



Revolutionizing urban sustainability

District energy systems as key
players in the decarbonization
of commercial buildings



Commercial buildings significantly contribute to carbon emissions in the U.S.—[826 million metric tons](#) per year, to be exact. Building operations alone contribute nearly [30%](#) of global carbon emissions annually. To tackle this substantial carbon footprint and combat climate change, urgent action is necessary, including a swift transition from fossil fuels to cleaner heating and cooling methods.

According to the World Meteorological Organization’s [report](#), the *State of Climate in 2021: Extreme Events and Major Impacts*, “record atmospheric greenhouse gas concentrations and associated accumulated heat have propelled the planet into uncharted territory, with far-reaching repercussions for current and future generations....The past seven years are on track to be the seven warmest on record....Global sea level rise accelerated since 2013 to a new high in 2021, with continued ocean warming and ocean acidification.”

As described in the report, extreme weather events occur more frequently each year as a result of climate change. Cities and states already feel the impacts of flooding, hurricanes, wildfires, and other climate-related crises. Many areas, especially coastal areas, are preparing for how these emergencies will affect them. Leaders are considering infrastructure enhancements to protect citizens from the impacts of climate change, such as rising sea levels and extreme weather events. It’s clear that our cities need resilient, reliable, and agile solutions to face an uncertain climate future.

In addition to operational flexibility and reliability, district energy systems have expedited restoration capability, making it possible to recover much faster than electric and gas utilities during emergencies. Unlike other utilities, flood waters will not damage district distribution systems because they are fortified underground. Given the rising ocean levels worldwide, this is an essential benefit of district energy, especially for coastal cities.

For decades, building owners, developers, and tenants have embraced district energy for its reliability, ease of use, cost competitiveness, and notably lower carbon footprint compared to alternative heating and cooling methods. Originating over a century ago, many district

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energy systems were historically owned by local electric utilities, strategically co-located with electric substations, paving the way for electrification with easy access to existing transmission infrastructure.

The resilience of district energy systems is evident in their transformative journey of fuel-switching—from coal to oil, natural gas, and, more recently, cogeneration and biogenic fuels. Designed for seamless fuel-switching and adaptability to cleaner energy sources, these systems continue to evolve with new, environmentally friendly technologies and fuel options.

Pioneering a carbon-free future in the next energy transition

The global shift towards clean energy is at a critical juncture, with district energy systems leading the way. District energy solutions guide us towards a future free from carbon emissions, reducing our dependence on fossil fuels. District energy systems are at the forefront of aggressive climate action, emerging as invaluable assets in achieving ambitious sustainability goals. These systems, comprised of centralized facilities that produce and distribute thermal energy for the heating and cooling of building spaces through underground piping networks, offer a compelling solution for cities and communities.

The centralized nature of thermal energy and chilled water generation positions district energy as a catalyst for change. Each and every building connected to a district energy system immediately benefits from any technology, efficiency, or carbon reduction strategies implemented at the system's central facilities. This eliminates the need for individual, costly in-building retrofits and associated capital investments, offering a scalable and cost-effective approach to reducing carbon emissions in cities. Decarbonized district energy service also meets the challenges posed by retrofitting and decarbonizing existing building stock, particularly for cities with aging infrastructure and historic buildings.

Transforming North America with decarbonization solutions

As the largest owner and operator of district energy systems in the U.S., Vicinity Energy is at the forefront of bringing decarbonization solutions to North America. Currently serving 12 cities with 19 systems, our extensive underground networks serve over 900 buildings, totaling 250 million square feet of space. The steam, hot water, and chilled water we provide plays a vital role in essential community services, serving major hospitals, hotels, biotech facilities, and higher education campuses for heating, cooling, humidification, and sterilization.

After committing to net-zero carbon emissions by 2050, Vicinity has taken significant strides in this direction. Our strategy revolves around the electrification of our operations, incorporating proven technologies such as electric boilers, industrial-scale heat pumps, and thermal storage. Notably, we're set to install our first industrial-scale electric boiler in 2024, marking a milestone in our journey toward decarbonization.

This technological advancement, coupled with the procurement of carbon-free electricity, enables Vicinity to introduce a groundbreaking carbon-free product—eSteam™. This reliable and cost-effective offering empowers our customers to achieve their decarbonization goals while contributing to the sustainability goals of the cities we proudly serve.

MALMÖ, SWEDEN

Sweden is arguably one of the world's leaders in decarbonization and introducing tech-forward, large-scale renewables into its energy mix. The City of Malmö is on the cutting edge, incorporating low/no carbon resources to fuel its district energy infrastructure to heat buildings sustainably.

In collaboration with the City of Malmö, Sweden, Germany-based E.ON, one of Europe's largest energy networks and infrastructure operators, announced the construction of five geothermal heating plants to feed the city's existing district heating network. The ultimate objective is for Malmö to be emissions-free, leveraging the district infrastructure and the world's deepest wells for using geothermal energy.

E.ON intends to drill its first well to a depth of 5 to 7 kilometers, where it expects to find temperatures of 160 degrees Celsius. Water is pumped into a borehole, which heats up at depth and then exits through a second borehole. The energy is fed into the district heating network via a heat exchanger, which transfers thermal energy to the district network. The company is now preparing to construct the first five planned plants, which will go live in 2027. The first plant will produce 40MW of heating power.

[!\[\]\(5361750c22c4e047a52f4eac1ec2d4cc_img.jpg\) Learn more](#)

To meet our net-zero carbon emissions target ahead of schedule, Vicinity has devised a comprehensive investment and execution strategy. This involves deploying various technologies and access to ongoing renewable energy sources from the grid, ensuring a multi-pronged approach to electrifying steam generation processes across our district energy systems. Vicinity is dedicated to leading the way in revolutionizing North America's energy landscape with innovative and sustainable solutions.

Our roadmap to net zero carbon emissions includes the following critical components:

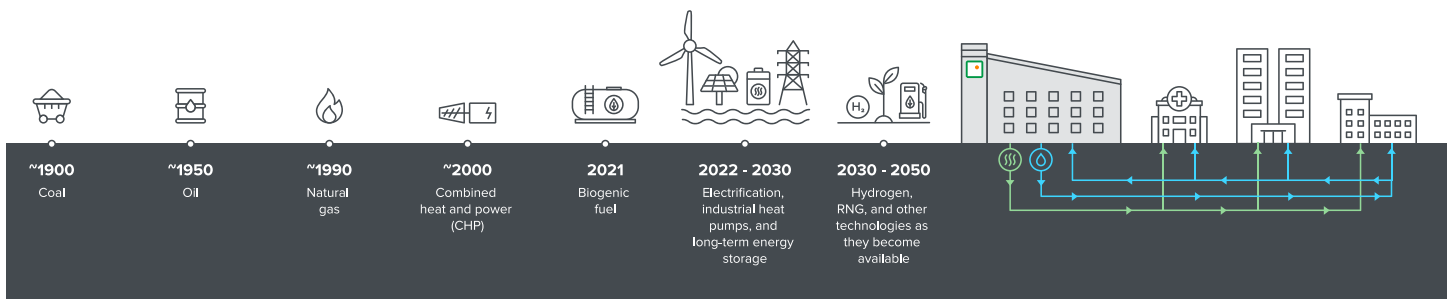
- Electrifying generation by converting our operations to heat pumps and electric boilers;
- Utilizing renewable or carbon-free electricity to power our equipment and integrating it into our fuel mix;
- Leveraging existing and installing new infrastructure to deliver renewable, carbon-free thermal energy;
- Installing thermal storage to buy renewable electricity when it's readily available and affordable and store it for use during peak district system demand;
- Investing in efficiency projects and upgrades to our existing energy infrastructure, and
- Exploring and implementing other leading-edge technologies to accelerate our decarbonization and the energy transition.

Empowering Environmental Justice communities

In the realm of climate legislation, Environmental Justice (EJ) communities rightfully take center stage due to the disproportionate impact of climate change on these areas. Vicinity's electrification plan aims to swiftly decarbonize urban spaces, focusing on ensuring direct benefits for EJ communities. This initiative promises access to a greener, more reliable, cost-effective energy solution, requiring no financial investment from EJ communities.

One notable advantage of connecting buildings to district energy services is eliminating the need for new smokestacks. Many structures in EJ communities currently rely on outdated, inefficient natural gas boilers for heating, known for unregulated emissions and a decades-long lifespan. Once installed, cities and states often overlook these boilers, leaving harmful greenhouse gas emissions unregulated. By transitioning to district energy systems, removing these unregulated boiler plants will help prevent unnecessary pollutants, safeguard community health, and address environmental concerns.

EJ communities often face capital constraints, making traditional decarbonization efforts challenging. Connecting buildings to district energy systems significantly reduces capital costs to mitigate this cost barrier, eliminating the need for onsite equipment management and maintenance. District energy service helps foster a more equitable and sustainable energy future for all by shifting energy and operations risk away from building owners to Vicinity's central facilities.



Fuel agnostic district energy systems have a 75-year history of greening their fuel sources. Vicinity is continuing this evolution, leveraging our existing district energy systems and deploying innovative technologies to reach net zero carbon emissions.

Revolutionizing North America's energy landscape: Vicinity's three-pronged electrification strategy

Electric boilers

Vicinity's journey to electrify district energy systems begins with adopting electric boilers—a proven, accessible technology that utilizes electricity to transform water into high-pressure steam. This process completes the electrical circuit by injecting water across oppositely charged plates, instantaneously heating water into steam. The advantages are manifold: once installed, Vicinity leverages existing distribution infrastructure to deliver electrically-generated, carbon-free steam, known as eSteam™, to customers.

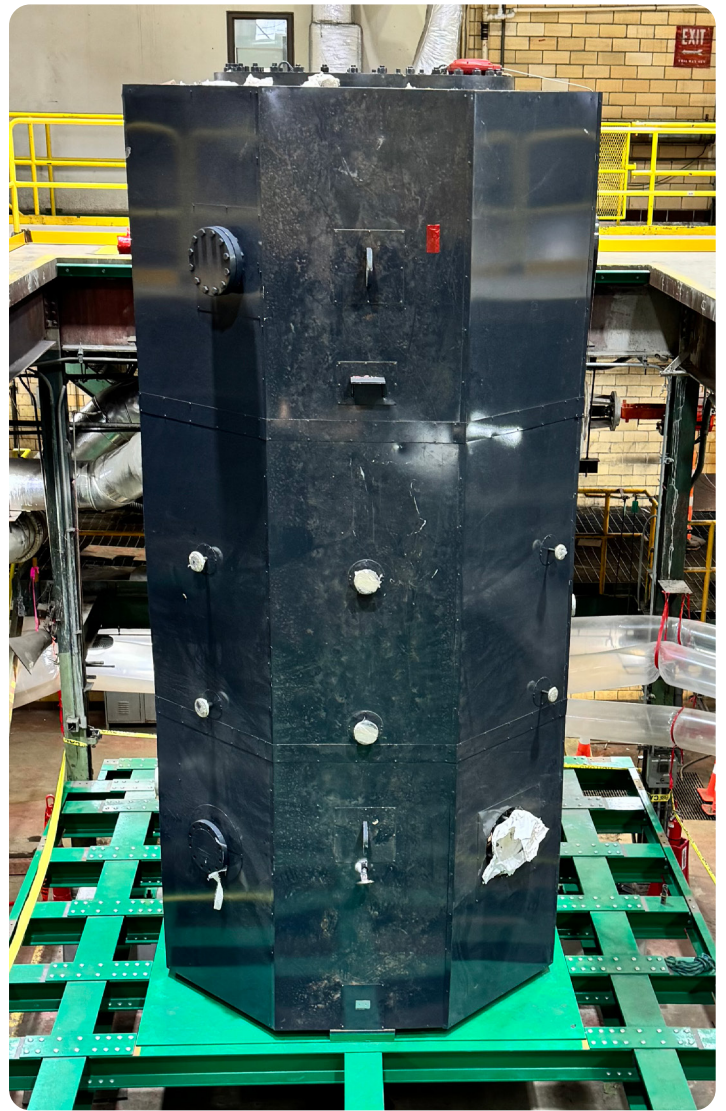
This approach capitalizes on our co-located facilities with large electric substations, ensuring reliable access to green electrons without requiring new electric infrastructure. This minimizes costs and sidesteps challenges associated with constructing new substations, such as permitting difficulties while generating public support. Vicinity's access to a lower-cost, high-voltage, electrical supply further reduces financial barriers, making eSteam™ a more affordable and sustainable alternative for customers.

Over time, electric boilers will transition into peaking steam-generating equipment, providing flexibility in meeting evolving energy needs.

Industrial-scale heat pump complex

Vicinity is also in the process of deploying industrial-scale, steam-generating heat pumps as the baseload generating equipment for electrification. These innovative systems extract heat from local water sources, such as rivers, lakes, or oceans, utilizing them as energy reservoirs. Operating with a generation coefficient of performance (COP) exceeding 2, Vicinity's heat pumps demonstrate exceptional efficiency by generating twice the energy output for every unit of electricity input.

Powered by green electricity from the grid, these heat pumps contribute to reducing carbon emissions in our operations. The environmental impact is carefully



Vicinity's first 42MW electric boiler that was installed at our Cambridge facility.

managed, with Vicinity adhering to stringent regulations regarding water use and ensuring minimal disruption to local ecosystems. Ensuring that rivers and their ecosystems remain unharmed, the river intake system lifts heat from the river and brings it into our facilities.

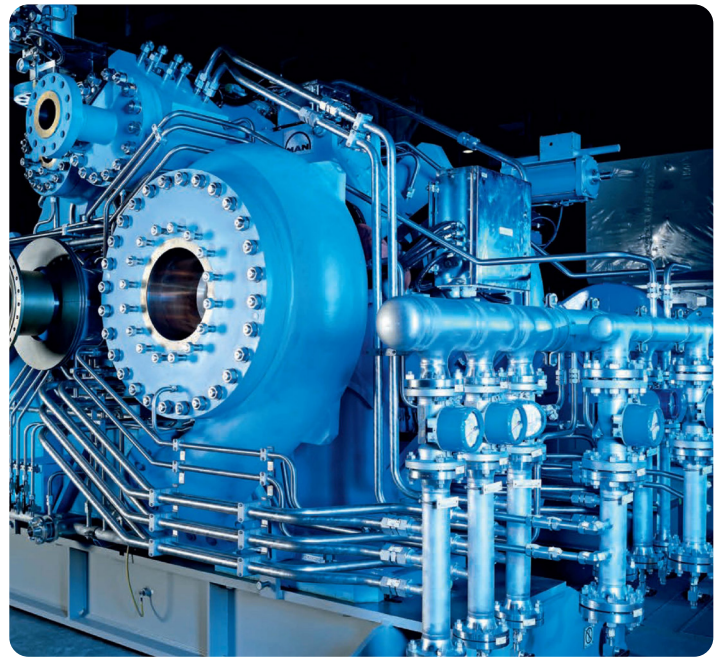
This heat pump will have a steam export capacity of 35MW and will occupy a space of approximately 25,000 sq ft. Lifting heat from the Charles River, the Kendall heat pump will circulate 24.5 million to 49 million gallons of water daily, returning the water at a cooler temperature.

Thermal storage

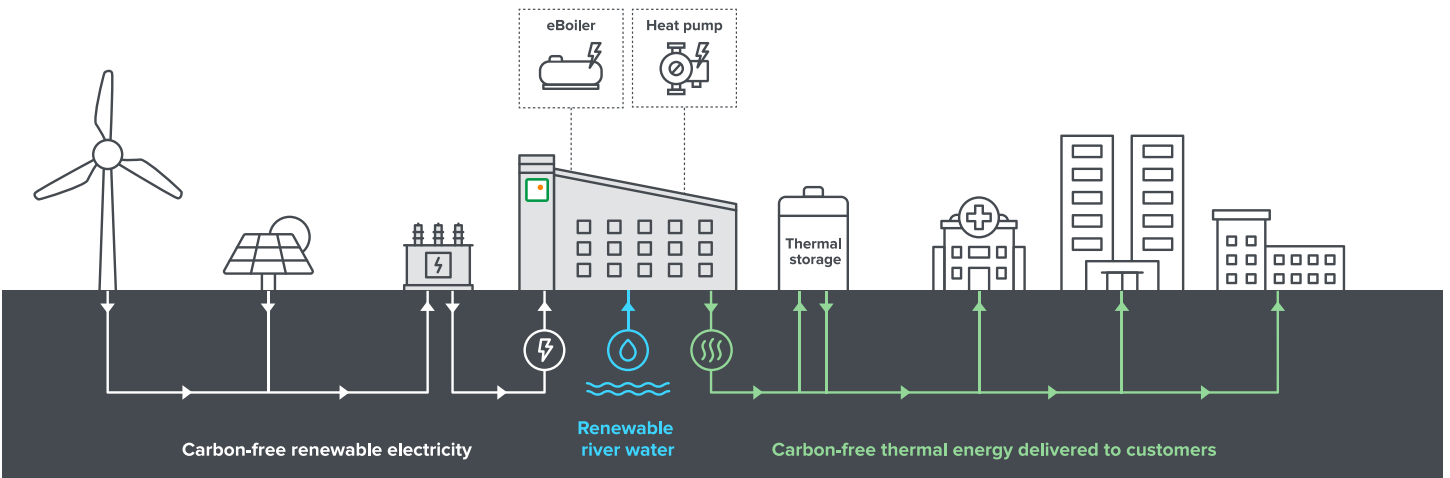
Vicinity’s electrification strategy also embraces extensive thermal storage facilities. Unlike traditional lithium battery storage systems, thermal storage leverages the favorable thermodynamics of molten salt or high-temperature substrate to store vast amounts of thermal energy efficiently. This approach allows Vicinity to “valley hunt” and “peak shave,” procuring green electricity during off-peak hours and storing it for periods of high demand. By strategically timing energy procurement and storage, Vicinity mitigates costs associated with peak demand periods, dramatically lowering customers’ average cost of renewable thermal energy.

Furthermore, connections to high-voltage substations and transmission-level electricity rates reduce local utility distribution constraints, ensuring a reliable and cost-effective supply of renewable thermal energy.

As Vicinity progresses with our three-pronged electrification strategy, marked by installing the first electric boiler in 2024 and installing an industrial-scale heat pump complex in 2028, the company stands as a beacon of innovation in North America’s energy transition.



Mock-up of part of the industrial-scale heat pump complex that is being developed to be installed at Vicinity’s Cambridge facility.



Customers benefit from carbon-free eSteam™ generated with renewable electricity.

Nationwide momentum: navigating the evolving landscape of environmental legislation

In response to the urgent need for environmental action, a collective effort is underway nationwide, involving policymakers, business leaders, and communities. The commitment to address the impacts of climate change is evident in both federal and local initiatives.

On December 8, 2021, President Biden took a significant step by signing the Executive Order on Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability. This [executive order mandates](#) net-zero emissions from federal operations by 2050, with an interim target of a 65% emissions reduction by 2030. The directive includes specific requirements for federal buildings, reflecting a commitment to advancing sustainability and combating climate change.

In tandem with federal standards, various states and cities across the U.S. are taking decisive action by enacting regulations to limit fossil fuel usage and combat climate change. In response, organizations increasingly prioritize sustainability measures and decarbonization strategies at the highest level to comply with the evolving legislative landscape.

The cities we operate in are actively implementing or exploring strategies to reduce emissions. However, the decarbonization journey is unique for each city we serve, presenting distinct challenges and opportunities.

Recognizing the diversity in decarbonization progress, we engage closely with policymakers to align with and influence the scope and pace of emissions reduction laws and local ordinances. Our commitment extends beyond compliance, focusing on actively shaping the legislative landscape in collaboration with local authorities.

By working within the unique context of each system, we aim to contribute meaningfully to the broader mission of achieving sustainable and resilient urban environments. As we navigate this dynamic legislative landscape, our partnerships and advocacy efforts are crucial in fostering a collective commitment to a greener and more sustainable future.

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Tailoring tomorrow: customized decarbonization solutions across Vicinity's footprint

While the district energy systems owned and operated by Vicinity share commonalities across our footprint, the unique characteristics of each city necessitate a customized approach to our decarbonization roadmap. Recognizing the diversity in operational profiles, regulatory environments, available space, access to water, and other considerations, we are committed to tailoring our electrification strategies for each city we serve.

Our decarbonization journey involves a thoughtful blend of technologies, focusing on adapting to each location's specific needs and nuances. The key components of our customized approach include heat pumps, electric boilers, and thermal storage technologies strategically combined to optimize efficiency and sustainability. Leveraging these technologies allows us to address each city's distinct demand for decarbonized thermal energy.

In the following sections, we offer a deeper insight into our tailored decarbonization roadmaps, showcasing our commitment to providing localized solutions that align with the unique characteristics and challenges of the cities we serve. Our dedication to flexibility and adaptability remains paramount, ensuring we meet and exceed each community's expectations for sustainable and resilient urban environments.

Kansas City electrification roadmap

Electrification implementation

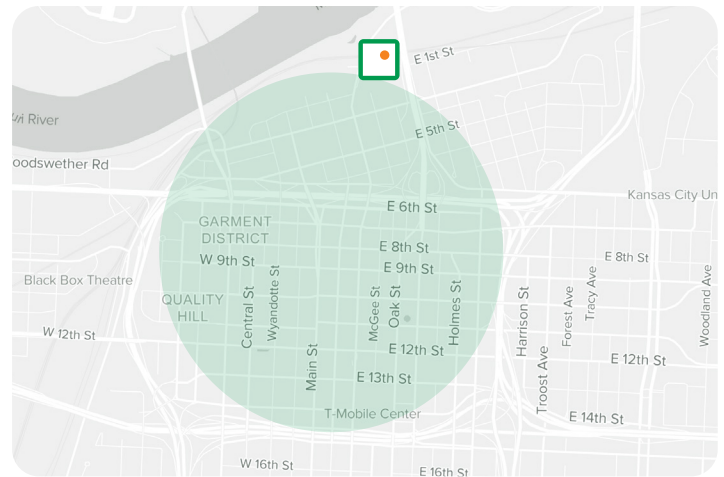
Vicinity's electrification plan for Kansas City is poised to capitalize on existing electric infrastructure and the synergistic co-location of steam and chilled water systems. The strategy involves installing decentralized heat pumps, introducing electric boilers, and optimizing waste resources to achieve a high coefficient of performance.

Additionally, Vicinity is exploring the adoption of the Energy Renewables Direct Green Tariff Offering or other renewable power purchase options. This multifaceted approach aligns with Vicinity's commitment to leveraging innovative technologies and sustainable practices to benefit Kansas City's energy landscape.

Building standards

Kansas City's proactive stance on sustainability is reflected in the 2022 Climate Protection and Resiliency Plan ([CPRP](#)), which outlines a comprehensive roadmap to achieve carbon neutrality by 2040. This visionary plan underscores the city's commitment to addressing climate challenges and building resilience against environmental risks.

As Vicinity embarks on its electrification journey in Kansas City, aligning with the city's CPRP ensures a synergistic effort towards shared sustainability goals. Vicinity contributes to realizing a net-zero carbon and resilient future for Kansas City by adhering to and collaborating with local standards.



Illustrated map of Vicinity's service area in Kansas City. Reach out to our team of experts to explore eSteam™ for your building.

Vicinity's electrification initiatives in Kansas City embrace cutting-edge technologies and align seamlessly with the city's broader vision for environmental stewardship and resilience. Through this strategic approach, Vicinity aims to be an integral partner in Kansas City's sustainable journey, fostering innovation and contributing to a resilient, carbon-neutral future.



To take the next step in decarbonizing your building, contact our energy experts at www.vicinityenergy.us, or **email** info@vicinityenergy.us