Community Heat Pumps: Technical Potential and Assessment of Favorable Opportunities in New York State

Final Report | Report Number 22-19 | August 2022

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NYSERDA provides resources, expertise, and objective information so New Yorkers can make confident, informed energy decisions.

Our Vision:

New York is a global climate leader building a healthier future with thriving communities; homes and businesses powered by clean energy; and economic opportunities accessible to all New Yorkers.

Our Mission:

Advance clean energy innovation and investments to combat climate change, improving the health, resiliency, and prosperity of New Yorkers and delivering benefits equitably to all.

Community Heat Pumps: Technical Potential and Assessment of Favorable Opportunities in New York State

Final Report

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Notice

Abstract

The New York State Energy Research and Development Authority (NYSERDA) is helping to address barriers in the adoption of electric heat pumps, which efficiently heat and cool buildings and reduce carbon emissions better than the current fossil fuel technologies used in many buildings. Compared to single-building heat pump solutions, there are opportunities to reduce costs and improve the speed of building electrification by promoting the installation of heat pumps for groups of buildings in district energy or community-scale configurations.

NYSERDA's Community Heat Pump Program was created to assess the feasibility of—and assist in the development of—community heat pump installations throughout the State. ICF was funded by NYSERDA to evaluate the potential for community heat pumps across New York State and perform a triage process to determine the most favorable project options. This report describes the technical potential for community heat pump opportunities in campuses and downtown building clusters, establishes criteria for favorable outcomes, and provides recommendations for community heat pump development at campuses and downtown redevelopment districts.

There is significant potential to incorporate community heat pumps throughout New York State, with over 400 campuses and 80 downtown clusters identified. Many of these sites have favorable characteristics for community heat pumps based on factors such as building age, current heating fuels, existing energy distribution infrastructure, available space for geothermal boreholes and central plants, electricity prices, and local carbon reduction laws.

Discussions with project developers informed successful strategies for community heat pump development, including (1) implementing flexible planning with hybrid solutions depending on site-specific factors, (2) maximizing geothermal capacity for base load heating and cooling, (3) offering substantial, clear, and consistent incentives, and (4) engaging all campus sectors in forward-thinking energy planning.

Insights from this study are intended to help NYSERDA and project developers target projects that are most likely to succeed, thereby maximizing the number of community heat pump projects, which will help reduce carbon emissions in New York State.

Acknowledgments

ICF and NYSERDA would like to acknowledge Dr. Dana Levy, who provided valuable guidance and direction in the development of this report. We would also like to acknowledge the members of the Advisory Committee who helped guide the triage process to identify the top campus and downtown redevelopment opportunities for community heat pumps. The Advisory Committee consisted of:

Charlie Marino, Partner, *AKF Group*
John Duchesneau, General Manager, *Rochester District Heating Cooperative*
Tony Amis, Senior Vice President, *Endurant Energy*
Mitch Dewein, Project Manager, *CHA Consulting Inc.*
Kurt R. Blemel, Associate Principal, *Wendel*
Dr. Vijay Modi, Professor, *Columbia University*
Steve Grgas, Project Manager, *Ramboll*

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Summary

In support of the New York State Energy Research and Development Authority's Community Heat Pump Program, ICF identified and assessed opportunities for community heat pump installations at campuses and downtown areas throughout the State. Community heat pumps use district energy systems to distribute hot water and chilled water to multiple buildings, where load variance and economies of scale can lead to more efficient operation and favorable economics compared to single-building solutions. ICF found significant potential to install new community heat pumps throughout New York State, with over 400 campuses and 80 downtown clusters identified.

Campuses such as colleges, hospitals, or multifamily housing often present the most favorable opportunities for community heat pumps. Campus buildings have common owners and decision-makers, and often include green spaces and parking lots that could be used for geothermal applications. For this analysis, ICF focused on campuses with estimated annual heating requirements of 25,000 MMBtu or higher. Identified community heat pump opportunities for New York City campuses are summarized in Table S-1.

Table S-1. Summary of Campus Community Heat Pump Opportunities in New York City

Campus Opportunities in NYC - By Application				
Application	**Number of Campus Opportunities**	**Space & Water Heating Requirements (MMBtu)**	**Space Cooling Requirements (MMBtu)**	**Building Emission Reduction (tons of CO2)**
Airports	2	1,395,416	439,316	95,955
Colleges & Universities	47	12,626,361	1,426,000	868,248
Correctional Facilities	2	65,489	68,726	4,503
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Multifamily Housing	75	22,701,198	292,821	1,561,041
Office	3	1,661,184	52,857	114,231
Totals	**176**	**45,643,724**	**5,321,154**	**3,138,677**

Campus opportunities for community heat pumps outside of New York City are summarized in Table S-2.

Table S-2. Campus Community Heat Pump Opportunities in New York State Outside of NYC

Campus Opportunities in Rest of State - By Application				
Application	**Number of Campus Opportunities**	**Space & Water Heating Requirements (MMBtu)**	**Space Cooling Requirements (MMBtu)**	**Building Emission Reduction (tons of CO2)**
Colleges & Universities	86	7,710,050	867,942	530,179
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Totals	**241**	**19,187,817**	**5,188,773**	**1,319,445**

Many of the identified campus sites have favorable conditions for community heat pumps based on the age of the buildings, current heating fuels, existing energy distribution infrastructure, available space for geothermal boreholes and central plants, electricity prices, and local carbon reduction laws. A triage process for each campus opportunity was used to develop a weighted scoring algorithm and determine the most favorable locations for campus community heat pump projects in New York.

The triage process included the following attributes:

- Building/Campus Characteristics
  - Size of combined building heating load – *for displacing fossil fuel-based heating*
  - Age of buildings – *older buildings are more likely to undergo redevelopment*
  - Operational hours of buildings – *buildings that operate year-round, 24/7 are preferred*
  - Building heating and cooling loads (annual and daily load factors)
  - Buildable space – *parking lots and green areas that could be utilized*
- Incumbent Heating and Cooling System
  - Primary heating technology – *prefer hot water boilers*
  - Distribution system for space heating – *prefer hot water distribution*
  - Presence of district energy system – *prefer existing district energy infrastructure*
  - Fuels used for heating, age of heating equipment – *prefer old equipment using fossil fuels*
- Locational Attributes
  - Climate – *moderate climate zones more favorable*
  - Local electricity prices – *lower electricity prices more favorable*
  - GHG emission reduction impact – *prefer locating in regions with low grid emissions*
  - Impact of Local Law 97 – *NYC buildings using fossil fuels may be affected*

Each attribute included associated metrics and weighted scoring, leading to a total weighted opportunity score for each campus. The top campus opportunities for New York City are shown in Table S-3.

Table S-3: Top 20 Campus Opportunities for Community Heat Pump Systems in New York City

Facility Name	City	Borough / County	Application	Total Weighted Score
CUNY College of Staten Island	New York	Staten Island	Colleges & Universities	88
Spring Creek Towers (WEGO & HCR)	New York	Brooklyn	Multifamily Housing	88
John F Kennedy International	New York	Queens	Airports	87
Parkchester North Campus	New York	Bronx	Multifamily Housing	85
Bronx Psychiatric Center	New York	Bronx	Hospitals	84
Co Op City	New York	Bronx	Multifamily Housing	84
Brightwater Towers Condominium	New York	Brooklyn	Multifamily Housing	83
CUNY Bronx Community College	New York	Bronx	Colleges & Universities	82
169-65 137th Avenue - Rochdale Village	New York	Queens	Multifamily Housing	82
Concourse Village	New York	Bronx	Multifamily Housing	81
Sunnyside Garden Apartments	New York	Queens	Multifamily Housing	81
Manhattan Psychiatric Center-Ward's Island	New York	Manhattan	Hospitals	80
Savoy Park Apartments	New York	Manhattan	Multifamily Housing	80
Parkway Village Coop- 36930	New York	Queens	Multifamily Housing	80
Third Housing Company Inc.	New York	Queens	Multifamily Housing	80
The Dorset - Kaled	New York	Queens	Multifamily Housing	80
Amalgamated Warbasse Houses-Block 7250	New York	Brooklyn	Multifamily Housing	79
Lafayette Boynton Apartments	New York	Bronx	Multifamily Housing	79
CUNY Brooklyn College	New York	Brooklyn	Colleges & Universities	79
New York University	New York	Manhattan	Colleges & Universities	79

The top 20 opportunities for campus community heat pump systems in New York City include multifamily housing (13 opportunities), colleges and universities (four opportunities), hospitals (two opportunities) and one airport. The top community heat pump opportunities for New York campuses outside of New York City are shown in Table S-4.

Table S-4: Top 20 Campus Opportunities for Community Heat Pump Systems Outside of New York City

Facility Name	City	Borough / County	Application	Total Weighted Score
Binghamton University	Vestal	Broome	Colleges & Universities	99
Syracuse University	Syracuse	Onondaga	Colleges & Universities	90
SUNY at Albany - Uptown Campus	Albany	Albany	Colleges & Universities	90
SUNY Oneonta	Oneonta	Otsego	Colleges & Universities	90
Westchester Medical Center	Valhalla	Westchester	Hospitals	89
Rochester Institute of Technology	Rochester	Monroe	Colleges & Universities	88
Buffalo Psychiatric Center	Buffalo	Erie	Hospitals	86
University at Buffalo - North Campus	Buffalo	Erie	Colleges & Universities	83
Monroe Community College	Rochester	Monroe	Colleges & Universities	82
Olean General Hospital	Olean	Cattaraugus	Hospitals	80
Adelphi University	Garden City	Nassau	Colleges & Universities	80
Rochester Psychiatric Center	Rochester	Monroe	Hospitals	80
Sisters of Charity Hospital of Buffalo	Buffalo	Erie	Hospitals	79
St. Catherine of Siena Medical Center	Smithtown	Suffolk	Hospitals	79
Stony Brook University - Southampton	Southampton	Suffolk	Colleges & Universities	79
Faxton St. Luke's Healthcare	Utica	Oneida	Hospitals	78
Good Samaritan Hospital	Suffern	Rockland	Hospitals	78
Veterans Affairs Hudson Valley Health Care System	Montrose	Westchester	Hospitals	78
Samaritan Hospital	Troy	Rensselaer	Hospitals	78
Four Winds Hospital	Katonah	Westchester	Hospitals	78

The top 20 campus community heat pump opportunities outside of New York City are found exclusively at hospitals (11 opportunities) and colleges and universities (nine opportunities).

In addition to campuses, ICF evaluated opportunities for community heat pumps in downtown areas of cities across New York state. First, we identified clusters of buildings with significant thermal energy requirements in all major cities. ICF started with dense downtown cores and expanded the clusters iteratively to include all large buildings (>1,000 MMBtu in annual heating requirements) within 0.25 miles of each identified building. In total, 80 unique clusters were identified in New York State, including over 5,300 large buildings. Fifty-one of these clusters and over 4,800 of the identified buildings were located in New York City.

Successful strategies for community heat pump development in downtown areas include taking advantage of existing or upcoming community redevelopment projects, where construction is already occurring across multiple buildings. ICF evaluated the potential for several redevelopment projects that are expected to begin within the next five years as starting points for community heat pump installations. Table S-5 provides details on the top twelve redevelopment opportunities for downtown community heat pumps.

Table S-5. Summary of Downtown Redevelopment Opportunities

City	Renovation or Construction Projects	Source of Funding	Potential to Connect Existing Buildings (>1,000 MMBtu/yr)		
			Number of Buildings	Building Types	Annual Heating (MMBtu)
Rochester	Rochester Riverside Convention Center Vacant Buildings on Division and E. Main St Riverside Hotel Cox and Edawards Buildings	DRI Round 5	7	Commercial Office Buildings (5), Hotel, Multifamily Building	46,000
Yonkers	Teutonia Mixed-Use Towers Chicken Island Buildings North Broadway Towers	Private Projects	10	Multifamily Buildings (6), Commercial Office Buildings (3), Government Office Building	43,000
Hempstead	Village of Hempstead Brownfield Opportunity Area Innovation District	Brownfield Opportunity Area	16	Multifamily Buildings (7), Commercial Office Buildings (4), Government Office Buildings (3), Hotel, Nursing Home	60,000
Schenectady	New Housing and Public Parking New Mixed-Use Space, State and Clinton Streets	DRI Round 4	13	Government Office Buildings (5), Commercial Office Buildings (5), Multifamily Buildings (2), Correctional Facility	50,000
White Plains	New Mixed-Use Space (2) Senior Living Facility	Private Projects	12	Commercial Office Buildings (8), Government Office Buildings (2), Multifamily Building, Hotel	94,000
Staten Island	Development of an Innovation Lab Seamen's Society Headquarters	DRI Round 4	10	Multifamily Buildings (4), Government Office Buildings (4), Commercial Office Buildings (2)	41,000
Utica	New Mixed-Use Space (2)	DRI Round 4	5	Commercial Office Buildings (3), Government Office Building, Hotel	36,000
Syracuse	New Mixed-Use Space	DRI Round 5	5	Commercial Office Buildings (3), Government Office Building, Hotel	58,000
Troy (Cluster 1)	Development of Music Center New Innovation Lab Community Resource Center New Mixed-Use Space (2)	DRI Round 5	1	Government Office Building	2,000
Troy (Cluster 2)	New Fitness Center New Grocery Store New Senior Housing Facility New Urban Grow Center	DRI Round 5	1	Commercial Office Building	4,000
Buffalo	New Apartment Building New Mixed-Use Space (2)	Private Projects	3	Government Office Buildings (2), Commercial Office Building	8,000
Manhattan (Chinatown)	New Affordable and Senior Housing Performing Arts Center New Senior Housing Facility	DRI Round 5	2	Multifamily Building, Government Office Building	3,000

Additional success strategies for community heat pumps were identified through project developer discussions, including (1) implementing flexible planning with hybrid solutions depending on site-specific factors, (2) maximizing geothermal capacity for base load heating and cooling, (3) offering substantial, clear, and consistent incentives, and (4) engaging all campus sectors in forward-thinking energy planning.

In summary, thousands of campuses and downtown buildings in New York State have the potential to benefit from community heat pump installations. The success of the identified opportunities will depend on the current heating and cooling infrastructure, available geothermal resources, flexible design strategies, concurrent community redevelopment projects, and state-, local-, and utility-level support for feasibility studies and project development.

1 Introduction

New York State's nation-leading climate goals include zero carbon electricity by 2040 and a net-zero carbon economy by 2050.[1] New York City (NYC) has developed specific plans and pathways to reduce the City's carbon emissions by 80 percent from 2005 levels across all sectors by 2050.[2] Achieving these goals will require millions of buildings to transition away from the fossil fuels that currently supply their thermal energy, and move toward clean heating equipment powered by zero-carbon electricity.

The thermal needs of buildings, such as heating of occupied spaces and production of domestic hot water, can be challenging to decarbonize due to the required retrofitting of existing building infrastructure. Decarbonizing these thermal loads will be critical for New York State to meet its mid-century decarbonization targets. Energy-efficient heat pump technologies, powered by zero-carbon electricity (either generated on site, or purchased from the power grid), are a viable decarbonization strategy for the buildings sector.

Heat pumps are frequently installed to serve the needs of a single building. To leverage economies-of-scale and expand clean energy options for customers with insufficient footprint space to serve their own needs, heat pumps can be integrated with a network of distribution pipes to serve multiple buildings in a district-style configuration. District energy systems can address the needs of new construction projects as well as retrofits of existing buildings in campuses or downtown areas. District energy systems that incorporate electric heat pumps—whether geothermal,[3] air-source, or a hybrid combination—are referred to as community heat pump systems.

A community heat pump system uses a network of pipes to share thermal energy among a cluster of buildings using hot water, chilled water, or ambient temperature water conditioned by electric heat pumps. The cluster of buildings uses the shared water loops to deliver comfort space heating, space cooling, and domestic hot water for occupied spaces.

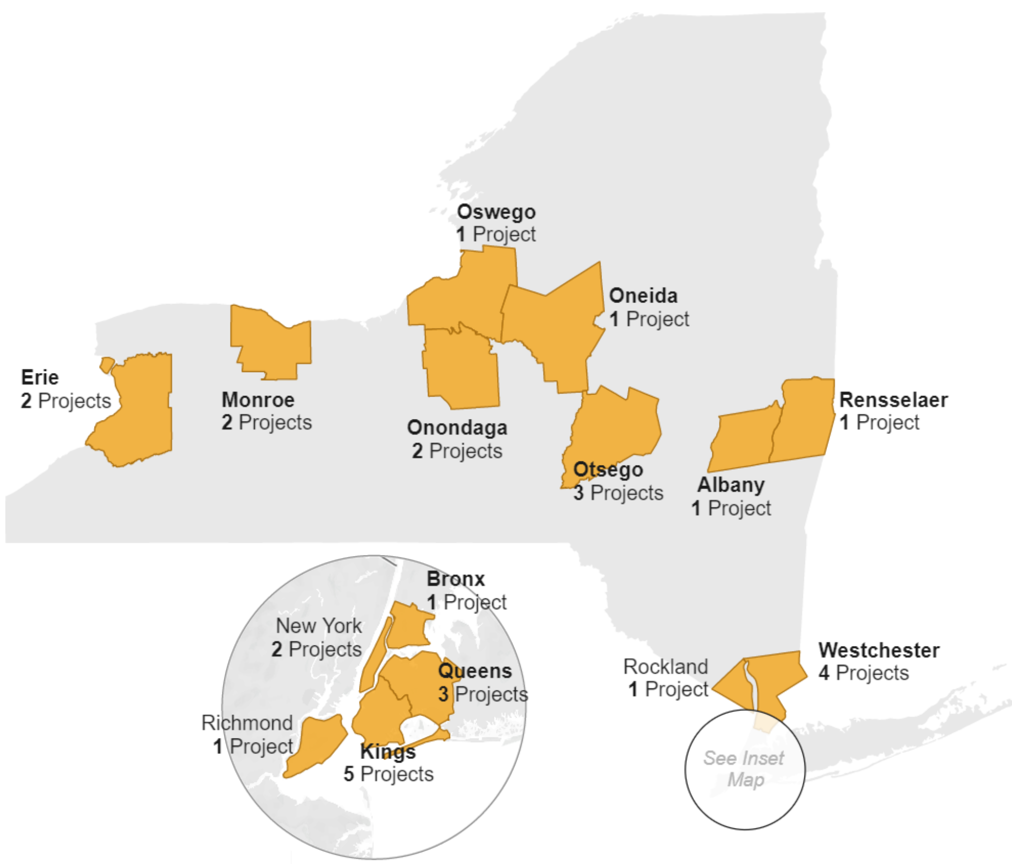
Historically, most district energy systems in the United States have used fossil fuel boilers to generate steam for heating and electric chillers to produce chilled water for cooling. In order to convert to hot water from heat pumps, buildings with steam systems require significant retrofitting. Additionally, in most New York State locations, natural gas has consistently been less expensive than electricity on an energy basis. These factors have contributed to impede the deployment of electric heat pumps for district energy projects.

NYSERDA issued a competitive solicitation—Program Opportunity Notice (PON) 4614—in 2021 to support development and demonstration of low-carbon community heat pump installations.[4] Five solicitation rounds were completed by 2022, resulting in the following 43 project awards.

- 34 Category A projects (scoping study)
- 6 Category B projects (detailed design)
- 3 Category C project (construction)

The goal is to move potential projects from Category A to C, with incentives provided for construction (Category C) if awardees demonstrate feasible and effective community heat pump solutions in the scoping study and design phases, (Categories A and B, respectively). Projects have been awarded throughout New York State, as shown in Figure 1.[5] PON 4614 also contains a Category D for market potential studies and best practice guidebooks.

Figure 1. Locations of NYSERDA PON 4614 Awardees (Rounds 1–3)



ICF was funded to evaluate the potential for community heat pumps across New York State and perform a triage process to determine the most favorable project opportunities. ICF consulted with the State heat pump developers and industry experts for input on favorable characteristics for community heat pump applications and developed a ranking system to score and categorize potential opportunities. The results of this study will enable NYSERDA and heat pump solution providers to focus their efforts on projects that present the best value proposition for the successful implementation of community heat pumps throughout the State.

This report contains a summary of the technical potential for campus and downtown community heat pump systems, followed by a triage process to establish the most favorable campus/building characteristics and identify the top project opportunities. The report is structured as follows:

1. Introduction
2. Community heat pumps as a decarbonization solution.
3. Community heat pump potential at large New York State campuses.
4. Community heat pump potential for downtown building clusters.
5. Triage of campus community heat pump opportunities.
6. Triage of community heat pump opportunities for downtown redevelopment.
7. Conclusions and takeaways for community heat pumps in New York State.

2 Community Heat Pumps as a Decarbonization Solution

State and local governments in New York have recently passed laws to accelerate the decarbonization of all forms of energy and reduce greenhouse gas (GHG) emissions. In the buildings sector, the most common approach involves electrifying energy end-uses, including water heating, space heating, and space cooling, while converting the grid to net-zero carbon emissions with renewable energy resources.

In June 2019, New York State passed the Climate Leadership and Community Protection Act (CLPCA), one of the most ambitious climate laws in the United States. The CLPCA requires that the State reach 100 percent carbon free-electricity by 2040 and economy-wide net-zero carbon emissions by 2050.[6] In order to reach the targets outlined in the CLPCA, the State will have to reduce GHG emissions from its buildings sector, which is its largest source, producing roughly 32 percent of the State's GHG emissions in 2019.[7] Emissions from the buildings sector are even more pronounced in New York City, representing roughly 71 percent of citywide GHG emissions.[8]

New York City recently passed Local Law 97 (LL 97), which aims to reduce building GHG emissions by 40 percent by 2030 and 80 percent by 2050. Starting in 2024, buildings in New York City will be required to meet escalating energy efficiency and greenhouse gas emission limits depending on their "building occupancy group." LL 97 covers all buildings that exceed 25,000 square feet (sq. ft.) with exceptions for private hospitals, city-owned buildings, and city-owned housing. Buildings that do not comply with LL 97 GHG limits will be fined $268 for every excess metric ton of GHG emissions they produce.[9]

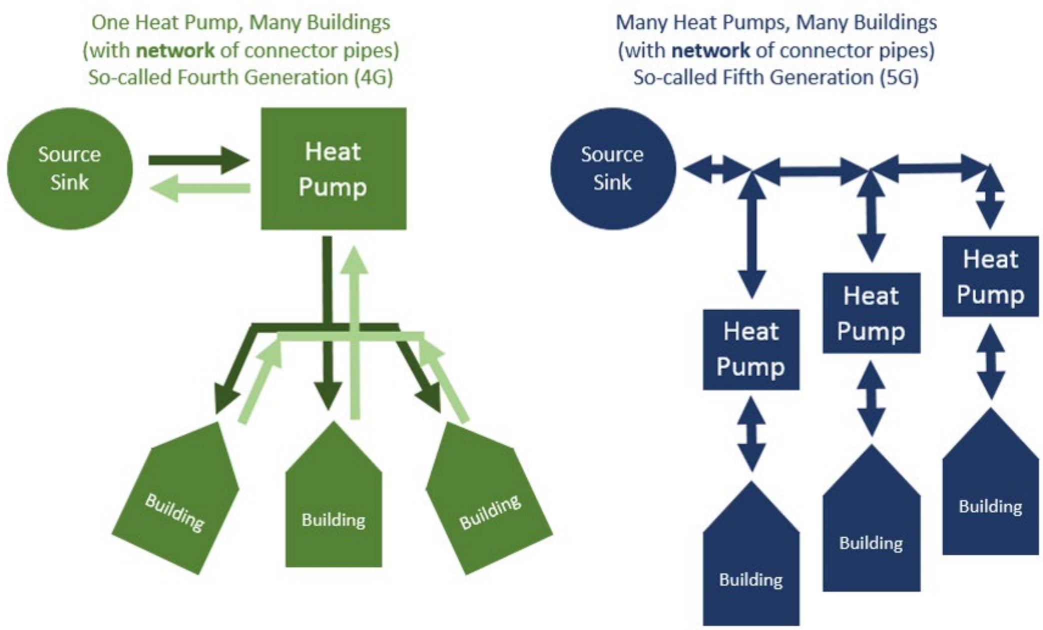
One of the most promising strategies for decarbonizing the State's building stock is to deploy electric heat pumps that are powered by zero-carbon electricity sources. Heat pumps use electricity to move heat outside during warmer months and move heat inside during cooler months. The most prevalent type of heat pump is the air-source heat pump, which transfers heat between the inside of a building and the air outside. Another type of heat pump is the geothermal heat pump, which uses a network of pipes to move heat to and from the ground, taking advantage of the relatively constant temperature of the earth. Throughout this study, geothermal heat pumps refer to all underground heat pumps including ground-source (soil), water-source (ground water), and deep geothermal wells.

Community heat pumps are typically designed in one of two primary configurations:

- **4G**—Central heat pump with hot or chilled water distribution and no interchange between buildings.
- **5G**—Decentralized heat pumps with ambient temperature water distribution and interchange of heating/cooling between buildings.

5G (fifth generation) community heat pumps can enable flexible designs with multiple heat pumps and heat sinks/sources, and they can enable higher operational efficiencies compared to 4G (fourth generation) systems. The difference between 4G and 5G configurations are shown in a simplified schematic in Figure 2.

Figure 2. 4G versus 5G Heat Pump Configurations



Applicable technology options for community heat pumps are location and building specific, depending on available space, thermal resources, existing infrastructure, and other factors. Multiple heat pump technologies can often be deployed for a single community heat pump project. In some cases waste heat resources such as wastewater treatment plants and subway stations can be tapped for additional heat energy. The optimal heat pump technology configuration for a campus or group of buildings can only be determined through site-specific feasibility and engineering studies.

The GHG emission benefits of heat pumps are two-fold. First, heat pumps are an energy efficient way to meet the thermal requirements of a facility. Compared to traditional water heaters and furnaces, electric heat pumps use three to four times less energy to operate.[10] Second, as the grid incorporates greater levels of zero-carbon electricity sources, the emission reductions benefits of electric heat pumps will improve compared to fossil fuel alternatives.

While electric heat pumps can be deployed at the building level, there are several advantages to developing large-scale heat pumps that can distribute hot water, chilled water, or ambient temperature water to multiple buildings in a campus or downtown setting. Advantages of a district-style heat pump approach compared to an individual building heat pump approach include:

- Higher energy efficiency and lower costs: large-scale heat pumps can have higher efficiencies and lower per-unit capital and maintenance costs.
- Improved operation from diverse building loads: connecting multiple buildings with varying schedules can smooth out spikes in heating/cooling demand and increase resource utilization.
- Better use of building space: heat pumps can be constructed separately from the connected buildings, allowing floor space and rooftop space to be used for other purposes.

Community heat pumps are most effective when they can connect multiple buildings with diverse heating and cooling loads while leveraging existing building heating or cooling infrastructure. Large campuses, such as colleges/universities, multifamily housing complexes, hospitals, or military facilities tend to have relatively high-heating and cooling requirements and sufficient land area to drill wells for ground loops. Community heat pumps can also be applied in downtown areas, especially in conjunction with planned multi-building redevelopment projects, where construction and permitting requirements can potentially be reduced by spreading these costs over the entire project.

The NYSERDA Community Heat Pump Program was developed to facilitate the deployment of district energy heat pump systems. It is important to quantify the potential market for community heat pumps and target opportunities with the best value propositions. Successful community heat pump installations at targeted campuses and downtown areas will help to reduce barriers and costs for future community heat pump systems.

ICF performed two separate assessments to quantify and characterize the technical potential for large-scale community heat pumps in the State based on building locations and estimated heating and cooling loads: (1) single-owner campus opportunities and (2) multi-building, multi-owner downtown opportunities. These assessments are summarized in Section 3 and Section 4 of this report.

3 Community Heat Pump Potential at New York State Campuses

Campuses of buildings such as colleges, hospitals, or multifamily residential complexes are some of the most ideal candidates for community heat pumps. These campuses often consist of large buildings in proximity with diverse heating and cooling requirements. Ownership models include private companies, public institutions, and public-private partnerships. In all cases, single ownership of campus buildings offers advantages compared to multi-owner downtown community heat pump opportunities where permitting, rights-of-way, and owner agreement present additional challenges.

ICF maintains a Technical Potential Database for buildings across the United States that can support combined heat and power (CHP) and other distributed energy projects.[11] The database includes estimates of electricity and thermal energy requirements for buildings and campuses in the commercial and institutional sectors. ICF used this information, along with New York City benchmarking data on energy use for office and multifamily buildings, to develop potential estimates for campus district energy systems in the April 2021 Pathways to Carbon-Neutral NYC study.[12] The Pathways study evaluated how technologies like CHP and geothermal heat pumps could be applied in district systems at large NYC campuses to reduce carbon emissions and help the City reach its 2050 clean energy targets.

For this NYSERDA project, ICF assessed the opportunity for heat pump-based district energy systems to be applied at campuses throughout the entire State. ICF's Technical Potential Database was used to identify a preliminary list of State commercial and institutional campuses. Compared to the NYC Pathways study, the size threshold for campus heating loads was reduced from 50,000 million British thermal units (MMBtus) to 25,000 MMBtus of annual heating in order to capture more opportunities across the State. Smaller campuses may present opportunities for community heat pumps, but the goal of this effort was to capture campuses that present the best value proposition for community heat pump integration with potential for large decarbonization impacts.

For each identified campus, ICF estimated the potential for carbon emission savings by assuming heat pumps are replacing heat supplied with natural gas combustion with an 85% conversion efficiency. Replacing onsite fossil fuel heating is the primary source of emission savings for heat pump installations.

Electric chillers are typically used for space cooling in commercial and institutional buildings, with similar cooling efficiencies compared to heat pumps, and using the same grid electricity resources. When the grid converts to renewable or zero-carbon electricity, the only source of emission savings from community heat pumps will be replacing onsite fossil fuel combustion used for heating.

ICF identified 176 campus opportunities in New York City and 241 campus opportunities in the rest of the State. All 417 identified campuses have estimated annual heating requirements of 25,000 MMBtu or higher. Many of these campuses currently make use of district energy systems, which could provide an advantage in converting to community heat pumps.

Campus opportunities are summarized in Tables 1 and 2 for New York City and the rest of the State.

Table 1. Summary of Campus Community Heat Pump Opportunities in New York City

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Office	12	427,052	186,589	29,366
Totals	**241**	**19,187,817**	**5,188,773**	**1,319,445**

The majority of campuses shown in Tables 1 and 2 use onsite heating systems fueled by natural gas or fuel oil. The technical potential estimates show that nearly 46 million MMBtus of heating in New York City and 19 million MMBtus in the rest of the State could potentially be converted from onsite fossil fuel heating to electric heat pumps at the community scale. In total, when using renewable or zero-carbon electricity, an estimated 4.5 million tons of annual carbon emissions could be reduced assuming that electric heat pumps are displacing onsite natural gas heating systems.[13]

Approximately 10 million MMBtu of space cooling requirements could also be converted to community heat pumps throughout the whole State. The relatively low estimates for cooling compared to heating requirements could potentially limit the size and/or efficiency of heat pumps as they are applied to the identified campus applications.

Figures 3 and 4 show where campus community heat pump opportunities are located in New York City and in the State as a whole.

Figure 3. Map of Technical Potential for Community Heat Pumps in New York City by Application Type

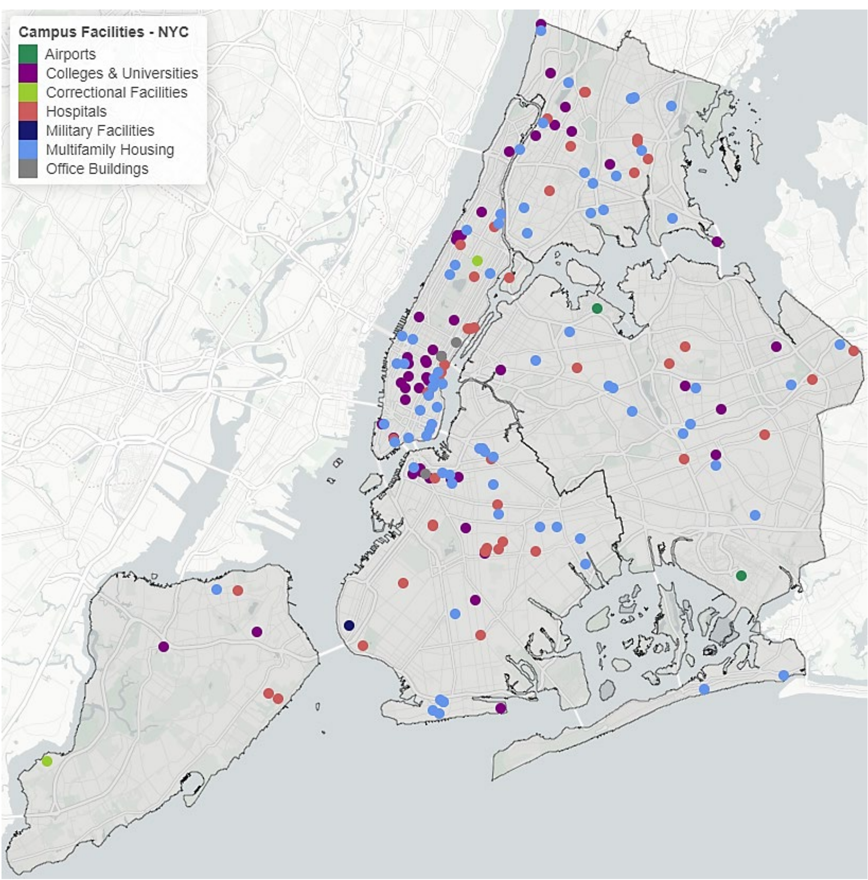
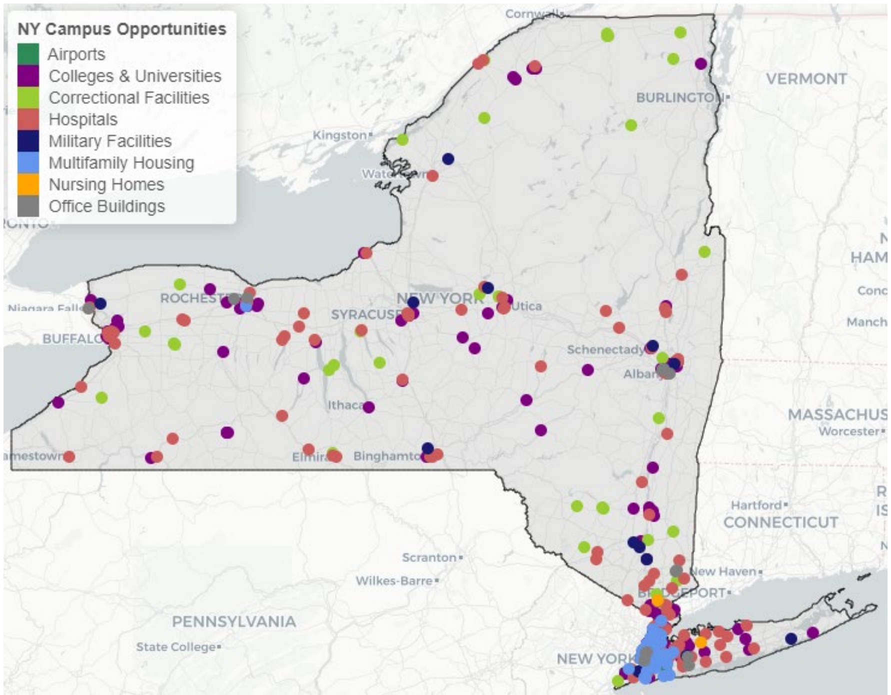


Figure 4. Map of Technical Potential for Community Heat Pumps in New York State by Application Type



Section 5 of this report discusses factors that influence the applicability and viability of community heat pump systems for these campuses, including a ranked scoring system to identify the top campus opportunities in the State.

4 Community Heat Pump Potential for Downtown Buildings

Downtown community heat pumps, connecting densely clustered buildings across city blocks, require multiple building owners to work together, and there are increased permitting requirements, construction limitations, and rights-of-way considerations for underground piping compared to single-owner campuses. However, downtown buildings have significant and diverse heating and cooling requirements that can be efficiently served by district systems. Several downtown district energy systems are currently operational in the State, including Rochester, Syracuse, the Brooklyn Navy Yard, and Con Edison's steam system that serves buildings in Manhattan's Downtown and Midtown neighborhoods.

ICF used its Technical Potential Database to identify clusters of buildings in downtown areas that could potentially be connected with community heat pump systems. First, buildings in New York cities, townships, or villages with annual heating requirements of at least 1,000 MMBtu were mapped out across the state. From this data set, ICF removed any buildings previously identified as multibuilding campus community heat pump opportunities (see Section 3). Next, ICF applied a clustering algorithm for the mapped buildings to identify downtown cores containing multiple buildings with substantial heating loads located within a quarter mile of each other. The algorithm was defined as follows:

1. Designate the densest collection of large (>1,000 MMBtu/year) buildings in the city as the initial downtown core.
2. Identify additional downtown opportunities within 0.25 miles from any of initial downtown core opportunities.
3. Iteratively expand the downtown core by including opportunities in 0.25-mile distance increments until no additional opportunities are in the required proximity.

Thermal (space heating and hot water) requirements as well as space cooling requirements were estimated for the identified clusters of buildings using ICF's Technical Potential Database. Potential carbon emission savings were calculated assuming that zero-carbon electricity is replacing onsite heating systems fueled by natural gas, with 85% conversion efficiencies.

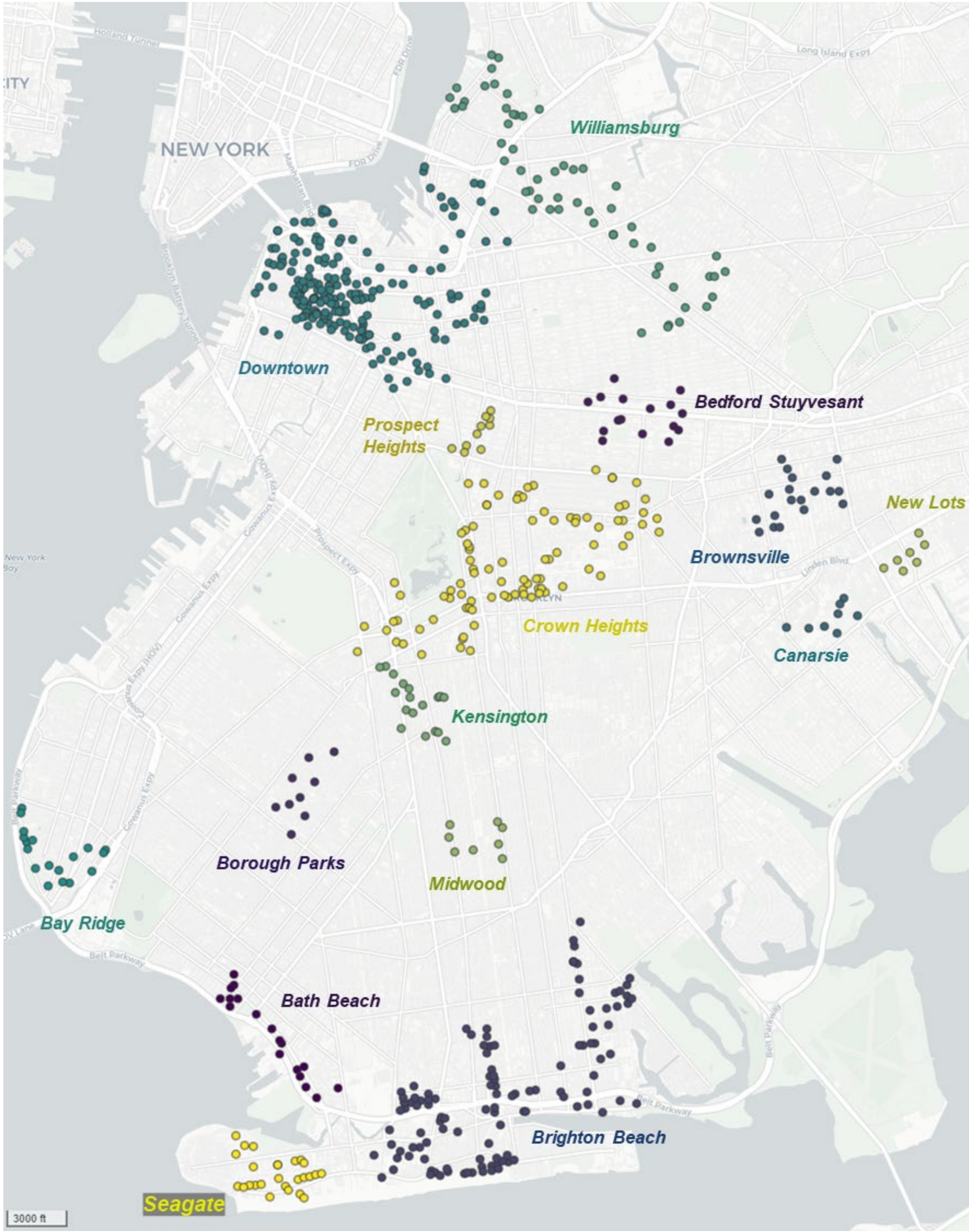
The process was first completed for New York City. Due to the high density of NYC buildings and large number of potential clustering opportunities, only clusters of four or more buildings were considered. The results are shown in Table 3.

Table 3. Technical Potential for Downtown Community Heat Pumps in New York City by Borough

Borough	Clustered Buildings	Number of Clusters	Thermal Requirement (Annual MMBtu)	Space Cooling Requirement (Annual MMBtu)	Building Emission Reductions (tons of CO_2)
Manhattan	2,867	3	26,878,159	9,844,691	1,848,309
Queens	814	18	3,337,128	798,889	229,506
Brooklyn	627	15	3,225,446	863,793	221,811
Bronx	528	11	2,366,551	459,718	162,745
Staten Island	39	4	144,300	43,152	9,923
Total	**4,875**	**51**	**35,951,584**	**12,010,243**	**2,472,294**

The map in Figure 5 shows the fifteen identified clusters for the borough of Brooklyn.

Figure 5. Clusters of Large Buildings Identified in Brooklyn



Similar opportunities for neighborhoods of connectable buildings were found in the Bronx and Queens. The island of Manhattan showed potential for nearly all large buildings to be connected to each other, while fewer opportunities were found in Staten Island. Multifamily buildings were the most common application for clustered New York City buildings.

While New York City showed strong potential for clustered buildings to be connected, projects involving multiple owners across dense, heavily trafficked, city blocks with zoning and permitting requirements could prove difficult, and places limits on the achievable potential.

Outside of New York City, several additional opportunities for downtown clusters were identified in cities, townships, or villages with populations above 25,000. Results are summarized in Table 4.

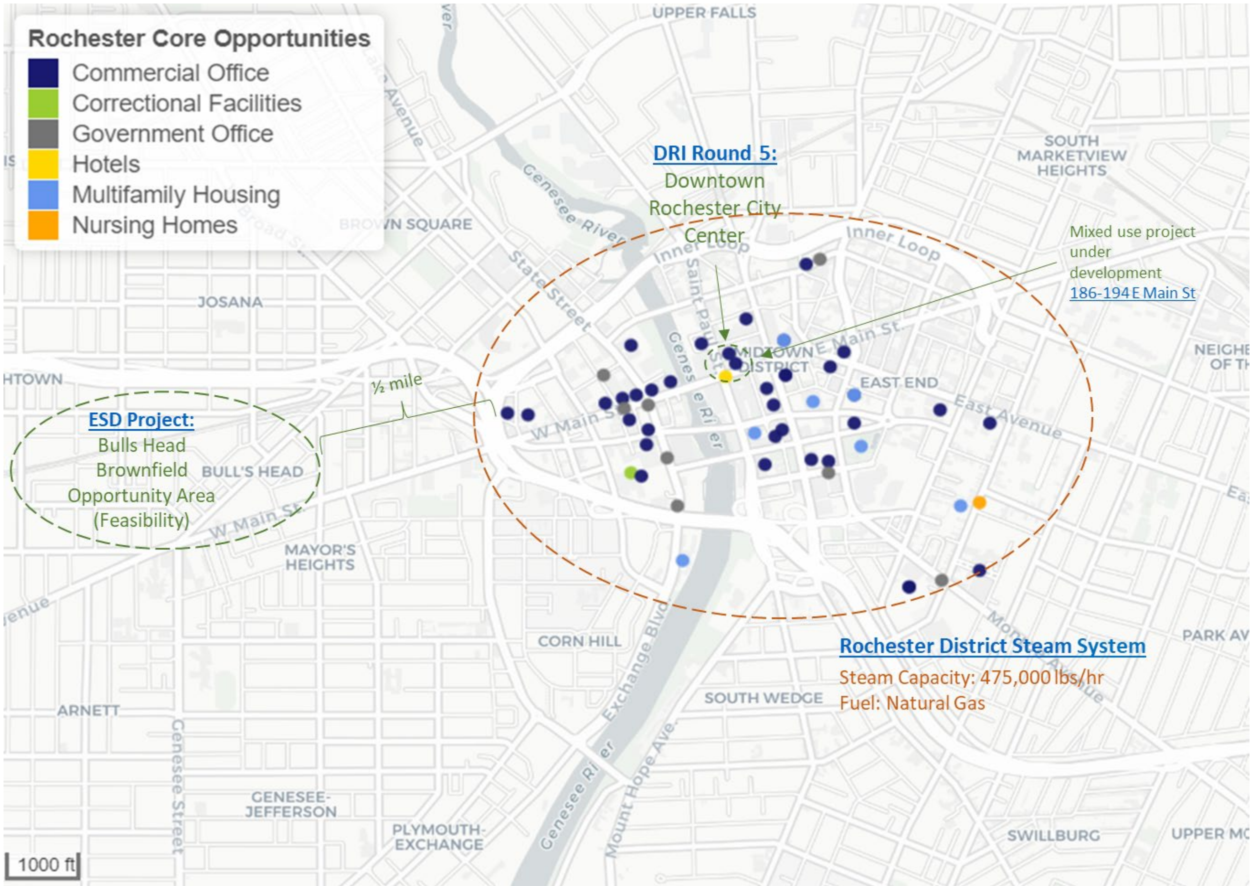
Table 4. Technical Potential for Community Heat Pumps in Downtown Clusters Outside of NYC

Geographic Area	Population	Clustered Buildings	Thermal Requirement (Annual MMBtu)	Space Cooling Requirement (Annual MMBtu)	Building Emission Reductions (tons of CO_2)
Buffalo	255,284	95	658,858	282,450	45,218
Rochester	205,695	54	386,292	166,374	26,565
Yonkers	200,370	18	103,870	32,453	7,143
Syracuse	142,327	49	313,645	134,322	21,569
Albany	96,460	74	683,774	297,931	47,023
New Rochelle	78,557	2	14,898	2,151	1,025
Mount Vernon	67,345	4	34,981	15,265	2,406
Schenectady	65,273	13	50,755	22,363	3,491
Utica	59,750	9	53,492	23,034	3,677
White Plains	58,109	34	240,938	96,658	16,571
Hempstead	55,113	16	60,818	18,845	4,184
Troy	49,154	10	30,458	11,627	2,096
Niagara Falls	47,720	3	15,125	6,519	1,040
Binghamton	44,399	16	82,553	35,213	5,679
Freeport	42,956	2	4,505	1,279	310
Valley Stream	37,431	2	8,808	1,272	606
Long Beach	33,454	4	13,188	3,852	907
Spring Valley	32,261	2	5,807	1,907	400
Rome	32,148	3	6,494	937	446
Ithaca	30,837	2	6,154	2,559	423
Poughkeepsie	30,515	6	26,430	10,968	1,819
Port Chester	29,163	3	9,297	3,107	639
Jamestown	29,058	4	15,349	6,707	1,056
Saratoga Springs	28,212	3	188,698	22,146	12,975
Newburgh	28,177	5	45,867	20,008	3,154
Glen Cove	27,166	5	16,738	4,775	1,152
Elmira	27,054	2	7,852	4,128	540
Lindenhurst	26,801	3	9,550	4,172	656
Auburn	26,173	5	14,688	5,572	1,011
Total	**1,886,962**	**448**	**3,109,882**	**1,238,594**	**213,781**

The largest technical potential outside of NYC is found in the highly populated cities of Buffalo, Rochester, Syracuse, and Albany. White Plains and Yonkers near NYC also showed strong potential. Some cities with relatively large populations, such as New Rochelle, showed limited opportunities for downtown clustering. Generally, opportunities started to diminish as populations fell below 40,000, and clusters were not identified for any geographic areas with a population below 25,000.

While clusters of large downtown buildings could be connected with community heat pumps throughout the State, projects are more likely to move forward when they are part of a larger redevelopment effort, and when existing infrastructure can be repurposed. Figure 6 shows the downtown cluster for Rochester, including notes for planned redevelopment projects (Downtown Revitalization Initiatives, brownfield opportunity areas, and other projects). A rough boundary of the current district energy system supplying district steam to Rochester customers is also shown.

Figure 6. Rochester Downtown Community Heat Pump Potential



Maps of selected downtown areas with clustered buildings, existing district energy, and notable redevelopment projects have been provided in separate deliverable files. Opportunities to incorporate downtown community heat pumps with planned redevelopment activities are explored in Section 6 of this report.

5 Triage of Campus Community Heat Pump Opportunities

ICF identified over 400 New York State campuses with technical potential to install community heat pumps in Section 3. Some of these campuses may present more favorable opportunities than others, considering factors such as load diversity, energy rates, local policies, and potential emission reductions. Identifying the most favorable campus opportunities for community heat pumps will allow NYSERDA and project developers to focus their efforts on projects that are most likely to succeed. Additionally, successful implementation of early community heat pump projects will help push associated technologies and services down the cost curve, improving economics for future projects.

For the triage process, ICF held calls with eight developers planning community heat pump projects across the State to get a sense of which attributes should be considered when evaluating potential campus candidates. ICF also assembled an Advisory Committee of heat pump developers to provide feedback on the triage process ICF had developed. The Advisory Committee provided insight on challenges facing the development of community heat pumps, as well as reviewed and confirmed key attributes for successful heat pump projects along with relative scores and weights for a triage process. The result of the process was a list of New York State campuses ranked according to a combination of favorable or unfavorable attributes for community heat pump installations.

Key attributes for potential community heat pump projects include the age of the buildings, the heating and cooling load profiles of the buildings, the amount of buildable space on the campus, and the incumbent heating and cooling systems onsite. Locational and economic attributes, such as regional grid emissions, utility electricity prices, and local government policies, are also considered.

ICF used publicly available data to assemble attributes for each of the campus opportunities. In cases where specific campus attributes were not publicly available, ICF conducted a trend analysis to assume the attributes of probable heating and cooling systems based on building age (pre–1945, 1945–1979, or 1980–present) and location (New York City, Long Island/Hudson Valley, or Upstate).

Each attribute is assigned a weight, representing the relative influence of that attribute on a campus owner's decision to install a community heat pump system. Within each attribute, criteria are scored zero to four, with higher scores indicating criteria that are more favorable for community heat pump installations. Each opportunity identified is given a total weighted score, with 144 being the total maximum score possible.

5.1 Building/Campus Characteristics

The following attributes are used to characterize the favorability of building or campus characteristics for community heat pump opportunities. A summary of attributes, weights, and criteria scoring for the Building/Campus Characteristics category is provided in Table 5.

5.1.1 Size of Combined Heating Load

The total heating requirements of the campus, measured in MMBtu per year, is used as a proxy to represent the size of the community heat pump opportunity. Large-scale community heat pump opportunities can eliminate large amounts of onsite fossil fuel combustion with a single project, with higher efficiencies and lower per-unit costs compared to distributed single-building heat pumps. A campus with a combined heating load greater than 200,000 MMBtu per year is given the maximum score of four, meaning the size of its heating load makes it a favorable opportunity for a community heat pump. Lower scores are given for smaller sizes, down to a score of one in the range of 25,000–50,000 MMBtu per year.

5.1.2 Age of Buildings and Planned Redevelopment Activities

The age of the buildings on the campus was also considered in evaluating whether or not a specific campus is well-suited for community heat pump installations. Older buildings are more likely going to require renovations and upgrades and community heat pump technologies can be incorporated during these renovations or upgrades. Buildings built before 1945, and that have had no major renovations since 1980 are given the maximum score of four. Buildings built after 2000 are unlikely to require renovations or upgrades in the near future, and thus were given a score of zero.

Table 5. Building/Campus Characteristics: Category Weights and Scoring Criteria

Building/Campus Characteristics (Weight)	Score
Size of Combined Heating Load (3)	
>200,000 MMBtu	4
100,000-199,999 MMBtu	3
50,000-99,999 MMBtu	2
25,000-49,999 MMBtu	1
Age of Buildings (2)	
Pre-war, no major renovation identified after 1980	4
1945-1979, no major renovations identified 1980	3
Pre-1980, major renovations identified 1980-2000	2
2000 or later, or major renovations identified 1980-200	0
Operational Hours of Buildings (1)	
Buildings operate consistently (24/7/365)	4
Buildings operate consistently, with limited nighttime loads	3
Majority of buildings operate consistently, with season/diurnal variations	2
Majority of buildings operate 7 days a week, shut down at night	1
Buildings primarily operate 5 days a week, shut down at night	0
Annual Heating and Cooling Load Factors (2)	
Load factor greater than 50% (Hospitals, Airports)	4
Load factor of 20-49% (Nursing Homes)	3
Load factor of 10-20% (Multifamily, Military)	2
Load factor 10-20% (Downstate Offices, Correctional Facilities)	1
Load factor <10% (Upstate Offices, Colleges/Universities)	0
Daily Loads of Buildings (2)	
Daily load factor >75% (Hospitals, Nursing Homes, Airports)	4
Daily load factor 50-74% (Downstate Multifamily and Military)	3
Daily load factor 50-74% (Upstate Multifamily and Military, Office Building)	2
Daily load factor 30-49% (College/University, Correctional Facilities)	1
Buildable Space: Parking and Greens Spaces for Heat Pump Development (3)	
Plentiful (Green areas/parking spaces >100% of building space)	4
Sufficient (Green areas/parking spaces 50-100% of building space)	2
Limited (Green areas/parking spaces 10-50% of building space)	1
Very Limited (Green areas/parking spaces <10% of building space)	0
Publicly Owned Campuses (1)	
Yes	4
No	0
Planned Campus Renovations (1)	
Yes	4
No	0
Member of REV Campus Challenge (1)	
Yes	4
No	0

Campuses that have major planned redevelopment activities can incorporate heat pump systems into their redevelopment efforts. Therefore, campuses with upcoming redevelopment activities were given a score of four, while campuses with no major renovations planned were given a score of zero.

5.1.3 Operational Hours of Buildings

Campuses that have consistent seasonal and diurnal loads are better suited to incorporating community heat pumps than campuses that operate less frequently, or that have limited nighttime loads. Hospitals, nursing homes, airports, and hotels are all buildings that typically operate 24 hours a day, year-round, making them excellent candidates for community heat pump installations, and were given the maximum score of four. Alternatively, office buildings were given a score of zero because they typically operate five days a week and have limited nighttime loads, making them less favorable candidates to incorporate heat pumps.

5.1.4 Annual Heating and Cooling Load Factors

An annual load factor is calculated by dividing the average annual heating or cooling load by the maximum load experienced throughout the year. Campuses that have high-load factors throughout the year—representing consistent heating or cooling requirements can make more efficient use of community heat pumps compared to campuses that have high-seasonal variations in heating and/or cooling requirements. ICF used DOE Commercial Reference Building Models in New York State's climate zones to estimate the annual heating and cooling load factors for each campus building type.[14]

The State's climate zones (from the International Energy Conservation Code, used in DOE building modeling) are shown in Figure 7. The New York City area, including Long Island, has a more moderate climate (Zone 4) compared to Albany, Buffalo, and Rochester which are in the colder Zone 5 Climate Zone. Colder climates (Zone 6) are found in the more mountainous and northern areas of the State.

In all climate zones, hospitals and airports have heating and cooling load factors greater than 50%, making them well-suited to incorporating heat pumps, and were given the maximum score of 4. Alternatively, office buildings in upstate New York and colleges/universities tend to have heating and cooling load factors less than 10% and were thus given a score of zero.

Figure 7. New York Climate Zones for Load Modeling

5.1.5 Daily Loads of Buildings

Campuses with consistent heating and/or cooling loads on a daily basis are also ideal candidates for community heat pump systems. Heat pumps can be sized larger and operate more efficiently when buildings have steady heating or cooling requirements throughout a typical 24-hour period.

On a given winter day, heating requirements for some building types depend heavily on outdoor ambient temperatures. Other types of buildings or campuses have diverse heating loads with more consistent heating demand throughout the day and night. The same is true of space cooling loads for different building or campus types on a typical summer day.

Building heating and cooling load profiles from DOE Commercial Reference Building Models were evaluated for daily load requirements on typical winter and summer days. A "daily load factor" metric was developed to represent the ratio of the average load to the maximum load for heating and space cooling on a typical winter or summer day. Hospitals, nursing homes, and airports have consistent daily heating requirements in the winter and consistent daily cooling requirements in the summer (>75% daily load factor) and were thus given the maximum score of four. Colleges/universities and correctional facilities have lower daily load factors, roughly 30–49%, and were thus given a score of one.

5.1.6 Buildable Space: Parking and Green Areas for Heat Pump Development

A geothermal heat pump installation requires that a campus has sufficient land area to drill multiple boreholes for ground loops. Sufficient area was determined by comparing the total footprint of green areas and/or parking spaces to the total footprint of all buildings. If the green area/parking space footprint exceeded the building footprint, the campus was deemed to have "plentiful area" (i.e., more than sufficient area) to install a geothermal heat pump system. Campuses with the plentiful area designation were given the maximum score of four. As the ratio of available land area to building footprint decreased, lower scores were assigned as described in Table 5. A campus with a buildable space ratio of 10% or lower was deemed to have very limited (i.e., insufficient) buildable space, and was given a score of zero.

5.1.6.1 Publicly Owned Campuses

Public institutions may be more likely to install clean energy technologies that are promoted through government programs, because government entities ultimately decide the types of renovation projects their buildings will undergo. Thus, a campus was given a score of four if it is owned by a government entity (such as the New York City Housing Authority or State University of New York), or it was given a score of zero if it was a privately owned campus.

5.1.7 Member of Reforming the Energy Vision Campus Challenge

Launched in 2015, the Reforming the Energy Vision (REV) Campus Challenge helps promote clean energy projects at colleges and universities across the State. This is done by helping these institutions shape their clean energy goals, providing funding for clean energy projects, and by promoting the projects that colleges/universities have already implemented on their campuses. Colleges/universities that are a part of the REV Campus Challenge are considering ways to reduce their GHG emission footprints and are therefore more likely to consider incorporating community heat pumps, giving them a score of four. Campuses not part of the challenge were given a score of zero.

5.2 Incumbent Heating and Cooling System

In this category, buildings are scored based on the type of heating and cooling systems that are currently installed. The focus is on incumbent heating systems, which have a large influence on both the viability and emission reduction potential of community heat pump systems. Campuses with district energy (central plants distributing chilled water, hot water, and/or steam to multiple buildings) are also considered. A summary of incumbent heating/cooling system attributes, weights, and criteria scoring is provided in Table 6.

Table 6. Incumbent Heating and Cooling System: Category Weights and Scoring Criteria

Incumbent Heating/Cooling System (Weight)	Score
Primary Heating Technology Currently Used (1)	
Hot water Boilers	4
Furnace or CHP	3
Steam Boilers	2
Electric Heat Pumps	1
Distribution System for Space Heating (3)	
Hydronic distribution	4
Forced air distribution	4
Steam distribution	2
Presence of District Energy System (4)	
District energy with hot water and chilled water	4
District energy with steam and chilled water	3
District energy with chilled water	2
District energy with steam	1
No district energy	0
Fuels Currently Used for Heating (2)	
Coal or Oil	4
Dual Fuel (Gas and Oil)	3
Natural Gas	2
Electric Heat Pumps	1
Age of Heating Equipment (2)	
Pre-1950	4
1950-1979	3
1980-1999	2
Post 2000	1

5.2.1 Primary Heating Technology Currently Used

Campuses that use hot water boilers to heat buildings are given a maximum score of four, as heat pumps also produce hot water. Steam conversions can add complexity and are scored lower, while buildings that already use electric heat pumps are given a minimum score of one.

5.2.2 Distribution System for Space Heating

Developers indicated that the distribution system is more important than the primary heating technology. Campuses that use hydronic and forced-air distribution systems for space heating are most favorable for community heat pump conversions and are given a maximum score of four. Campuses that use a steam distribution system are given a score of two.

5.2.3 Presence of District Energy System

Campuses that currently employ district energy systems are more likely to incorporate community heat pumps, as the piping and tunnel infrastructure necessary is already in place to deliver hot and chilled water from a central plant to buildings around the campus. Community heat pumps distribute both hot water and chilled water, so these piping systems are preferred. A campus already using a district energy for both hot and chilled water is given a score of four. Campuses with other district energy arrangements are scored lower, and those with no district systems are given a score of zero.

5.2.4 Fuels Currently Used for Heating

It is important to consider the fuels the campus currently uses to operate their heating/cooling systems. Campuses that use coal-fired technology were given a score of four, since coal is a highly polluting and more expensive fuel source compared to natural gas. Campuses that already use electric heat pumps were given a score of one, since a transition on these campuses would not be needed.

5.2.5 Age of Heating Equipment

It is important to consider the age of the heating equipment when evaluating whether the campus has favorable conditions for incorporating a community heat pump. Campuses with older heating equipment are more likely to replace the equipment in the near future and could decide to incorporate a new heat pump system instead of upgrading or replacing the incumbent system. If the heating equipment was built before 1950, the campus was given a score of four, while equipment built after 2000was given a score of one.

5.3 Locational Attributes

The final category scores campus community heat pump opportunities on attributes related to location. A summary of locational attributes, weights, and criteria scoring is provided in Table 7.

Table 7. Locational Attributes: Category Weights and Scoring Criteria

Locational Attributes (Weight)	Score
Climate (1)	
Climate Zone 4	4
Climate Zone 5	2
Climate Zone 6	1
Local Electricity Prices (2)	
<9 cents/kWh	4
9-12 cents/kWh	3
12-15 cents/kWh	2
15-20 cents/kWh	1
GHG Emission Reduction Impact (1)	
Upstate New York (lowest grid emissions)	4
New York City/Westchester (low grid emissions)	2
Long Island (highest grid emissions)	1
Electric Heat Pump currently used	0
Impact of Local Law 97 (4)	
Located in NYC, currently using coal or oil	4
Located in NYC, currently using dual fuel	3
Located in NYC currently using natural gas	2
Not located in NYC or Exempt from Local Law 97	0

5.3.1 Climate

Campuses in Climate Zone 4 (including the New York Metropolitan Area) experience mild winters with limited low ambient temperatures and generally experience more balance between heating and cooling requirements. These campuses were given a score of four. Campuses in Climate Zone 6 (mountainous and northern upstate areas) experience cold winters with long periods of low ambient temperatures, and require significantly more heating compared to cooling, so they were given a score of one. Those located in Climate Zone 5 were given a score of two.

5.3.2 Local Electricity Prices

Since heat pumps electrify the heating and cooling loads of buildings, their cost-effectiveness is highly dependent on electricity prices in the region where they are being installed. Campuses located in areas with electricity prices less than $0.09 per kilowatt-hours (kWh) are more likely to integrate community heat pumps given the low-cost of electricity, and thus were given the maximum score of four. Campuses located in areas with high electricity prices, greater than $0.20 per kWh, were given a score of zero.

5.3.3 GHG Emission Reduction Impact

A major driver of the deployment of community heat pumps is their ability to reduce emissions, relative to fossil-fueled boilers and furnaces. However, the potential for heat pumps to reduce GHG emissions is dependent on the electric grid emissions of an area. Community heat pump projects at campuses located in areas of New York State with the lowest grid emissions (upstate) are going to have the highest emission reduction potential and were given the maximum score of four. Heat pump projects at campuses located in areas of the State with the highest grid emissions (Long Island) were given a score of one.

5.3.4 Impact of Local Law 97

Local Law 97, passed by New York City Council in 2019, aims to reduce emissions from the City's building by 40 percent by 2030 and 80 percent by 2050. Buildings that do not comply with the limits outlined in the Local Law 97 will be fined $268 for every excess metric ton of GHG emissions they produce.[15] Certain building types are not required to adhere to the GHG emission reduction limits outlined in the Local Law 97 including a classified religious place of worship, nonprofit hospitals and healthcare facilities, rent-regulated housing, industrial facilities predominately used for electric power or steam generation, housing owned by the NYC housing authority, buildings that are part of a federal housing program, Housing Development Fund Corporation properties, multifamily dwellings three-stories or lower, and city owned buildings with the exception of senior colleges in the City of New York system.

Local Law 97 provides a major incentive for campuses across New York City to incorporate community heat pumps. Therefore, if an eligible campus is located in the City and currently uses high-GHG emitting fuels like coal or oil, it was given a score of four, and if located outside the City or if the building is exempt from complying with the law, it was given a score of zero.

5.4 Top Campus Community Heat Pump Opportunities in New York State

Using the criteria laid out above, each campus opportunity was given a total weighted score, representing how well-suited the specific campus was for incorporating a community heat pump. ICF produced a ranked list of campus opportunities in New York City, opportunities located outside of New York City, as well as a combined list that includes all campuses in the State.

Table 8 displays the campuses that have a combination of characteristics that make them the most favorable opportunities for community heat pump installation in New York City.

Table 8: Top 20 Campus Opportunities for Community Heat Pump Systems in New York City

Facility Name	City	Borough / County	Application	Total Weighted Score
CUNY College of Staten Island	New York	Staten Island	Colleges & Universities	88
Spring Creek Towers (WEGO & HCR)	New York	Brooklyn	Multifamily Housing	88
John F Kennedy International	New York	Queens	Airports	87
Parkchester North Campus	New York	Bronx	Multifamily Housing	85
Bronx Psychiatric Center	New York	Bronx	Hospitals	84
Co Op City	New York	Bronx	Multifamily Housing	84
Brightwater Towers Condominium	New York	Brooklyn	Multifamily Housing	83
CUNY Bronx Community College	New York	Bronx	Colleges & Universities	82
169-65 137th Avenue - Rochdale Village	New York	Queens	Multifamily Housing	82
Concourse Village	New York	Bronx	Multifamily Housing	81
Sunnyside Garden Apartments	New York	Queens	Multifamily Housing	81
Manhattan Psychiatric Center-Ward's Island	New York	Manhattan	Hospitals	80
Savoy Park Apartments	New York	Manhattan	Multifamily Housing	80
Parkway Village Coop- 36930	New York	Queens	Multifamily Housing	80
Third Housing Company Inc.	New York	Queens	Multifamily Housing	80
The Dorset - Kaled	New York	Queens	Multifamily Housing	80
Amalgamated Warbasse Houses-Block 7250	New York	Brooklyn	Multifamily Housing	79
Lafayette Boynton Apartments	New York	Bronx	Multifamily Housing	79
CUNY Brooklyn College	New York	Brooklyn	Colleges & Universities	79
New York University	New York	Manhattan	Colleges & Universities	79

The top 20 opportunities for campus community heat pump systems in New York City include multifamily housing (13 opportunities), colleges and universities (four opportunities), hospitals (two opportunities) and one airport. The top 19 campus opportunities are defined as having plentiful green and/or parking space that could be used for borehole sites to incorporate a geothermal heat pump system. With the exception of the psychiatric centers, the Bronx Community College, and JFK airport, these campuses must comply with the emission guidelines outlined in Local Law 97, making it more likely that they will consider community heat pump systems to meet their respective emission targets. All top 20 campus opportunities are also located in a part of the State that has low-grid emissions, meaning that a community heat pump project at these sites will be able to contribute to significant amounts of GHG emission reductions.

A majority of these favorable community heat pump opportunities are found at multifamily housing campuses with high-operational loads, and daily load factors greater than 50%. The four colleges that had the best value-proposition for incorporating community heat pumps are part of the REV Campus Challenge, and all four colleges have established clean energy goals. Additionally, these four college campuses already have district energy systems on campus, making it easier to incorporate community heat pumps systems into their campuses. This is also true of John F. Kennedy International Airport and six of the multifamily housing campuses identified, all of which already use district steam systems.

Campus Snapshot: Co-Op City

Co-Op City, located in Bronx, NY, is a housing cooperative originally constructed in 1973 made up of 35 buildings, housing roughly 60,000 residents. The characteristics of this housing development make it a strong candidate for a community heat pump system. The campus requires a significant amount of thermal energy to meet the needs of its residents, with an estimated heating load of nearly 3 million MMBtu per year. Co-op City has plentiful green/parking space that can be used for boreholes for a geothermal heat pump.

Co-Op City currently supplies steam to buildings through a district energy system. In 2007, the central plant was upgraded with a combined heat and power system, used to generate both electricity and high-pressure steam for campus buildings. Co-op City can take advantage of its current district steam infrastructure to facilitate incorporation of a future Community Heat Pump system on its campus.

Photo courtesy of districtenergyaward.org

Table 9 displays New York campuses with the most favorable characteristics for community heat pump installations outside of New York City.

Table 9: Top 20 Campus Opportunities for Community Heat Pump Systems Outside of New York City

Facility Name	City	Borough / County	Application	Total Weighted Score
Binghamton University	Vestal	Broome	Colleges & Universities	99
Syracuse University	Syracuse	Onondaga	Colleges & Universities	90
SUNY at Albany - Uptown Campus	Albany	Albany	Colleges & Universities	90
SUNY Oneonta	Oneonta	Otsego	Colleges & Universities	90
Westchester Medical Center	Valhalla	Westchester	Hospitals	89
Rochester Institute of Technology	Rochester	Monroe	Colleges & Universities	88
Buffalo Psychiatric Center	Buffalo	Erie	Hospitals	86
University at Buffalo - North Campus	Buffalo	Erie	Colleges & Universities	83
Monroe Community College	Rochester	Monroe	Colleges & Universities	82
Olean General Hospital	Olean	Cattaraugus	Hospitals	80
Adelphi University	Garden City	Nassau	Colleges & Universities	80
Rochester Psychiatric Center	Rochester	Monroe	Hospitals	80
Sisters of Charity Hospital of Buffalo	Buffalo	Erie	Hospitals	79
St. Catherine of Siena Medical Center	Smithtown	Suffolk	Hospitals	79
Stony Brook University - Southampton	Southampton	Suffolk	Colleges & Universities	79
Faxton St. Luke's Healthcare	Utica	Oneida	Hospitals	78
Good Samaritan Hospital	Suffern	Rockland	Hospitals	78
Veterans Affairs Hudson Valley Health Care System	Montrose	Westchester	Hospitals	78
Samaritan Hospital	Troy	Rensselaer	Hospitals	78
Four Winds Hospital	Katonah	Westchester	Hospitals	78

The top 20 campus community heat pump opportunities outside of New York City are found exclusively at hospitals (11 opportunities) and colleges and universities (nine opportunities). All 20 of these opportunities are found at campuses with plentiful green and/or parking space available for drilling boreholes for potential geothermal systems. Except for Adelphi University, Stony Brook University and St. Catherine of Siena Medical Center, the campuses are located in parts of the State with low-grid emissions, meaning that community heat pump installations at these facilities will result in significant GHG emission reductions. A majority of these top 20 campus opportunities are located in areas of the State with electricity prices below $0.11/kWh, making the transition to electric heat pump systems at these campuses more affordable than at campuses located in parts of the State with higher electricity prices.

All colleges and universities ranked in the top 20 campus opportunities already use district energy systems, with most using district hot water systems, making the campuses well-suited to integrate community heat pump opportunities. With the exception of SUNY at Albany's uptown campus and

University at Buffalo-North Campus, all other colleges and universities are part of the REV Campus Challenge and have a strong desire to improve their institutions commitment to clean energy. Rochester Institute of Technology and SUNY Oneonta are considered leaders in the REV Campus Challenge, since they currently have campus clean energy projects.

Campus Snapshot: Rochester Institute of Technology

The Rochester Institute of Technology (RIT), located in Rochester, NY is a favorable candidate for a Community Heat Pump system. RIT is a large university with significant heating and cooling requirements and is located in the region of New York with the lowest grid emissions. These factors improve the potential emissions benefits for a community heat pump installation, compared to projects with lower heating and cooling loads in regions with higher grid emissions. RIT also has plentiful green areas and parking spaces, which accommodates the necessary borehole drilling needed for a geothermal heat pump system.

The campus currently uses a district energy system to distribute medium temperature hot and chilled water to meet the domestic hot water, space heating/cooling, and snow melt needs of the different buildings on campus. RIT can take advantage of its district system and therefore more easily integrate a community heat pump arrangement on its campus. Furthermore, RIT is a leader in the REV Campus Challenge, already making considerable investment in clean energy projects across its infrastructure.

Photo courtesy of rit.edu

6 Top Community Heat Pump Opportunities for Downtown Redevelopment

In addition to single-owner campuses, community heat pumps can be applied to multi-owner building clusters in downtown areas. Downtown areas in cities including Rochester and Manhattan currently utilize district energy systems with steam distribution. Downtown community heat pump systems connecting multiple buildings are most likely to be implemented alongside other redevelopment efforts where buildings and roads are constructed and renovated.

ICF communicated with multiple heat pump developers who were actively working on downtown systems across the State. ICF wanted to better understand the (1) obstacles when developing multi-owner community heat pumps, as well as (2) factors that make certain downtown areas better suited to incorporating these systems. The biggest barrier cited by the developers ICF spoke to is that multi-owner heat pump systems face significant permitting and right-of-way challenges. Coordinating a downtown community heat pump with multiple owners and stakeholders often results in a complex project development process, which can stall and add costs to a project. Timing with other construction projects can be another difficult aspect.

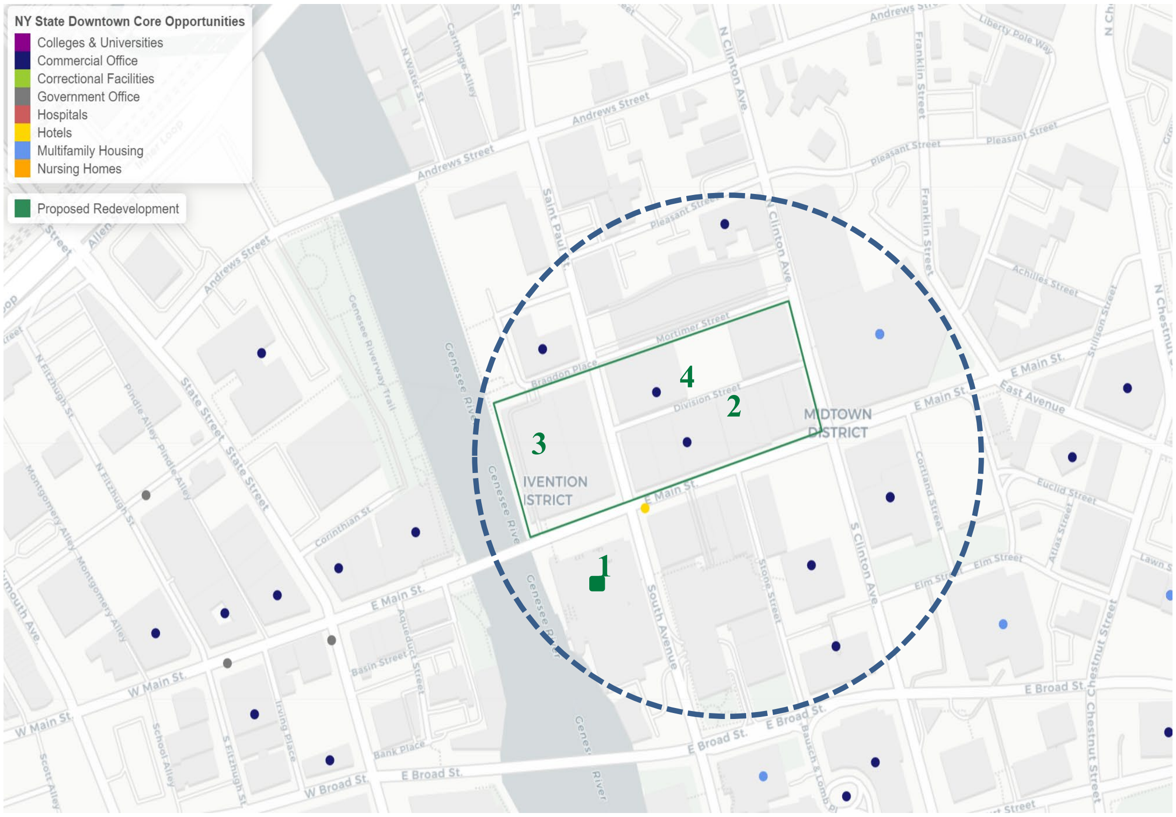
One way to address these barriers is to target downtown areas that have planned redevelopment activities in order to coordinate permitting processes involving multiple building owners. Downtown areas are considered more favorable for downtown community heat pump systems if the redevelopment projects are backed by State or local programs and funds. Many of the downtown areas that ICF identified as being favorable for community heat pump systems are receiving funds from New York State's Downtown Revitalization Initiative (DRI) or have been granted funding from the State's latest round of Regional Economic Development Council (REDC) Initiative. Other characteristics that ICF analyzed to assess favorability are the number of connectable buildings, diverse and consistent heating and cooling loads for connectable buildings, and the presence of a body of water that can be used as a natural heat sink or source for the heat pump project.

6.1 Top Redevelopment Projects for Downtown Community Heat Pump Opportunities

This section presents ICF's findings for favorable downtown community heat pump opportunities across the State, with maps to demonstrate where and which buildings can be connected to the downtown community heat pump system.

6.1.1 Rochester, NY

Figure 8. Community Heat Pump Redevelopment Opportunity in Downtown Rochester



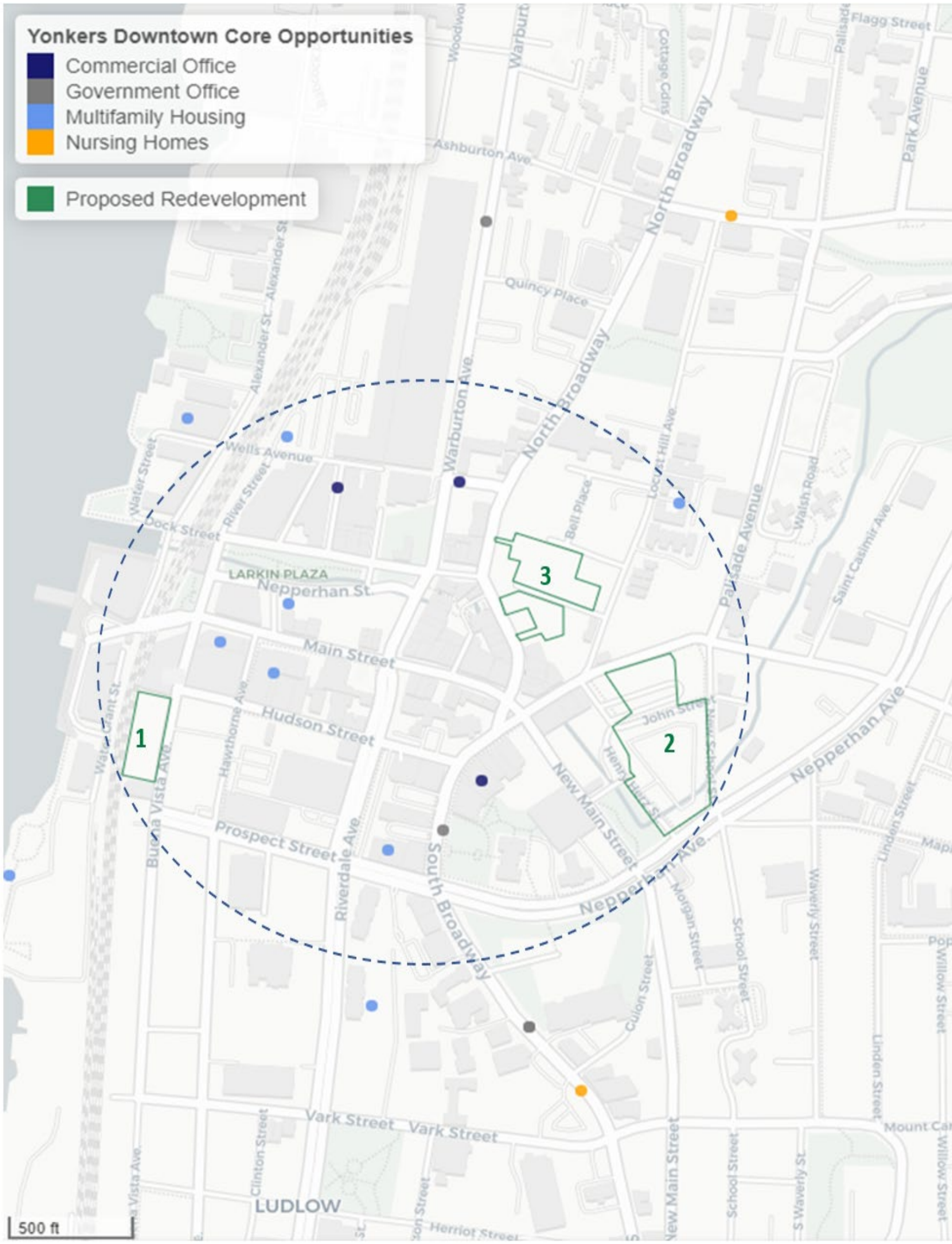
Rochester's center city was awarded DRI funds in the last round of the initiative, with funds directed toward projects aimed at transforming vacant and blighted buildings into redeveloped mixed-use buildings. John Duchesneau, General Manager of the Rochester District Heating Cooperative, and member of the Advisory Committee that ICF assembled, informed ICF of a geothermal community heat pump feasibility study looking at the area near Broad Street in downtown Rochester. In parallel with the redevelopment activities occurring in downtown Rochester, there is the possibility of expanding the potential geothermal community heat pump to provide heating and cooling to buildings currently served by Rochester's existing district steam system. The dashed blue circle in Figure 8 represents the cluster of buildings that could be connected to a community heat pump system in Rochester, including planned redevelopment projects. The proposed redevelopment activities include the following:[16]

- Expansion of the Rochester Riverside Convention Center.
- Renovation of vacant buildings on Division and E. Main Street.
- Renovation of the Riverside Hotel.
- Renovation of the Cox and Edwards buildings.

The Rochester Riverside Convention Center and the Cox/Edwards buildings are estimated to have 15,000 MMBtu per year of heating load between them. There is a potential to also connect seven other large buildings to the proposed redevelopment projects. These include five commercial office buildings, the Hyatt Regency hotel, and a Spectra at Sibley multifamily housing facility. The estimated heating load for these buildings is roughly 46,000 MMBtu per year, presenting a relatively sizeable community heat pump opportunity, especially when adding on the heating loads of the proposed redevelopment opportunities. One critical reason Rochester is identified as having favorable conditions for a downtown community heat pump system is that Rochester currently uses district steam to meet the thermal needs of some buildings in the downtown area, and all the opportunities identified in the cluster lie within the service area of the district steam system. Additionally, these opportunities are located fairly close to the Genesee River, which could be used as heat sink and/or source for the community heat pump system.

6.1.2 Yonkers, NY

Figure 9. Community Heat Pump Redevelopment Opportunity in Downtown Yonkers



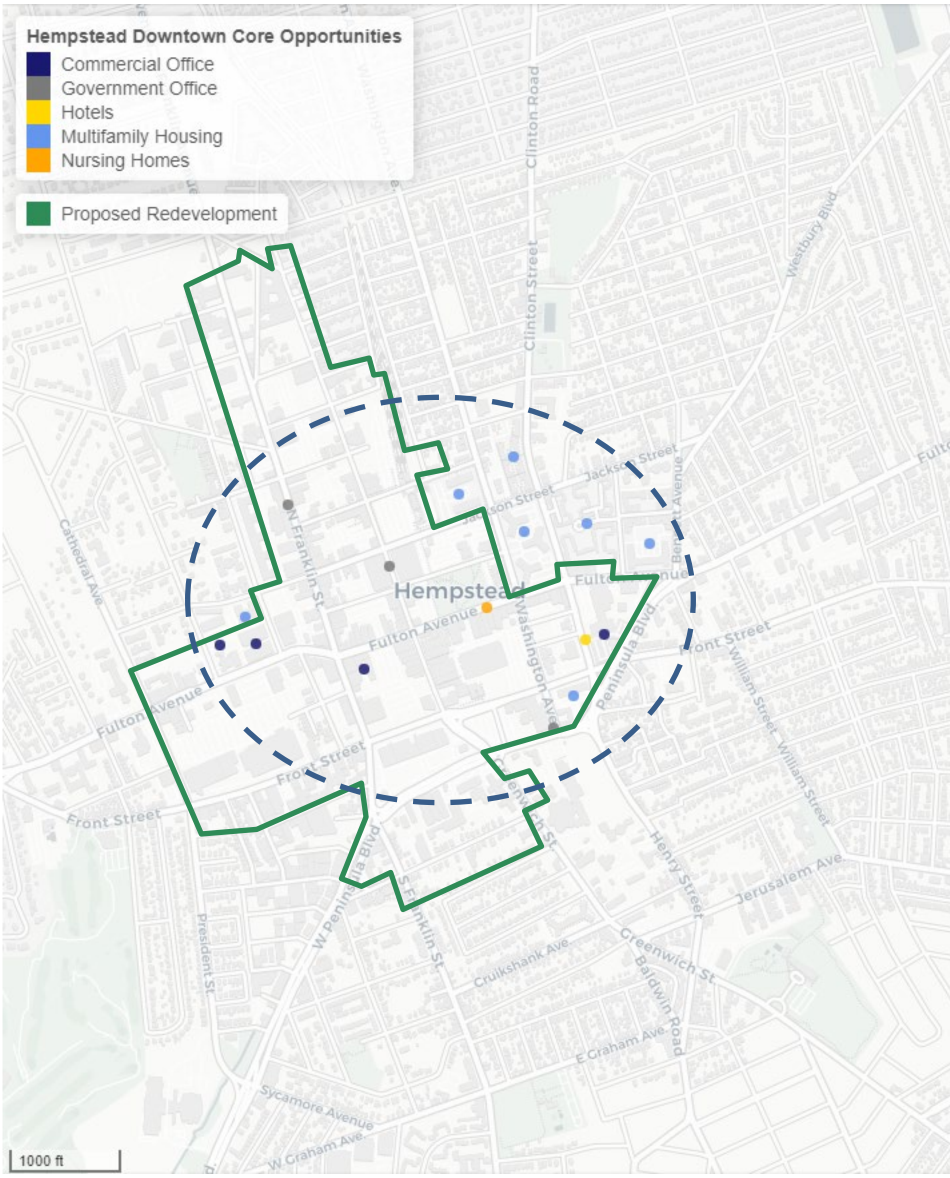
The City of Yonkers is aiming to transform its downtown area into a vibrant mixed-use center for commerce and residency. In a period of approximately 10 years, AMS Acquisitions is planning on adding roughly 3,500 apartments and more than 4.5 million square feet of new development across three sites in downtown Yonkers. The dashed blue circle in Figure 9 represents the cluster of buildings that could be connected to a community heat pump system in Yonkers including three planned redevelopment projects[17]:

- The Teutonia site, two mixed-use towers with 906 residential units and ground floor retail space.
- Chicken Island site, a six-building, transit-oriented project with roughly 70,000 sq. ft. of retail space and 2,200 parking spaces.
- North Broadway site, two towers with retail and office spaces, and a significant amount of parking.

There is the potential to connect 10 large buildings (>1,000 MMBtu/year heating) to the proposed redevelopment projects. This cluster area includes six multifamily housing buildings, three commercial office buildings, and one government office structure. The estimated heating load for these buildings is estimated to be 43,000 MMBtu per year. While a downtown community heat pump system could potentially use the Hudson River as a heat sink and/or source, the environmental permits required to do so present a significant barrier.

6.1.3 Hempstead, NY

Figure 10. Community Heat Pump Redevelopment Opportunity in Downtown Hempstead

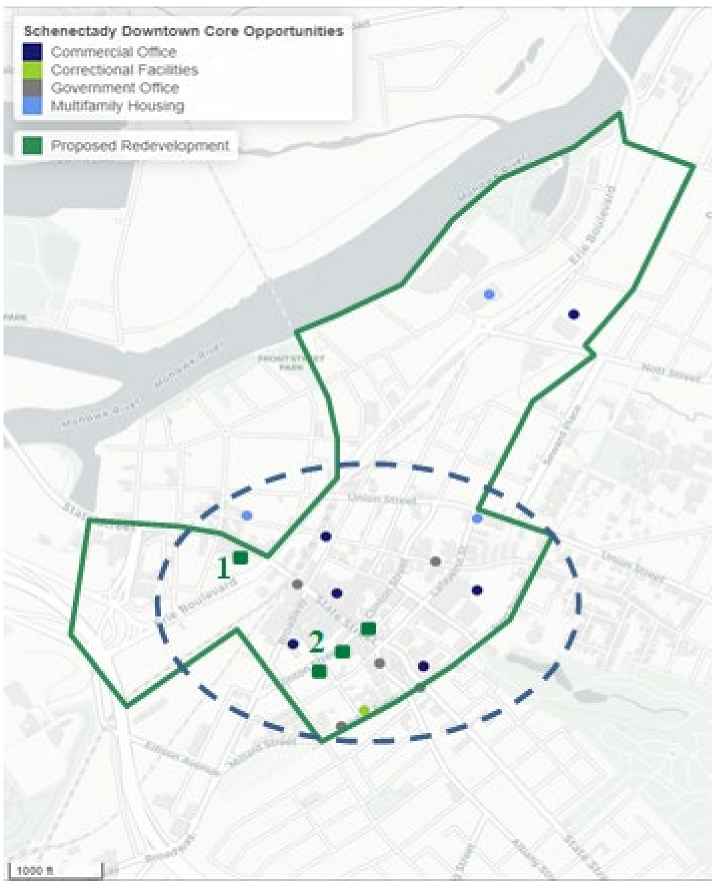


The Hempstead downtown area was awarded funds for the Hempstead Brownfield Opportunity Area (BOA) Innovation District project from the New York Department of State BOA Program in the latest round of the REDC initiative. The innovation district is going to use funds to reclaim and reuse multiple brownfields and blighted properties and redevelop the area to include housing options for all-income groups, a community meeting space, and a healthcare cluster. The dashed blue circle in Figure 10 represents the cluster of buildings that could be connected to a community heat pump system in the Village of Hempstead in the area of proposed redevelopment.

The cluster also includes 16 connectable buildings with significant heating and cooling requirements identified within and around the proposed redevelopment area. This includes seven multifamily buildings, four commercial offices, three government offices, the Nevele Hotel, and the Family Service Association nursing home. The estimated heating load for these buildings is roughly 60,000 MMBtu per year, presenting a sizeable community heat pump opportunity, especially when adding on the heating loads of the proposed redevelopment opportunities.

6.1.4 Schenectady, NY

Figure 11. Community Heat Pump Redevelopment Opportunity in Downtown Schenectady



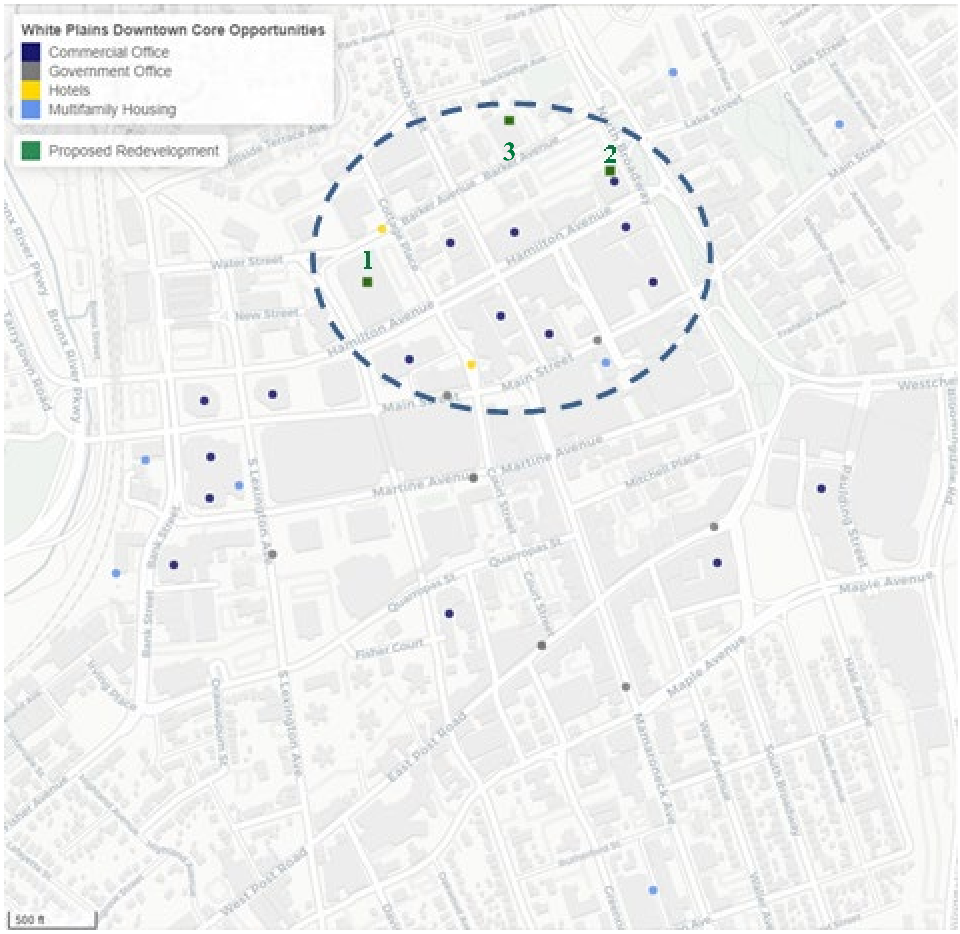
Schenectady received DRI funds in round four of the initiative, with the goal of adding 125 new housing units and 200 jobs to the downtown area to transform Schenectady's waterfront into a vibrant urban center. The dashed blue circle in Figure 11 represents the cluster of buildings that could be connected to a community heat pump system in Schenectady, including the city's planned redevelopment projects. The proposed redevelopment activities include the following:[18]

- Adding new housing and public parking to lower State Street, which will include a five-story building with plentiful parking spaces.
- Redevelop underutilized blocks near State and Clinton streets to include 108 apartments, 5,000 sq. ft. of retail space and 52,000 sq. ft. of medical office space.

The cluster also includes 13 large buildings (>1,000 MMBtu/year heating) that could be connected to the proposed redevelopment projects through a downtown community heat pump system. These buildings include five government offices, five commercial offices, two multifamily buildings and one correctional facility. The combined heating load for these buildings is estimated to be 50,000 MMBtu per year. Additionally, there is the potential to use the Mohawk River as a heat sink/source for the downtown heat pump project.

6.1.5 White Plains, NY

Figure 12. Community Heat Pump Redevelopment Opportunity in Downtown White Plains



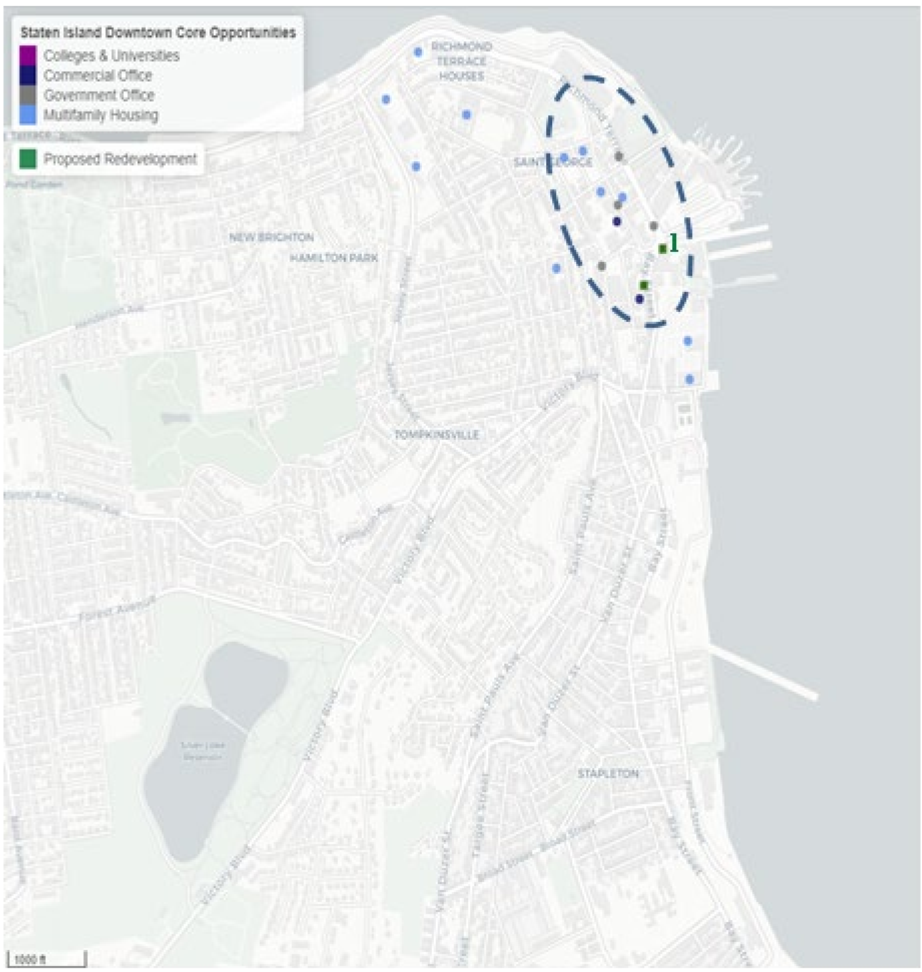
White Plains has announced several projects across the city aimed at transforming its downtown area into a mixed-use community. The dashed blue circle in Figure 12 represents the cluster of buildings that could be connected to a community heat pump system in White Plains. The proposed redevelopment projects in White Plains include the following:

- Transforming the White Plains Mall into four apartment buildings with both office and retail space.[19]
- Redevelopment of a 15-story apartment building it a mixed-use space with roughly 250 apartments and retail space.[20]
- Development of a new 164-unit senior living facility.[21]

The cluster also includes 12 large buildings that can be connected to the proposed redevelopment sites through a downtown community heat pump project. This includes eight commercial office buildings, two government buildings, the One City Place multifamily building, and the Ritz-Carlton Hotel. The buildings have an estimated combined heating load of 94,000 MMBtu per year, representing a sizeable downtown community heat pump opportunity.

6.1.6 Staten Island, NY

Figure 13. Community Heat Pump Redevelopment Opportunity in Downtown Staten Island



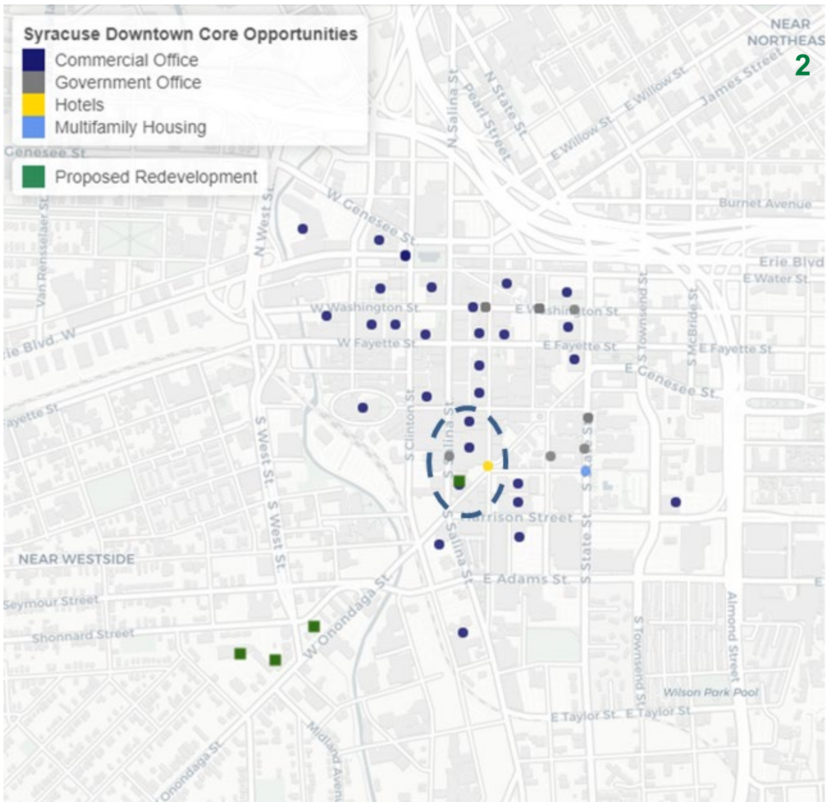
Staten Island was awarded DRI funds in round four of the initiative and will use these funds to attract additional public and private investment, to transform its downtown area into a hub of business and tourism. The dashed blue circle in Figure 13 represents the cluster of buildings that could be connected to a community heat pump system in Staten Island. The proposed redevelopment activities include the following:[22]

- Development of an Innovation Lab focused on virtual and augmented reality.
- Redevelopment of the headquarters of the Seamen's Society for Children and families.

The cluster also includes 10 large buildings (>1,000 MMBtu/year heating) that could be connected to the redeveloped sites through a downtown community heat pump system. These buildings include four multifamily buildings, four government offices, and two commercial offices. The total estimated heating load for these buildings is roughly 41,000 MMBtu per year.

6.1.7 Syracuse, NY

Figure 14. Community Heat Pump Redevelopment Opportunity in Downtown Syracuse

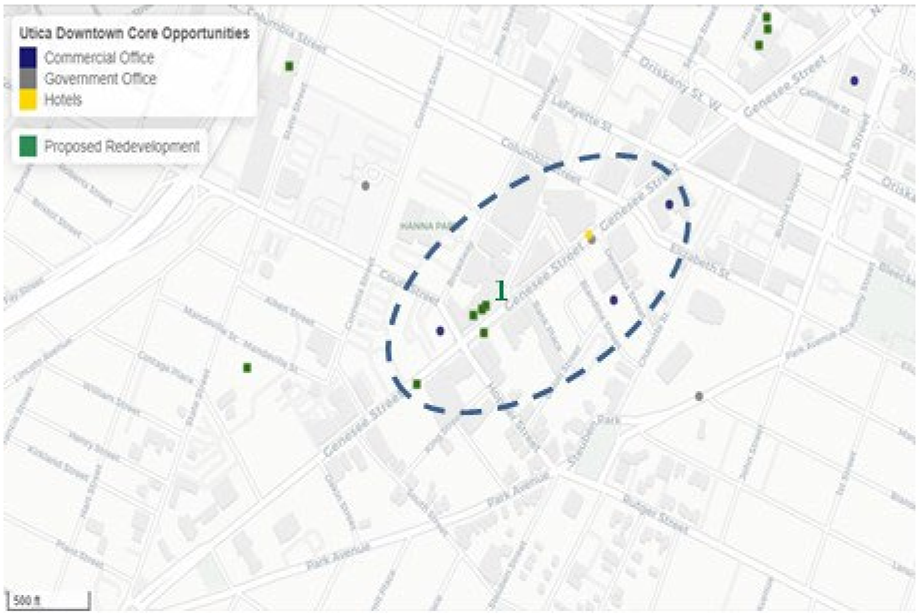


The Downtown Redevelopment Initiative for Syracuse is focused on the Southwest Gate portion of the city—represented by the three green points Southwest of the downtown core. Within the core is one proposed development project, converting the former Symphony Tower hotel into residential apartments and an extended stay hotel, with ground floor retail.[23] The dashed blue circle in Figure 14 represents the cluster of buildings that could be connected to a community heat pump system centered on this redevelopment opportunity.

There is potential to connect the Symphony Tower redevelopment project to five large buildings (>1,000 MMBtu/year heating) using a downtown community heat pump system. These buildings include three commercial office buildings, one government office, and a hotel. The estimated combined heating load of these buildings is 58,000 MMBtu per year.

6.1.8 Utica, NY

Figure 15. Community Heat Pump Redevelopment Opportunity in Downtown Utica



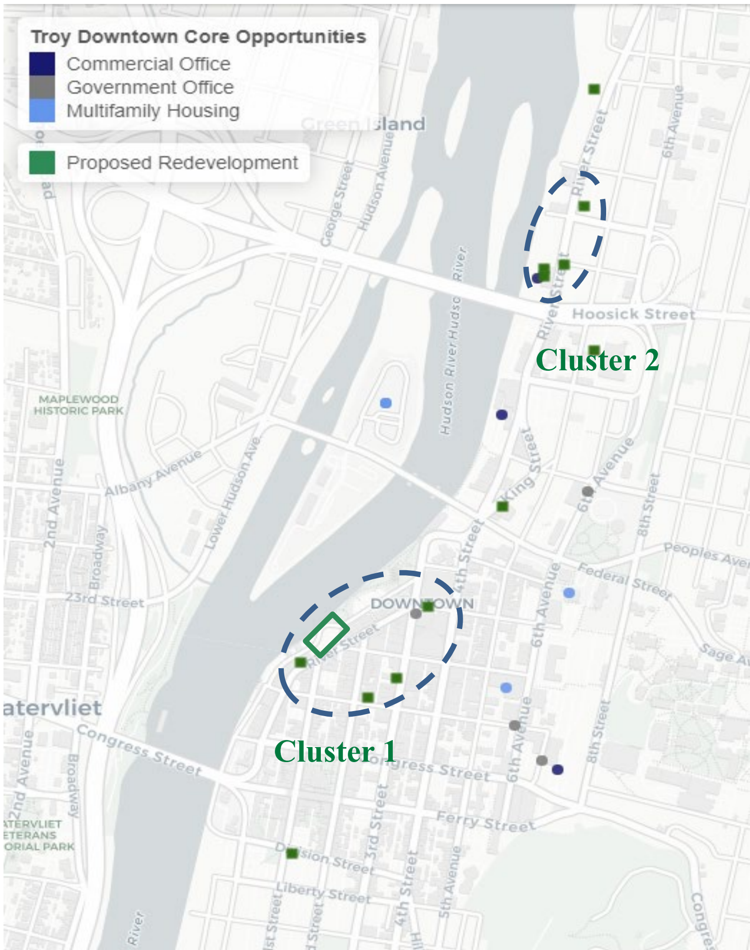
Utica was awarded DRI funds in Round 4 of the initiative, with the aim of revitalizing vacant buildings and developing mixed-use housing on Genesee Street, Utica's primary commercial corridor, in order to stimulate economic investment in the area. The dashed blue circle in Figure 15 represents the cluster of buildings that could be connected to a community heat pump system in Utica. Proposed redevelopment activities include the following:[24]

- Redevelopment of Kempf Block into a mixed-use property including 38 apartments with office and retail space.
- Construction of mixed-use residential/work facility with 40–45 residential/workspaces.

The proposed redevelopment opportunities could be connected to five other large buildings in the downtown area through a community heat pump system. These buildings include the Radisson Hotel, the New York Department of Transportation, and three other commercial office buildings. The estimated combined heating load of these buildings is roughly 36,000 MMBtu per year.

6.1.9 Troy, NY

Figure 16. Community Heat Pump Redevelopment Opportunity in Downtown Troy



Troy was awarded funds through the latest round of New York State's DRI with the aim of creating new market-rate and affordable housing, new public gathering spaces, and redeveloped mixed-use spaces in order to revitalize its downtown area. Troy also received funds for a district geothermal demonstration project that could serve buildings in the DRI district. This district geothermal system would be the first phase of a broader DRI district community geothermal system in downtown Troy. The dashed blue circles in Figure 16 represent two clusters of buildings that could be connected to a community heat pump system in Troy. The projects in Cluster 1 include the following:[25]

- Development of the Troy Music Center, a 25,000 sq. ft. community center.
- Development of Dockside Lofts, which is a mixed-use facility with 26 residential units and retail space.
- An innovation lab focused on sustainability.
- Development of a 18,000 sq. ft. community resource center for early childhood education.

- Redevelopment of a mall into mixed-use facility with housing and commercial development spaces.

There is also the potential to connect the New York State Department of Health to these redevelopment projects. The estimated heating load of that office building is 2,000 MMBtu per year.

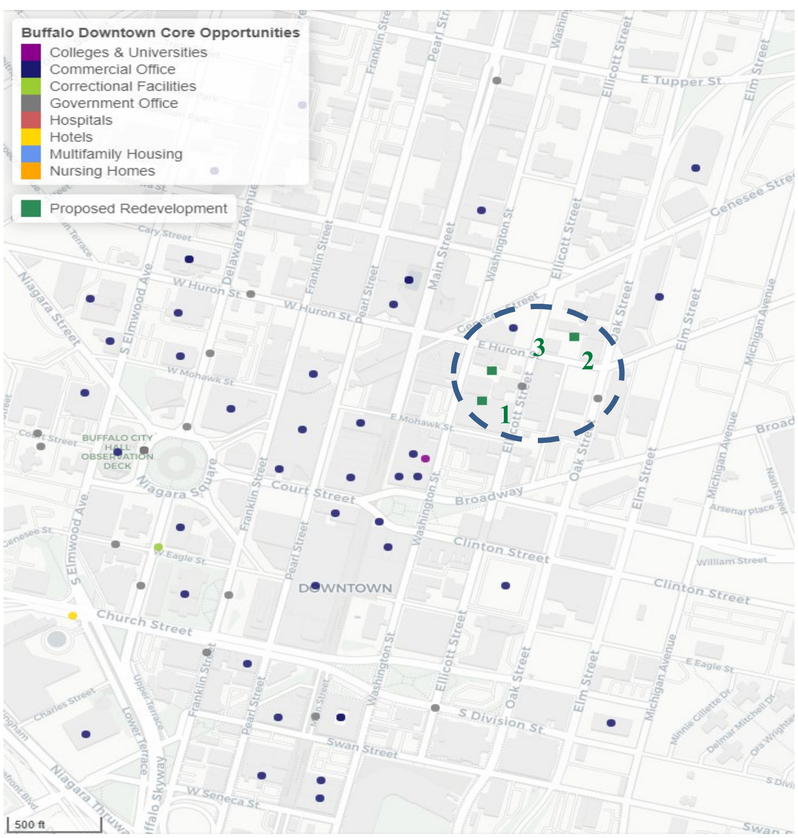
Cluster 2 in Troy includes:

- Development of a 17,000 sq. ft. fitness center.
- Conversion of a 100-year-old building into a grocery store.
- Development of a senior housing facility.
- Construction of an urban grow center with a commercial kitchen.

There is the potential to connect a commercial office building to these redevelopment projects. The estimated heating load of that office building is 4,000 MMBtu per year. In all these projects the Hudson River could potentially be used as heat sink/source for the community heat pump.

6.1.10 Buffalo, NY

Figure 17. Community Heat Pump Redevelopment Opportunity in Downtown Buffalo



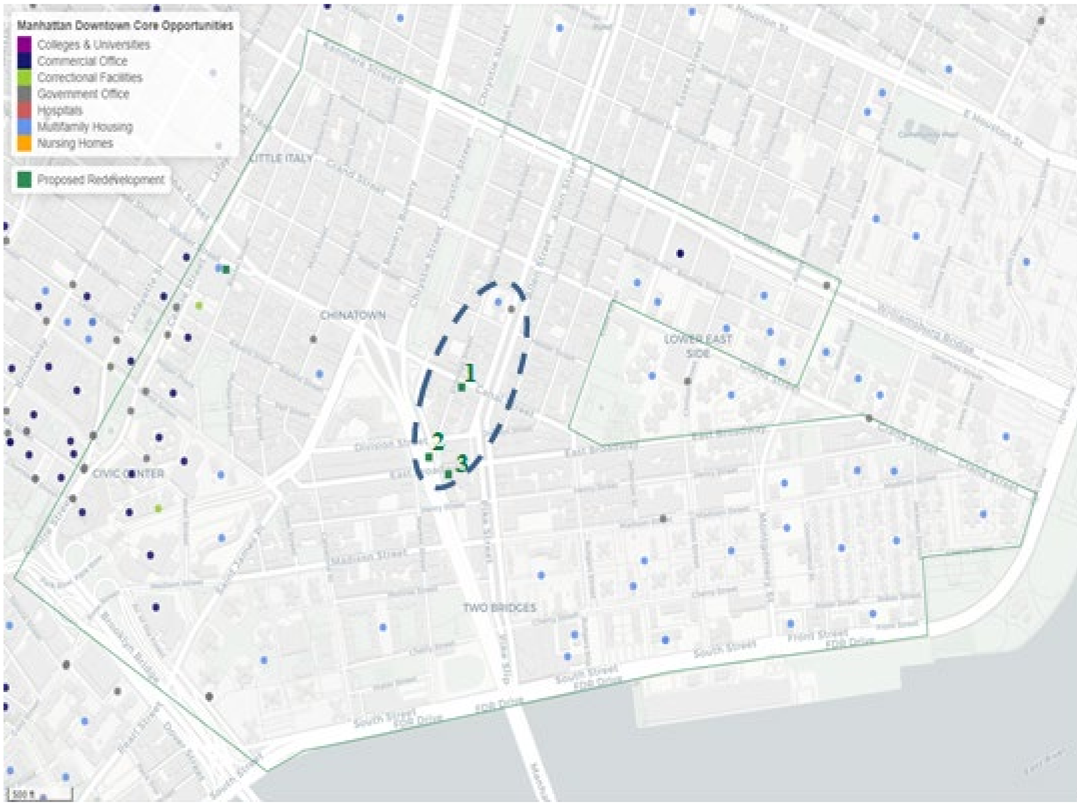
Buffalo was awarded DRI funds in the Round 5 of the initiative. However, the DRI project was focused on Broadway Street about one mile east of downtown, in an area of the city with relatively low-building density. Developer Douglas Jemal plans to redevelop the Mohawk Ramp in downtown Buffalo and transform it into apartment buildings, along with two other mixed-use developments nearby. The dashed blue circle in Figure 17 represents the cluster of buildings that could be connected to a community heat pump system in Buffalo. The proposed redevelopment projects include the following:[26]

- Redevelopment of the Mohawk Ramp site into a 200-unit apartment building with 900 parking spaces.
- The Simon East project which will include a 250-unit apartment building with ground floor retail.
- The Simon West project with 150-unit apartment building with ground floor retail.

There is the potential to connect two government office buildings and one commercial office building to these construction projects. The estimated combined heating load for the additional buildings is roughly 8,000 MMBtu per year.

6.1.11 Manhattan, NY

Figure 18. Community Heat Pump Redevelopment Opportunity in Downtown Manhattan



While Manhattan has the building density to connect many buildings via a community heat pump project, it is likely limited to multi-building renovation projects due to the significant permitting barriers multi-owner community heat pump systems face. Manhattan was awarded DRI funds in the last round of the initiative with projects focused on redeveloping community centers and affordable/senior housing facilities across Manhattan’s Chinatown neighborhood. The dashed blue circle in Figure 18 represents the cluster of buildings that could be connected to a community heat pump system in Manhattan. Proposed redevelopment activities include:

- Development of an affordable and senior housing facility.
- Construction of a center for performing arts with a business incubator and retail tenants on the ground level.
- Development of a senior housing facility.

There is the potential to connect large multifamily housing and government office buildings to these redevelopment projects through a downtown community heat pump system. The estimated combined heat load for these buildings is 3,000 MMBtu per year.

6.2 Summary of Downtown Redevelopment Opportunities

Several downtown redevelopment projects currently in preliminary planning processes could potentially incorporate community heat pump systems, including those identified in this report. All of the highlighted projects involve multiple buildings undergoing redevelopment located near one or more buildings with large thermal requirements. Rather than applying a community heat pump to an entire downtown cluster, it makes sense to start smaller, tying the initial heat pump design to redevelopment projects and adjacent properties. The district energy network can be expanded from there, with additional heat pumps constructed and connected in a 5G configuration to support the additional buildings and loads.

Table 10. Summary of Downtown Redevelopment Opportunities

City	Renovation or Construction Projects	Source of Funding	Potential to Connect Existing Buildings (>1,000 MMBtu/yr)		
			Number of Buildings	Building Types	Annual Heating (MMBtu)
Rochester	Rochester Riverside Convention Center Vacant Buildings on Division and E. Main St Riverside Hotel Cox and Edawards Buildings	DRI Round 5	7	Commercial Office Buildings (5), Hotel, Multifamily Building	46,000
Yonkers	Teutonia Mixed-Use Towers Chicken Island Buildings North Broadway Towers	Private Projects	10	Multifamily Buildings (6), Commercial Office Buildings (3), Government Office Building	43,000
Hempstead	Village of Hempstead Brownfield Opportunity Area Innovation District	Brownfield Opportunity Area	16	Multifamily Buildings (7), Commercial Office Buildings (4), Government Office Buildings (3), Hotel, Nursing Home	60,000
Schenectady	New Housing and Public Parking New Mixed-Use Space, State and Clinton Streets	DRI Round 4	13	Government Office Buildings (5), Commercial Office Buildings (5), Multifamily Buildings (2), Correctional Facility	50,000
White Plains	New Mixed-Use Space (2) Senior Living Facility	Private Projects	12	Commercial Office Buildings (8), Government Office Buildings (2), Multifamily Building, Hotel	94,000
Staten Island	Development of an Innovation Lab Seamen's Society Headquarters	DRI Round 4	10	Multifamily Buildings (4), Government Office Buildings (4), Commercial Office Buildings (2)	41,000
Utica	New Mixed-Use Space (2)	DRI Round 4	5	Commercial Office Buildings (3), Government Office Building, Hotel	36,000
Syracuse	New Mixed-Use Space	DRI Round 5	5	Commercial Office Buildings (3), Government Office Building, Hotel	58,000
Troy (Cluster 1)	Development of Music Center New Innovation Lab Community Resource Center New Mixed-Use Space (2)	DRI Round 5	1	Government Office Building	2,000
Troy (Cluster 2)	New Fitness Center New Grocery Store New Senior Housing Facility New Urban Grow Center	DRI Round 5	1	Commercial Office Building	4,000
Buffalo	New Apartment Building New Mixed-Use Space (2)	Private Projects	3	Government Office Buildings (2), Commercial Office Building	8,000
Manhattan (Chinatown)	New Affordable and Senior Housing Performing Arts Center New Senior Housing Facility	DRI Round 5	2	Multifamily Building, Government Office Building	3,000

7 Conclusions and Takeaways for Community Heat Pumps in New York State

New York State has ambitious decarbonization goals and reducing fossil fuel consumption in buildings can make a significant contribution to meeting these goals. Community heat pumps that use low or zero carbon electricity have been identified as an important technology that can help buildings throughout the New York State transition away from fossil fuels.

Campuses with multiple buildings owned by a single entity are favorable locations for community heat pump systems. ICF identified 400 campuses across New York State with the potential for large-scale community heat pump installations. If these campuses installed community heat pumps to meet their heating and cooling requirements, in conjunction with State utilities converting to zero-carbon electricity, up to 4.5 million tons of GHG emissions could be reduced on an annual basis.[27]

The triage process showed that the most favorable campus opportunities across New York State tend to be found at colleges/universities, multifamily complexes, and hospitals. The campuses that are best positioned to incorporate community heat pumps systems already use district energy systems to meet the thermal needs of its buildings. A majority of campuses that are well-suited to incorporating community heat pumps have sizeable heating requirements and are located in parts of the State with low-grid emissions. This means they can integrate large-scale community heat pump systems that can reduce large amounts of GHG emissions, with higher efficiencies and lower per-unit costs compared to distributed single-building heat pumps. The most favorable opportunities also tend to be found on campuses with plentiful green and/or parking space, which can be use as sites for boreholes necessary to install geothermal ground loops. Additionally, most colleges/universities that were identified as favorable candidates for community heat pump systems are part of the REV Campus Challenge and, therefore, committed to reducing their GHG emission footprints, with some already building clean energy projects on their campuses. Finally, many campuses in New York City will have to comply with the GHG emission guidelines set out in the Local Law 97, requiring them to consider emission reduction strategies, such as community heat pumps, or pay fines if carbon emissions are not reduced.

Downtown areas with densely clustered buildings also present opportunities for community heat pump installations. In New York City, there are thousands of buildings that could potentially be connected across the five boroughs. However, multi-building, multi-owner community heat pumps can be challenging, requiring coordination across building owners, multiple permits with lengthy permitting processes, and construction limitations in densely populated and highly trafficked locations. For downtown opportunities, community heat pumps can be planned alongside other redevelopment efforts.

ICF assessed upcoming redevelopment projects to identify opportunities for community heat pump projects to be incorporated, potentially connecting multiple buildings undergoing construction and renovation with other large downtown buildings in the area. According to project developers, the best strategy may be to start small, identifying multiple buildings with high-thermal loads undergoing redevelopment that can form the core of a downtown community heat pump system. Ideally, a large geothermal heat pump can be constructed near this core of buildings, fulfilling base load requirements for heating and cooling. Supplemental heat pumps, including air source heat pumps located on rooftops, can be connected and used to fill out the peak loads. Several developers engaged in PON 4614 projects are currently planning to install hybrid community heat pump systems incorporating multiple heat pump technologies.

Key takeaways and success strategies for community heat pump project developers include:

1. Flexible Planning for Site-Specific Solutions: Community heat pump opportunities are unique—developers should tailor their proposed heat pump technologies and configurations to take advantage of the following:
   - Available resources (i.e., natural heat sinks/sources).
   - Available ground space (for boreholes, central plant, and distribution infrastructure).
   - Available rooftop space (for air source heat pumps).
   - Make use of multiple technologies in hybrid system.
   - Utilize existing infrastructure for steam/hot water/chilled water distribution.
2. Maximize Geothermal Capacity and Utilize Available Heat Sources:
   - Community heat pumps should maximize the use of boreholes for geothermal energy. Geothermal projects are capital-intensive and benefit from economies of scale. The constant heat sink temperatures also make these systems ideal for base load heating and cooling.
   - Heat pump networks can be expanded to utilize available heat sinks/sources from nearby aquifers, ponds, lakes, rivers, industrial facilities, or wastewater treatment plants.

3. Incentives Should be Substantial and Consistent:
    - Community heat pumps are an emerging technology and incentives will help to increase adoption and drive down costs.
    - Currently, New York State's Clean Heat program offers incentives to customers of investor-owned electric utilities. For geothermal heat pumps, the incentive depends on utility territory, in units of dollars per10,000 Btu/h of full-load heating capacity:[28]
        - Con Edison: $5,000
        - Orange & Rockland: $2,000
        - National Grid, NYSEG, Rochester Gas & Electric: $1,500
    - The disparity in incentives may push developers towards projects in Con Edison's service area.
4. Engage All Campus Sectors in Energy Planning
    - New York State's REV Campus Challenge was successful in engaging Colleges and Universities to assess their current energy use and develop long-term decarbonization plans for their campuses.
    - Similar programs could help hospitals, military bases, correctional facilities, multifamily buildings, and other campus sectors.

NYSERDA's Community Heat Pumps Pilot Program has been successful thus far in engaging heat pump developers to put forward potential community heat pump solutions for campuses and downtown areas, with nearly 40 project sites awarded to date to do a scoping study, detailed design, or construction.

This study showed that there is substantial potential to incorporate community heat pumps throughout the State, which if implemented, will significantly reduce GHG emissions. Criteria for successful community heat pump projects were established, applications were ranked, locations for potential projects were identified, and key barriers and takeaways from current project developers were summarized. With this information, NYSERDA and project developers can target their efforts toward projects that are most likely to succeed and increase the implementation of large-scale community heat pump decarbonization solutions.

Endnotes

[1] Vox article details the climate and clean energy goals in New York’s Climate Leadership and Community Protection Act. https://www.vox.com/energy-and-environment/2019/6/20/18691058/new-york-green-new-deal-climate-change-cuomo

[2] New York City Mayor’s Office of Sustainability report detailing NYC’s 2050 emission targets. https://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/Carbon-Neutral-NYC.pdf

[3] Geothermal heat pumps, sometimes referred to as GeoExchange, earth-coupled, ground-source, or water-source heat pumps, use the relatively constant temperature of the earth as the exchange medium. https://www.energy.gov/energysaver/geothermal-heat-pumps

[4] NYSERDA webpage that details NYERDA’s Community Heat Pumps Pilot Program and PON 4614. https://www.nyserda.ny.gov/All-Programs/Community-Heat-Pump-Systems/Community-Heat-Pumps-Pilot-Program

[5] NYERDA webpage with a map displaying PON 4614 winners. New York State Energy Research and Development Authority, Community Heat Pump Systems Projects, https://www.nyserda.ny.gov/All-Programs/Community-Heat-Pump-Systems/Winners, accessed April 2022.

[6] New York City Mayor’s Office of Sustainability report detailing the climate and clean energy goals in New York’s Climate Leadership and Community Protection Act. https://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/Carbon-Neutral-NYC.pdf

[7] New York Department of Environmental Conservation report that summarizes 2021 statewide greenhouse gas emissions sources. https://www.dec.ny.gov/docs/administration_pdf/ghgsumrpt21.pdf

[8] New York City Council webpage with information on greenhouse gas emissions from the buildings sector. https://council.nyc.gov/data/green/#:~:text=Climate%20change%20is%20primarily%20driven,quarters%20of%20all%20citywide%20emissions.

[9] New York City government link to the bill text of Local Law 97. https://www1.nyc.gov/assets/buildings/local_laws/ll97of2019.pdf

[10] Sierra Club webpage that explains the climate and energy benefits of electric heat pumps. https://www.sierraclub.org/articles/2020/04/new-analysis-heat-pumps-slow-climate-change-every-corner-country

[11] ICF’s Technical Potential Database estimates electric, heating, and cooling loads for commercial, institutional, and industrial buildings throughout the United States above 50 kW average electric load and 1,000 MMBtu/year in heating requirements. Data on buildings and size characteristics are obtained from industry-specific sources (hospitals, colleges, military facilities) or the D&B Hoovers Database. Energy loads are estimated using energy consumption data from the United States Department of Energy’s Energy Information Administration.

[12] New York City Mayor’s Office of Sustainability report detailing the climate and clean energy goals in New York’s Climate Leadership and Community Protection Act and emission reduction estimates associated with district energy systems. https://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/Carbon-Neutral-NYC.pdf

[13] Potential carbon emissions savings were calculated assuming that zero-carbon electricity is replacing on-site heating systems fueled by natural gas, with 85% conversion efficiencies.

[14] U.S. Department of Energy webpage with details about their Commercial Reference Buildings Models. https://www.energy.gov/eere/buildings/commercial-reference-buildings

[15] New York City government link to the bill text of Local Law 97. https://www1.nyc.gov/assets/buildings/local_laws/ll97of2019.pdf

[16] Rochester’s Downtown Revitalization Initiative application. https://www.ny.gov/sites/default/files/2021-12/DRI5_Rochester.pdf

[17] AMS Acquisitions proposal to redevelop downtown Yonkers. https://www.yonkersny.gov/Home/ShowDocument?id=24744

[18] Schenectady’s Downtown Revitalization Initiative application. https://www.ny.gov/sites/default/files/atoms/files/Schenectady_DRI_%20Strategic_Investment_Plan.pdf

[19] Real estate article about plants to redevelop downtown area of White Plains. https://therealdeal.com/tristate/2021/09/29/rxr-agrees-to-build-part-of-860-unit-white-plains-project/

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[23] Syracuse's Downtown Revitalization Initiative application. https://www.ny.gov/sites/default/files/2021-12/DRI5_Syracuse.pdf

[24] Utica's Downtown Revitalization Initiative application. https://www.ny.gov/sites/default/files/atoms/files/Utica_DRI_Strategic_Investment_Plan2021.pdf

[25] Troy's Downtown Revitalization Initiative application. https://www.ny.gov/sites/default/files/2021-11/DRI5_Troy.pdf

[26] Buffalo New article about Douglas Jemal being selected to redevelop the Mohawk Ramp in downtown Buffalo. https://buffalonews.com/business/local/douglas-jemal-selected-to-redevelop-mohawk-ramp/article_a22630b4-892b-11ec-9838-77348b55e42f.html

[27] Potential carbon emissions savings were calculated assuming that zero-carbon electricity is replacing on-site heating systems fueled by natural gas, with 85% conversion efficiencies.

[28] New York State publication that details statewide heat pump incentives. https://saveenergy.ny.gov/NYScleanheat/assets/pdf/NYS-Clean-Heat-Program-Manual.pdf

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