City of Kingston

Municipal Renewable Energy

Implementation Plan

Steven T. Noble
Mayor

May 2025
FINAL

City of Kingston
Municipal Renewable Energy Implementation Plan

Table of Contents

Table of Tables

Table of Figures

Executive Summary

The City of Kingston aspires to a future based on sustainability and resilience. Foundational to this goal is the development of a renewable energy strategy that ensures the City's electricity supply is sourced from local and renewable resources. Given its history of sustainability leadership, the City aims to advance more ambitious renewable energy goals and realize the numerous benefits of local clean energy. It also hopes to pilot innovative models that can be replicated and scaled by other jurisdictions or municipalities throughout the region. Alongside Ulster County's leadership, the City of Kingston commits to the transition to renewable energy, reduce emissions by 50% below 2010 levels by 2030[1], and reach 70% renewable energy by 2030[2].

The City of Kingston used 170,731 MWh of electricity in 2022-23, with 14% (23,902 MWh) from renewable sources. By 2030, electricity use is expected to grow 12% to 191,219 MWh. To meet the goal of 70% renewable energy by 2030, the City needs 133,853 MWh of renewable power. With the assumption that 53% of electricity on New York's grid is expected to come from renewable sources by 2030[2], Kingston still needs an extra 32,507 MWh from local renewable sources.

The City of Kingston has significant potential for expanding renewable energy sources to support the City's goal to reduce emissions by 50% by 2030 and New York's goal of achieving 70% renewable electricity by 2030. Various renewable energy options, including energy storage, solar, geothermal, biofuels, hydroelectric, wind, and microgrid management have been evaluated for their feasibility and impact. Throughout this evaluation it has been determined that the most achievable renewable resource would be solar energy. Below are considerations of other means of renewable energy.

Solar Energy produced within Kingston currently provides 3% of the City's 2030 electricity needs and Kingston's potential for expanded solar energy production is large. This report estimates the City could produce 173,828 MWh annually, more than enough to meet and exceed the 70% goal, if solar was installed on rooftops and parking lots. The highest-impact opportunity is large rooftop solar, which could contribute 15% of projected demand and 87% of the City's 2030 renewable energy goals across only 56 privately owned rooftops.

Solar Thermal Energy has the potential to offset a large portion of energy required for hot water or the energy needed to heat buildings. Although Solar Thermal Energy was not considered in this report it will be considered in full in future iterations of this plan.

Geothermal Energy also presents a promising opportunity for heating and cooling applications rather than electricity generation. Several public and private geothermal projects are underway, including a municipal Thermal Energy Network (TEN) strategy, which could expand access to geothermal heating and cooling solutions.

Biomass and Biogas Energy are already utilized in Kingston for heating and waste-to-energy applications. While no biomass power plants operate in the City, some households do use wood for heating. The wastewater treatment plant has the potential to generate 891 MWh of biogas-sourced electricity annually through a combined heat and power system.

Energy Storage will be critical in integrating renewable energy sources into the grid, ensuring reliability and efficiency. Kingston currently has 44.78 kW of energy storage, with additional capacity connected to power circuits that extend beyond municipal boundaries. Virtual power plants and pumped storage projects have also been identified as emerging opportunities, though financial and infrastructure challenges remain.

To accelerate Kingston's transition to clean energy, a strategic approach is needed to expand solar installations on municipal, commercial, and residential properties. Between 2013 and 2023, solar installations in Kingston averaged 500 kW per year, which, if continued, would add only 3 MW by 2030—far below the City's renewable energy targets. To

[1] https://engagekingston.com/climate-action-plan
[2] https://climate.ny.gov/dashboard

bridge this gap, Kingston must implement targeted strategies to increase solar adoption and enhance renewable energy deployment.

The framework for Kingston's renewable energy transition is structured around four key pillars:

1. **Foundational Policies and Programs** – Align policies with advancing renewable technologies, reducing costs, and removing barriers to adoption.
2. **Municipal Supply Mix Strategies** – Increase the share of renewable energy in the municipal electricity supply to set a strong leadership example.
3. **Community Choice Aggregation** – Pool residential and business electricity demand to procure more renewable energy at a community level.
4. **Scaling Local Generation** – Encourage distributed energy projects to increase renewable energy production within Kingston.

By prioritizing these strategic initiatives, Kingston can accelerate solar deployment, expand local clean energy generation, and achieve its goal of 70% renewable electricity by 2030. Strategic investments in energy storage, community-based solar initiatives, and geothermal heating networks will further enhance the City's renewable energy capacity while promoting environmental sustainability and energy equity.

1. Background and Context

1.1 About the Plan

In December, 2023, then Legislative Chair Tracey Bartels appointed the Ulster County (UC) 70x30 Renewable Energy Implementation Plan (REIP) Working Group to develop an implementation plan for Ulster County to generate 70% of the electricity used by all sectors from renewable energy resources and to see how we can contribute to the achievement of the goals of New York State's Climate Leadership and Community Protection Act (CLCPA) to transition to a renewable energy economy with increased electricity storage and energy efficiency. Each municipality in Ulster County was also asked to create a similar plan for their municipality. The City of Kingston committed to creating this plan to compliment the County's plan and to set a pathway forward.

To inform this plan, multiple Kingston board members participated in the "How to Solar Now" Mapping Tool Trainings, offered by Clearwater, Scenic Hudson and New Yorkers for Clean Power. The training taught participants to use Scenic Hudson's Solar Mapping Tool, which determines prime areas for solar development and areas to be avoided and protected, such as forested areas and prime agricultural lands. The training also touched upon Scenic Hudson's SMART Solar Siting concept and the importance of having a strong zoning code. The practices recommended in the Solar Mapping Tool send an important signal to developers and ensure that local planning and zoning are aligned with New York's goal of 70% renewable generation by 2030 and 100% by 2040. Kingston participation in training has included:

Full Training

Melissa Iachetta	Climate Smart Kingston Commission
Kevin McEvoy	Kingston Conservation Advisory Council
Brad Borquist	Climate Smart Kingston Commission; Kingston Engineering Office

Tutorial

Ted Griese	Kingston Conservation Advisory Council
Emilie Hauser	Kingston Conservation Advisory Council
Briana Gary	Kingston Conservation Advisory Council
Roberto Rivera	Climate Smart Kingston Commission
Chaya Huber	Climate Smart Kingston Commission
Elizabeth Broad	Climate Smart Kingston Commission
Dan Smith	Climate Smart Kingston Commission
Karen Sullivan	Climate Smart Kingston Commission
Cal Trumann	Climate Smart Kingston Commission
Vicky Kennedy	Climate Smart Kingston Commission
Arielle Gartenstein	Kingston Environmental Specialist
Julie Noble	Kingston Sustainability Coordinator

This training provided a baseline template for how to create a Municipal Renewable Energy Implementation Plan, as well as assistance with the methodology for computing data. All of these inputs help to inform this plan.

This City of Kingston Municipal Renewable Energy Implementation Plan was primarily authored by City Staff: Brad Borquist (Engineering), Philip Schoettle-Greene (Sustainability), and Julie Noble (Sustainability). Review and revision contributions came from Kingston Conservation Advisory Council members Malia DuMont, Emilie Hauser and Brendan Walsh. Once completed, this plan will be incorporated into the Ulster County 70 x 30 Renewable Energy Implementation Plan as an Appendix. This plan serves as a guide for the municipal energy transition and should be revisited and updated every 5 years.

1.1 Energy in Context

Throughout New York the average residential consumption of electricity was about 6,800 kWh per year and throughout the US the average per household consumption is 10,791 kWh per year according to the EIA. To put this into perspective one microwave (1000 watt) uses 1 KWh if it was running for one hour. This could also be represented by one 40-watt incandescent light bulb or three (3) LED light bulbs on for one full day. The difference between power(capacity) and energy is that power is the rate at which energy is moved, and energy is the intrinsic quantity or property of physical things. For example, the energy to boil a pot of tea is 0.1 kWh and would take an hour if that energy is transferred at only 100 watts. At higher power the pot of tea could boil in 6 minutes if the energy transferred at a rate of 1 kilowatt. The power and energy consumed throughout a community is much higher and needs to be explained in Megawatt-hours (MWh) and Megawatts. A Megawatt is the power equal to 1,000 kilowatts and the energy is in Megawatt-hours or equal to 1,000 kilowatt-hours(kWh). Throughout the City of Kingston there is approximately 74 Megawatts of grid capacity and approximately 173,000 MWh flow through the grid system each year.

1.2 Equitable Implementation

The City acknowledges that we can build a just, resilient, stable, and affordable future for all our residents by taking our energy future into our own hands. This means including everyone as we transition away from fossil energy, making homes and businesses more energy efficient, and creating new forms of cooperative energy ownership and wealth-building. We value a community centered approach which leverages local knowledge, facilitates local control, and

provides opportunities for community ownership of shared clean energy resources. We acknowledge the importance of addressing environmental injustices, and so proceed with particular emphasis on low-income, Black, Indigenous, and communities of color that have been disproportionately harmed by the extractive energy economy and continue to experience the effects of climate change first and worst.

Most of Kingston's residents live in NYS Climate Act designated Disadvantaged Community (DAC) areas. DACs are census tracts that are both low income, have vulnerable or historically marginalized populations and are more likely to have negative public health effects from environmental pollution and the impacts of climate change. Of Kingston's eight census tracts, five are categorized as DAC (Figure 1).

It is a key tenet of Kingston's energy transition that we focus on maximizing benefits and reducing harm to all communities within the City, recognizing that particular attention must be given to those that are disadvantaged. Implementing a renewable energy plan will drive transformative growth of new industry and job opportunities as well as changes to land use and development. Kingston is dedicated to ensuring, to the best of its ability, that DACs have access to the opportunities that come with this energy transition and that these same communities not bear a disproportionate burden of the costs that will come with implementation.

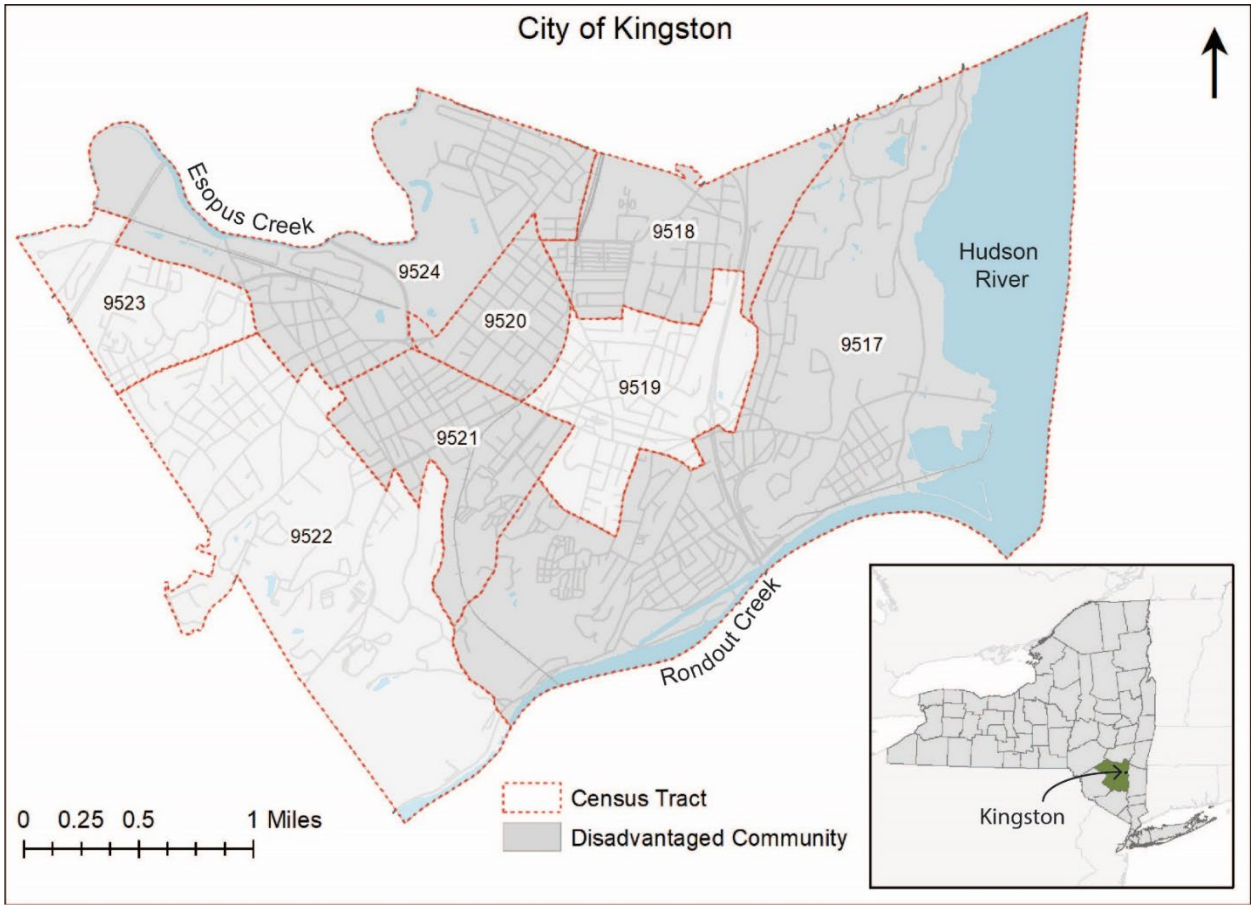

Figure 1: A map of the City of Kingston showing Designated Disadvantaged Communities (DACs).

1.3 NYS Energy Statutes and Background[3]

- New York law requires 70% renewable electricity by 2030 and 100% carbon-free electricity from both renewable sources and nuclear energy by 2040. In 2023, renewable sources and nuclear power combined supplied 49% of New York's total in-state generation from utility-scale and small-scale facilities.
- Nuclear power accounted for 22% of New York's utility-scale net generation in 2023, down from 34% in 2019 because the Indian Point nuclear power plant, one of the state's four nuclear power plants, shut down. The last two reactors at the Indian Point plant shutdown in 2020 and 2021.
- In 2022, New York accounted for 11% of U.S. hydroelectricity net generation, and the state was the third-largest producer of hydropower in the nation, after Washington and Oregon.
- In 2023, only 7% of electricity was renewably produced in Downstate New York, the area that includes Kingston.
- New Yorkers consume less total energy per capita than the residents in 48 other states in the U.S., and per capita energy consumption in New York's transportation sector is lower than in all other states.
- New York's per capita energy-related carbon dioxide emissions are consistently lower than those of any other state in the nation.
- The CLCPA, effective January 2020, outlines New York State's goals for reducing greenhouse gas emissions and transitioning to renewable energy.
    - 40% reduction in greenhouse gas emissions from 1990 levels by 2030.
    - 85% reduction in greenhouse gas emissions from 1990 levels by 2050.
    - Net-zero emissions statewide by 2050.
    - 100% zero-emission electricity by 2040.
    - 70% renewable energy by 2030.
    - Significant targets for offshore wind, solar energy, and energy storage installations.

1.4 City of Kingston's Climate Leadership and Goals

The City of Kingston is a municipal leader in the clean energy transition. From designing blueprints for sustainable, resilient, and independent energy systems, to making community-wide, bold, transformative plans, the City has been a champion in the region and the state.

Achievements since 2007

- Accolades
    - Highest ranking City in NYS New York State Energy Research and Development Authority (NYSERDA) Clean Energy Community Designation
    - Highest ranking Climate Smart Community in NYS- Silver Certified
    - Bronze SolSmart Community

[3] From EIA Quick Facts

- Action
  - 49 kilowatt (kW) Solar System installed on Andy Murphy Neighborhood Center
  - $1.8 Million NYSERDA Grant award to decarbonize City Hall and Andy Murphy Neighborhood Center
  - LED Conversion of all City Streetlights
  - LED Conversion of all Municipal Buildings
  - 20% Reduction in greenhouse gases (GHGs) by 2020
- Energy Legislation
  - NYStretch Energy Code
  - Unified Solar Permit
  - Environmentally Preferrable Procurement Policy
  - Green Fleet Policy
  - Anti-Idling Policy
  - Building Energy Benchmarking
  - Energize NY Financing
  - Adoption of Community Choice Aggregation Program
- Planning
  - 100% Renewable Energy Transition Roadmap (2020)
  - 2030 Climate Action Plan
  - Municipal Utility Thermal Energy Network Feasibility

Goals

- 100% Clean Energy by 2050
- 50% GHG Emissions Reductions Below 2010 Levels by 2030
- 100% Committed: City pledge to help our community shift to 100% renewable electricity

1.3.1 City of Kingston 100% Renewable Energy Transition Roadmap 2020

In 2019, in partnership with the NoVo Foundation, the City of Kingston hired Cadmus and the National Renewable Energy Laboratory (NREL) to develop a long-term roadmap for Kingston to achieve a 100% renewable and resilient community-wide electricity supply. The roadmap identified four key pillars to achieving this transition:

- **Foundational Policies and Programs** that enable and support Kingston's energy transition by ensuring alignment with current and future renewable energy technologies to reduce costs and policy barriers associated with renewable energy integration.
- **Municipal Supply Mix Strategies** that allow Kingston to lead by example by taking direct action to increase the renewable share of the municipal electricity supply mix.
- **Community Choice Aggregation** that enables Kingston to pool the electricity load of residents and businesses within the community and procure electricity on their behalf.
- **Scaling Local Generation** by encouraging the deployment of local distributed energy resources within Kingston.

The current report builds on this previous analysis, incorporating a review of City renewable electricity capacity, providing an update on progress towards the implementation of each pillar, and present additional strategies to achieve the goal of 70% renewable energy by 2030.

Image 1. Solar array ribbon cutting

2. Electricity Landscape

2.1 Electricity Delivery and Supply

Electricity is delivered to the City of Kingston by a power grid owned and maintained by Central Hudson Gas & Electric (Central Hudson). Consumers have the option to purchase electricity from any energy service company (ESCO)[4] that serves Central Hudson territory, paying Central Hudson for delivery fees alone. While this option means that any consumer's mix of electricity sources can be different, the electricity mix purchased by Central Hudson[5] to sell to customers is largely derived from fossil fuels, with only 14% produced by renewable sources (Figure 2, A).

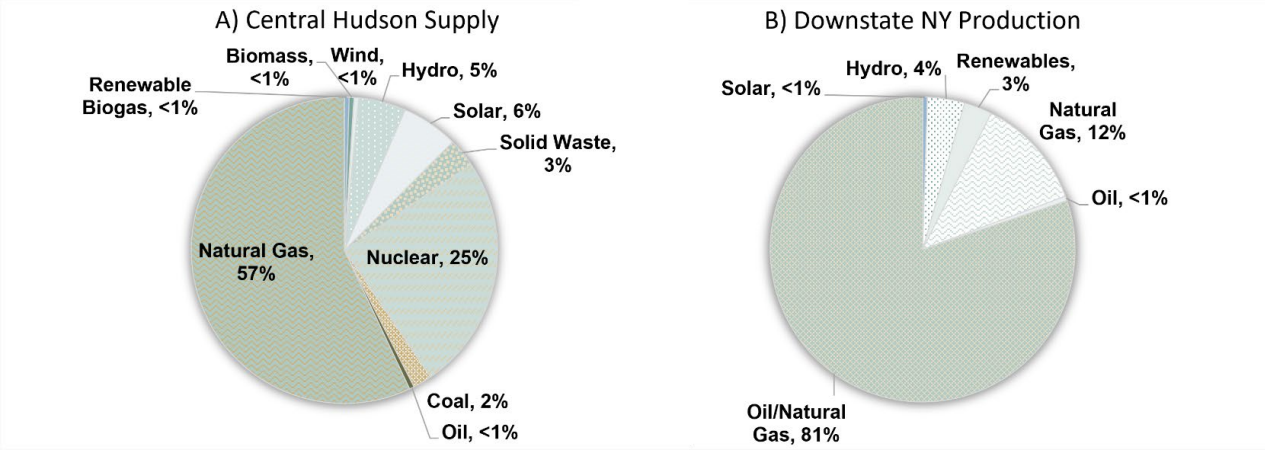

Figure 2: A) Central Hudson electricity supply mix in 2023. B) Electricity production in Downstate NY.

[4] https://documents.dps.ny.gov/public/common/EscoSearch.aspx
[5] https://www.cenhud.com/globalassets/pdf/about-us/environmental-responsibility/2023edplabel.pdf

Electricity production in the Downstate region of New York[6], spanning the Hudson Valley, NYC, and Long Island, in 2023 was overwhelmingly from fossil gas and oil power plants, with only 6.65% from renewable electricity plants according to the 2024 NYISO Power Trends Report[7] (Figure 2, B). Less than 1% of the renewable energy came from solar power and there was negligible wind power generated in the Downstate region.

2.1.1 Electricity Grid Hosting Capacity

The hosting capacity of Kingston's electricity grid is a measure of how much electricity can be fed into the grid in the City. Central Hudson provides regularly updated hosting capacity maps[8] that illustrate the available capacity for integrating electricity from distributed energy generation like solar panels and battery storage sources across their service area. These maps are part of a broader initiative by the Joint Utilities of New York to enhance transparency and support the integration of renewable energy sources.

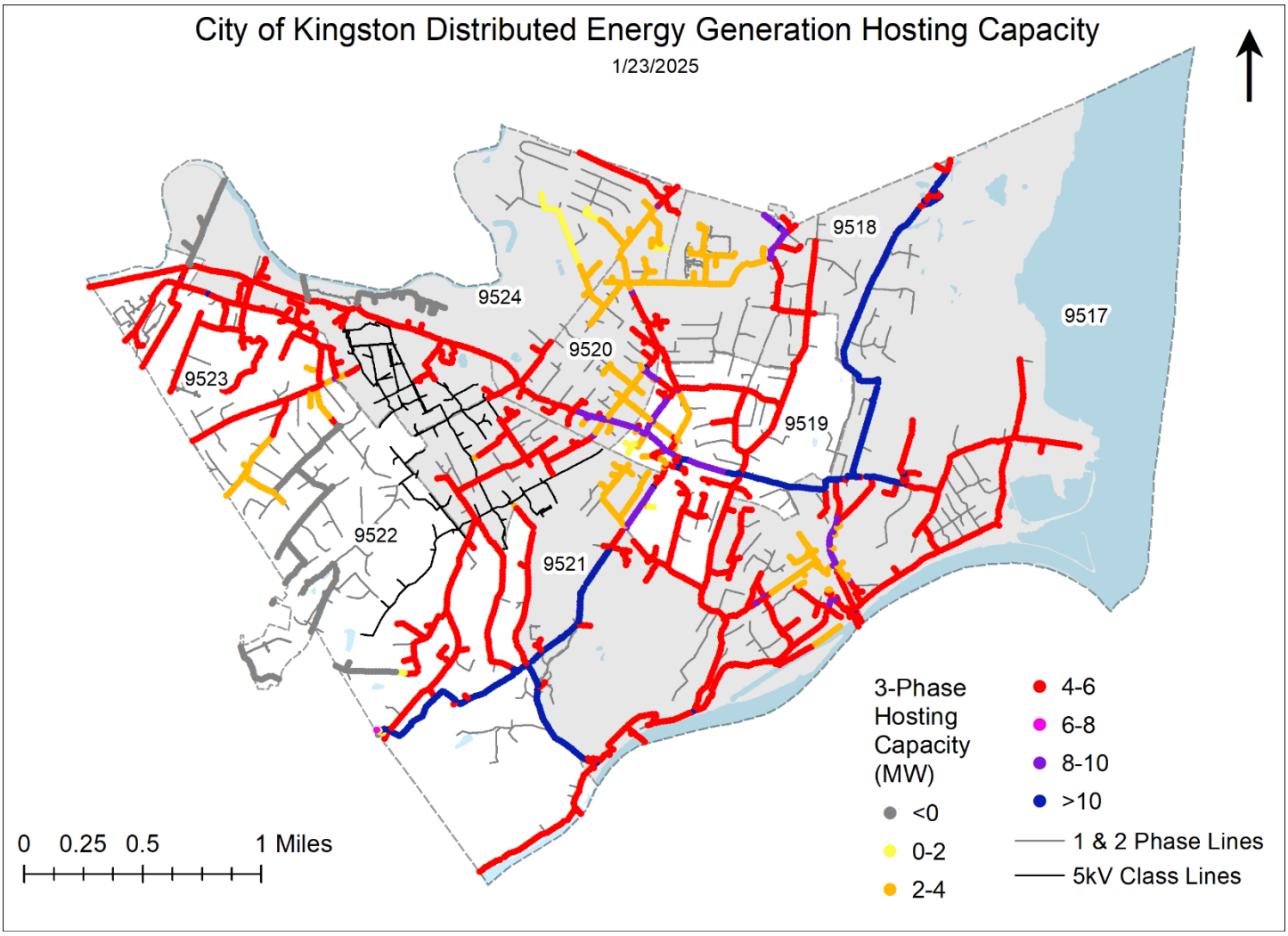

Figure 3: Map of Central Hudson distributed energy generation hosting capacity in the City of Kingston.

[6] https://www.nyiso.com/documents/20142/2223020/2024-Power-Trends.pdf
[7] https://www.nyiso.com/power-trends
[8] https://www.cenhud.com/en/my-energy/distributed-generation/hosting-capacity-maps/

There are a total of eight (8) Central Hudson grid circuits fed by two of the substations located within the City of Kingston and fed by other substations outside of the City limits. These circuits and substation capacity limit the amount of local generation of renewable energy. The current total distributed energy generation hosting capacity for all feeders within Kingston is approximately 74 MW. This capacity is not evenly distributed, however, with some 3-phase corridors with more than 10 MW of capacity and others where little to no capacity remains (Figure 3). In areas with only 1 & 2 phase and 5kV power lines, distributed energy projects are limited to 50 kW in size. Similarly, the hosting capacity for battery discharge is varied across Kingston. Generally, hosting capacity for battery discharge is lower than that for distributed energy generation on the main 3-phase energy circuits in the City.

2.2 Kingston's Electricity Consumption

Analysis of data from the Utility Energy Registry[9], a service provided by NYSERDA and the federal Department of Energy, reveals that the City of Kingston's electricity consumption in 2022 was 180,971 megawatt hours (MWh) (Figure 4). In 2023, this figure dropped significantly to 160,490 MWh, reflecting a notable year-over-year decrease of 20.1%. This sharp decline cannot be fully explained by changes in weather patterns or efficiency improvements. A potential explanation may lie in issues with new billing software introduced at the end of 2021, which may have affected the accuracy of these data sets. As additional data becomes available, the Renewable Energy Implementation Plan (REIP) will be updated to reflect any changes or new insights.

Electricity use data for all utility accounts in the City of Kingston from 2021 to 2024 show seasonal and year-over-year trends. Over all four years, there is higher consumption in winter months and during summer. 2022 generally exhibited the highest monthly electricity usage compared to other years, particularly in March, where it peaked significantly. Data was not available from April 2022. Conversely, usage in 2024 appeared lower compared to previous years in most months, indicating a possible reduction in City-wide electricity demand.

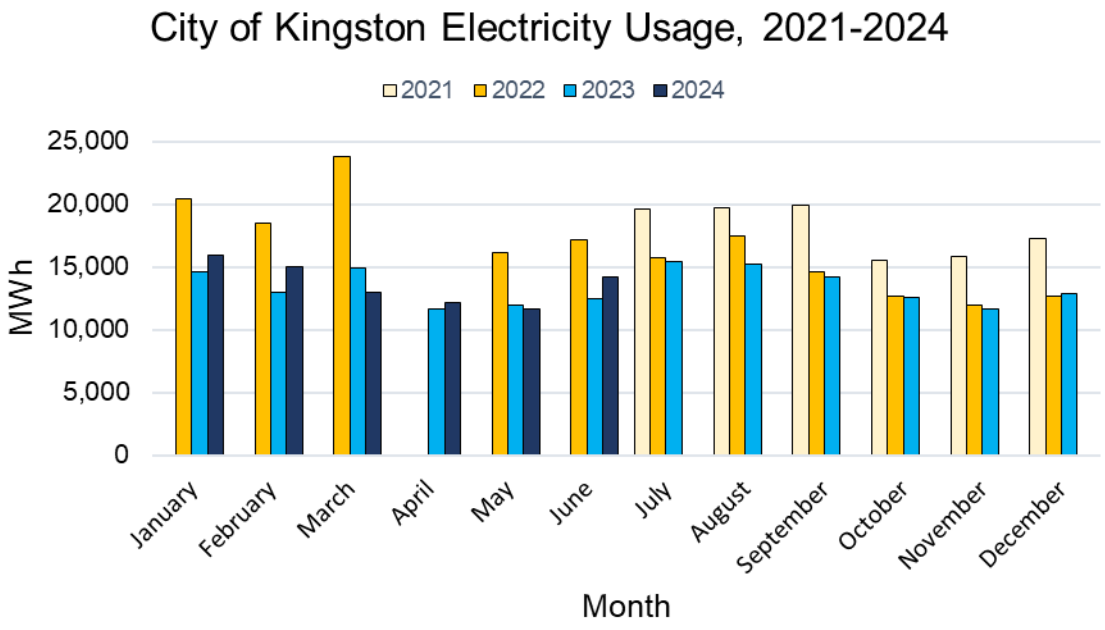

Figure 4: City of Kingston electric consumption.

[9] https://utilityregistry.org/app/#/

In both 2022 and 2023, the two years with nearly complete records, Kingston residential Central Hudson accounts represented about 81% of the total accounts, while non-residential accounts accounted for 19% (Table 1). On average, residential accounts used approximately 61,000 to 67,500 MWh of energy, making up 37% to 39% of total energy consumption. Non-residential accounts, on the other hand, used around 98,600 to 113,500 MWh, which constituted 61% to 63% of total energy use. These figures highlight that residential accounts have a smaller share of total energy consumption compared to non-residential accounts, despite the larger number of residential accounts.

	Accounts (#)		Use (MWh)		Accounts (%)		Use (%)	
Year	**2022**	2023	**2022**	2023	**2022**	2023	**2022**	2023
Residential	**10,424**	10,331	**67,507**	61,837	**81**	81	**37**	39
Non-Residential	**2,396**	2,440	**113,464**	98,653	**19**	19	**63**	61
Total	**12,819**	12,771	**180,971**	160,490	**100**	100	**100**	100

Table 1: City of Kingston electricity account affiliations and consumption.

2.2.1 Benchmarking - How do we compare?

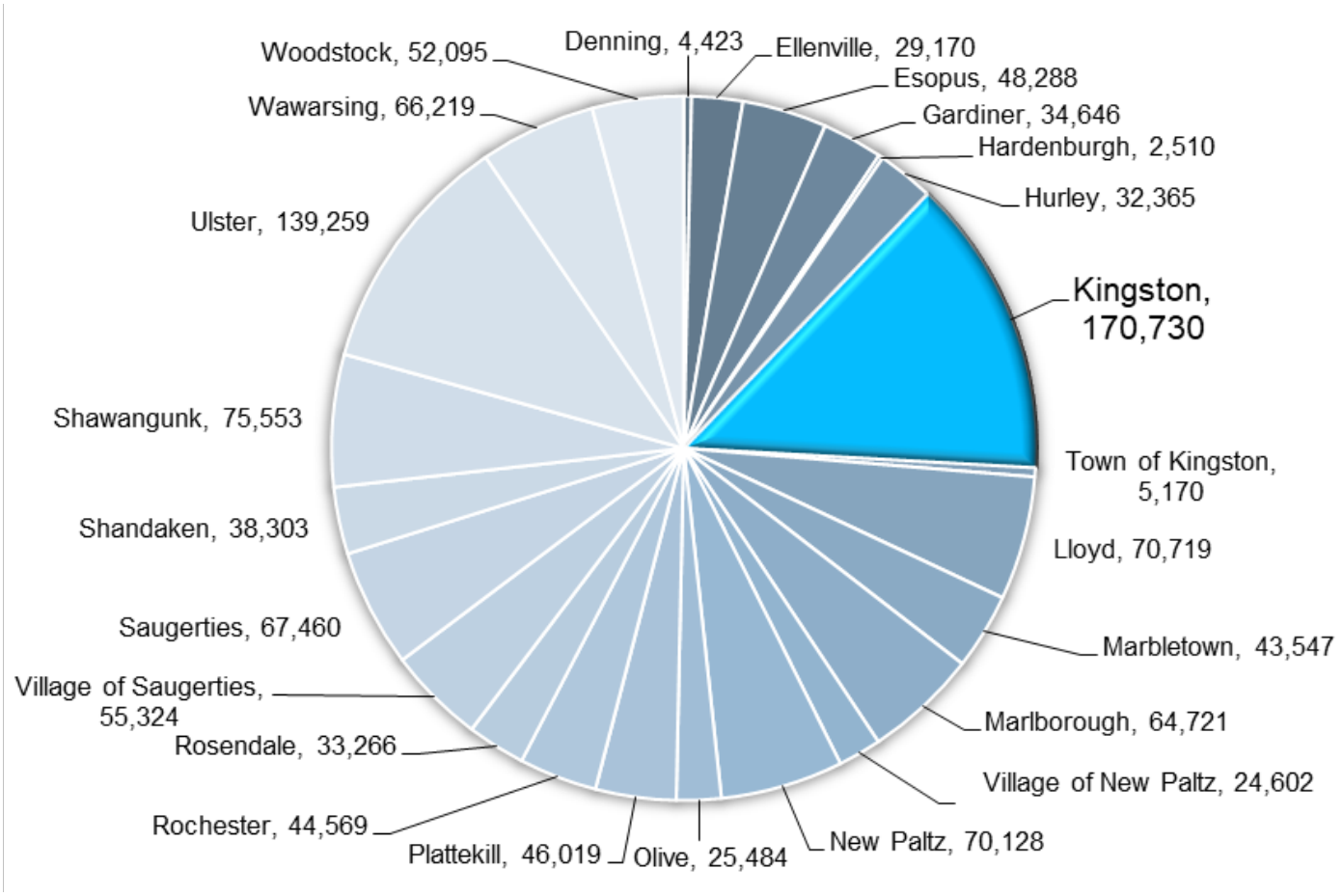

Figure 5: Annual average electricity consumption in MWh/yr for Ulster County communities from 2022-23.

The Ulster County municipalities with the largest electricity consumption (Figure 5) are the City of Kingston, Town of Ulster, and Town of Shawangunk. The City of Kingston and Town of Ulster combined alone account for approximately 25% of the County's electricity demand. Below is a list of per-capita electricity consumption for these municipalities:

City of Kingston: usage = 170,730 MWh and population of 23,920

7.14 MWh per-capita

Town of Ulster: usage = 139,259 MWh and population of 12,660

11 MWh per-capita

Shawangunk: usage = 75,553 MWh and population of 14,332

5.27 MWh per-capita

Differences in per-capita consumption may reflect the portion of electricity used for non-residential purposes in each location. In the Town of Ulster, where there is considerable energy demand for large retail and industrial space, the per-capita electricity use is higher than in the more residential Kingston and Shawangunk municipalities.

2.2.2 Municipal Electricity Use

The City of Kingston is dedicated to fostering a sustainable future by taking steps toward transitioning municipal accounts to 100% renewable electricity as is evident by the City's 2030 CAP goals and progress to date. While municipal consumption is only about 3% of the City's total electricity usage (4,550 MWh in 2023), sourcing this electricity from renewable sources offers the opportunity to lead by example. To advance the transition to renewable energy, the City participates in and sources from a varied portfolio of renewable energy initiatives (Figure 6). These include the purchase of Renewable Energy Certificates (REC), participation in community solar programs, and the installation of municipal solar arrays.

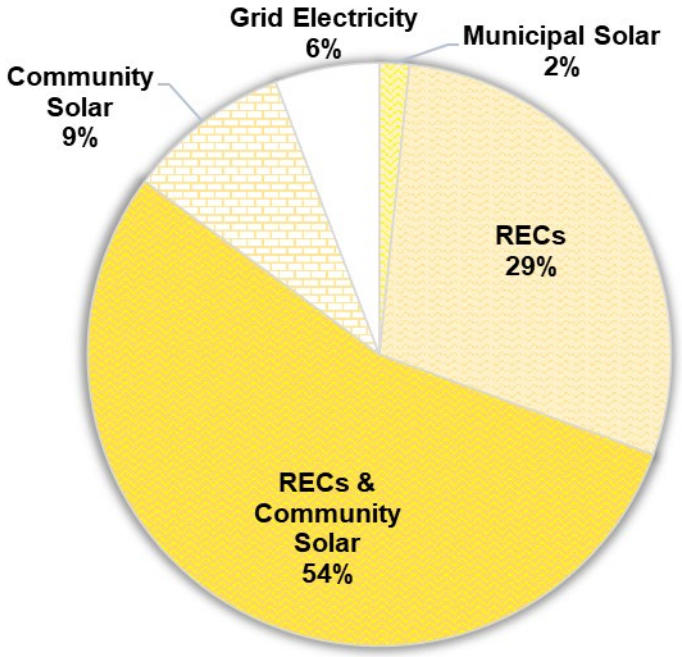

Figure 6: Electricity account affiliations for the City of Kingston municipal accounts in 2024.

To access renewable energy, the City entered into a power purchase agreement with Constellation Energy through the NewMix® Renewable Energy Certificates (RECs) program in 2021. This program sells RECs produced by wind and/or solar facilities nationwide. The City's contract with Constellation Energy provided electricity and RECs for approximately 70% of

municipal accounts in 2023 (68% of municipal electricity consumption), increasing to 83% of municipal accounts in 2024 (approximately 90% of municipal electricity consumption).

Kingston supports local renewable energy efforts through community solar in partnership with Community Energy, SunCommon, and Radio Kingston. Municipal solar generation is also becoming increasingly important to the City's energy mix. In 2023, Kingston saw notable contributions from its on-site solar systems, including the installation of a 49-kW system on the Andy Murphy Neighborhood Center (AMNC), with an annual generation 52.9 MWh, as well as a 6-kW system at Forsyth Park. Additional municipal solar projects in planning and construction phases will increase on-site production, covering approximately 10% of municipal electricity needs.

3. Local Renewable Energy Production and Storage

In the section below, there is a review of different renewable energy sources and their applicability to the City of Kingston and NY's goal of 70% grid renewable electricity by 2030. Table 2 outlines the current forms of renewable energy and their production in the City of Kingston, Ulster County, and New York State (Table 2).

Location	Energy Storage	Hydroelectric	Wind	Geothermal	Biofuel	Solar
Kingston	Yes	No	No	Yes - heating	Yes - heating	Yes
Ulster County	Yes	Yes	Yes	Yes - heating	Yes - heating	Yes
New York	Yes	Yes	Yes	Yes - heating	Yes – heating & electricity	Yes

Table 2: Summary of renewable energy production and storage in Kingston, Ulster County, and New York State.

3.1 Energy Storage

Energy storage will play an increasingly important role in the electricity grid as Kingston expands its renewable energy capacity. Energy storage systems are technologies that store energy for later use, helping to balance supply and demand in power grids. These systems are essential for integrating renewable energy sources, like solar and wind, which can be intermittent. Common types of energy storage include batteries, pumped hydro storage, compressed air energy storage, and thermal storage. By storing excess energy when demand is low or generation is high, these systems release power when demand spikes or renewable generation drops, ensuring a stable and reliable energy supply.

In 2019, the CLCPA set goals including 1,500 MW of energy storage by 2025 and 3,000 MW by 2030. In June 2024, New York's Public Service Commission expanded the goal to 6,000 MW by 2030.

On June 20, 2024, the New York Public Service Commission approved the Order Establishing Updated Energy Storage Goal and Deployment Policy[10] . This Order formally expands the State's goal to 6,000 Megawatts of energy storage to be installed by 2030, and authorized funds for NYSERDA to support 200 Megawatts of new residential-scale solar, 1,500 Megawatts of new commercial and community-scale energy storage, and 3,000 Megawatts of new large-scale storage. These projects will reduce projected future statewide electric system costs by nearly $2 billion, in addition to improved public health from reduced exposure to harmful fossil fuel pollutants.[11] The Order specifies that at least 35% of the benefits of these new energy storage projects will accrue to disadvantaged communities, in accordance with the Climate Act.

[10] https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Programs/Energy-Storage/2024-06-6GW-Energy-Storage-Order.pdf
[11] https://www.nyserda.ny.gov/All-Programs/Energy-Storage-Program

A novel approach to energy storage is the virtual power plant. Virtual power plants interconnect and manage energy storage and distributed energy generation systems using networked software. They work to aggregate and optimize energy storage and consumption, mimicking the performance of a traditional power plant but without the need for centralized infrastructure. Companies like Green Mountain Power in Vermont are leading the way in deploying virtual power plants, offering programs that integrate distributed energy resources to create a more resilient and sustainable energy grid. Green Mountain Power's virtual power plant has ~50 MW capacity and is estimated to save customers around $3 million per year.

3.1.1 Local Potential for Energy Storage

At the writing of this report, there is at least 44.78 kW of energy storage from six projects in the City of Kingston[12]. An additional 4,077 kW storage from eleven sites are connected to power circuits that cross Kingston's municipal boundary. There is considerable room for expansion of energy storage in Kingston, with 38.4 MW of available hosting capacity on the power grid.

There are many types of energy storage systems, hydrogen, battery, chemical, mechanical and thermal storage systems. Mechanical storage takes advantage of gravitational potential energy. This can be achieved by lifting and lowering a large mass or pumping water from one elevation to a higher elevation. Most of these competing alternative energy storage and generation methods, besides mechanical storage, provide more lucrative financial payback. Pumped storage systems are a type of mechanical energy storage system that can take significant up-front investments. In the private and public investment markets a return of less than 20 years is typically desired, usually the lowest being best. Pumped energy storage on the other hand has a much longer return on capital in the range of 40 years or more. This makes implementation and broad adoption of this technology limited. In addition, battery technology can be installed and started much quicker than pumped storage. The CLCPA referenced above provides support for energy storage demonstration projects, including pumped storage projects, and the recent federal Infrastructure Investment and Jobs Act set aside $355 million for these projects.

An opportunity for adjoining communities of Port Ewen and the City of Kingston could be a possible location for pumped storage. From preliminary evaluation the location checks of one of the important components of pumped storage, a large change in elevation over a short distance. The rim of the reservoir made by previous mining activities sits approximately 120 feet above the normal level of the Rondout Creek and the Hudson River.

3.2 Hydroelectric Power

Hydroelectric power, or hydropower, is a renewable energy source that generates electricity by harnessing the energy of flowing water. Typically, water is forced to flow through turbines that spin and generate electricity. Hydropower is one of the oldest and most widely used forms of renewable energy, currently providing approximately 20% of New York State's electricity. It is clean, efficient, and capable of generating large amounts of power.

3.2.1 Local Potential

In 2013 and again in 2023, City staff undertook a preliminary evaluation of the feasibility of and potential value of in-conduit hydropower turbines both within the City's municipal drinking water transmission system and within the municipal wastewater discharge system. City staff and energy advisors from Mid-Hudson Energy Transition, met with Rentricity, a firm that designs, builds and installs hydropower systems, and completed an Electricity Recovery Simulator. This study found no opportunity for hydropower generation because there was not enough potential energy (or pressure) in Kingston's water and wastewater transmission systems.

[12] https://data.ny.gov/Energy-Environment/All-Statewide-Energy-Storage-Projects/hspb-4n4p/about_data

The Rondout, Esopus, and Hudson Rivers are possible candidates for new dammed hydropower, but each comes with significant environmental and social tradeoffs. If these rivers were to be dammed, endangered and threatened aquatic species in the Hudson River Estuary would be affected. The State is actively pursuing dam removal and mitigation projects to improve aquatic connectivity in the Hudson River Estuary[13] and permitting new dam construction is highly unlikely. Potential upstream flooding of private property with new dam construction is also a significant obstacle to a new hydropower dam being built within the City of Kingston.

While the City of Kingston is not well positioned to add to the State's hydropower capacity, the 2026 completion of the Champlain Hudson Power Express (CHPE) will deliver 1,250 MW of hydropower from Quebec to New York City. Additional existing in-state capacity also clearly positions hydropower as a major component of the State's goal to reach 70% renewable power by 2030.

3.3 Wind Power

Wind power is a form of renewable energy that harnesses wind to generate electricity. This is typically done using wind turbines, which convert the movement of air into mechanical energy, and then into electrical energy through a generator. Wind power is considered a clean, sustainable alternative to fossil fuels, as it produces no emissions or pollutants during operation.

New York State currently has 2,627 MW of installed onshore wind power and 132 MW of installed offshore wind power[14]. The CLCPA set a target of 9,000 MW of offshore wind energy in New York by 2035[15]. As of July 2024, the State has met 21% of this goal with installed and planned projects. The CLCPA does not have stated goals for onshore wind capacity but several wind facilities with approximately 100 MW capacity are planned for northern New York[16].

3.3.1 Local Potential

In the City of Kingston, average annual wind speeds[17] are too low to make installed turbines a viable renewable energy source currently. However, improvements to wind turbine efficiency may make wind power a viable source in the future. Nonetheless, increasing wind power capacity Upstate and offshore Long Island is set to play a major role in reaching the state-wide goal of 70% renewable power by 2030.

3.4 Geothermal Power

Geothermal power is a form of renewable energy that harnesses the heat stored beneath the Earth's surface to generate electricity or provide direct heating. This heat is accessed through drilled wells and can be used to drive turbines connected to generators, producing electricity, or it can be used directly for heating and cooling buildings. Using Geothermal heat directly can help reduce fossil fuel use for heating and cooling buildings. Geothermal energy is reliable, sustainable, and produces very low emissions.

3.4.1 Local Potential

Geothermal heat pumps are installed at several facilities in Kingston with several initiatives in the works to evaluate and design future geothermal systems. City Staff are evaluating models for geothermal operations to heat and cool City Hall

[13] https://dec.ny.gov/nature/waterbodies/oceans-estuaries/hudson-river-estuary-program/aquatic-habitats/aquatic-connectivity-and-barrier-removal
[14] https://windexchange.energy.gov/states/ny ; https://climate.ny.gov/dashboard
[15] https://www.nyserda.ny.gov/All-Programs/Offshore-Wind/Focus-Areas/NY-Offshore-Wind-Projects
[16] https://www.governor.ny.gov/news/governor-hochul-announces-nations-largest-ever-state-investment-renewable-energy-moving
[17] https://windexchange.energy.gov/maps-data/338

and the Andy Murphy Neighborhood Center, working with the New York Power Authority (NYPA) and the Northeast Services Company (NORESCO), with funding from NYSERDA to decarbonize the buildings.

To expand the scale of geothermal heating systems, City staff have also begun a Thermal Energy Network (TEN) strategy planning group, which meets regularly to research and begin conceptual designs for a municipally owned TEN, likely to incorporate several civic buildings and nearby residences. Research, planning and development will be ongoing through 2025.

There is little potential for geothermal electricity (vs. heat) production in the City of Kingston given the low geothermal gradient of Earth's crust in this part of New York[18]. Similarly, geothermal electricity production is not likely to play a major role in meeting the State's 70% renewable energy by 2030 goal. Instead, harnessing geothermal power for heating will play an increasing role in reducing energy demand. Currently the City of Kingston is in the process of developing thermal energy networks in two focus areas of the City, the Midtown neighborhood and the Rondout neighborhood. A Thermal Energy Network or TEN is a shared network of piping that is designed in such a way that buildings can reject heat to the network or they can remove heat from the network. This can be an avenue in which buildings that reject large amounts of heat consistently all year can reject this thermal energy to be utilized by others connected to the network.

3.5 Biomass and Biogas Power

Biomass power is a form of renewable energy that generates heat by burning organic materials, such as wood, agricultural residues, waste, or biogas (methane and carbon dioxide) from anaerobic digestion. This heat can be used directly for heating or to create steam, which would drive a turbine connected to a generator to produce electricity. Biomass power helps to reduce reliance on fossil fuels and can contribute to waste management by utilizing materials that would otherwise be discarded. While considered a cleaner alternative to coal or oil, environmental benefits depend on factors like land use, transportation, and the sourcing of biomass.

While no electricity is currently produced through burning biomass in the City of Kingston, biomass power accounts for roughly 1.5% of the State's electricity capacity[19]. Locally, the Dutchess County waste incinerator, which generates electricity by burning household waste, has a capacity of 9.2 MW and has been operational since 1989[20].

In the City of Kingston, energy from biomass is used for heating. This is done mainly in the form of burning wood. According to the 2022 American Community Survey, 108 households in the City use wood as their primary heat source[21]. In relation to total number of households that use fuel oil, 46% according to the Empire Center for Public Policy, while wood heating use is a very small fraction being just 1% of housing units. Biomass can be a renewable resource if the biomass that is consumed, in this case wood, is harvested sustainably and not overconsumed. This would mean utilizing more efficient wood burning appliances such as those rated by the EPA. The forest resource would need to be taken care of in a way to promote new growth and maintain the overall established living resource. Some local resources selling wood heating fuel are tree trimming service companies who sell the wood that has already been cut down. This would be a way to utilize a byproduct when it would normally decompose and release the stored carbon anyway.

While poorly combusted wood smoke can have a negative impact on air quality, there are efficient EPA certified wood stoves that burn cleaner and more efficiently. Biomass can be considered a renewable energy because, unlike historical uses of biomass as heating fuel, the consumption does not exceed the replacement rate of biomass locally. Typically, wood sourced for home heating needs is sourced from downed dead wood. According to an article from MIT's "Ask MIT Climate" "forests take in the most carbon when they're full of young trees". Therefore sustainably harvested biomass

[18] https://atb.nrel.gov/electricity/2024/geothermal
[19] https://www.eia.gov/state/analysis.php?sid=NY
[20] https://dec.ny.gov/news/environmental-notice-bulletin/2021-12-29/completed-application/dutchess-co-resource-recovery-facility
[21]https://data.census.gov/table/ACSDT5Y2022.B25040?q=house%20heating%20fuel&t=Heating%20and%20Air%20Conditioning%20(HVAC)&g=160XX00US3639727

heating resources such as wood can drive an increase in carbon sequestration through the need of replacing the resource.

3.5.1 Local Potential

At the City of Kingston's Wastewater Treatment Plant (WWTP), 14 million cubic feet of biogas are captured each year. Biogas is produced from aerobic or anaerobic digestion of organic material, in this case the sludge from the wastewater treatment process. A portion of this biogas is used to heat the anaerobic digesters while the gas that is not used for heating is burned without any energy capture. The average daily production of biogas at the City WWTP is 37,927 cubic feet per day in 2024 or an equivalent 6,669 kWh[6] per day. An energy content analyses was performed on the biogas and showed a heating value of 600 Btu per cubic foot or 60% of natural gas. The remaining biogas that is currently burned off could be used to run an onsite generator for electricity production and could have the potential to provide 891,000 kWh. The useful heat that could be recaptured would be approximately 3,040.8 million Btu (MMBtu)[22]. A combined heat and power system could be a unique solution for energy recapture and CO2 emissions reductions by offsetting purchased electricity.

The US Department of Energy publishes projects it has provided technical assistance, including 17 within the state of New York. One of these 17 projects, one with a similar applied Combined Heat and Power system is Saranac Brewing in Utica New York. The project summary can be seen below in Figure 10. The brewery processes spent grain in an anaerobic digester to produce useable biogas, which is used to generate power and heat.

Figure 7: Saranac Brewery Biogas CHP

[22] Based on the US Department of Energy (DOE) published efficiency of a similar biogas CHP system in Utica New York.
[23]

3.6 Solar Power

Solar power is a renewable energy source that captures energy from the sun to generate electricity. This is typically done using solar panels, which contain photovoltaic (PV) cells that convert sunlight directly into electrical energy. Solar installations can range from small-scale residential systems to massive utility-scale solar farms. Solar is expected to play a large part in New York's renewable energy growth, with the state setting a goal of 10 GW capacity by 2030.

The 2020 City of Kingston 100% Renewable Energy Transition Roadmap singles out solar as the most practical renewable energy resource for the City to develop. Solar's cost-effectiveness and easy installation make it the go-to technology for local renewable energy implementation. Because of the importance of solar in Kingston's renewable energy goals, this report presents an in-depth review of installed and potential solar capacity.

3.6.1 Installed Solar

Since the early 2000s, hundreds of rooftop and ground-mounted solar installation projects have been completed in the City of Kingston. While the City currently lacks a comprehensive list of all these completed projects, NYSERDA compiles statewide information on solar capacity. This database of solar projects across the state identifies the geography of projects to zip code scale[23]. This makes determining which projects are within Kingston difficult because the City shares the 12401-zip code with surrounding communities.

To ensure accuracy, this MREIP will reference a list of solar projects completed with the support of NYSERDA funding[24]. This list includes precise geographic coordinates, offering a reliable view of solar installations within Kingston. However, this list does not include projects not funded through NYSERDA thus likely omitting some installations. Despite this limitation, a review of the NYSERDA data suggests that it provides the most comprehensive assessment of the City's current solar capacity.

a) Capacity & Distribution

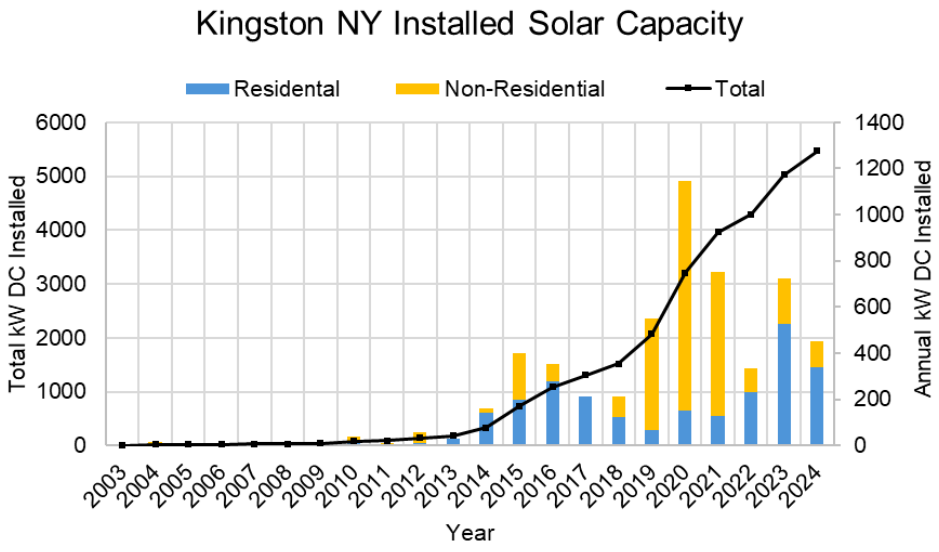

Figure 8: Installed City of Kingston solar power capacity since 2003 from a list of NYSERDA supported solar projects.

[23] https://www.nyserda.ny.gov/All-Programs/NY-Sun/Solar-Data-Maps/Statewide-Distributed-Solar-Projects
[24] https://data.ny.gov/Energy-Environment/Solar-Electric-Programs-Reported-by-NYSERDA-Beginn/3x8r-34rs/about_data

The annual rate of solar capacity installation in Kingston has varied over the years but has generally shown an upward trend since 2014 (Figure 7). Between 2014 and 2023, the City saw an average annual installation rate of approximately 500 kW. The most significant single-year growth occurred in 2020, with 1,143 kW of solar capacity added. This record-breaking increase was primarily driven by two major non-residential projects: a 322-kW solar array installed by Lighthouse Solar for Radio Kingston on Albany Avenue and a 671-kW array installed by SunCommon at the Pointe of Praise site on Hurley Avenue. These large-scale installations highlight the potential for commercial solar projects to significantly accelerate the City's renewable energy transition.

The NYSERDA Supported Solar list identifies a total of 387 solar installations from 2003-2024 within the City of Kingston, comprising 27 non-residential and 360 residential arrays (Appendix 1). Collectively, these projects have a combined nameplate capacity (the maximum demonstrated output of a piece of equipment) of 5,473 kW DC (4,652 kW AC) and an estimated annual production of 5,505 MWh (Table 3).

Census Tract	Completed Projects	Installed kW DC	Installed kW AC	Annual MWh	DAC
9517	63	642	546	617	Yes
9518	41	344	292	328	Yes
9519	59	437	371	410	No
9520	32	502	427	512	Yes
9521	57	763	649	749	Yes
9522	67	507	431	486	No
9523	17	103	88	95	No
9524	51	2,176	1,850	2,306	Yes
Total	**387**	**5,473**	**4,652**	**5,505**	

Table 3: Installed solar capacity by census tract.

Solar capacity in Kingston is nearly evenly distributed between residential and non-residential properties, with residential arrays contributing 2,998 kW and non-residential arrays accounting for 2,475 kW. Most solar arrays in the City are small-scale systems, with only six installations exceeding 100 kW DC in capacity. The median capacity of solar arrays is approximately 6 kW for residential systems and 46 kW for non-residential systems, reflecting the predominance of smaller-scale projects across both sectors.

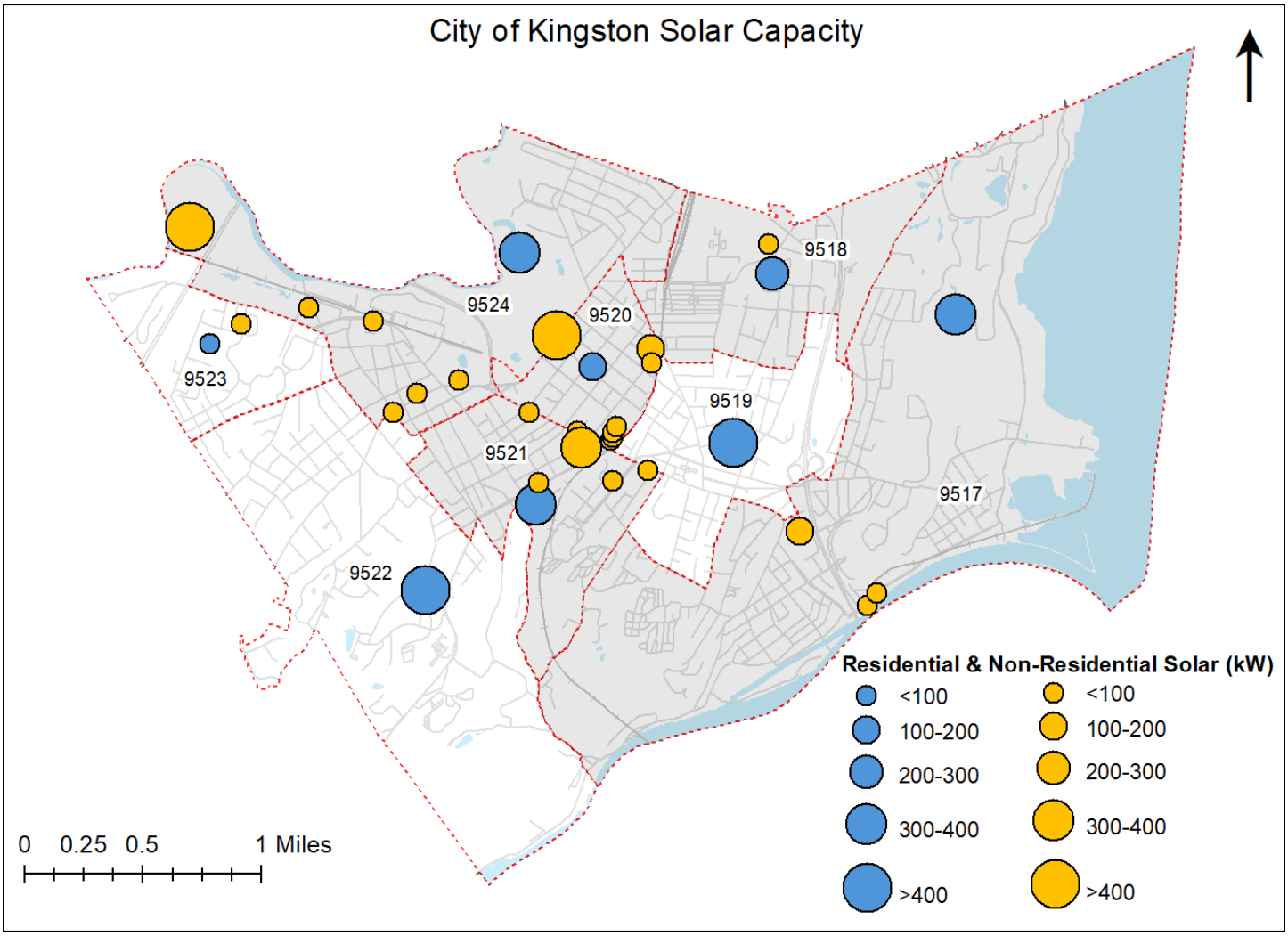

Figure 9: NYSERDA supported installed solar capacity in the City of Kingston.

Every census tract within the City of Kingston has solar capacity as of 2024 (Figure 8; Table 3). Census tract 9524 has the largest capacity, at 2,176 kW DC from 51 completed projects. This is ~6 times the capacity of census tract 9518, which has 344 kW DC from 41 completed projects. Residential solar capacity is greatest in census tracts 9519 and 9522; neither are designated DAC by the State. Census tract 9519 has no non-residential solar capacity despite being a major commercial and administrative hub for the City with numerous municipal buildings. Non-residential solar capacity is greatest in census tract 9524 which is the site of the two largest installed solar projects in Kingston. Of the installed solar arrays, 62% are in NYS Disadvantaged Community (DAC) census tracts.

Examining solar capacity trends across census tracts in Kingston shows the highest installed solar capacity in non-DAC tracts (9519 and 9522), despite these tracts having similar useable rooftop area as DAC tracts (Figure 9). This disparity suggests that non-DACs have benefitted more from solar installations, potentially due to more access to resources. To address this, focused investments in DACs could help increase their solar adoption rates, enhancing renewable energy equity and optimizing the City's overall solar potential.

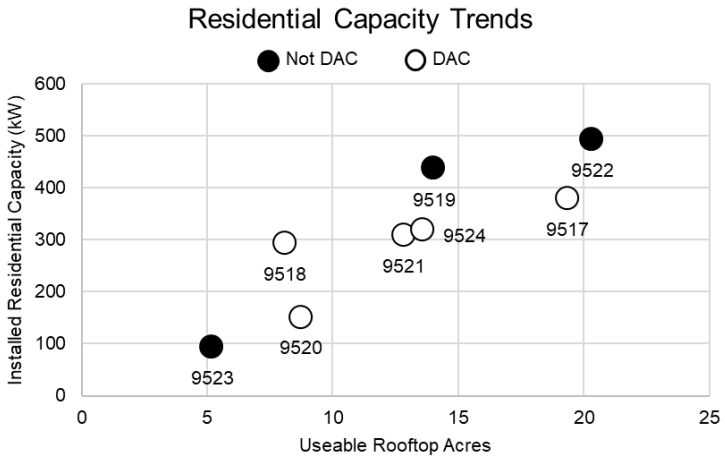

Figure 10: Trends in residential solar installation in the City of Kingston

b) Municipal Solar

Municipal solar generation plays an increasingly significant role in the City's energy mix, with notable contributions from three on-site solar systems. These include the Andy Murphy Neighborhood Center (AMNC) with a 49-kW system generating 52.9 MWh annually, as well two solar arrays at the Forsyth Nature Center with a combined 6 kW capacity. The electricity produced from these projects covers ~1% of municipal electricity consumption.

Image 2: Solar installed on the Andy Murphy Neighborhood Center

3.6.2 Planned/In Development Solar Capacity

a) Municipal Solar

The City of Kingston has several planned and in-development solar projects on municipal and private property. The municipality is taking a proactive role in advancing its renewable energy goals by directly supporting the near-term installation of four solar arrays with a total capacity of 313 kW on public property (Table 4). These planned solar installations are part of a larger effort to leverage municipal properties and resources for renewable energy production.

Project	Address	System Type	Expected kW	Expected MWh/yr	Status	Owner
First Avenue Yard	514-528 First Avenue, Kingston	Ground Mount	225	300	Funding is secure; design is underway; estimated construction 2025/26	City of Kingston
Hasbrouck Park Pavilion	375-405 Delaware Ave	Roof Mount	18	19	Funding is secure; design is underway; estimated construction 2025	City of Kingston
Andretta Pool	76 North Front St	Roof Mount	21.1	26	Contractor in contract; permitting phase underway; estimated construction 2025	City of Kingston
Rondout Neighborhood Center	103 Broadway	Roof Mount	49	63	Contractor in contract; permitting phase underway; estimated construction 2025	City of Kingston
		Total	**313**	**408**		

Table 4: Municipal solar projects in the development pipeline within the City of Kingston.

In early 2024, the City was approached by a firm, BlueWave, to explore the option of floating solar. The City of Cohoes, NY, has developed and permitted a 3.2MW, 8,000 panel system in their community which is expected to be in service in early 2025. The technology is promoted as being drinking water safe and 100% recyclable. Throughout 2024, City staff have been doing research in conjunction with BlueWave to understand the feasibility of implementing this technology, including any possible health and safety impacts, including the influence of heavy metals, leaching of PFAS, etc. Research and feasibility analysis will continue into 2025 and at the time of this report, there are no specific projections for capacity on City systems.

b) Non-Municipal Solar

According to records from NYSERDA, there are 22 solar projects currently in the pipeline in Kingston shown in Table 5 below. These projects reflect a growing interest in renewable energy among both residents and businesses. Of the 22 planned projects, 20 are residential installations, while 2 are non-residential. Collectively, these projects are expected to add a total capacity of 527 kW DC to the City's energy grid, with an estimated annual production of 537 MWh of clean, renewable energy.

Sector	Latitude	Longitude	Census Tract	PV module quantity	Expected kW	Expected MWh/yr	DAC
Residential	41.93660	-73.97346	9517	10	4.2	3.946	Y
Residential	41.93660	-73.97346	9517	12	5.04	3.461	Y
Residential	41.93366	-74.00328	9520	13	5.2	5.575	Y
Residential	41.92890	-73.99179	9519	13	5.33	4.603	N
Residential	41.93366	-74.00328	9520	16	6.4	7.016	Y
Residential	41.92011	-74.01717	9522	16	6.56	4.019	N
Residential	41.93366	-74.00328	9520	16	6.8	7.454	Y
Residential	41.92890	-73.99179	9519	16	6.8	7.285	N
Residential	41.92011	-74.01717	9522	18	7.56	7.928	N
Residential	41.92011	-74.01717	9522	20	8.2	9.087	N

Residential	41.93660	-73.97346	9517	21	8.61	7.26	Y
Residential	41.93660	-73.97346	9517	22	9.24	9.296	Y
Residential	41.92525	-74.00807	9521	23	9.77	8.073	Y
Residential	41.92525	-74.00807	9521	24	9.84	5.453	Y
Residential	41.92011	-74.01717	9522	27	11.48	12.164	N
Residential	41.93660	-73.97346	9517	28	11.48	12.401	Y
Residential	41.93528	-74.03455	9523	28	11.9	10.383	N
Residential	41.92890	-73.99179	9519	31	12.4	10.056	N
Residential	41.94066	-74.00916	9524	32	13.6	12.236	Y
Non-Residential	41.94284	-73.99648	9524	33	16	16.773	Y
Residential	41.93660	-73.97346	9517	40	16.8	11.074	Y
Non-Residential	41.93013	-73.99895	9519	630	333.9	361.862	N
			Total	**1,089**	**527**	**537**	

Table 5: NYSERDA-supported solar projects in the development pipeline within the City of Kingston.

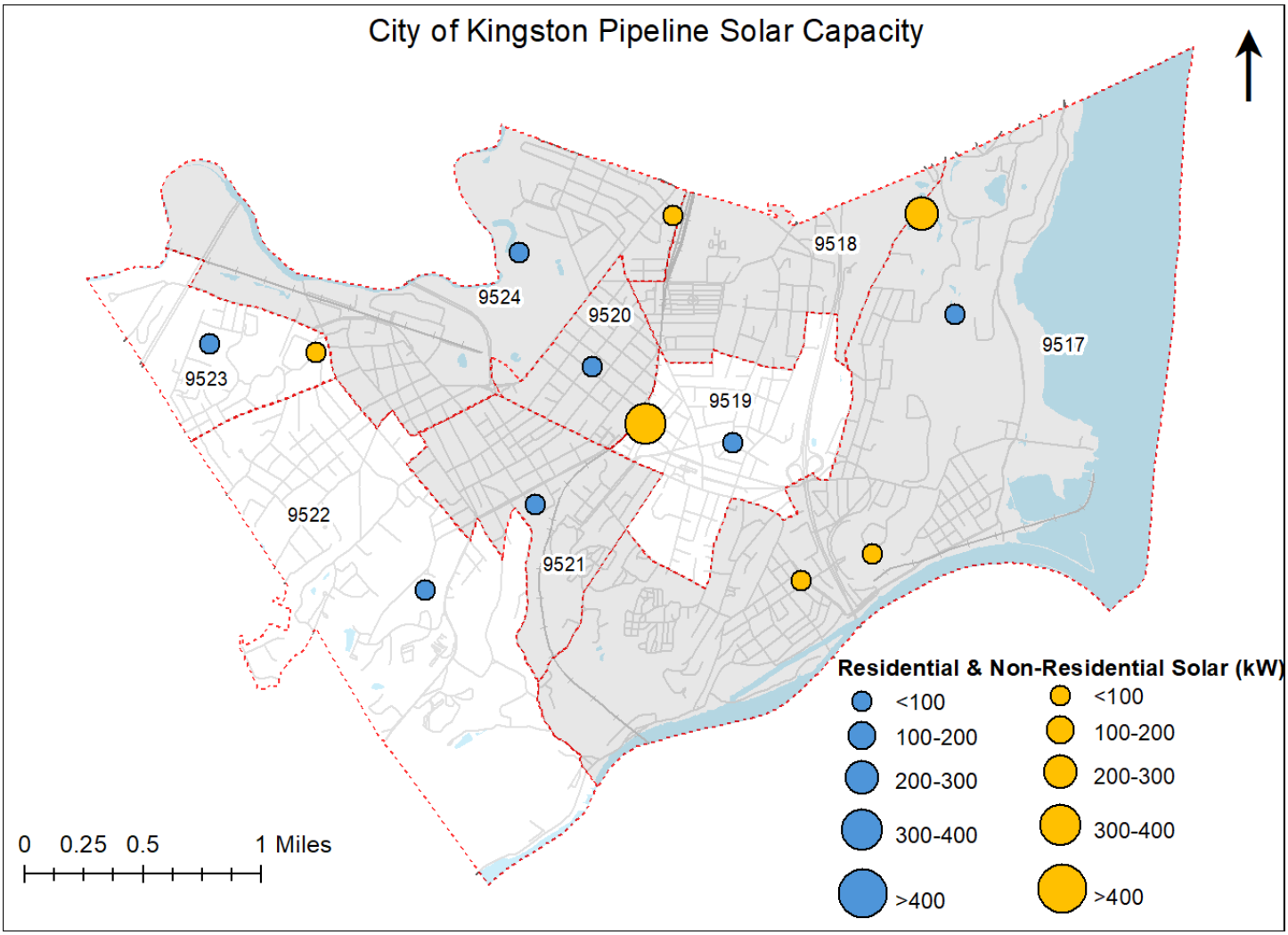

Figure 11: Solar projects in the development pipeline within the City of Kingston.

The distribution of planned residential solar installation across the City highlights widespread adoption of solar technology, with projects planned in nearly every census tract (Figure 10). One notable exception is Census Tract 9518, where NYSERDA reports no planned residential installations. This gap presents an opportunity for outreach and incentives to further encourage solar adoption in this area, ensuring that all parts of Kingston benefit from the City's transition to renewable energy.

3.6.3 Local Potential

The City of Kingston has significant potential for solar energy generation, with opportunities for rooftop solar, ground mount systems in parking lots, and along highways, railroads, and transmission corridors as appropriate. The following sections provide a first order estimate of the potential capacity these sites could host. This information is intended to help policymakers, and the people of Kingston make informed decisions that effectively support increasing local solar capacity in ways that are consistent with community standards for equity and environmental stewardship.

a) Undeveloped Land Potential

In December 2022, the City of Kingston completed the Kingston Community Preservation Plan, a culmination of years of mapping and prioritization for land preservation. This plan was ultimately adopted and further, a Community Preservation Fund, which establishes a dedicated funding source for preservation and stewardship-related activities on eligible properties within the City, was established. A prioritization map was made identifying, by increasing color intensity, the parcels within the City with the greatest preservation value (Figure 11). This value was determined through the lens of parkland, historic preservation, ecological, cultural, or recreational significance.

The City also established a Community Preservation Advisory Board which will utilize the Plan to allocate funding for preservation, these decisions will consider solar viability based on each site. The work of prioritizing land uses for preservation is significant for the City and due to the limited remaining open space parcels, potential agricultural lands and other lands of significance, it is the City administration's priority to avoid the use of those lands for renewable energy production UNLESS the installation is done so that the practice can be a benefit BOTH for solar and ecologically, such as the use of Agrivoltaics, Floatovoltaics, or other productive land uses.

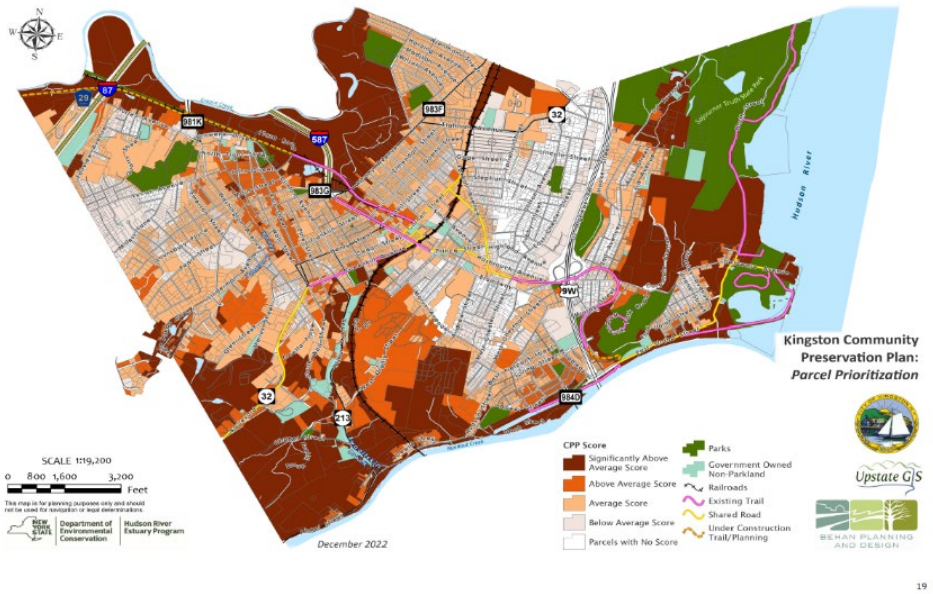

Figure 12: Kingston Community Preservation Plan Parcel Prioritization Map, December 2022.

b) Rooftop Solar Potential

With its mix of residential, commercial, and municipal buildings, the City has significant potential to generate renewable energy through rooftop solar installations. Rooftop solar systems can transform underutilized building surfaces into productive energy assets and often have lower installation costs relative to ground-mount solar systems.

To evaluate the City's rooftop solar potential, this report uses the area of building footprints[25] and several assumptions to estimate the solar capacity for individual rooftops (Figure 12). We assume that rooftops are the same size as building footprints, that 50% of each rooftop area is suitable for solar panel installation and rooftop solar capacity is 700 kW/acre. We also estimate that every kW of solar capacity produces 1.2 MWh/yr of electricity for rooftops greater than 3,100 square feet and that smaller rooftops produce 970 MWh/yr per kW capacity. These assumptions are adapted from the Solar Mapping Tool model developed by Scenic Hudson for the Hudson Valley region.

To correct for possible inconsistencies in the data, individual buildings over a half-acre in size were examined using the Scenic Hudson Solar Mapping Tool. Each rooftop was reviewed for available rooftop space and collected into a spreadsheet list format. This list of individual buildings is organized by parcel and in one case the tool has separated one rooftop into two, the Golden Hill Nursing Home. Some attached row housing is also combined by this tool into one single building rooftop. This list is shown in APPENDIX 2: Large Rooftop Solar Potential at the end of this report.

This analysis does not account for the characteristics of individual rooftops such as obstructions, rooftop condition, shadows from nearby buildings and trees, or whether the property is commercial or residential. The building footprint dataset may also contain inaccuracies or omissions that we do not account for. Nonetheless, an independent study[26] using Google Earth data that accounts for rooftop obstructions and shadows produced similar estimates of total capacity and power production potential for the City of Kingston. This independent corroboration gives us confidence that our evaluation is a useful first order analysis of City rooftop solar potential.

1. City-wide Rooftop Solar Potential

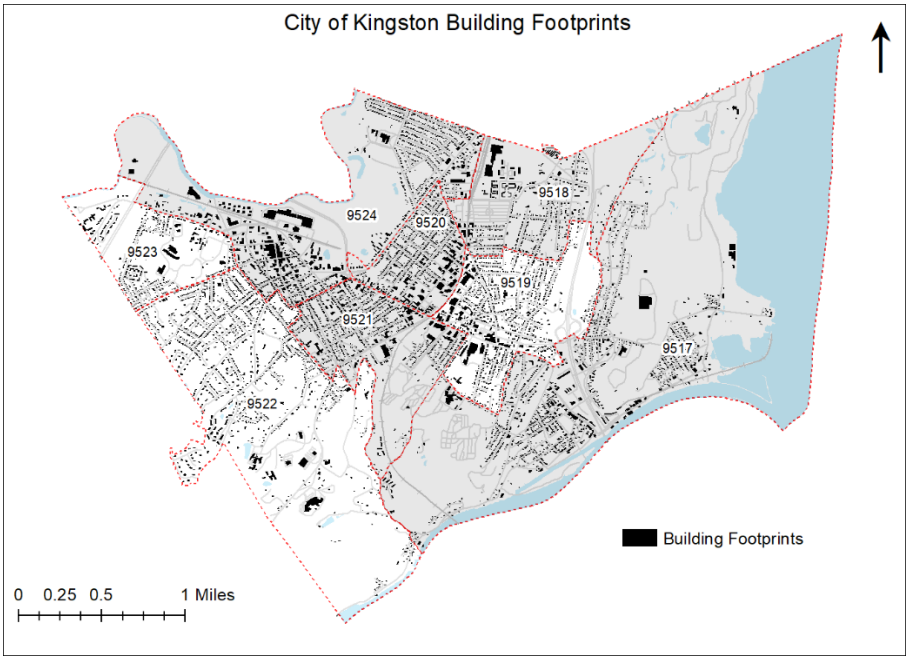

Figure 13: City of Kingston building footprints.

[25] https://cugir.library.cornell.edu/catalog/cugir-009087
[26] https://sunroof.withgoogle.com/data-explorer/place/ChIJJ4HJLQEP3YkRE8kyWFqJ10E/

Based on this report's analysis, there are 7316 buildings in the City of Kingston greater than 300 square feet, with a total usable rooftop area of 192 acres (Table 6). The potential for additional installations is substantial, with an estimated capacity of 133,437 kW and an annual energy generation potential of 143,666 MWh. Non-DAC tracts also present notable opportunities for solar development, though they are fewer in number. Overall, rooftop data highlights a considerable untapped potential for rooftop solar installation, particularly in DACs, which could benefit from focused investments in renewable energy infrastructure.

Census Tract	Rooftops	Rooftop Acres	Potential kW	Potential MWh/yr	DAC
9517	1,395	70	24,348	26,101	Y
9518	571	32	11,059	11,969	Y
9519	1,038	47	16,369	17,350	N
9520	681	34	12,056	13,060	Y
9521	978	42	14,628	15,492	Y
9522	1,316	62	21,573	22,612	N
9523	391	22	7,584	8,267	N
9524	946	74	25,819	28,815	Y
Total	**7,316**	**381**	**133,437**	**143,666**	

Table 6: Rooftop data and solar capacity estimates for the City of Kingston.

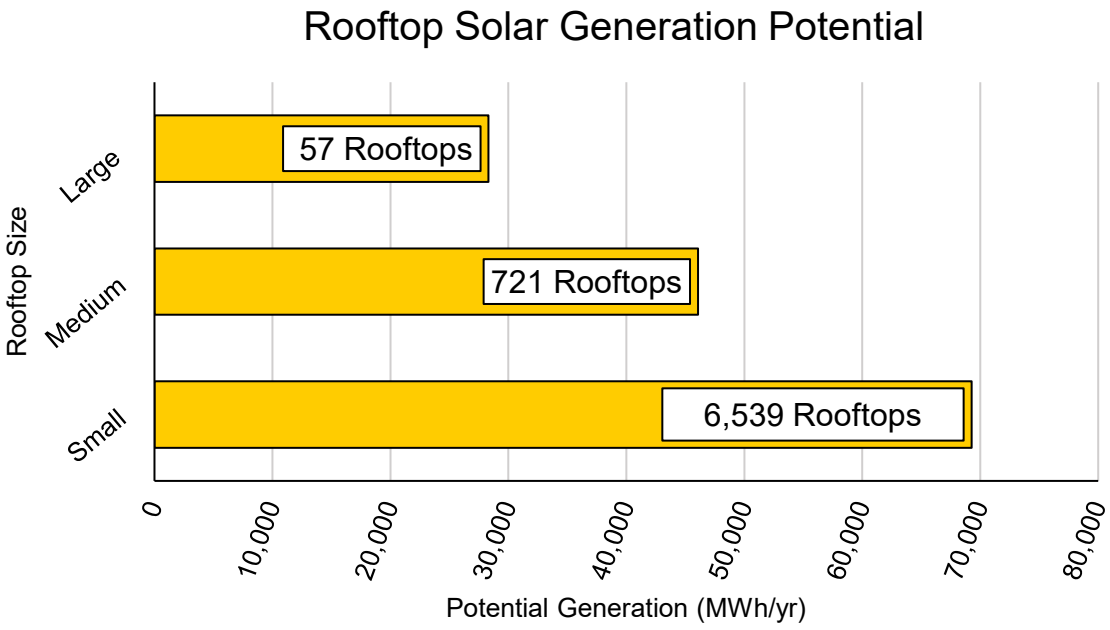

Figure 14: Potential solar generation capacity for different sized rooftops in the City of Kingston.

Most of the solar generation potential in Kingston is concentrated in small-sized rooftops between 300–3,100 square feet, which account for 6,539 rooftops and have the potential to contribute 69,271 MWh/yr (Figure 13; Table 7). These rooftops are in the size range of residential and mixed-use buildings, and at 50% utilization, encompass the range of

installation sizes considered residential by NYSERDA. Medium-sized rooftops between 3,100 square feet and a half acre have the second highest potential generation, at 46,076 MWh/yr across 721 rooftops. Buildings of this size are generally commercial, industrial, and municipal. Despite representing a small fraction of the total rooftop count, large-sized rooftops over a half-acre have the potential to contribute disproportionately to energy generation in Kingston. The 56 rooftops in this category have a potential capacity of 28,320 MWh/yr.

Rooftop Size	Rooftops	Rooftop Acres	Potential kW	Potential MWh/yr
Small (300-3100 sqft)	6,539	204	71,413	69,271
Medium (3100 sqft – 0.5 acre)	721	110	38,396	46,076
Large (>0.5 acre)	56	68	23,628	28,320

Table 7: Small, medium, and large rooftop data and solar capacity estimates for the City of Kingston.

Image 3: Rooftop solar installation at Energy Square, Kingston, a RUPCO project.

2. Municipal and Government Rooftop Solar Potential

There are approximately 55 municipal buildings in the City of Kingston covering a total area of 4.8 acres. Using the same assumptions as the analysis above, these rooftops have the potential to host 1,690 kW of solar, producing between 1,639 and 2,028 MW of electricity per year. This is as much as 45% of the electricity demand for municipal property in 2023.

Results from a more detailed analysis of municipal rooftop potential are provided in section 4.2.1.

3. Rooftop Solar Hosting Capacity

The current Central Hudson hosting capacity of electricity infrastructure in Kingston is not sufficient to accommodate all potential rooftop solar installations outlined above. Current Central Hudson infrastructure can host a maximum of 74 MW of additional solar generation which is approximately half the total potential capacity estimated above (Table 6). Furthermore, utility infrastructure hosting capacity is focused on specific corridors (Figure 3) and it is likely that some will see more significant solar generation interconnection than others. As more solar projects are installed the need for additional capacity is increased, the power grid may need to be upgraded.

While most potential rooftop solar projects in Kingston can be connected behind the meter, the larger systems will need additional work to be linked with the electricity grid. Thirteen rooftops with possible solar arrays larger than 500 kW will require reclosers to control the flow of electricity into the power grid and additional infrastructure to tie into the existing 3-phase infrastructure.

c) Parking Lot and Transport/Transmission Corridor Solar Potential

The City of Kingston's parking lots, highways, railroads, and electricity transmission corridors, have significant potential to generate renewable energy through ground mount solar installations. Focusing solar installation at these locations is beneficial because ground-mount solar could be installed without affecting the original use. For example, solar car ports can be installed over parking lots and solar arrays installed on the medians of certain highways.

To evaluate the available area of parking lots and transport/transmission corridors in the City of Kingston, several sources were used. Parking lot areas in the City of Kingston were downloaded from Open Street Map, railroad and highway footprints were extracted from Ulster County tax parcel data, and transmission line rights of way mapped from aerial imagery. Parking lots were analyzed for potential solar capacity assuming solar carports were installed across 50% of the parking lot. Further assumptions included 200 kW per acre solar capacity, and 1.2 MW/yr for every kW of capacity. Transport and transmission corridor area was documented but solar potential for these areas was not estimated due to more complicated siting considerations.

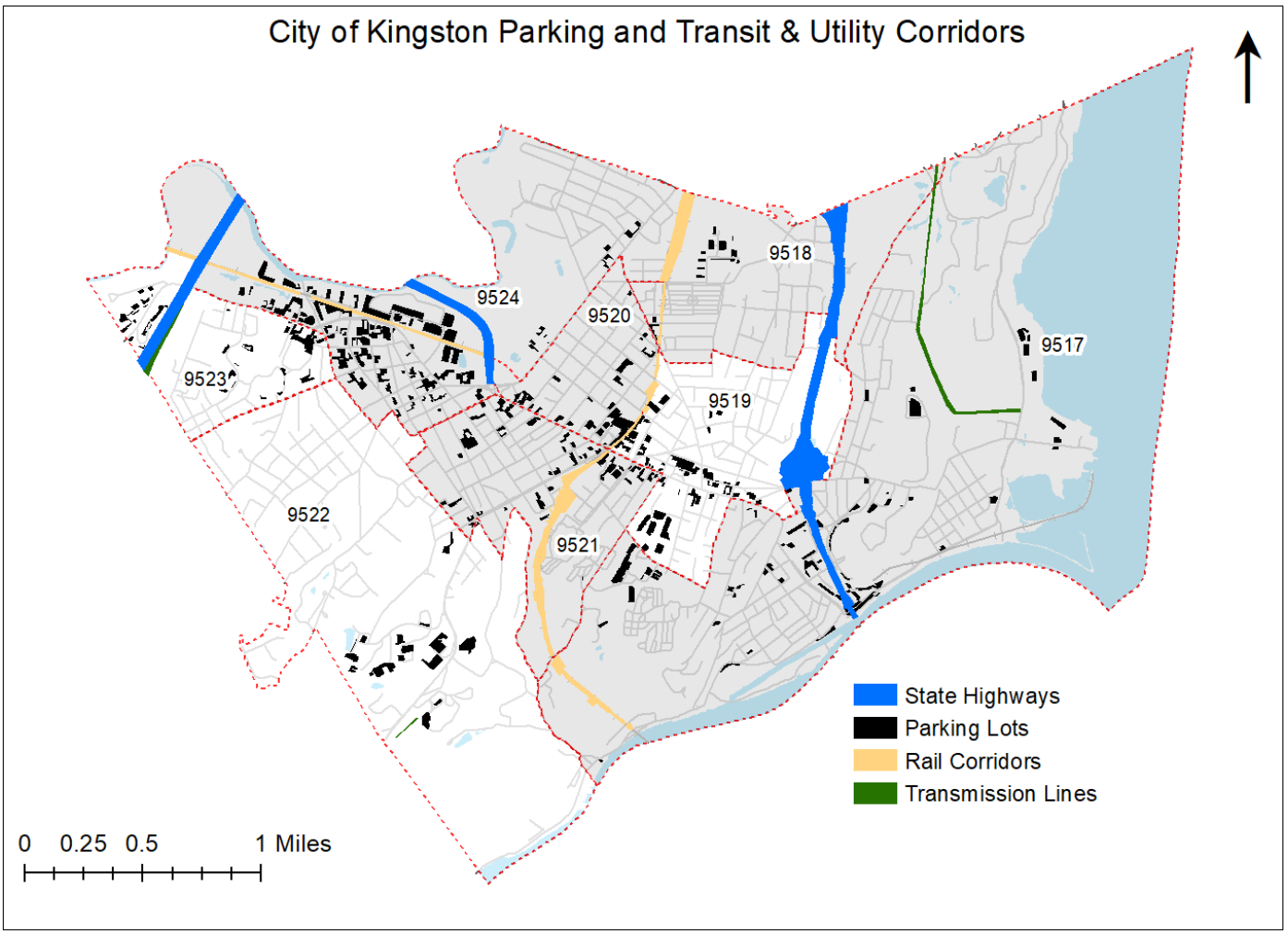

Figure 15: Parking lots, highways, active railroads, and transmission lines within the City of Kingston.

A subset of the total parking lots throughout the City of Kingston was analyzed using the Scenic Hudson Solar Mapping tool. All adjacent parking lots to the large rooftop buildings were reviewed for their solar installation potential. This list of parking lots comprises of some of the largest parking lots located within the City of Kingston and would be a great place to start for developing solar overtop parking lots. This list can be found in APPENDIX 3: Potential Ground Mount Parking Lot Solar Sites.

1. City-wide Parking Lot Solar Potential

Solar carports represent a practical and innovative approach to maximizing the use of Kingston's existing parking lots while contributing to the City's renewable energy goals. These structures provide dual functionality by generating solar power and offering shaded parking spaces for vehicles. With an estimated 251 acres of municipal and privately owned parking lots in the City, Kingston has significant potential to integrate solar carports into its urban infrastructure.

Typically, large footprint buildings require large parking lots to accommodate retail sales, employees or residents of a building. Also parking requirements have changed dramatically since the peak in popularity of shopping malls through the 1980's. With Scenic Hudson's solar mapping tool large parking lots can be analyzed from the dataset of buildings. These buildings would then have corresponding large parking lots that can accommodate large solar installations. Building types with retail, restaurants and quick service food establishments should have the biggest opportunity for solar installations or solar car ports.

The maximum parking lot size is 144,006 square feet, while the minimum size is 854 square feet. The median parking lot size is 13,800 square feet. An estimated 126 acres of panels could be installed on parking lots in Kingston, with a potential for 25,135 kW capacity, producing an estimated 30,162 MWh per year (Table 8).

Census Tract	Parking Area (acres)	Potential kW	Potential MWh/yr	DAC
9517	42	4,200	5,040	Y
9518	5	495	594	Y
9519	49	4,926	5,912	N
9520	30	3,009	3,611	Y
9521	37	3,679	4,415	Y
9522	15	1,539	1,847	N
9523	11	1,146	1,375	N
9524	61	6,139	7,367	Y
Total	**251**	**25,135**	**30,162**	

Table 8: Parking lot distribution and potential ground-mount solar capacity in the City of Kingston.

Of the 57 buildings with rooftops larger than a half-acre, 35 had parking lots where solar installations or solar car ports would be feasible to install. The total potential area of solar installations for these locations is 58.5 acres that could produce up to 6,251.7 MWh of electricity. The list of these locations can be found in APPENDIX 3: Potential Ground Mount Parking Lot Solar

2. Municipal and Government Parking Lot Solar Potential

There are approximately 18 acres of parking on City property, 11 acres on County property, and 2 acres on property owned by NYC. Using the same assumptions as those outlined above, there is potential for 1,800 kW, 1,100 kW, and 200

kW of ground mount solar on Municipal, County, and NYC parking lots, respectively. Together, these installations would produce an estimated 3,720 MW of electricity a year.

3. Transport/Transmission Corridor Solar Potential

In Kingston, 176 acres of land are dedicated to large-scale transportation and utility infrastructure rights of way (ROW; Figure 14). This includes 57 acres for the CSX West Shore railway, 65 acres for Route 9W, 39 acres for I-87 and I-587, and approximately 15 acres of transmission line ROW. These corridors offer substantial opportunities for solar installation in underutilized land areas in medians, below power lines, and adjacent roads or railroad tracks. Providing an accurate estimate for total solar capacity along these ROWs is beyond the scope of this report and would require a more in-depth analysis of regulations and local conditions. Future work, in tandem with property owners including NYSDOT, NYSTA, CSX, and Central Hudson could explore the viability of solar installation at these locations.

4. Parking Lot and Transport/Transmission Solar Hosting Capacity

The interconnection of ground-mount solar arrays to the electricity grid may require more significant infrastructure than that needed for rooftop solar. Specifically, there will be less opportunity for behind the meter installation because parking lots and transport and transmission corridors often do not have electricity meters that can be used for this style of interconnection. Instead, ground mount systems will likely be directly linked to the power grid. The cost of interconnection to this infrastructure may be affected by proximity to 3-phase lines with the required hosting capacity. To reduce costs, installation locations close to the necessary electricity infrastructure should be prioritized for the buildout of ground-mount solar.

d) Summary of Kingston Solar Capacity Potential

The City of Kingston has significant potential for expanding solar capacity, with opportunities spanning rooftops, parking lots, highways, railroads, and transmission corridors. This can be done while also promoting the preservation of high-priority ecological, cultural, and recreational lands.

Census Tract	Rooftop Acres	Parking Lot Acres	Total Acres	Rooftop Potential MWh/yr	Parking Potential MWh/yr	Total MWh/yr	DAC
9517	70	42	112	26,101	5,040	34,297	Y
9518	32	5	37	11,969	594	13,880	Y
9519	47	49	96	17,350	5,912	26,732	N
9520	34	30	64	13,060	3,611	18,085	Y
9521	42	37	79	15,492	4,415	21,999	Y
9522	62	15	77	22,612	1,847	27,765	N
9523	22	11	33	8,267	1,375	10,492	N
9524	74	61	135	28,815	7,367	38,360	Y
Total	**381**	**251**	**632**	**143,666**	**30,162**	**173,828**	

Table 9: Summary of rooftop and parking lot area and potential annual solar generation estimates.

Rooftop solar offers the most immediate potential, with 192 usable acres of 381 total rooftop space estimated to generate a maximum of 143,666 MWh annually (Table 9). This useful space assumes that the available rooftop space is only half of the total rooftop area. Small-sized rooftops represent the largest share of this potential, while large rooftops present a significant opportunity for large, high-capacity, arrays. Further, prioritizing installations in disadvantaged communities (DACs) can promote equity and reduce energy burdens on low-income households.

Parking lots across the City provide another substantial opportunity for solar development, particularly through solar carports that generate renewable energy while offering shaded parking. With 126 acres of usable parking lot space (251 acres total), an estimated 25,135 kW of capacity and 30,162 MWh of energy could be produced annually (Table 9). Additionally, City water bodies and 176 acres of transportation and utility infrastructure, including rights of way for highways, railroads, and transmission corridors, may offer more solar installation opportunities, pending further study.

Image 4. Mayor Steve Noble at Pointe of Praise solar array ribbon cutting

3.7 Summary

2022-23 Annual Electricity Usage (Average)	2022-23 Annual Renewable Electricity (14% of grid mix) (Average)	2030 Predicted Usage (12% increase)	70% by 2030 Renewable Electricity Goal	2030 Renewable Electricity Goal (53% renewable grid mix)
170,731 MWh	23,902 MWh	191,219 MWh	133,853 MWh	32,507 MWh

Table 10: Summary of the City of Kingston's electricity usage and renewable electricity goals.

Achieving 70% renewable energy by 2030 is an ambitious yet attainable goal for the City of Kingston. The City's average annual electricity usage for 2022-23 was 170,731 MWh, with 14% of this energy (23,902 MWh) coming from renewable sources shown above in Table 10. By 2030, electricity demand is expected to rise by 12% to 191,219 MWh. To meet its goal of 70% renewable electricity by 2030, Kingston will need 133,853 MWh of its total electricity to come from renewable sources. With an anticipated 53% renewable contribution from the New York State grid, the City will still need an additional 32,507 MWh to meet the 70% by 2030 goal. This deficit highlights the need for additional local renewable energy projects to close the gap and ensure Kingston meets its sustainability objectives.

Renewable Electricity Source	# of Projects	kW	MWH/yr	Percentage of 2030 Goal	Goal Including Grid Renewables
Existing Solar	387	5,473	5,505	4%	n/a
Potential Sources					
Biogas	1	102	891	1%	3%
Solar (Small Rooftops)	6,539	71,413	69,271	52%	213%
Solar (Medium Rooftops)	721	38,396	46,076	34%	142%
Solar (Large Rooftops)	56	23,628	28,320	21%	87%
Solar (Parking Lots)	523	25,135	30,162	23%	93%
Total Potential	**7,840**	**158,572**	**173,828**	**130%**	**535%**

Table 11: Comprehensive review and summary of renewable energy potential within the City of Kingston

Based on this report's analysis, renewable electricity installations in the City of Kingston currently generate 4% of the predicted electricity load for 2030 through existing solar arrays (Table 11). Furthermore, potential sources for renewable electricity could generate an additional 173,828 MWh annually, 91% of the City's predicted 2030 total electricity usage. Taking into consideration a potential grid renewable composition of 53%, there is potential of more than 5 times the renewable electricity needed to meet local 70% renewable energy by 2030 goals. Small rooftop solar presents the largest opportunity, contributing 69,271 MWh per year, which accounts for 36% of the City's projected electricity demand and 213% of its 2030 renewable electricity goal. Medium rooftop solar could provide 46,076 MWh annually (24% of projected demand and 142% of the 2030 goal), while large rooftop solar adds another 28,320 MWh (15% of projected demand and 87% of the 2030 goal respectively). Solar installations in parking lots could generate 30,162 MWh annually, covering 16% of electricity demand, and 93% of the 2030 goal. Biogas, though a smaller contributor, could provide 891 MWh, covering less than 1% of projected demand and 3% of the 2030 goal. Overall, the City's total renewable energy potential surpasses its 70% renewable energy target, making the goal not only achievable but potentially exceedable.

4. Implementation

To accelerate progress toward the clean energy goals of the City of Kingston, a strategic approach to increasing solar installations on municipal, commercial, and residential property is essential. Between 2013 and 2023, residential and commercial solar installations in Kingston averaged approximately 500 kW per year (Figure 9). At this rate, only an additional 3 MW (3,000 kW) of capacity will be installed between 2025 and 2030, which will not be enough to meet the electricity production goals for the City in Table 11 above. These goals can be represented in total yearly production of renewable solar energy or the power capacity of renewable energy production. To overcome this limitation, a number of implementation strategies should be pursued to expand solar adoption and enhance renewable energy deployment across the City.

Building on the strategic insights outlined in the 2020 City of Kingston 100% Renewable Energy Transition Roadmap and this report's analysis, the steps outlined below serve as a detailed guide for the City of Kingston to achieve a 70% renewable energy implementation goal. The previous report highlighted opportunities for advancing clean energy initiatives and this plan revisits those recommendations, outlining additional actionable steps and reporting on the progress already made. Grounded in data-driven insights, these steps emphasize equity and sustainability in renewable energy adoption. They address both the technical and policy frameworks required to transition effectively and, by aligning with the previous report's foundational strategies, provide a forward-thinking approach to transforming Kingston's energy sector.

The roadmap identified four key pillars to achieving this transition that will serve as the framework for this section (Figure 15):

Figure 16: The four pillars to achieving a renewable energy transition in the City of Kingston.

These sections are outlined as follows:

- **Foundational Policies and Programs** that enable and support Kingston's energy transition by ensuring alignment with current and future renewable energy technologies to reduce costs and policy barriers associated with renewable energy integration.
- **Municipal Supply Mix Strategies** that allow Kingston to lead by example by taking direct action to increase the renewable share of the municipal electricity supply mix.
- **Community Choice Aggregation** that enables Kingston to pool the electricity load of residents and businesses within the community and procure electricity on their behalf.
- **Scaling Local Generation** by encouraging the deployment of local distributed energy resources within Kingston.

4.1 Foundational Policies and Programs

There are several foundational policies and programs that the City should enable to support Kingston's energy transition by ensuring alignment with current and future renewable energy technologies to reduce costs and policy barriers associated with renewable energy integration. Several options are outlined below

4.1.1 Reduce Permitting, Zoning, and Inspection Processes

Zoning rules play a critical role in shaping how renewable energy systems are installed and utilized in the City of Kingston. Understanding these rules is essential for property owners and developers to ensure their renewable energy projects align with local standards, avoid permitting issues, and contribute effectively to sustainable development in the City.

In *Section 405-21 O*[27] of the City of Kingston's zoning code, the City outlines rules and regulations for small-scale renewable energy systems. These systems are defined as those with minimal impact on their surroundings, intended to power individual buildings or enhance local resilience efforts.

Examples of permitted small-scale renewable energy systems include roof-mounted solar panels, which can cover up to 100% of a building's roof area, and ground-mounted solar systems, limited to a maximum footprint of 600 square feet. Roof-mounted wind turbines are permitted, provided they do not exceed 10 feet in height from the roof's highest point to the bottom of the rotor blade assembly; taller turbines or multiple units per building require a special permit. Ground-mounted wind turbines are restricted to one per lot with a height limit of 30 feet, measured to the bottom of the rotor blade assembly, and are only permitted in designated districts (T3L, T2C, T1, and SD). Turbines in other districts or additional turbines on the same lot require a special permit. Other renewable energy systems, such as hydropower, geothermal heat pumps, and solar water heaters, are allowed if their aboveground components have a combined footprint of no more than 200 square feet.

Any system exceeding these limits is classified as a large-scale renewable energy system and falls under separate regulations. All small-scale renewable energy systems must adhere to local setback requirements, including a 15-foot front setback and 5-foot side and rear setbacks for ground-mounted installations. Additionally, all systems must comply with applicable state and local laws and regulations.

In 2022-2023, the City worked with the Cadmus Group, to participate in the SolSmart program[28]. SolSmart is led by the Interstate Renewable Energy Council (IREC) and the International City/County Management Association (ICMA) and funded by the U.S. Department of Energy Solar Energy Technologies Office and is a national program that helps cities,

[27] https://ecode360.com/44615183#6727720
[28] https://solsmart.org/our-communities

towns, counties, and regional organizations become solar energy leaders. The City, through evaluation of existing programs, initiatives and policies, was awarded Bronze SolSmart designation.

One significant function of this program is that Zoning review was conducted to look at the City's zoning requirements to identify restrictions that intentionally or unintentionally prohibit solar PV development. The review found the following best practices were followed:

1. The code contains a purpose or intent for including solar energy regulations in the code.
2. The code contains definitions for solar energy.
3. The code explicitly permits accessory use of roof-mounted solar PV systems as a by-right or allowed use.
4. The code explicitly permits accessory use ground-mounted solar PV systems as a by-right or allowed use in at least 1 zoning district.
5. The code contains setback standards for accessory use ground-mounted solar PV.
6. The code contains placement standards for accessory use ground-mounted solar PV.
7. The code includes standards for primary use ground-mounted solar PV.
8. The code does NOT require screening for roof-mounted solar PV systems.
9. The code does NOT include standards to limit system visibility (e.g. not visible from public rights of way).
10. The code does NOT include aesthetic standards for solar PV systems.
11. The code does NOT include glare, glint, and/or noise standards for solar PV systems.
12. The code does NOT limit solar PV system coverage to a percentage/part of the available roof space.
13. The code does NOT prohibit solar PV systems on flat or low sloped roofs.
14. The code does NOT include limits on how much electricity a solar PV system can produce.
15. The code does NOT include limits on where a solar PV system's energy is consumed.
16. The code does NOT identify a discretionary review process for accessory solar PV.

Recommendations for Implementation:

1. Roof mounted solar height: The height requirements referenced in the code are reasonable, however, it is best practice to explicitly exempt roof-mounted solar energy systems from district height requirements.
2. The code does NOT exempt accessory use ground-mounted solar PV from lot coverage and/or impervious surface standards.
3. The code defines both large-scale (renewable energy systems that exceed the limits for a small-scale renewable energy system as established; large-scale renewable energy systems may produce renewable energy for public or private entities) and small-scale (renewable energy systems that have limited impacts on surrounding properties and uses, and are intended to supply renewable energy to an individual building, or contribute to block-scale resiliency efforts) renewable energy systems. Standards for small-scale systems are covered, however, standards for large-scale systems are not provided.

4.1.2 Adopt Solar Ready Guidelines

In 2021, the City of Kingston adopted NYStretch Energy Code-2020, which outlines and regulates new and substantial redevelopment in the City[29]. This code, which is more stringent than the existing building code, addresses renewable energy in several components. In the NYStretch-2020, these requirements are found in sections 1.26 and 1.27 (commercial buildings) and 3.14 (residential buildings). These are “readiness” requirements applying to new construction, to ensure that basic accommodations are made to more easily allow future addition of photovoltaics and/or electric vehicle charging. New buildings with a certain amount of roof area are required to be "solar-ready," meaning they must have designated space and electrical capacity to potentially install solar panels in the future, but the code does not mandate the installation of solar panels itself; essentially, it prepares the building for future solar adoption without making it mandatory.

Details:

NYStretch Energy Code-2020 requires: A solar-ready zone for newly constructed detached one- and two-family homes and townhomes that have more than 1400 sf of conditioned floor area according to Appendix RA of the NYS Energy Code.

Solar-ready zone:

The code defines a specific area on the roof, usually facing south, that must be designated as a "solar-ready zone" where solar panels could be installed if desired.

No mandatory solar installation:

While buildings need to be solar-ready, the NYStretch Energy Code-2020 does not require the actual installation of solar panels on new construction.

Exceptions:

Certain conditions, like excessive shading, may exempt a building from the solar-ready requirement.

Recommendations for Implementation:

Ensure all developers are aware of and familiar with NYStrech Energy Code requirements and enforce the code with all new construction.

4.1.3 Beneficial Electrification and Decarbonization of Buildings

Some of the first building heating systems available were coal or wood fired cooking stoves. Existing homes that are old enough still have remnants of these heating systems such as coal chutes and multiple chimneys. Heating systems transformed from these wood and coal fired stoves to central steam systems during the turn of the 19th century. Some homes today still have steam heating radiators with a central steam boiler. Today, the heating systems available are much more advanced and efficient than the original means. It is well published the efficiency of old steam boilers is nearly 50% while new condensing boilers can be up to 95% efficient. Even further efficiency gains and greenhouse gas reductions can be achieved with new heat pump technology.

Without any combustion for heating, electrification of buildings heating systems eliminates the potential release of carbon monoxide. At the same time electrification of buildings heating systems also dramatically decreases the CO2 equivalent emissions. Finally, the electrification of buildings within the City of Kingston will decrease the demand for heating energy as described above. The resulting reduction in energy demand will have two benefits, lower greenhouse gases and less energy demand overall.

[29] https://kingston-ny.gov/filestorage/8399/8469/8471/NYStretch-Energy-Code-2020.pdf

Efficiency though, cannot be the only basis for comparison of new beneficial electrification. Although 100% efficient, electric heat pumps can provide more heat than the energy consumed like the one-to-one ratio in combustion. For example, one unit of natural gas Ccf, is equivalent to 100,000 Btu or 29.31 kWh. With combustion an input of 100,000 BTU might result in 95,000 BTU of useful heat. That same energy, if applied utilizing a heat pump can output over 400,000 BTU of heat due to the refrigeration cycle. A simplified refrigeration cycle is shown in Figure 16 below. Heat pumps can reverse this cycle providing heating and cooling when necessary.

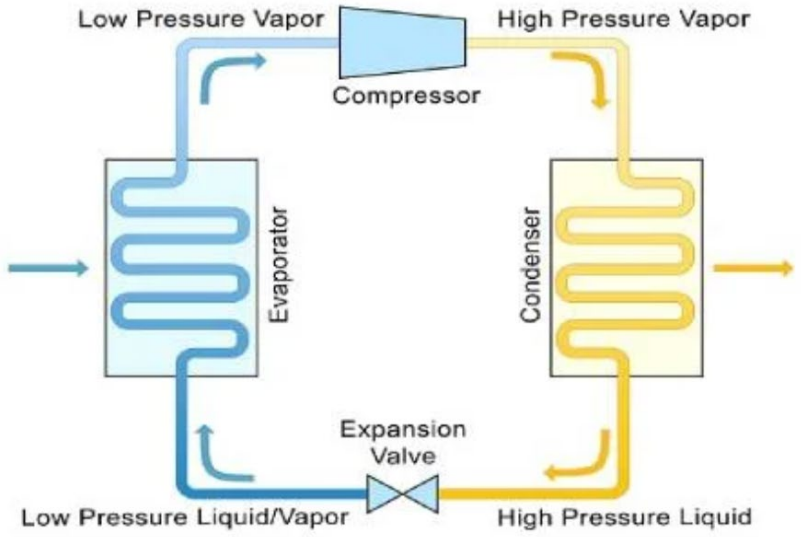

Figure 17: Refrigeration Cycle.

Residents of the City of Kingston now have available energy-related savings through the Inflation Reduction Act (IRA) which was passed by the federal government in 2022. The IRA will provide $370 billion in funding for clean energy and environmental justice initiatives nationwide, representing the largest investment in climate action by the U.S. government. A significant portion of IRA funding includes tax credits and rebates for residents (homeowners and renters) and businesses to make energy efficiency upgrades to their homes or buildings, or purchase clean energy equipment like solar panels, electric vehicles (EVs), and heat pumps. NYSERDA also provides incentives and rebates for these improvements.

4.1.4 Implementation of Energy Efficiency Conservation Measures

Building Envelope

The City of Kingston was once a major producer of bricks during the industrial revolution and as such this abundantly available building material was utilized for the insulation of houses at that time. Today there are much more efficient means and methods to insulating buildings and residential homes. From techniques like blow in insulation into the popular balloon framed buildings to new construction with multiple vapor and air barriers with spray foam insulation, buildings can become highly efficient regarding the building envelope. The number one driver of energy losses in old and new construction are from air leaks in the door and window installations. These air leaks are caused from the buoyancy of room temperature air in relation to outdoor colder air; this is what is called the stack effect. Despite their size, natural ventilation from drafty buildings and attics can have a large impact on heating costs and the corresponding greenhouse gas emissions. Also common is the heat energy loss and gained from single pane windows. Best practice is now double and triple paned windows with low-E technology.

Energy conservation measures that can be implemented for the building envelope are the following:

1. Sealing windows, doors and penetrations through the building exterior.
2. Adding insulation in the attic or rooftop of a building.
3. Adding more insulation or adding insulation where there was originally none.
4. Replacing old windows and doors.
5. Replacing the siding and house wrap with higher R-value materials.

Building HVAC

As described in detail above, the switch from fossil fuel burning heating equipment to electric heating equipment such as heat pumps will result in lower greenhouse gas emissions and lower overall energy demand. Further benefits may include the removal of the need for a chimney or flue going through the roof resulting in less heat loss.

For example: The following will outline a quick analysis on the equivalent GHG emissions between a 90% efficient gas fired appliance and an air source heat pump with an average COP of 2.9 (conservative)[30]. The equivalent emissions rate per unit of energy, for these analyses 1 kWh of heat into a space, is 0.095 lbs/kWh for heat pumps and 0.444 lbs/kWh of natural gas. Utilizing air-source heat pumps provides a 78.6% reduction in emissions.

Other reductions in GHG emissions can be achieved with the implementation of Heat Recovery Ventilators and in larger air handling equipment energy wheel or heat pipes energy recovery technology.

4.1.5 Engage and Support the Community in Achieving Energy Goals

The City currently works directly in collaboration with many community organization partners, including Mid-Hudson Energy Transition, to offer extensive community outreach and to engage the public in the City's energy transition. Through this outreach and education, the City collectively offers programs to help make homes and workplaces more energy efficient, healthier and affordable with clean electricity supply, community-based renewable energy, building retrofits and innovative clean transportation initiatives. These efforts have had a particular emphasis on low-income, Black, indigenous, and communities of color that have been disproportionately harmed by the effects of climate change. Many households in Kingston struggle with inadequate living conditions including poor indoor air quality, high energy bills, and uncomfortable homes. The City of Kingston has some of the oldest housing stock in the region, with more than 50% being built before 1939. This creates a never-ending list of home upgrades to be completed.

Specific support includes and should continue to include:

1. Home Upgrade Grants, which deliver free and immediate improvements to eligible homeowners, including free energy audits and upgrades such as heat pumps and induction stoves, and other energy efficiency measures, to reduce GHG emissions and energy bills.
2. Home Energy Loan Program, which combines investments from philanthropic organizations, impact investors, and non-accredited investors with federal, state, and local funding to accelerate a just and local renewable energy transition by providing extremely low-interest loans and small grants to low-income individuals to finance healthy, energy efficient, and climate resilient home improvements.
3. Kingston Community Energy, which is a Community Choice Aggregation (CCA) Program that will allow the City to purchase electricity on behalf of its residents and businesses from a variety of sources, including renewable

[30] https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.pdf

energy sources like wind and solar, but most likely through New York State hydropower. This program provides the benefits of:

- Price stability
- Renewable Energy
- Community Control
- Municipal Funding Support
- Resilience

The Kingston Community Energy CCA has enhancements that go well beyond a renewable energy supply contract, including City-wide building decarbonization and resiliency support through energy efficiency programs, electrification of transportation, and innovating finance mechanisms to ensure that nobody is left behind.

The transition to clean energy will continue to build the local job market, particularly with local renewable energy production and the building sector, for instance building new solar installations as well as jobs due to the maintenance and operation of existing solar arrays. The Kingston Roadmap to 100% Renewable Energy outlines how each new strategy is projected to contribute to the job market (see pages 30,31)[31].

4.1.6 Collaboration with Central Hudson

Central Hudson and other New York electric utilities are beholden to the CLCPA goals as one of their mandates, in addition to reliability and cost-effectively serving ratepayers' electricity demand. Unfortunately, this mandate is not yet reflected in the utility grid planning processes.

City staff participated in the 2023 Central Hudson Climate Change Vulnerability Study and Resilience Planning Working Group, to provide input into the planning process as Central Hudson outlines and plans for future energy efforts. Collaboration like this is critical, especially as local community distributed generation, battery storage, and commercial scale systems are planned, designed and interconnected, to ensure a seamless transition.

As distributed generation and battery storage capacity increases, hosting capacity for some sections of Kingston may become inadequate. Currently, electricity infrastructure in the City can accommodate approximately 74 MW of distributed electricity generation, but capacity is locally varied and in some parts of the City there is little remaining capacity (Figure 3).

4.1.7 Continue to Streamline Interconnection Processes

Central Hudson collaboration

The City and Central Hudson both play critical roles in the advancement of green energy within the City. Due to that critical interrelationship, it is crucial that City staff maintain open and clear communication with Central Hudson, including such actions as:

- Review interconnection best practices; identify challenges and concerns regarding the existing interconnection process
- Engage Central Hudson and hold a collaborative discussion to discuss concerns and potential solutions.

[31] https://kingston-ny.gov/filestorage/8399/22301/22336/Kingston_100%25_RE_Roadmap_Final_Clean_ext_-_Copy.pdf

SolSmart

The City of Kingston has received a Bronze designation from the national SolSmart program for encouraging the growth of clean, affordable solar energy at the local level. As a SolSmart Bronze designee, Kingston has adopted nationally recognized best practices to advance solar market growth and worked with SolSmart's no-cost technical assistance team to increase local knowledge of solar energy so the entire community can benefit. To achieve SolSmart Bronze designation, Kingston has posted an online checklist detailing the permitting process for residential rooftop solar and has reviewed local zoning requirements and identified restrictions that intentionally or unintentionally prohibit solar energy development. These and other actions taken will make it faster, easier, and more affordable for residents, businesses, and nonprofit organizations to install solar in this community. Staff should continue to advance Solsmart initiatives to streamline the work.

Kingston Solar Guide and Permit

The NY-Sun team at NYSERDA developed the Solar Guidebook as a tool for municipalities, in collaboration with the New York Department of State, solar contractors, and other stakeholders. It supports NY-Sun's efforts to implement a unified permitting process for residential solar PV systems. The City of Kingston has adopted the Unified Solar Permit to streamline the approval process for installing solar in the community. An expedited process is established to ideally cut costs for both installers and the City. This is done by creating a uniform permitting process to allow these standard systems to pass quickly though the permit review process, freeing up time for all involved parties, decreasing the overall installation time for customers, and allowing non-standard systems the necessary time for detailed review. Staff should continually check in on the process to ensure it is as streamlined as possible.

Solar Guidebook[32]

Unified Solar Permit[33]

4.2 Municipal Supply Mix Strategies

While municipal operations comprise only a limited proportion of the total community electricity demand, it is an area directly within the City's control and therefore can be addressed in the near-term through City action. Action by the City of Kingston can serve as a role model for other entities within the City and region.

The municipal supply mix of electricity is tracked in an annual Electricity Source Report compiled by the City of Kingston[34].

4.2.1 Purchase Renewable Energy On-site to Supply City Operations

The City of Kingston has already funded and installed and is actively pursuing additional solar installation projects on municipal properties (Table 12). Once all these projects are complete, 10% of municipal electricity use will be covered by local production. To make up the remaining current electricity demand an additional 4.2 acres of rooftop solar or 15 acres of ground-mount solar will need to be installed. Total municipal rooftop acreage is 4.8 acres and parking lot acreage is 18 acres, which, at 50% utilization, equates to 2.4 acres of rooftop and 9 acres of ground-mount solar. If all were to be built out, the City could expect to have up to 3,480 kW of municipal solar capacity on municipal property, accounting for 76% of 2023 municipal electricity use. By installing solar panels on City-owned buildings and facilities, Kingston will make use of underutilized spaces, reduce energy costs for municipal operations, and decrease the direct greenhouse gases released by municipal operations.

Site	Address	System Size	Status

[32] https://kingston-ny.gov/filestorage/8463/10792/10798/17792/Kingston_solar-guidebook_Vrs2.pdf
[33] https://kingston-ny.gov/filestorage/8463/10792/10798/17792/Kingston_solar_Permit_Vrs3.pdf
[34] https://www.kingston-ny.gov/filestorage/8399/22301/22336/2023_Municipal_Operations_Renewable_Energy_Report.pdf

Andy Murphy Neighborhood Center	467 Broadway	49 kW	Complete, online as of August 2022
Andretta Pool	76 N. Front Street	21 kW	In Contract, Spring 2025 installation
Rondout Neighborhood Center	103 Broadway	50 kW	In Contract, Spring 2025 installation
1st Avenue Yard	514-528 First Ave	225 kW	In Pre-Design, Spring 2025 Bidding
Hasbrouck Park Pavilion	Delaware Ave	19 kW	In Pre-Design, Summer 2025 Bidding

Table 12: Installed and planned City solar projects to date

To expand the portfolio of municipally generated energy via solar, technical and feasibility analysis has been done for several sites to identify potentially feasible sites for new solar. Simultaneously, financing options are regularly evaluated and sought, including grants, incentives and direct municipal bonding. Sites reviewed to date can be found in Table 13.

Site	Address	Estimated System Size
Wilbur Avenue Annex	376 Wilbur Ave	160-180 kW
Kingston Point Beach Pavilion	50 Delaware Ave	14 kW
DPW Garage	464 Hasbrouck Ave	158 kW
WWTP Main Building	91 E. Strand St	47 kW
Central Fire	19 E. O'Reilly St	30 kW
Dietz Stadium	North Front St	60 kW
Rondout Fire	5 Garraghan Dr	67 kW
Hutton Park Pavilion	Grant St	11 kW
Uptown Fire	Frog Alley	62 kW
Kingston Police and Court Building	1 Garraghan Dr	79 kW

Table 13: Prospective Municipal Building Solar Installations

4.2.2 Procure Renewable Energy from Retail Electricity Providers

Where municipal generation does not meet demand, the City of Kingston attempts to purchase renewable energy on the energy market. In 2024, approximately 90% of municipal electricity consumption was from Constellation Energy's NewMix renewable energy electricity product shown in Figure 6 above. The price of this electricity and specifics of the contract signed are periodically updated and reported in the City's annual Electricity Source Report. While this electricity is technically renewable, its source is not necessarily local, and purchasing from Constellation Energy does not increase local renewable electricity generation.

4.2.3 Offsite Power Purchase Agreement: Partner with a Third Party to Produce Renewable Energy

The City is exploring partnering with an independent power producer (IPP) within the Central Hudson service territory to directly procure renewable electricity for municipal operations through a power purchase agreement. With this approach, the IPP builds, maintains, and continues to operate a renewable energy system, while the City of Kingston receives title to the electricity and RECs produced by the system. When selecting energy providers, the City should consider how different companies factor diversity and equity in their internal policies through measures such as diversity or inclusion goals for recruiting and retaining members of the workplace or internal equity training.

4.2.4 Municipal Operations Energy Transition

New York State has a variety of policies and programs that are focused on the electrification of heating and transportation including the Clean Heating and Cooling Communities program focusing on building electrification, the Make Ready initiative to support electric vehicle supply equipment and infrastructure, and the Drive Clean Rebate to

support electric car purchases or leases through a point-of-sale rebate. These programs will reduce New York State and Kingston's use of fossil fuels, increase electricity load over time, and increase the need for renewable energy sources.

Switching municipal operations from fossil fuel driven vehicles and fossil fuel heating systems to electric will allow the City of Kingston to lead by example. It is the City of Kingston's goal to reach 70% renewable energy usage and or production by 2030 as well as reducing the GHG emissions to 50% of 2010 levels. It is imperative for this goal to switch to heat pumps and electric vehicles to meet this goal. While municipal operations comprise only a limited proportion of the total community electricity demand, it is an area directly within the City's control and therefore can be addressed in the near-term through City action. Additionally, action by the City of Kingston may also inspire other entities in the commercial and industrial sector to pursue similar strategies to supply their electricity demand with renewable resources.

The City of Kingston's fleet drives approximately 1.15-1.5 million miles every year. Once the fleet is transitioned to all electric, where practicable, the electricity demand would be 1,205 MWh to 1,500 MWh. This would require the equivalent of 6.5 to 8.1 acres of solar panel production to power the City of Kingston's future electric fleet.

Kingston is also taking an active role in transitioning municipal buildings from natural gas heating to electric heat pumps. The City tracks and inventories how energy is used across municipally owned properties as a first step in determining where and how to implement energy improvements. Per the City of Kingston's Benchmarking legislation, all facilities larger than 1000 square feet have their energy use tracked, and an annual report is given to the Common Council. Through this process, Kingston has established baselines for building energy use that help identify the highest-impact sites for improvement.

4.3 Community Choice Aggregation (CCA)

Kingston can promote the uptake of renewable energy through the implementation of an advanced Community Choice Aggregation (CCA) program, often referred to as CCA 3.0. Designed to enhance renewable energy sourcing, support local distributed energy projects, and encourage the deployment of clean energy technologies across the community, this CCA could play a pivotal role in supporting an equitable transition.

4.3.1 Establishing a Community Choice Aggregation Program

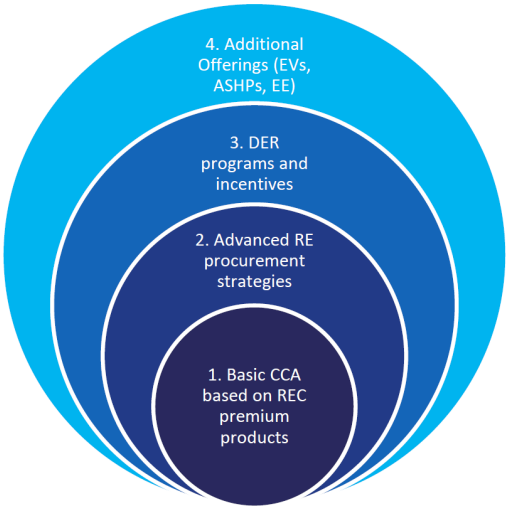

Figure 18: Advanced CCA model

Kingston's 2030 Climate Action Plan recommended that the City pursue a Community Choice Aggregation program. While typical CCAs focus only on electricity supply, the City selected Mid-Hudson Energy Transition to serve as the City's CCA administrator through a competitive process to administer an advanced CCA model. As proposed, the Kingston CCA would go beyond the typical CCA 1.0 model that focuses only on electricity supply in favor of a comprehensive CCA 3.0 model. In January 2025, Mid-Hudson Energy Transition was approved as a CCA Administrator by the Public Service Commission, and at the time of this writing, the CCA program is in further development.

Kingston's CCA foundation could include the standard approach employed by most New York State CCA programs (Figure 17). Typically, these programs focus on purchasing in-state Renewable Energy Certificates (RECs) to deliver 100% renewable energy products for residents and businesses. From this foundation, Kingston could pursue a more ambitious model that emphasizes local renewable energy generation, investment in distributed energy resources, and alignment with community priorities such as energy equity and resilience.

This advanced CCA model could be achieved through a phased approach, enabling Kingston to make steady progress, engage stakeholders, and adapt to evolving resources and regulatory conditions. Key steps include prioritizing local renewable energy projects, integrating distributed energy infrastructure, and fostering community engagement to ensure alignment with the Clean Energy Program Framework. Equity considerations could be central to the program's design, prioritizing accessibility and affordability by offering a range of renewable energy options to maximize participation. Premium 100% renewable energy options could be opt-in, with clear pricing transparency to avoid burdening customers. The program could also ensure that residents retain existing utility discounts and provide greater autonomy by enabling them to make informed decisions about their energy supply. Furthermore, the advanced CCA model could focus on intentional municipal procurement to promote equity by investing in disadvantaged communities, reinforcing Kingston's commitment to sustainable and inclusive energy solutions.

4.4 Scaling Local Generation

4.4.1 Local Requirements for Local Renewable Energy Production

One of the recommendations through the DOE SolSmart program is that a community establishes local requirements for renewable energy production. The City of Kingston does not currently have such requirements established. However, the City has adopted the NYStretch Energy Code which does address local production. The NYStretch Energy Code does not mandate the installation of solar panels on new buildings, but it does require that buildings with a certain roof area be "solar ready," meaning they must have designated roof sections prepared for future solar photovoltaic or thermal system installation, including electrical pathways and breaker space for a potential solar array; this applies mainly to buildings with at least 600 square feet of roof area facing southwards.

To advance a local requirement for renewable energy production, the City should:

- Review existing requirements for communities across the U.S. and adapt to the Kingston context as needed.
- When requiring renewable energy, ensure that implementation can be conducted in a cost-effective way that would not lock underserved groups out of participation in distributed generation.
- Consider potential unintended consequences of such requirements, such as increased rent on renewable energy-equipped buildings and residences.
- Implementation should consider opportunities to foster a local workforce to complete installations.

4.4.2 Increase Participation in Community Solar

To be able to reach 70% renewables, the City will need to look beyond roof top and ground mount systems within the City limits to reach our goals. A strategy to address this is the participation in community solar, also known as Community Distributed Generation (CDG). Community solar is a program that allows households to participate in the CCA, support a local solar project, and to get a guaranteed discount on their electricity bill Instead of installing a renewable energy project on their property, households subscribe to a solar farm in the area. It costs nothing to join, households save money on electricity and support new solar energy projects. The community solar project generates utility bill credits based on the amount of electricity produced by the solar panels. As a subscriber, a portion of those solar credits are applied directly to the household's monthly electric bill, reflected as a discount on the electricity bill each month.

Currently, there is no federal legislation to support community solar. Instead, states can choose to develop and administer their own community solar policies and programs. Equitable access to project funding is one of the most persistent barriers to community solar development. To get smaller community solar projects deployed, especially in underserved communities, developers need expertise, capacity, and access to predevelopment funds to prepare materials for funding applications.

The City of Kingston is partnering with Mid-Hudson Energy Transition (MHET) and PowerMarket on a community choice aggregation program called Kingston Community Energy (KCE). A priority initiative of Kingston Community Energy is Community Solar. In partnership with PowerMarket and Mid-Hudson Community Energy, the City is currently enrolling eligible residents in Mid-Hudson Community Solar at www.kingstoncommunityenergy.org/solar. As of August 2024, 261 families are enrolled in Kingston Community Solar, with distribution across the City as shown in Figure 18 below.

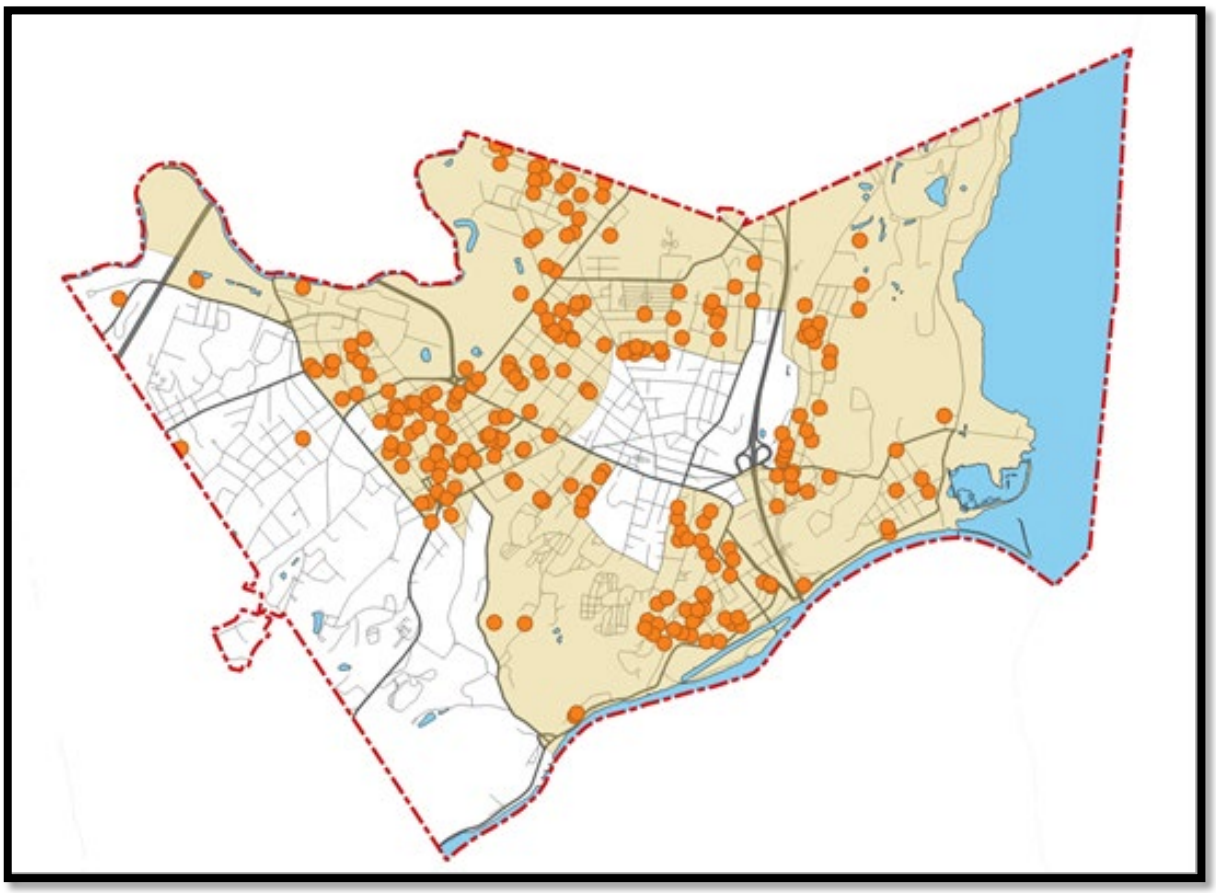

Figure 19: Community Solar Enrollment Distribution.

The currently available community solar projects, which can be found using the Central Hudson Clean Energy Marketplace[35]:

- Mid-Hudson Community Solar - LMI Program - 20% Discount Rate

  Solstice Community Solar

  - Bogart (Palenville)
  - Reisender (Ellenville)

- Perch Energy Community Solar projects
  - Maple Solar 1 (Rock Tavern)
- Arcadia Community Solar projects
  - Broadhead (West Shokan)

Image 5. Solar project example

NYSERDA also has a list on their website to help Central Hudson customers access projects. See NSYERDA's Find a Community Solar Project[36]. Local project providers include:

- Ampion
- Arcadia
- Clearway Community Solar LLC
- Common Energy
- Meadow
- Nexamp
- PowerMarket
- Solar Generation
- Solstice Power Technologies
- SunCommon

[35] https://cleanenergymarket.cenhud.com/
[36] https://www.nyserda.ny.gov/All-Programs/NY-Sun/Community-Solar/Community-Solar-Map

a) Increased Community Outreach and Education

Education and awareness are key tenets to a successful culture shift and surely key to a comprehensive energy transition. The City has numerous efforts in place which serve to inform residents and businesses about their energy choices. These programs should continue to expand, serve and support the community with energy needs. Existing programs/partners include:

1. Wraparound Services
    a. Mid-Hudson Energy Transition
    b. Cornell Cooperative Extension Clean Energy Hub
2. Housing Assistance
    a. Family of Woodstock Housing Assistance
    b. RUPCO Restore Program
    c. RUPCO Home Repair Program
3. Weatherization
    a. UCCAC Weatherization Assistance
    b. Ulster County Home Energy Assistance Program (HEAP)
4. Energy Coaching/Green Jobs/Advocacy
    a. New Yorkers for Clean Power
    b. Communities for Local Power
5. Community Engagement
    a. Climate Smart Kingston Commission

4.4.3 Establish and/or Participate in Group Purchasing Programs

In addition to the work being advanced for Community Choice Aggregation, the City has coordinated efforts and will continue to coordinate group purchasing programs for renewable energy, in order to reduce costs and support market development. The City has coordinated with local solar providers to host a Solarize Kingston Campaign, which provided discounted solar installations for participating households. This efforted netted about 12-14 households' participation. The City should offer this type of campaign every 5 years with a goal of 20 participants each round. To complete this task, actions should include:

- Research the process for developing a group purchasing campaign and train staff as needed.
- Develop a team to support campaign activities, including City staff and/or community volunteers.
- Issue a request for proposals (RFP) for installers, evaluate responses, and select an installer.
- Promote the campaign through community outreach.

4.4.4 Financial and Non-financial Incentives for Renewable Energy

As mentioned above, equitable access to project funding is one of the most persistent barriers to solar development whether it is for a single-family home or larger community solar project. The Inflation Reduction Act has setup a 30% tax credit that can be taken right off the top of solar installation projects. In addition, New York State also provides incentives for residential renewable energy projects of 25% with a maximum of $5000 towards any one project.

a) Existing Municipal Incentives

The City of Kingston has multiple avenues at its disposal for providing incentives to homeowners and commercial businesses to transition to clean energy and specifically to install renewable technologies.

1. Unified Solar Permit

The City has adopted the Unified Solar Permit, which provides consistent and thorough review of solar PV permitting applications and installations and streamlines the process for submitting applications to the City[37].

2. EIC Open C-PACE Program

EIC Open C-PACE (Property Assessed Clean Energy) is a program operated by Energy Improvement Corporation (EIC) and provides a low cost, long-term alternative to traditional loans to fund clean energy projects in commercially owned buildings. To enable Open C-PACE, the City of Kingston passed Local Law #2 of 2019 and signed an EIC municipal agreement[38]. EIC bills the property owner and directs them to remit the funds to the capital provider, removing any collection obligation from the municipality. As the program administrator, EIC will review and approve each financing, ensuring it conforms with the enabling legislation and NYSERDA C-PACE guidelines. Open C-PACE is not a bank loan and differs from traditional financing options because:

-financing is available for up to 100% of the project cost, or can be combined with other financing

-competitive private financing from EIC-approved capital providers

-customizable loan terms up to the expected life of the improvement

-repayment is secured through a benefit assessment lien that is subordinate to municipal taxes

-financing automatically transfers to a new owner if the property is sold

-projects must comply with NY State Article 5-L (NY's PACE law) and NYSERDA's Commercial PACE Guidance Document

Recommendations for Implementation:

Examining best practices from other communities across the Country, Kingston has many possible incentive programs to consider for implementation. Some examples include:

- *Online automated platforms, such as SolarAPP+*, to manage high volumes of applications. These platforms can help local governments to stay up to date with relevant codes, catch errors, improve communication with applicants, accelerate approval for standardized PV systems, and improve record keeping.
- *Exempt or waive fees for residential solar PV permit applications:* To incentivize solar development within the City, exempting or waiving permit fees for solar energy systems can incentivize community members to install solar by lowering the overall cost of the system.

[37] https://kingston-ny.gov/filestorage/8463/10792/10798/17792/Kingston_solar_Permit_Vrs3.pdf
[38] https://kingston-ny.gov/filestorage/8399/10476/11808/36541/36543/LOCAL_LAW_2_of_2019.pdf

- *Exempt or waive fees for residential solar PV permit applications for LMI customers:* One way to further reduce the barriers for Low to Moderate Income (LMI) residents to install solar PV systems, is to exempt or waive permit fees.
- *Provide technical assistance for businesses and residents for Federal Tax Credits*: There are tax credits available for businesses and residents that install solar through New York State and the Inflation Reduction Act. The owner of a qualified solar installation can file for federal tax credits and accelerated depreciation on the cost of the installation. City staff can assist businesses and residents in how to file for these credits.
- *Connect homeowners to Affordable Solar program and Empower+:* Households earning less than 80 percent of the median income in Kingston may qualify for additional incentives through Affordable Solar which works just like other NY-Sun incentives, except it requires you to make additional low-cost energy upgrades to your home along with your solar installation. Support is available through EmPower+ to integrate minor energy upgrades in homes. Staff can connect residents with these programs.
- *Connect solar owners to the NYS Solar Sales Tax Exemption*, which offers 100% exemption from state sales tax for solar technologies, which also include solar water heat, solar space heat, and solar pool heating.
- *Grant Exemption for the local sales tax for residential solar panel systems.*
- *Establish a Solar Electric Generating Systems Tax Abatement Program:* An example of this is designed for residential and commercial building owners in New York City. It encourages them to establish solar electric generating systems in their buildings. The systems must not "include any equipment connected to a solar electric generating system that is a component of a non-solar electric generating system or that uses any sort of recreational facility or equipment as storage." The program provides a four-year tax abatement of 5% of eligible expenditures, with a maximum tax abatement of $62,500 each year.
- *Establish a Green Building Financial Incentive Program:* There are lots of local-level incentives. For example, the town of Riverhead, Long Island, includes a Green Building financial incentive for solar panels in the commercial and residential sectors. The law was initially passed in 2005 and requires a permit fee of $50 to $150. This is in contrast to the $1,000 that was the normal permit fee for anyone who wanted to install solar panels on their buildings.
- *Ulster County IDA could incentivize large commercial solar:* This could include an incentive such as a 20-25-year PILOT agreement for new solar projects of $5-6,000 per megawatt.
- *Explore opportunities to access REC markets:* Helping DG producers get access to the REC market could act as an additional monetary incentive to producing renewable electricity.

5. Further Considerations

While the Kingston Municipal Renewable Energy Implementation Plan (REIP) outlines a roadmap to achieving the City's renewable energy goals, additional factors must be addressed to ensure long-term success. These include community buy-in, financial feasibility, and climate resilience.

Achieving the CLCPA goal of 70% renewable energy by 2030 depends on continued investment in solar by the people of Kingston. Meeting the goals outlined in this report will require significant political and financial capital, and these goals will not be reached without an engaged community. Encouraging economic development in the renewable energy sector will be critical for maintaining community buy-in, particularly by fostering local workforce training programs and supporting local green businesses.

The financial feasibility of large-scale uptake of solar power may be a challenge to Central Hudson. As more residential customers install solar systems that offset their electricity demand, the revenue collected by Central Hudson could be negatively affected. At present, Central Hudson customers with solar panels can use the electricity they produce to offset both delivery and supply charges on their bills. Since utilities are required to cover operational costs and capital expenses, the Public Service Commission (PSC) allows them to adjust delivery rates accordingly. This could result in a cost shift, where the financial burden of maintaining grid infrastructure through delivery charges is shifted to customers who have not transitioned to solar energy.

The long-term management of solar panel systems must also be accounted for. Although this report focuses on 2030 goals, solar panels have a lifespan of 20 to 40 years. Establishing decommissioning plans to facilitate their removal, recycling, and land restoration while ensuring proper financial assurances will be critical to reducing the environmental impact of the plan. To withstand climate impacts, renewable energy projects will also need to incorporate resilience strategies. These could include siting renewable systems outside flood-prone areas and the establishment of community microgrids for critical facilities like hospitals and emergency shelters.

6. Conclusion

The City of Kingston is at a pivotal moment in its transition to a renewable energy future. By setting ambitious goals, implementing strategic policies, and leveraging innovative solutions, Kingston is demonstrating its leadership in the clean energy transition. This Municipal Renewable Energy Implementation Plan lays out a comprehensive pathway for achieving 70% renewable electricity by 2030, aligning with state and regional targets.

Key strategies outlined in this plan include expanding local solar capacity, integrating energy storage, electrifying municipal operations, and fostering community participation through initiatives such as Community Choice Aggregation (CCA) and community solar. Additionally, the City is committed to ensuring that its energy transition is equitable, prioritizing disadvantaged communities and providing opportunities for inclusive economic growth.

While the progress made so far is significant, continued collaboration with regional stakeholders, utility providers, and community organizations will be essential to meeting the City's clean energy targets. The success of this plan depends on the collective effort of residents, businesses, policymakers, and energy developers working together to build a more sustainable, resilient, and independent energy system.

As this plan is implemented, it will be revisited and updated every five years to incorporate technological advancements, policy changes, and emerging opportunities. The City of Kingston remains steadfast in its commitment to leading by example, demonstrating that a transition to a renewable energy economy is not only possible but necessary for a healthier, more just, and climate-resilient future.

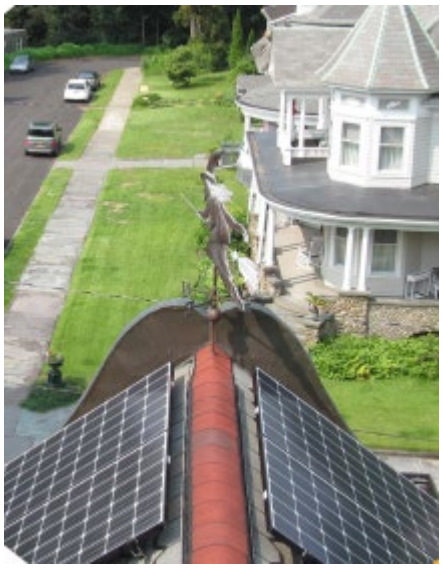

Image 5. View from residential rooftop solar on President's Place

APPENDIX 1: Methodology

Grid Electricity

The New York Independent System Operator (NYISO) is responsible for overseeing the design, deployment, administration, and monitoring of the state's electricity market. In 1999, NYISO took control of New York's electric power system and bulk electricity grid from the New York Power Pool. NYISO publishes an annual Power Trends report detailing regional power capacities and production.

NYISO divides the state into 11 zones, classified as either Upstate (Zones A–E) or Downstate (Zones F–K). Zone G largely corresponds to Central Hudson's service territory and is part of the Downstate group. Central Hudson's energy sales, relative to the surrounding area, are relatively small—only 4,921,000 MWh. According to NYISO's 2024 Power Trends report, total Downstate energy production was 60,426,000 MWh, with only 6.65% derived from renewable sources (see Figure 2). To better understand the composition of local renewable energy generation, multiple data sources were examined.

While NYISO reports on energy production rather than consumption, additional research was conducted to assess energy demand. This analysis included utilities within NYISO's Downstate territory: Central Hudson, Orange & Rockland, Consolidated Edison, and the Long Island Power Authority. In 2023, these utilities collectively sold 79,349,100 MWh of energy. Since Downstate energy production only totaled 60,426,000 MWh, this resulted in an additional need of 18,923,100 MWh above what downstate produced, necessitating additional imports. Upon further analysis, based on additional assumptions, upstate energy generation consisted of 43% nuclear and 49.5% renewable energy. Based on this distribution, and assuming the energy is imported only from upstate, the imported energy was calculated to include 8,136,933 MWh from nuclear sources and 9,366,935 MWh from renewable sources. This results in an estimated regional energy composition of 10.25% nuclear and 11.8% renewable energy, totaling a maximum of 18.45% clean energy consumption.

Solar Capacity Potential

The methodology used to assess the potential for solar installations followed three steps. The first step involved collecting all available data and analyzing it using an Excel spreadsheet or Scenic Hudson's Solar Mapping tool. Scenic Hudson developed a rooftop analysis tool that leverages Microsoft's deep learning-generated building footprints. Although designed for the Hudson Valley, this tool utilizes broad-scale datasets that cover entire regions, states, or the country, which may contain some inaccuracies or omissions. Scenic Hudson has made efforts to use the most up-to-date datasets available. The footprints can be visualized in vector tile format or as a hosted feature layer for analysis. From this, a list of large-footprint buildings was created and identified as potential solar installation sites. Each highlighted location in Kingston was reviewed and compiled into a spreadsheet, which is presented in APPENDIX 2: Potential Large-Scale Rooftop Solar Sites.

While the mapping tool was originally designed to aggregate rooftops larger than half an acre (21,780 square feet), an additional analysis was conducted to assess residential solar potential. Three categories of rooftop sizes were analyzed: residential rooftops ranging from 300 to 3,100 square feet, medium rooftops spanning from 3,100 to 21,780 square feet, and large rooftops, which were analyzed using Scenic Hudson's tool.

Scenic Hudson and New Yorkers for Clean Power have provided training on solar site selection and energy production estimates. Three types of solar installations were analyzed in this report, with specific assumptions for each type. Rooftop solar was categorized into residential roofs, which are less than 3,100 square feet but larger than 300 square feet, and medium to large roofs, which are greater than 3,100 square feet but smaller than 21,780. The large rooftops, those above half an acre or 21,780 were visualized using the Scenic Hudson Solar Mapping Tool. These categories are discussed further in Section 3: Local Renewable Energy. Carport solar installations were also analyzed with the assumption that 50% of parking areas can be covered with solar panels, as parking aisles typically account for 30% to 50% of total lot space. Ground-mounted solar installations were assessed based on analyses from NYSERDA and NREL, which estimate that large ground-mounted systems require approximately 5 to 6.5 acres per megawatt (MW), equating to a density of 155–200 kW per acre.

Large and medium rooftops were estimated to produce 1,200 kWh per kW of installed capacity, while small rooftops, which are more likely subject to obstructions and shading, could produce as little as 970 kWh per kW of installed capacity. This methodology provides a comprehensive assessment of the solar energy potential within Kingston and the surrounding region, offering insights into both large-scale and residential solar deployment opportunities.

Ulster County Solar Capacity Calculator Methodology

Ulster County provided the City of Kington with the following methodology and dataset to determine the solar capacity and 2030 capacity goals for the City. However, the dataset provided did not distinguish between solar installations in the City of Kingston and those in the 12401 zip code. Because of this discrepancy, we chose to use another method for determining solar capacity and 2030 goals as outlined in section 3.6.3.

APPENDIX 2: Large Rooftop Solar Potential

Assumptions					
	From Part I HTSN	700	kw/acre		
	Percent usable roof space	50%			
	Production KwHrs per KW	1200	KwHrs/Kw		
Tag Number	Owner	SBL	Area	kW	KwHrs
1	Stony Run Apartments	48.70-1-2	0.5	175	210,000
2	Adirondack Trailways	48.70-1-41.100	0.6	210	252,000
3	The Best Western PLUS	48.71-1-1	2	700	840,000
4	Daily Freeman Building	48.71-2-11	0.5	175	210,000
5	Bailey Middle School	48.78-2-1.111	2.1	735	882,000
6	Edson Elementary	48.78-2-1.111	0.9	315	378,000
7	Ulster Savings Bank	48.71-1-6	1.2	420	504,000
8	Kingston Plaza	48.80-1-3.100	6.8	2380	2,856,000
9	Herzog's Store	48.80-1-3.100	0.7	245	294,000
10	Herzogs Lumber Yard	48.80-1-27.110	0.5	175	210,000
11	Uptown North Front St. Row	Multiple	0.5	175	210,000
12	Uptown Crown St to Wall St.	Multiple	2.6	910	1,092,000
13	Uptown Wall St. to Fair St.	Multiple	1.3	455	546,000
14	South of John, Wall St. to Fair St.	Multiple	0.8	280	336,000
15	Landmark Place 1 Alb. Ave	48.80-1-12.110	0.6	210	252,000
16	MMJD Equities	48.80-1-10.100	0.7	245	294,000
17	Peoples Place	56.92-1-32.100	0.5	175	210,000
18	Kingston National Guard	48.65-1-68	1.4	490	588,000
19	JBT	48.74-3-29.114	3.29	1151.5	1,381,800
20	Ertel Alsop (EA Flatbush)	48.74-3-29.113	1.94	679	814,800

21	Statewide Storage	48.74-1-51	0.9	315	378,000
22	Ulster County Records	48.82-1-27	0.5	175	210,000
23	Cedar Holdings Associates (Post Office)	56.25-4-9	0.9	315	378,000
24	KOKA Holdings	48.334-3-15	0.7	245	294,000
25	The Arc (US NYS Arc)	48.334-5-13	1.3	455	546,000
26	BF Apartments LLC (MHBF Developer)	48.82-1-7.100, 48.82-1-7.200, 48.82-1-7.300	0.7	245	294,000
27	Senior Living Alemar LLC	56.25-2-18.210, 56.25-2-18.110	0.6	210	252,000
28	Owl Thrift	56.25-3-29.1	0.6	210	252,000
29	DEP Building	56.25-4-39	1.1	385	462,000
30	DBTL LLC (9 Bellows Ln)	56.25-4-43.1	0.6	210	252,000
31	Scott Dutton & Funky Kingston	56.25-4-32, 56.25-4-29	0.6	210	252,000
32	82 Prince St	56.26-9-44	0.6	210	252,000
33	DPW Hasbrouck Ave	56.26-8-44, 56.26-8-43	0.6	210	252,000
34	Kingston Hospital Campus WMC	56.26-6-32.110	1.6	560	672,000
35	Private Row Housing (362 to 338 Broadway)	Multiple	0.6	210	252,000
36	UPAC	56.109-3-19	1	350	420,000
37	YMCA	56.25-5-3	1.3	455	546,000
38	Fuller Holdings	56.25-5-35	0.9	315	378,000
39	The Metro	56.33-2-20.100	1.6	560	672,000
40	101 Greenkill LLC	56.109-2-41	0.6	210	252,000
41	George Washing Elem	56.124-1-1	1	350	420,000
42	Kingston High School Center	56.34-2-40.111	2.8	980	1,176,000
43	Kingston High School East	56.34-2-40.111	0.8	280	336,000
44	Kingston High School West	56.34-2-40.111	0.6	210	252,000
45	SUNY Ulster	56.34-2-40.112	0.5	175	210,000

46	Hospital Main Campus	56.41-3-1.110	1.8	630	756,000
47	Golden Hill Nursing Home	56.40-1-19.100	1.8	630	756,000
48	Ulster County (Does not exist now)	56.40-1-19.310	0.7	245	294,000
49	Gateway	56.40-1-20.2	1.2	420	504,000
50	UC Jail	56.48-2-6	3.1	1085	1,302,000
51	Broadway East Townhouses	56.35-3-16	0.5	175	210,000
52	Private Row Housing (Art & REHR)	Multiple	0.8	280	336,000
53	JFK Elementary	56.35-9-33	0.9	315	378,000
54	Kingston Business Park	56.27-6-42	3.4	1190	1,428,000
55	Hutton Brickyards North Building	48.84-1-4	0.8	280	336,000
56	Hutton Brickyards South Building	48.84-1-4	1	350	420,000
	TOTAL		68.4	23,601	28,320,600

APPENDIX 3:
Potential Ground Mount Parking Lot Solar Sites

Assumptions				
	From Part I HTSN	200	kw/acre	
	Percent usable roof space	50%		
	Production KwHrs per KW	1200	KwHrs/Kw	
Tag Number	Owner	Area	kW	KwHrs
P1	Village Court Condos	0.56	56	67,200
P2	The Best Western	2.12	212	254,400
P3	Daily Freeman Building (former)	0.61	61	73,200
P4	DOT lot	2.8	280	336,000
P5	Ulster Savings Wash. Ave	1.22	122	146,400
P6	Kingston Plaza	11.26	1126	1,351,200
P7	Herzog's Lumber Yard	1.47	147	176,400
P8	Lorpak Willow Park	2.26	226	271,200
P9	MMJD Equities	0.57	57	68,400
P10	People's Place	0.39	39	46,800
P11	Kingston National Guard	1.57	157	188,400
P12	JBT ErtelAslop	1.72	172	206,400
P13	9W Entrance and exit	3.8	380	456,000
P14	Riker Industries (East Chester)	0.76	76	91,200
P15	The Lace Mill south parking	0.38	38	45,600
P16	9 Cornell St Property Owners	0.66	66	79,200
P17	Midtown Parking Lot (Cornell)	1.29	129	154,800
P18	Owl Thrift	0.77	77	92,400
P19	DBTL LLC (9 Bellows Ln)	0.76	76	91,200
P20	Scott Dutton & Funky Kingston	0.55	55	66,000

P21	Kingston Hospital Campus WMC	2.1	210	252,000
P22	Fuller Holdings	1.42	142	170,400
P23	Kingston High School Center	3.09	309	370,800
P24	SUNY Ulster	0.29	29	34,800
P25	Hospital Main Campus	3.34	334	400,800
P26	Wilbur Ave DPW yard	2.38	238	285,600
P27	Ulster County	2.27	227	272,400
P28	Gateway & Inst. Urban Family Health	1.1	110	132,000
P29	UC Jail	1.3	130	156,000
P30	Broadway East Townhouses	0.63	63	75,600
P31	Broadway Parking lot	0.20	30	36,512
P32	Post Office Cedar Holdings Assoc. Govt	0.9	135	162,000
P33	Post Office Parking Lot	2.7	405	486,000
P34	Police Station Carports	0.5	75	90,000
P35	Washington Elementary	0.74	111	133,200
TOTAL		58.5	6,100.4	7,320,512.3