520 Madison Avenue

- New York City
- 1,000,000 SF
- 43 stories commercial
- office building built in 1982

Empire Building Challenge
PARTNER
Reimagining Low-carbon Buildings

Tishman Speyer to drill for geothermal energy below Madison Avenue

Project Team:

TISHMAN SPEYER

JBB

Brightcore
BUILDING ENERGY PERFORMANCE™

Disclaimer: The project plan outlined in this presentation is in its early design stage and can be subject to potential changes in the future.

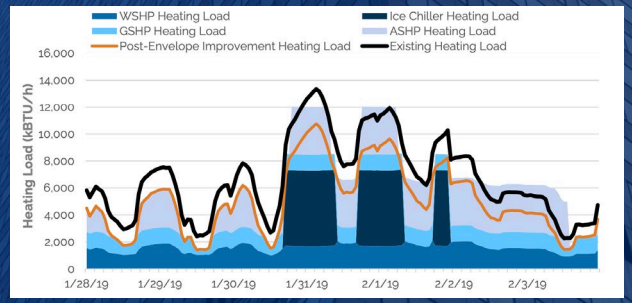
520 Madison Avenue is a class A commercial office building located in Midtown Manhattan with ground floor retail and restaurant spaces. The energy profile of this property is strong, with an 87.4 EUI and energy grade of *A* based on 2019 baseline.

Tishman Speyer is planning a lobby upgrade and restaurant renovation for the building and is leveraging these improvements to simultaneously upgrade the building systems. These upgrades will help position the property to reach carbon neutrality by 2035.

This project will involve reduction of energy loads, recovery and reuse of heat that would conventionally be wasted, and development of an urban geothermal system. The European geothermal drilling technology slated for this project has never been implemented in New York City for a building of this size. In doing so Tishman Speyer sets a strong precedent for scalability and replication of this solution throughout the high-rise office building market.

NYSERDA Investment	Roadmap Phase 1 Private Investment
$3 Million	**$22.2 Million**

Tishman Speyer demonstrates how to strategically reduce loads, recover heat, and electrify equipment over time



Enabling Steps:

The project team's vision for decarbonizing 520 Madison requires enabling steps to significantly reduce heating loads and facilitate heat pump integration. This is achieved via envelope improvements, waterside heat recovery, ventilation upgrades and lower heating hot water supply temperatures.

Electrification:

Heat pumps will be deployed in various applications throughout the building to electrify onsite heating loads. This includes water source heat pumps (WSHPs) for heat recovery, ice heating and geothermal (ground source heat pumps or GSHPs) combined with air source heat pumps (ASHPs) for the remaining heating load.

Thermal Layering:

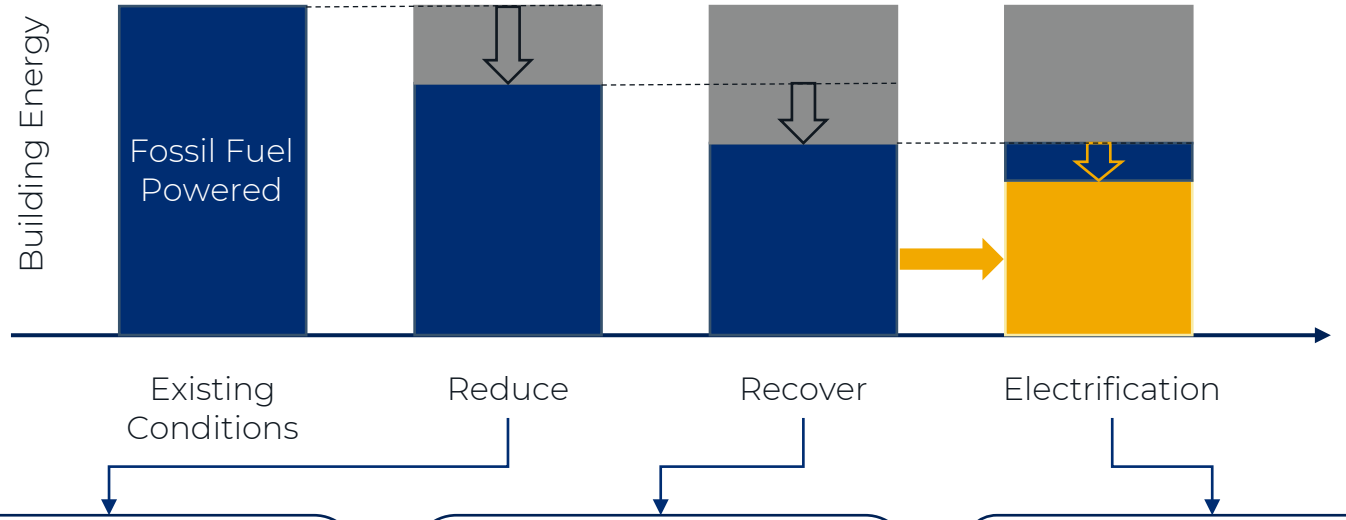
The decarbonization approach for this project utilizes thermal layering, in which multiple heat sources overlap to meet operational energy needs in the building while minimizing the use of fossil fuels and carbon emissions.

2019 Baseline	Expected by 2030	
87.4 kBtu/SF/yr	**68** kBtu/SF/yr	↓ 23%
3% Natural Gas + **67%** Electricity + **30%** District Steam	**5%** Natural Gas + **95%** Electricity	
2,294 tCO2e/yr	**1,166** tCO2e/yr	↓ 49%

Resource Efficient Decarbonization (RED):

An incremental methodology and integrated design process combined with strategic capital planning creates a path towards carbon neutral buildings.

A holistic approach and phasing can make decarbonization technically and economically feasible.



Phase 1:

- **New Hydronic Distribution:** to serve new system while transitioning to low supply temperature and enable heat pump integration
- **Façade efficiency upgrades** to bottom portion of tower

Phase 2:

- **Dedicated Outside Air System (DOAS):** decouple ventilation from heat and cooling systems using terminal DOAS delivery and central DOAHU
- **Envelope upgrades** to top portion of tower

Phase 1:

- **Condenser Water Heat Recovery:** piping work and Water Source Heat Pumps (WSHPs) to recapture heat from cooling systems
- **Geothermal:** UrbanGeo drilling and ground sources heat pumps

Phase 2:

- **Thermal Network Expansion:** interconnecting central plant components allows for deeper heat recovery and storage
- **Energy Recovery Ventilator:** expanded DOAHU continues air side heat recovery expansion

Phase 1 – Partial Electrification:

- **WSHPs:** for UrbanGeo and condenser water loop heat recovery
- **Domestic Hot Water (DHW):** point of use electric water heaters to reduce district steam use

Phase 2 – Full Electrification:

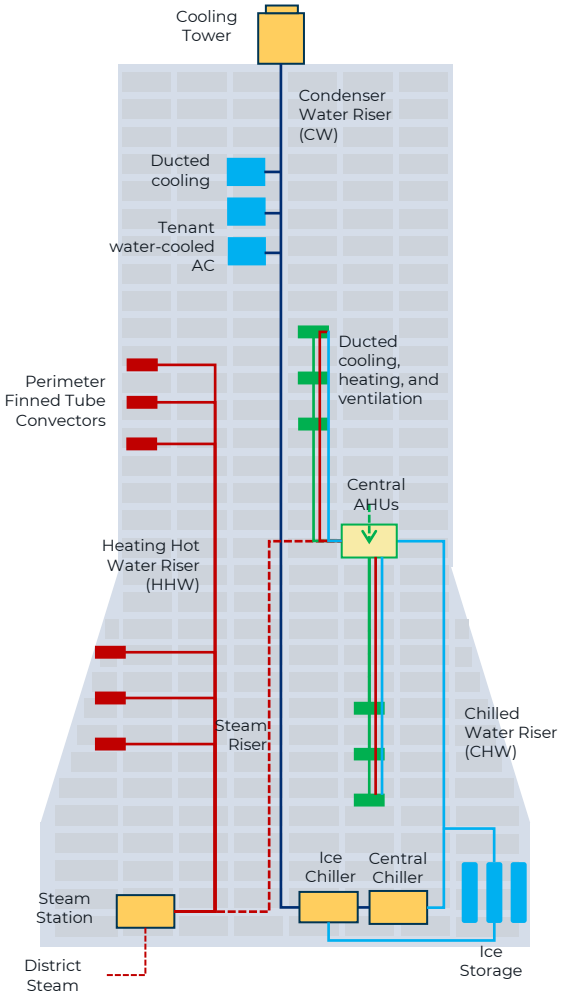
- **Air Source Heat Pump:** integrate ASHPs
- **Ice Heating:** install ice storage and use WSHPs to store and extract heat
- **Thermal Layering:** a multi-source approach using advanced controls to combine and integrate multiple equipment to meet load

520 Madison Decarbonization Plan

Heating
Cooling
Ventilation

Key Takeaways: Façade improvements, urban geothermal drilling, heat recovery, low temperature heating hot water, DOAS, distributed electric DHW, ice heating and ASHPs

BEFORE



2023: **Domestic Hot Water**
Install point-of-use electric DHW heaters to replace central system

2024: **Condenser Water Heat Recovery**
Install WSHPs to extract wasted heat from the condenser water loop and serve perimeter heating loop.

2024-2025: ***UrbanGeo* Geothermal Drilling**
Use ground floor vacancy to drill a geothermal borefield beneath the existing building footprint using *UrbanGeo* technology.

2025: **Ground Source Heat Pump**
Install water source heat pumps for the geothermal borefield.

2025-2030: **Envelope Improvements**
Install new windows and improve air leakage.

2026+: **Central DOAS+ERV**
Install new central DOAS with ERV to condition fresh air.

2026-2035: **Tenant Fit-out: Terminal Unit DOAS Boxes**
Replace terminal units with DOAS boxes to accommodate low temp. heating hot water and incorporate conditioned air.

2028+: **Air Source Heat Pumps**
Addition of ASHP capacity to serve low temperature HHW.

Ice Heating
Reuse ice storage tanks and WSHP to enable ice heating.

Thermal Layering
Combine multiple heating sources (Geothermal, ASHPs, Heat Recovery, Ice Heating, Steam) and optimize deployment.

AFTER