International Exchanges

Solutions for Low-Carbon Building:

Stockholm

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The Stockholm delegation was hosted by the Swedish Energy Agency and Smart City Sweden/IVL Swedish Environmental Research Institute, in collaboration with the New York State Energy Research & Development Authority and Building Energy Exchange. June 2023.

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introduction:

With ambitious goals of fossil-fuel-free operations and net-zero greenhouse gas emissions by 2030, Stockholm has become a frontrunner in sustainable urban development, with leading examples of district-level smart growth encompassing buildings, transportation, waste, and community engagement.

In the buildings sector, **Stockholm touts one of the world's largest open district heating networks**, building- and district-level electrification initiatives, and Passive House-level performance standards for municipal buildings, among its many accomplishments. Stockholm's successes in these areas present a major opportunity for knowledge exchange between New York City (NYC) and Sweden, given our closely aligned climate objectives.

introduction:

To identify potential areas of collaboration and share expertise, the Swedish Energy Agency and Smart City Sweden/IVL Swedish Environmental Research Institute welcomed a delegation of leading U.S. companies, assembled by Building Energy Exchange and the New York State Energy Research & Development Authority (NYSERDA), to Stockholm in June of 2023. The mission focused on knowledge transfer and capacity building, connecting senior representatives from both countries' top real estate, engineering, and utility firms to learn from one another and foster long-term cooperation and partnership.

Seeing Is Believing

This report summarizes our findings, identifying key areas of interest for the NYC market—and key differences—and proposes opportunities for future collaboration and exchange.

The climate crisis is a global problem that requires a global solution. This initiative represents one step forward towards meeting our collective climate goals, leveraging technologies, attitudes, and expertise from around the world to inspire industry action—both in NYC, and abroad.

US delegation:

Brett Bridgeland, Principal, Carbon-Free Buildings, RMI	9
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Lidia Partheni, Visit Program Manager, IVL Swedish Environmental Research Institute	
Michael Reed, Team Lead, Advanced Efficiency Solutions, NYSERDA	

itinerary:

Day 1

SISAB, Meatpacking District (Slakthusområdet):
Introduction to SISAB and their work around AI-driven digital building controls, spanning 150 properties and 20,000 sensors.

Sofia Johansson	Chief of Staff, SISAB

GrowSmarter:
Presentation of three projects by GrowSmarter, a consortium of European cities and industries focused on pilot-level smart city solutions for energy, infrastructure, and transport.

Lisa Enarsson	Project Manager, City of Stockholm
Peter Andersson	Business Development Energy Solutions, Lassila & Tikanoja
Johanna Nerell	Open District Heating, Stockholm Exergi
Harry Matero	Installation Consultant, Insam AB

Slaktkyrkan & Palmfelt Center:
Commercial buildings with smart energy management, control systems, and district heating with heat recovery technologies.

Mathias Mellqvist	Technical Manager, Atrium Ljungberg
Peter Andersson	Business Development Energy Solutions, Lassila & Tikanoja Sverige

Valla Torg:
1960s-constructed multifamily apartment complex, recently retrofitted to reduce energy use by more than 60%, using envelope upgrades, district heating, geothermal, and heat recovery strategies.

Harry Matero	Installation Consultant, Insam AB
Ary Zanganeh	Projet Manager, Stockholmmshem

KTH Live-In-Lab:
A testbed for innovation in construction and real estate sectors, hosted at the Royal Institute of Technology.

Per Lunndqvist	Director of Research and Education, KTH Live-in Lab
Marco Molinari	Co-Director, KTH Live-In Lab

Day 2

Hötorgshusen:
Four 1960s-built high-rise commercial properties recently retrofit with geothermal systems.

Ulf Naslund	Director of Technology and Development, Vasakronan
Daniel Holm	Technology and Development, Vasakronan

Hästskopalatset:
Historical building retrofitted to LEED standards, focused on materials reuse, geothermal, and energy efficiency upgrades.

Therese Hultquist	Property Developer, Vasakronan
Claire Mirjolet	Project Manager Sustainability, Vasakronan
Lotta Björnstad	Project Manager, Skanska Sverige AB
Mikael Kelfve	Installation Strategist, Skanska Sverige AB
Sigrid Månsson Wikander	Marketing Director, Skanska Sverige AB

URBAN ESCAPE:
Cluster of five mixed-use commercial properties, retrofitted with energy efficiency, comfort, and sustainability in mind.

Christer Forsblad	Energy Coordinator, AMF Property Developers
Michael Eskils	Sustainability Manager, AMF Property Developers
Jonas Glennstål	Technical Manager, AMF Property Developers

Day 3

Stockholm Exergi:
Presentation of district heating followed by a guided tour of Stockholm Exergi, Stockholm's energy provider and district heating and cooling network operator.

Erik Dahlén	Head of CDR Research Program, Stockholm Exergi

Geothermal Energy Storage Presentation:
Presentation on the technical and economic aspects of storing heating and cooling in the bedrock.

Kim Ojanne	Country Manager, Rototec LLC

ECO Governance Workshop:
Workshop on collaborative approaches and horizontal management skills to address complex environmental issues in energy, real estate, and policymaking arenas.

Jonas Törnblom	CEO, Envito
Kim Ojanne	Country Manager, Rototec Group
Mikko Ojanne	CEO, Rototec Group
Johnny Lönnroth	Principal Analyst, Rototec Group
Teresa Enander	COO, Formica Capital
John Wibrand	System Development Director Digital Services, Swegon
Ulf Hörman	Business Development Director System & Solutions, Swegon
Johan Lindskog	Project Development Manager, AMF
Mikael Kefve	HVAC Specialist, Skanska
Charles Caure	Building Performance Engineer, Skanska

Public Policy and Energy System Decarbonization

Ambitious national resource efficiency and climate policy goals have transformed the Swedish energy sector over 50 years, resulting in a nearly decarbonized electric grid and space heating system. As of 2023, natural gas infrastructure is minimal, as are fossil-fuel-based building systems. Sweden's energy mix relies largely on hydropower and nuclear for electricity, while Stockholm's district heating system relies on biomass and biogenic waste incineration.[1]

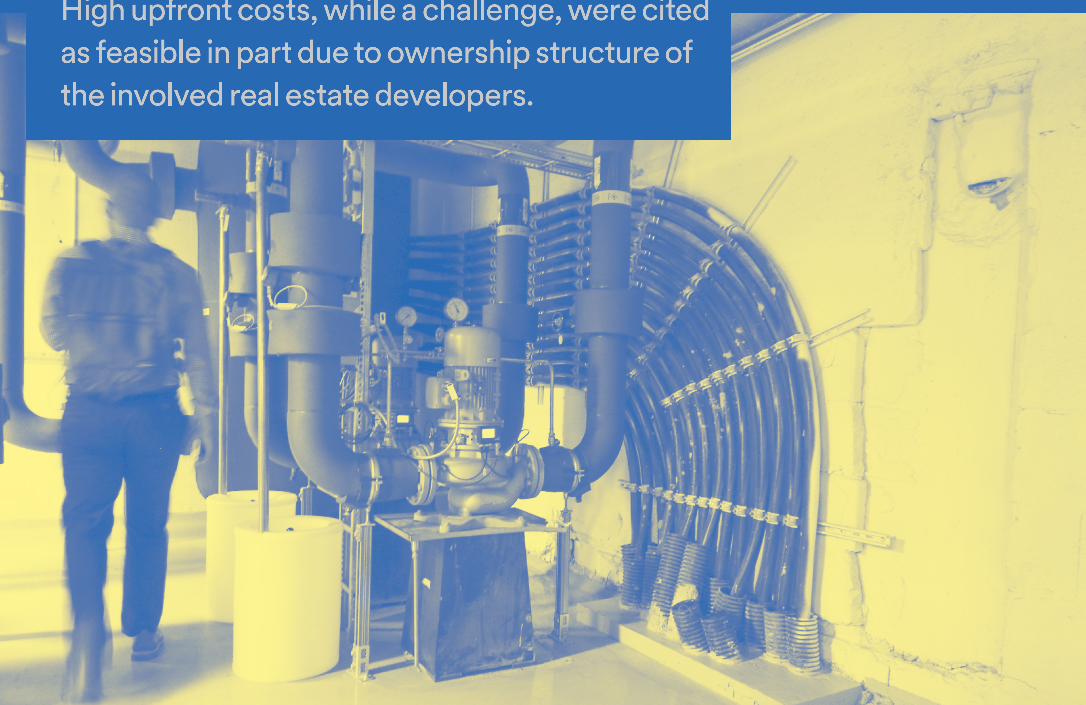
Open District Heating and Cooling

Stockholm's open district heating network is powered by 99% renewable and recovered energy. Stockholm Exergi, a utility owned in part by the City of Stockholm and a consortium of pension funds, operates the network. The open network incentivizes building-level heat recovery at every opportunity, as owners can sell excess heat back into the system at the market rate. Applications of heat sharing and recovery are increasing, with heat-intensive facilities like data centers and supermarkets selling waste heat back into the system. A successful carbon capture and storage (CCS) pilot, partially funded by the European Union (EU), is paving the way towards climate-positive operations.[2]

executive summary:

Geothermal Energy

Sweden has been a leader in geothermal energy since the oil crisis of the 1970s, with more than 500,000 shallow geothermal energy systems installed for space heating and domestic hot water.[3] In Stockholm, geothermal energy is cited as a practical choice given the prevalence of low-temperature, water-based heating and cooling systems supplied by the district system, allowing for simple integration. Sustainability and economics are also driving factors: lower emissions, reduced exposure to district heating price fluctuations, and low maintenance costs. High upfront costs, while a challenge, were cited as feasible in part due to ownership structure of the involved real estate developers.



Real Estate Ownership Structures Support Longer Payback Periods

Many of Sweden's major real estate developers are wholly or partially owned by the Stockholm government and/or government pension funds. Long-term investment horizons of both government and pension funds, compounded by well-established public climate goals, enable decarbonization investments with longer paybacks than are generally accepted in U.S.markets.

Centralized Controls and Demand Management

Sweden was one of the first European countries to roll out smart meters,[4] with national-level regulations requiring monthly metering for small consumers and hourly metering for larger consumers by 2009. Moving beyond data transparency, advanced controls deployed by Stockholm Exergi are increasingly used for automated energy use optimization and demand management for thousands of residential customers. These services continue to grow, with Exergi filling the role of “decarbonization concierge,” not only ensuring system reliability and reducing costs for customers, but facilitating connections to solar, EV charging, and batteries.

Policy, Business, and Tech Solutions for Low-Carbon Building

Policy Context and Climate Objectives

Sweden has been a leader in climate action for decades, with ambitious environmental and climate policies driving a 50-year transition to a low-carbon economy. The 1970s oil crises resulted in a broad shift away from oil use in buildings, in favor of cheap and abundant electricity generated by hydropower and nuclear energy.[5] In the 1990s, a series of ambitious federal policies, including a first-of-its-kind CO2 tax, marked another shift in energy production, resulting in a nearly decarbonized electric grid and space heating system through increased use of biofuels and biogenic waste incineration.[6] Unlike the US, Sweden has very little natural gas infrastructure, with natural gas accounting for 2% of total energy supply in 2021.[7]

Sweden has successfully coupled decarbonization with energy efficiency by setting national energy intensity targets among their many energy policy objectives. Accordingly, energy consumption peaked in the late twentieth century, while gross domestic product and population have continued to grow.[8]

On the local level, Stockholm has set aggressive city-wide goals, with "fossil-free and climate-positive by 2040" being the highest priority—more ambitious than Sweden's national goal of net-zero GHG emissions by 2045.[9] Stockholm's city government has committed to an even stricter timeline, phasing out fossil fuel use from government operations by 2030 and prioritizing energy efficiency work in buildings. These efforts have been successful. Between 1990 and 2023, city-wide GHG emissions have fallen by two-thirds.[10]

I was swayed by heat recovery approaches and technologies that we saw during the visit. We considered these approaches in recent projects to see how applicable the technology or approach could be here in the NYC market. From an engineering perspective, the solutions in place in Sweden aren't different from our own solutions, it's really their attitude and processes that are much more proactive and streamlined than our own here in NY.
— Molly Dee-Ramasamy, Director, Deep Carbon Reduction Group, JB&B

Swedish industry has established ambitious decarbonization targets covering operations and supply chains. Targets set by property owners and developers are aligned with the action and ambition of industry and utilities.
— Ben Myers, Senior Vice President, Sustainability, BXP

In 2022, Sweden required all real estate developers to calculate the embodied carbon emissions for new buildings to receive final building permit approval.

The Act on Climate Declarations for New Buildings is designed to increase transparency around embodied carbon, with the aim of setting limits for new construction in the coming years.[11]

That same year, NYC Mayor Adams' Executive Order 23 required the City's capital projects to specify low-embodied carbon construction materials.[12]

District Thermal Networks

The success of Stockholm's building decarbonization efforts hinges on their robust open district heating and cooling network, which serves 12,000 buildings in the greater metropolitan area using 99% renewable and recovered energy.[13] With 1,740 miles of district heating piping and 186 miles of district cooling piping, the network not only supplies heating and cooling, but also allows for the recovery and redistribution of thermal energy that would otherwise be wasted.[14]

In New York, space heating is powered by a diverse mix of sources, including natural gas and oil boilers, electric sources (both resistance and heat pumps), and district heating, such as Con Edison's steam system. In contrast, all the sites visited during our study tour in Stockholm—commercial, mixed-use, and residential developments—relied on district heating for some, or all, of their needs, with geothermal energy as an alternative or supplemental source.

Stockholm Exergi, the city's district heating and cooling provider, is owned in equal parts by the City of Stockholm and Ankhiale, a consortium of European pension fund providers. The company's environmental commitments mirror those of the City's, focusing on both carbon reductions and resource efficiency. A model of success, heating in Stockholm generates 0.8 tCO_2 per resident per year, over 70% reduction from the 2.9 tCO_2 emitted per resident in 1990—attributable to both energy efficiency improvements and the widespread replacement of fossil fuel-powered boilers for district heating connections.[15]

Reducing Emissions: Renewable Sources

Since the closure of Stockholm's last coal-fired plant in April 2020, the city's district heating system has been based on renewable energy sources, primarily residual products from the forestry sector. Biogenic waste is used to a lesser extent. As such, organic waste has not been allowed in landfills since 2005.[16] To limit the burning of non-biogenic sources, Stockholm Exergi launched a waste sorting plant in 2023, applying novel infrared technology to automatically sort out plastics from household waste.

Both biomass and biogenic waste is burned to generate heat and electricity via Combined Heat and Power (CHP) plants. Using CHP, or cogeneration, waste incineration and biofuel power turbines to generate electricity, while excess heat is used for district heating.

Biomass is seen as CO2-free in Sweden, with the assumption that unused biomass waste will cycle back into atmospheric carbon if not used and that biomass emissions are offset by an equal amount of carbon sequestration (e.g., forest regrowth). This assumption is not universally accepted, with accounting varying across countries.[17]

Resource Efficiency: Heat Recovery

Unlike NYC's district thermal network—Con Edison's district steam system—which provides heat to users unidirectionally, Stockholm's open network allows users to sell excess heat back into the system. Building owners can transfer heat, either directly, or using a heat pump, to the district heating return line through a heat exchanger. Stockholm Exergi builds the connection to the distribution system, with the supplier paying back the costs of connection over 15 years. Payments are determined by the temperature of return lines in relation to Exergi's desired 68° C temperature.

With heat recovery, buildings move from consumer to prosumer. Buildings connected to the district heating network become energy assets by deploying waste heat that would typically be rejected into the atmosphere. The market for recovered heat incentivizes heat recovery strategies, particularly for facilities with significant excess heat, like data centers and supermarkets. For example, the Stockholm Data Parks initiative, launched in 2014, recovers over 100 GWh yearly from 20 suppliers through open district heating, equivalent to the annual heating needs of 30,000 modern apartments and 1.5% of Exergi's total customer demand.[18] Early successes, like the Stockholm Data Parks initiative, have laid the foundation for a growing market, while the EU's European Energy Efficiency Directive, updated in 2023 to include targets for data center heat reuse, will likely contribute to additional growth in this area.[19]

Wastewater is handled similarly, with heat recovered and sent back into the district system. At the utility scale, Hammarbyverket, the world's largest heat pump plant, extracts district heating from wastewater sent from Henriksdal's wastewater treatment plant. At the building scale, heat recovery coils over wastewater lines recover and transfer heat back into the building or district system.

Resource Efficiency: District Cooling

Exergi's growing district cooling system, while currently only 5% of the sales of their district heating system, is the largest in the world. Unlike New York, Sweden's climate requires little cooling in most residential and commercial spaces—although demand is growing as the global climate warms. Cooling demand is primarily supplied by one of the world's largest sea water-based cooling facilities.[20] Depending on the season, cold seawater is used directly, or with industrial-scale heat pumps, which extract heat to generate cold water.

Success Through Scale

A chief driver of success for Stockholm's district heating and cooling networks is scale. The greater number of buildings served in a network, especially given diverse loads, increases heat sharing opportunities, improving overall system efficiency and reducing costs. As the network grows, so does the opportunity for energy recovery and sharing via the processes described above.

Stockholm is incentivizing data centers to come to the city center for utilization of the heat while we push them to population density dry cool climates, partially for easier heat rejection.
— Travis Smith, Principal, Smith Engineering

From Carbon-Neutral to Carbon-Positive

In line with the City's climate-positive by 2040 goal, Stockholm Exergi launched a Bioenergy Carbon Capture & Storage (BECCS) pilot in 2019 at their Värtaverket cogeneration plant. By capturing and sequestering biogenic CO2 emissions associated with the combustion of biofuels at the plant, the climate-neutral cogeneration process becomes climate-positive. The carbon scrubbing pilot has shown promising results, with Exergi estimating a potential 800,000 tCO2/year sequestration capacity at the plant, once scaled.[21] Plans to expand are underway, made financially viable in part through funding from the EU Innovation Fund, and by growing demand for renewable energy credits across the EU.

Drawing Parallels: New York's Utility Thermal Energy Networks and Job Act

In 2022, the New York State Legislature passed the Utility Thermal Energy Network and Jobs Acts to accelerate the implementation of utility-scale infrastructure that connects multiple buildings into a shared thermal network. The law directed the NYS Public Service Commission (PSC) to oversee utility efforts to develop new thermal energy networks. The seven largest gas and combination electric-gas utilities are required to propose at least one pilot project connecting at least two buildings. While at the pilot stage, this development seeks to replicate thermal network successes deployed in Stockholm and other Nordic countries and provide a vision into the future of gas utilities in a zero-carbon economy.


Hastkopala


The combination of shared purpose, energy systems and design approach, including bioenergy carbon capture and sequestration, a robust district heating system, low cooling demand and air conditioning infrastructure, ground source heat pump systems, heightened focus on efficiency and laser-beam focus on heat recovery, puts Sweden on a firm footing for meeting their ambitious decarbonization targets.
— Ben Myers, Senior Vice President, Sustainability, BXP

Valla torg

Fully integrated development and operational teams, educated in efficiency and carbon reduction at every level, were able to execute holistic and relatively complex solutions on even the simplest of buildings.
— Geoff Hurst, Vice President, Sustainability, Related

Everywhere we went in Stockholm, we saw efficient hydronic heating and heat recovery—smart engineering and foundational to decarbonized heating. It was a vision into the future for U.S. heating.
— Brett Bridgeland, Principal, Carbon-Free Buildings, RMI

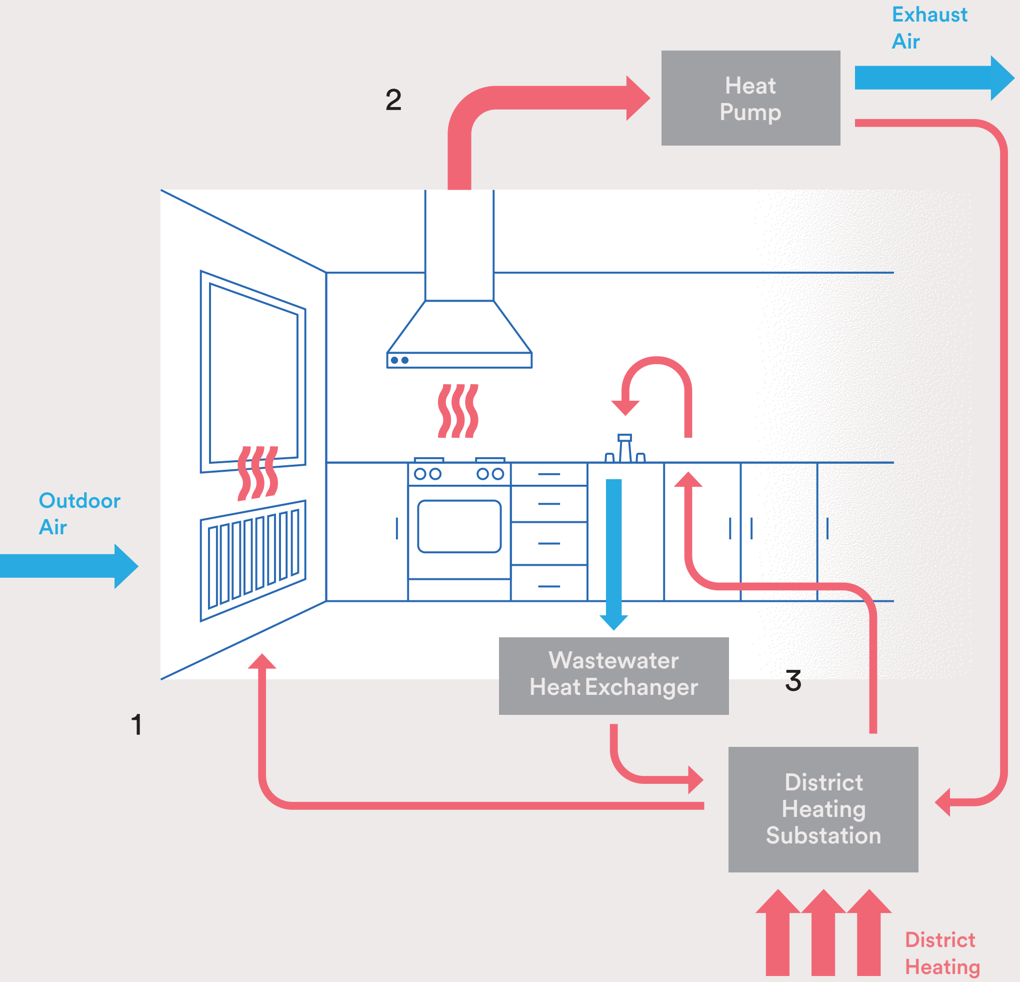
Heat Recovery at Valla Torg

The renovation of Valla Torg, a 1960s-built, City-owned social housing complex, updated 6 buildings with a wide range of efficiency measures, including heat recovery applications, like exhaust air heat pumps and wastewater heat exchange systems. Separate heat exchangers were installed in every building for direct, efficient connections to the district heating system. These strategies, in tandem with aggressive insulation and airtightness improvements, enabled significant heat recovery for reuse across the complex, with excess sold back into Stockholm Exergi's district heating system. In total, the improvements resulted in a nearly 50% drop in energy intensity.

year built:	1961
size:	302 apartments across two 4-floor buildings + four 14-floor buildings
ownership:	Stockholmshem (major Stockholm-based public housing company)
timeline:	6 buildings, mostly unoccupied, between 2016-2019
consumption:	pre-retrofit 154 kWh/m2/year post-retrofit ~80 kWh/m2/year
retrofit measures:	heat recovery (exhaust air heat pumps, wastewater heat exchange systems) full overclad (added insulation, new windows, new balcony doors, increased airtightness) finetuning set-points, climate controls

Energy Flow

Heat recovery at every opportunity, incentivized by participation in Stockholm's open district heating system



1
Outdoor air is tempered by hot water from the district heating substation.

2
Exhaust air is sent to an air-to-water heat pump, which recovers and returns heat back to the district heating substation.

3
Wastewater heat exchanger recovers and returns heat from wastewater back into the district heating substation.

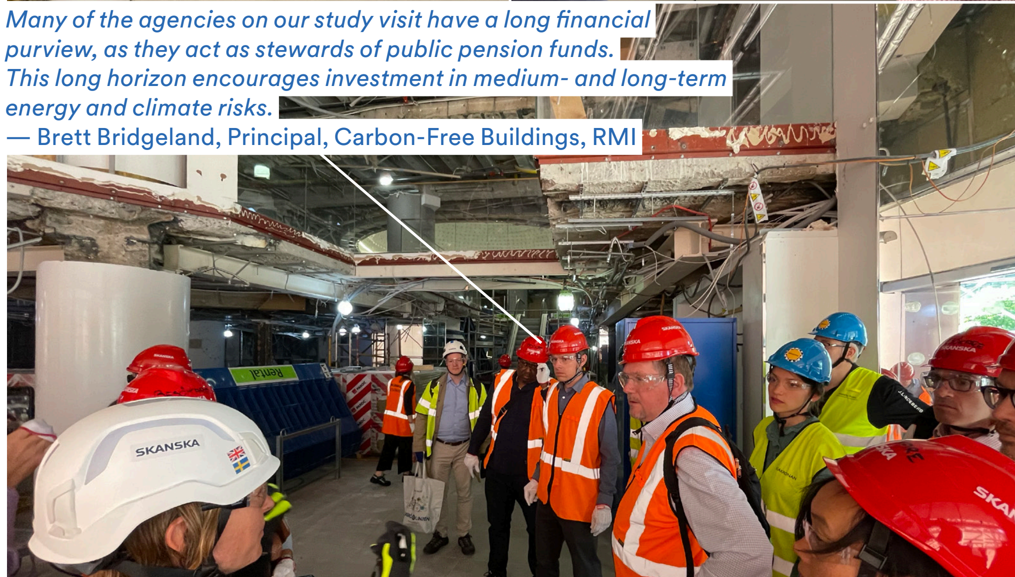
Geothermal

While Stockholm' Exergi's district heating and cooling systems dominate the market, geothermal energy, or ground source heat pumps (GSHP), are also used (in addition to, or in place of the district system) for buildings at all scales. Sweden has been a leader in geothermal energy since the oil crises of the 1970s, with more than 500,000 shallow geothermal energy systems installed for space heating and domestic hot water.[22]

In Stockholm, geothermal energy is a practical choice given the prevalence of low-temperature water-based heating and cooling systems. GSHPs are well suited to provide heating and cooling in buildings designed for district heating, as the required infrastructure is the same—the main difference is that heat is pulled from the ground, rather than the district network.

Sustainability and economics are also core drivers. Geothermal energy is a relatively low-maintenance, high-efficiency energy source, relying on GSHPs to extract heating and cooling from the ground, rather than the outdoor air (which is colder than groundwater in winter, and warmer during the summer). While the upfront costs are significant relative to other systems, involved Swedish developers cited GSHPs as a way to increase self-sufficiency and reduce risk, insulate companies from district system price fluctuations, and put downward pressure on district heating and cooling prices. For many of Sweden's largest developers, ownership structure (e.g., pension funds, direct government ownership), justify these investments due to longer acceptable payback horizons and institutionalized environmental goals.[23]

Many of the agencies on our study visit have a long financial purview, as they act as stewards of public pension funds. This long horizon encourages investment in medium- and long-term energy and climate risks.
— Brett Bridgeland, Principal, Carbon-Free Buildings, RMI



Hötorgshusen

Hötorgshusen

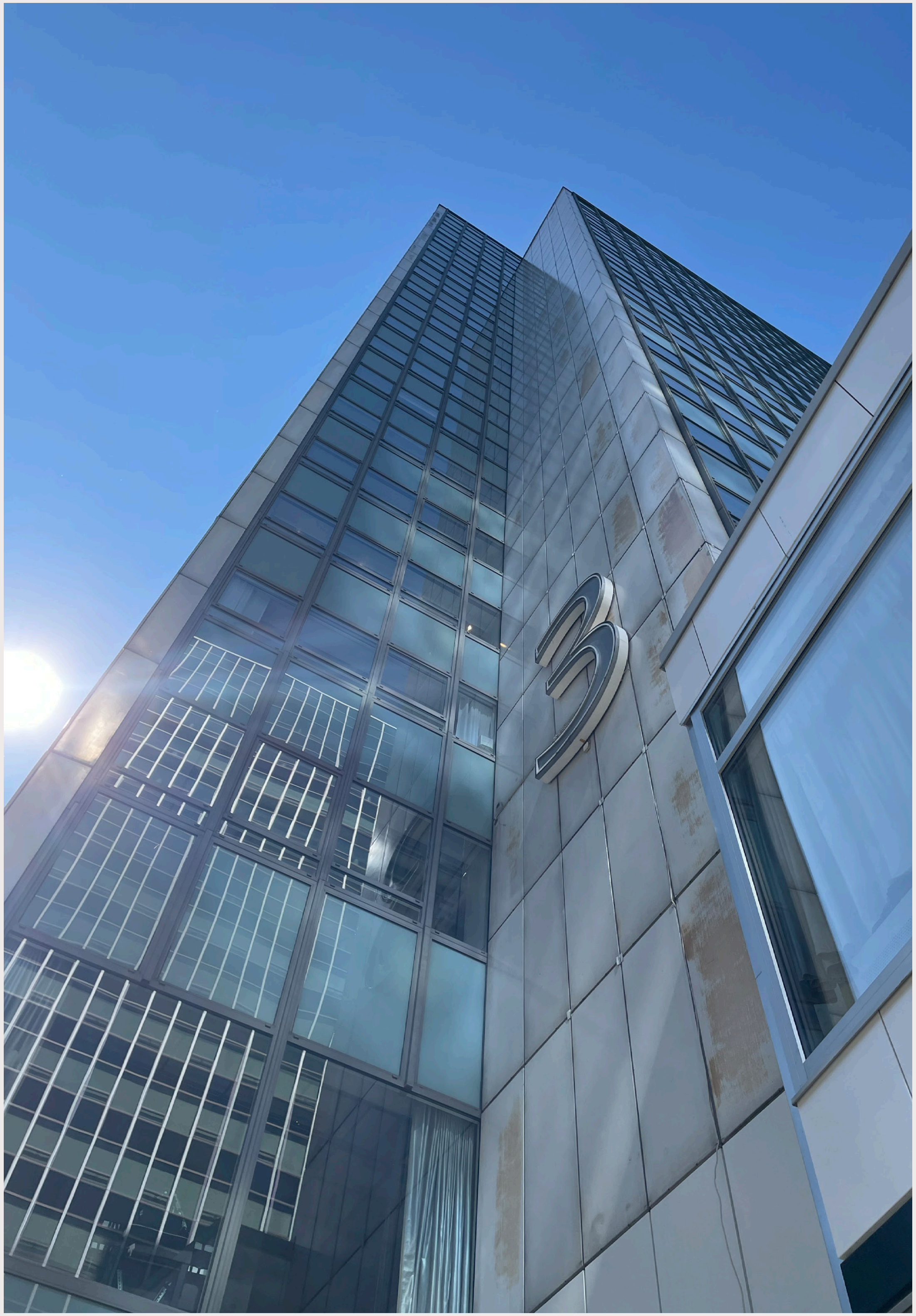
case study:

Vasakronan – Hötorgshusen

One of Sweden's largest real estate companies, Vasakronan is owned by the country's four largest pension funds. With sustainability at the core of their mission, Vasakronan has halved energy use across its portfolio and reduced emissions by 95% since 2006.[24] At Hötorgshusen, one of Stockholm's largest commercial complexes, Vasakronan was able to greenlight a geothermal retrofit project with a payback of 11 years, in alignment with the mission of its four owners—the First, Second, Third, and Fourth Swedish National PensionFunds—to "deliver a high and long-term risk-weighted return without damaging the environment." [25]

year built:	1960(s)
size:	Four high-rise commercial buildings, central Stockholm
ownership:	Vasakronan (large real estate company, owned by national pension funds)
timeline:	2019–22
consumption:	pre-retrofit 154 kWh/m2/year (Tower 1-4, lower parts) post-retrofit 75 kWh/m2 /year (Tower 1-4, lower parts)
retrofit measures:	Geothermal across all buildings (63 boreholes at 400 meters deep, with ground source heat pumps) Full envelope retrofit, new lighting and controls for one of four buildings, Hotorgshus 2

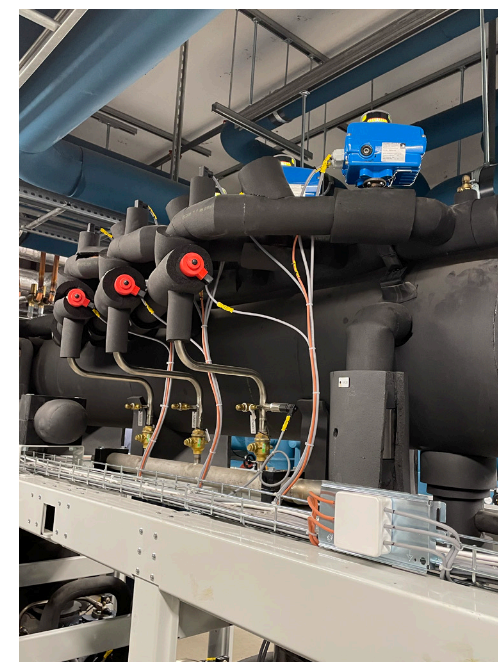
Vasakronan's retrofit of the 1935-built commercial building Hästskopalatset also included geothermal systems, connected to an aquifer under the block, for heating and cooling. While district heating and cooling is still used at both sites to meet total demand, Vasakrnonan hopes to rely solely on geothermal for heating and cooling through gradual improvements and system optimization across its entire portfolio.[26]



The project, a major retrofit of the 1960s-built four-building office complex Hötorgshusen, centered around the installation of 63 geothermal boreholes with GSHPs to provide heating and cooling across the complex. In addition, one of four buildings, Hötorgshus 2, received a full envelope retrofit, along with new lighting and controls. Hötorgshus 2 is expected to earn a LEED Platinum certification—a major step up from their “F” Energy Declaration Rating (on an A–G scale). The combined effort resulted in a nearly 50% energy use reduction across towers 1–4.

Drawing Parallels: Geothermal in New York City

The Community Heat Pumps Pilot Program by NYSERDA, issued in 2020, solicited proposals for projects that leverage GSHPs to serve multiple buildings.[27] Both Swedish and U.S. companies are entering the New York market with a focus on geothermal retrofits in existing buildings, while developers are beginning to opt for geothermal in new construction—like 1 Java Street, a 5-building, 834-unit multifamily complex in Brooklyn developed by Lendlease.



Centralized Controls

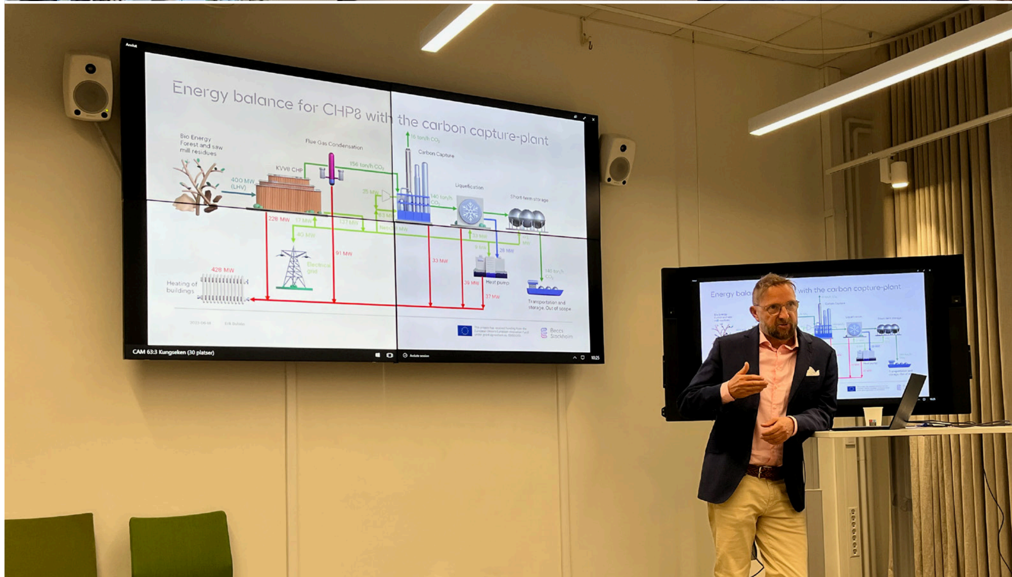
Sweden was one of the first European countries to roll out smart meters, with national-level regulations requiring monthly metering for small consumers and hourly metering for larger consumers by 2009.[28] During our study visit, advanced building controls were often cited as a core strategy for building retrofits in residential, commercial, and institutional settings.

SISAB, a publicly owned property management firm overseeing 600 schools, centralized and digitized building system monitoring and operation to optimize energy use and indoor air quality across all schools. Using 15-minute-increment data, and centralized controls informed in part by artificial intelligence and digital twins, SISAB has seen meaningful reductions in energy use (4%), electricity use (15%), and yearly costs ($270,000), while maintaining target indoor temperature and quality conditions for students and staff.[29]

On the utility side, Stockholm Exergi's Intelligy Solutions targets system optimization through advanced controls for both small and large residential customers. Through 2,000 service agreements, Intelligy Solutions automates climate control and energy optimization services for individual customers, while providing thermal demand side management and peak shaving services to ensure for system reliability—a key function in a district system where coordination between participants is needed during peak conditions.

These strategies are common to electricity providers, like Con Edison, but not typically deployed for heating and cooling services in the United States. In contrast to New York utilities, frequency and transparency of data is prioritized, with residents collecting easily accessible per-minute usage data through utility-installed sensors. Secondary services, as described above, are opt-in. These services continue to grow, with Intelligy Solutions aspiring to fill the role of "decarbonization concierge," facilitating connections to solar, EV charging, and batteries.

The shared purpose in the decarbonization mission is palpable, embraced as a responsibility and opportunity for innovation in pursuit of improving and maintaining quality of life. — Ben Myers, Senior Vice President, Sustainability, BXP



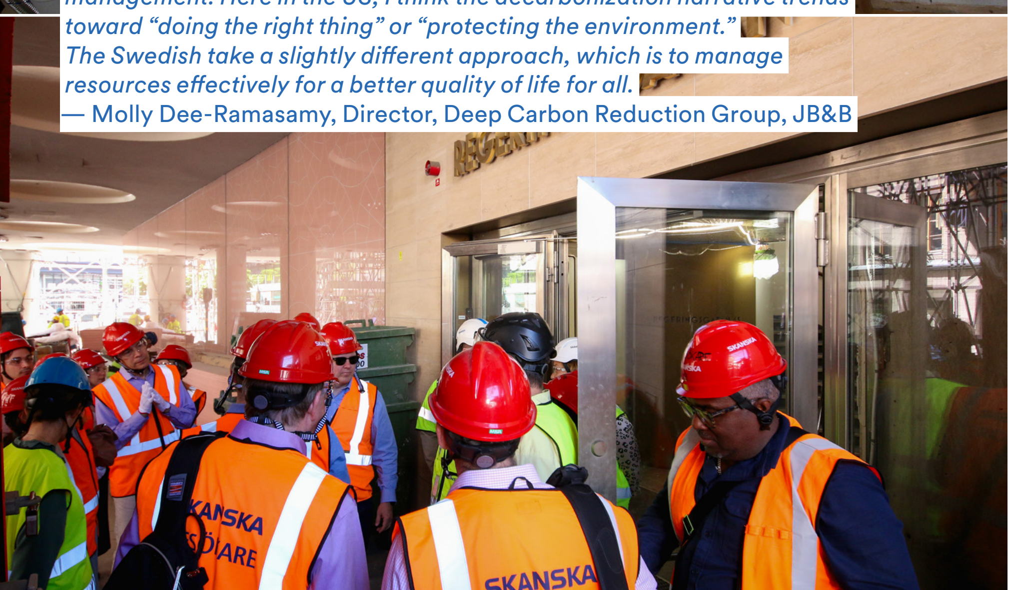
Stockholm Exergi

New York real estate is starting to recognize the value of future-proofing our assets, and through programs like Empire Building Challenge, is discovering ways to strategically decarbonize, often over time, under terms and triggers particular to U.S. real estate.
— Brett Bridgeland, Principal, Carbon-Free Buildings, RMI

Stockholm Exergi

Stockholm Exergi

Hastkopala



I was impressed by the Swedish people's social trust and shared responsibility around decarbonization as a means of resource management. Here in the US, I think the decarbonization narrative trends toward "doing the right thing" or "protecting the environment." The Swedish take a slightly different approach, which is to manage resources effectively for a better quality of life for all.
— Molly Dee-Ramasamy, Director, Deep Carbon Reduction Group, JB&B

takeaways:

Stockholm & New York: Differences and Opportunities

Sweden's sustained aggressive climate policy, initiated by the oil crises of the 1970s, and deepened by growing concern around climate change in the 1990s, has fueled a transformation of their energy sector and built environment. In 2020, per capita emissions in Sweden were 3.2 mtCO2,[30] compared to 11 mtCO2 per capita in New York City as of 2019.[31] In the building sector, sustained deployment of geothermal energy, renewable electricity, and low-carbon district heating, has crowded out fossil fuels for heating, driven by a federal-level carbon tax.

In contrast to New York, many of Sweden's largest real estate actors are partly or wholly owned by government or pension funds, a factor cited by developers as contributing to their commitment to energy efficiency and emissions reductions. In New York, real estate development is largely a private sector activity. Given the lack of publicly owned real estate actors, aggressive public policy, combined with strategic public-private partnerships, will be key to influencing the real estate market and accelerating the deployment of low-carbon building solutions.

Stockholm's cold climate is another key difference. Space heating is the focus of Swedish decarbonization efforts, unlike New York, which has both significant heating and cooling demand across the year.

Despite these key differences, New York and Swedish climate objectives are closely aligned, with Sweden aiming for carbon neutrality by 2045, and New York's Climate Leadership and Community Protection Act (CLCPA) requiring economy-wide

takeaways:

carbon neutrality by 2050. Similar to Sweden's carbon tax, the CLCPA includes the development of a market-based tool (Cap-and-Invest Program) to drive emissions reductions.

With a population almost twice that of Sweden's, robust natural gas infrastructure, and a largely fossil fuel-based electric grid, New York has a long way to go—but recent policy, utility, and industry developments are providing a glimpse into the state's low-carbon future.

At the state level, the CLCPA has mandated 100% carbon-free electricity by 2040, with two major renewable energy generation and transmission projects in the pipeline: the Champlain Hudson Power Express transmission line, connecting New York to Quebec-based hydropower, and the Clean Path NY, comprised of large-scale in-state solar and on-shore wind projects.

At the district level, policies and programs are driving investigation into low-carbon district thermal networks and geothermal energy, echoing strategies deployed in Stockholm. NYSERDA's Community Heat Pumps Pilot Program solicited submissions for projects that included thermal energy networks and geothermal heat pumps. The State's Utility Thermal Energy Network and Jobs Act requires the seven largest gas, electric, or combination gas and electric utilities to pilot thermal energy network projects—a small step towards a repurposing gas utility infrastructure in alignment with New York's climate objectives. Last year, NYC's Local Law 2 of 2022 committed the City to a feasibility study of district-scale geothermal projects that connect multiple buildings to shared infrastructure. Meanwhile, Con Edison's 2022 Clean Energy Commitment includes a vision for a decarbonized district steam system, citing boiler electrification via industrial-scale heat pumps and storage, low-carbon fuels, and carbon capture and sequestration as strategies.[32]

The shared purpose in the decarbonization mission is palpable, embraced as a responsibility and opportunity for innovation in pursuit of improving and maintaining quality of life.
— Ben Myers, Senior Vice President, Sustainability, BXP

Underpinning these programs and policies are Local Law 154 of 2021—phasing out on-site fossil fuel usage in new construction—and Local Law 97 of 2019—NYC's building carbon emissions limit law.

While industry transformation takes time, these efforts have had meaningful impacts. Developer Tishman Speyer, as part of a Con Edison Utility Thermal Energy Network pilot, is actively exploring opportunities to deploy geothermal systems, thermal networks, and heat recovery technologies for low-carbon heating and cooling across the 17 million SF Rockefeller Center complex. In early 2023, NYC Mayor Adams announced plans for the 400,000 SF New York Climate Exchange, an all-electric complex using district geothermal system to service the entire campus. Led by Stony Brook University, the project team includes Urbs, a Swedish infrastructure consulting firm and thermal energy networks expert. Urbs has also consulted on two in-progress commercial projects—both retrofit and new construction—for developer Hudson Square Properties in Manhattan, centered around thermal energy networks, heat sharing, and geothermal energy. Across the East River, Leandlease's 1 Java Street, completed in early 2023, provides heating and cooling via ground source heat pumps to 834 units across five interconnected buildings on a full city block—the largest residential project to be heated entirely by geothermal energy in New York State.

On the heels of these new policies and programs, UpgradeNY, a consortium of unions, climate justice advocates, building industry representatives, and environmental groups, are advocating for thermal energy network projects to reduce local pollution, carbon emissions, and create jobs.[33]

conclusion:

Despite climate, utility, technical, and policy differences between Stockholm and New York, Swedish innovations in low-carbon building provide great insight and inspiration into future opportunities for building decarbonization in New York—from thermal energy networks, geothermal energy, and heat recovery to advanced controls.

Already, New York is looking to Stockholm, as well as other northern European cities, to inform climate policy and program objectives; local industry leaders are recognizing the promise of many Nordic technical solutions; and transnational real estate professionals are building effective collaborations resulting in innovative low-carbon outcomes. Though the path to building decarbonization is steep, with years of hard work ahead, Stockholm's successes offer a glimpse into a cleaner, greener future for New York's built environment.

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