air.



conclusion

2020

2021

2022
- data strategy (connect everything)
- replace primary AHU with high energy recovery DOAS
- deep retrofit 9 floors

2023
- move to hydronic loop
- enable data & AI solutions
- connect thermal storage water tanks
- connect to 555 GW to share energy

2024

2025

2026

2027
- deep retrofit 2 floors

2028

2029
- deep retrofit 5 floors

2030
- complete hydronic loop
- 100% electric building

The Road Ahead

For HSP and other Empire Building Challenge partners, the path to decarbonization is steep—but a clear path forward is beginning to reveal itself.

345 Hudson's 10-year deployment plan first targets improvements to the building's core infrastructure, then phases in tenant retrofits, floor by floor. First, the primary air handling unit will be replaced with a high energy recovery DOAS system; followed by installation of the thermal spine; and finally connecting it all to a building management system. Select floors will be retrofitted up front, with the hope of providing showcases to prospective tenants and their engineering staff to witness engineering solutions applied in practice—a critical step in moving the market given the systems' novelty in New York. From there, additional floors will be phased in during periods of tenant turnover. As the project progresses floor by floor and use of the thermal network expands, heat pumps will supplant existing packaged terminal units and efficiency will improve dramatically. Updated floors will effectively become *energy producers* engaging in intra-floor heat exchange, rather than receivers of linear energy supply, benefiting the overall system.

By 2023, HSP aims to not only connect the thermal spine to rooftop storage, but HSP's neighboring building at 555 Greenwich. By 2030, the building will operate using only electricity, and take full advantage of the fully formed thermal network across all floors. With all floors connected, the thermal inertia (the energy stored within the hydronic network itself) of the whole building will often be substantial enough to store or release energy in response to changing utility rates or renewable energy generation—importing or exporting heat energy when needed, particularly during peak demand conditions. Reactive to grid demands, this solution allows the building to become an asset to the grid rather than simply a consumer.

Looking beyond 345 Hudson, HSP seeks to replicate the same set of solutions across their whole portfolio, a process that will see increasing returns to scale as local trades and service providers are familiarized with new technologies, international supply chains are strengthened, and innovative market actors enter the New York market. A core element of their Empire Building Challenge partnership, scalability was incorporated into the proof-of-concept project in a variety of ways. Their solution incorporated familiar building technologies (e.g., heat pumps, DOAS units) to reduce barriers to implementation by local building owners, engineers, and construction groups. Typical commercial building infrastructure (e.g., water tanks, condenser water loops) were repurposed for the thermal network. New solutions providers, like Energy Machines and Noda, through involvement in 345 Hudson, are now establishing themselves in the New York market. Others are soon to follow, as EBC Partners continue to follow up on their commitments, and the market for low-carbon retrofits expands to meet New York's aggressive climate legislation.

Nonetheless, the path to full building decarbonization will present challenges, including persisting knowledge gaps and cloudy planning horizons. The Empire Building Challenge, representing NYSERDA, HSP, and other leading real estate partners, continues to actively engage with the market, communicating lessons learned from these showcase high-rise, low-carbon retrofits. One result is the *Resource Efficient Electrification* framework,[9] an approach emerging out of EBC partner collaboration, that distills common strategies across the challenge's funded projects. This conceptual framework outlines the thermal network approach to clean heat in cold-climate tall buildings and traces phased stages for heat pump-based electrification:

- **Review** (analyze energy profile to identify waste)
- **Reduce** (optimize controls, improve envelopes)
- **Reconfigure** (building systems to enable thermal networking)
- **Recover** (deploy a variety of heat recovery systems), and
- **Store** (heat storage)

The Resource Efficient Electrification report, echoing HSP's 345 Hudson project and the work of other EBC partners, presents a comprehensive strategy for key building stakeholders through which to design and deploy their own low-carbon retrofits, and get involved in the radical transformation of New York's built environment for a sustainable future. HSP's 345 Hudson project, a cross-collaborative, resource-efficient, and comprehensive approach to decarbonizing our state's high-rise buildings, offers a glimpse at what this transformation will look like at scale, in the years to come.

9 Read about Resource Efficient Electrification at https://www.nyserda.ny.gov/All-Programs/Empire-Building-Challenge/Building-Decarbonization-Insights

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Additional Resources

- **NYSERDA Empire Building Challenge Website**
  https://www.nyserda.ny.gov/All-Programs/Empire-Building-Challenge/
- **BE-Ex High Rise / Low Carbon Series Portal**
  https://be-exchange.org/high-rise-low-carbon-series/
- **NYSERDA Building Decarbonization Insights & Resource Efficient Electrification Framework**
  https://www.nyserda.ny.gov/All-Programs/Empire-Building-Challenge/Building-Decarbonization-Insights
- **NYSERDA Strategic Decarbonization Assessment Tool**
  https://knowledge.nyserda.ny.gov/pages/viewpage.action?pageId=99877032