Appendix 1: North American City Case Studies

New York City

Summary

This report is part of a series on best-practice municipal energy strategies within Europe and North America. The series is part of a larger project of recommendation on *TransformTO*, with other series' discussing waste, transportation, and buildings. This document highlights strategies & recommendations from New York City to improve *TransformTO*. Similar reports are written for Vienna, Munich, Lyon, Manchester, Vancouver, Portland, and San Francisco. This report is focused on heating/cooling, energy efficiency, renewable energy, electricity, intergovernmental co-operation, and community/district energy. Findings indicate that New York's colder climate and large stock of aging residential buildings make it a highly comparable and relevant case study for Toronto. Strategies emphasizing building energy efficiency measures, progressively stringent policies and expansion of renewable infrastructure in Transform TO can lead to significant reductions in energy-associated emissions.

Background on City

New York City (NYC) has the largest and most dense population of any American city, with 18.8 million total residents and 28000 residents/sq. mile (Macrotrends, 2020; Rosenthal, 2020). Average temperatures range from 0.5 °C to 24.5 °C and the city gets about 4-9 hours of sunshine per day (Climates to Travel, n.d.). The city lies on the Eastern coast of the US and is frequently windy due to colliding air masses from the north and south (Climates to Travel, n.d.).

NYC has the smallest carbon footprint per capita of all large American cities attributed to its extensive transit system which permits many inhabitants to function without cars (NYC, 2019a). The greatest obstacle to reducing the city's emissions and energy use lies in its buildings, responsible for 66% of the city's emissions as displayed in Figure 1. NYC has been tracking GHG emissions since 2007 resulting in a rich data set to inform climate policy (NYC, 2014). The city has established an *Office of Sustainability* to facilitate accomplishment of climate action initiatives.

Energy/Climate Change Plans

Overview

NYC has continuously added and amplified climate action targets throughout its climate plans. In 2007 the city released *PlaNYC,* a roadmap to improving life in NYC containing sections on climate action and energy. *PlaNYC* aimed to reduce emissions 30% below 2005 levels (NYC, 2007). In 2014, *One City: Built to Last* was released which escalated citywide emissions reduction goals to 40% by 2030, 80% by 2050 and aimed to reduce building emissions 30% by 2050 (NYC, 2014). In 2016, the city released *Roadmap to 80x50* to supplement these targets and continues to release annual progress reports. In

April 2019, the city released *OneNYC 2050*, a Green New Deal-based strategy with a section on climate action entitled *A Livable Climate* that amplified the city's emission reduction target to 100% by 2050 (NYC, 2019a). A roadmap to meet energy goals within city operations is currently under development and the 2020 implementation report has been delayed to account for the effects of the COVID-19 pandemic (NYC, 2019a; NYC, 2019b)

Key Initiatives (2005 baseline emissions)

- *One City Built to Last & One NYC 2050:* Reduce NYC building heating/cooling/power emissions 30% by 2025 and new buildings meeting net-zero standards by 2030 (NYC, 2014; NYC, 2019a)
- *One City Built to Last & OneNYC 2050:* Reduce NYC emissions 40% by 2030 and 100% by 2050 (NYC, 2014; NYC 2019a)
- *One City Built to Last:* Reduce emissions from city operations 35% by 2025 (NYC, 2014)
- *One City Built to Last:* 100 MW of solar PV capacity on city facilities by 2025 and of 1000 MW of solar PV capacity community-wide by 2030 (NYC, 2014; Zielinski et al, 2016; NYC, 2019b)
- *OneNYC 2050*: Develop 500 MW capacity for renewable power storage by 2025 (NYC, 2019a)
- *OneNYC 2050*: 100 % clean electricity by 2040 (NYC, 2019a)

Energy

NYC's electricity comes from natural gas, hydro, nuclear, solar and wind (NYC, 2019a). Half of the electricity used in the city originates from 24 on-site power plants and the rest is produced offsite (NYC, 2019a; NYC, 2014). Emissions from natural gas combustion plants contributes 30% of city-wide emissions (NYC, 2014). NYC's energy supply is regulated & operated by state and privately-owned utility companies (NYC, 2014). NYC's municipal operations use 10% of the city's total electricity and uses this purchasing power to influence utility companies' decisions (NYC, 2014).

NYC has many old, inefficient buildings producing exorbitant levels of greenhouse gas (GHG) emissions. Figure 2 displays how various buildings in New York sourced their power, heating, and cooling in 2017 (NYC Mayors Office of Sustainability, 2019). Figure 3 displays the same data in the year 2014 for comparison (NYC, 2014). Residential buildings are the greatest culprit for emissions (NYC, 2014). The median age of residential buildings in New York is 90 years and over 20% of the buildings in the city were built in the 1920's (Renthop, 2017). Heating, cooling, and hot water for buildings is derived from natural gas, petroleum, and utilities company Con Edison's district steam

production system (NYC, 2014). The city's use of fossil fuels in buildings results in more emissions than the city's entire electricity supply (NYC, 2014; DCAS, n.d.).

Implementation Status of Key Initiatives

NYC has had some success achieving emissions reductions and increasing energy efficiency. The American Council for an Energy Efficient Economy (ACEEE) has found that NYC is on track to achieving its' emissions reduction goals within city operations but not community-wide emissions reduction targets (ACEEE, 2020b). As of 2019, city operations emissions have been reduced by 30% (NYC, 2019b).

Heating/Cooling

Building emissions have decreased 21% largely due to the transition from oil to natural gas (Urban Green Council, 2020a; NYC Mayors Office of Sustainability, 2019). Of NYC's emissions in 2017, 39% come from burning fossil fuels for hot water and heating (NYC, 2017). Residential buildings are the largest contributors, "over 80 percent of large multifamily buildings use steam heat, and as a sector, these buildings are responsible for at least 25 percent of NYC building emissions," (Urban Green Council, 2020b). The city has been working on a *Clean Heat Program*, encouraging buildings to phase out No. 6 fuel oil and transition to cleaner fuels (Zielinski et al., 2016).

NYC has utilized a wide range of strategies to increase the efficiency of heating/cooling systems within buildings including heat management systems, burner & draft controls, replacement of steam traps, monitoring of radiator shut off valves, pipe/boiler installation, weatherization, annual efficiency testing, installation of heating zones, downsizing of boiler capacity, and the installation of cogeneration systems & solar thermal system for hot water (NYC, n.d.). A list of additional energy conservation measures (ECM's) with high emissions reductions potential from 2014 are displayed in Figure 4 (NYC, 2014). The city has performed extensive heating-related retrofitting on one of its' most famous buildings, the Empire State Building. These measures include installing reflective barriers on radiators to preserve heat, improving window insulation, utilizing automated systems to align blinds with the sun, refurbishing old chillers, and sourcing warm tap water from recycled condensate (Kaplan & Steckelberg, 2020).

Energy Efficiency

As of 2019, NYC had completed over 5000 energy retrofits in 2600 buildings (NYC, 2019a; NYC, 2019b). Another 2500 buildings requiring retrofits were identified and were being prioritized when the last implementation update was released (NYC, 2019a; NYC, 2019b). The city has transitioned 70% of its' streetlights to LED (ACEEE, 2020b). In 2015, the city committed $2.7 billion towards retrofitting city-owned properties and $63 million on lighting upgrades alone (e.g. occupancy sensors and daylighting) (NYC, 2017; ACEEE, 2020b). The program for retrofitting city-owned properties is called *Accelerated Conservation & Efficiency* (ACE) and has led to the reduction of 125800 metric tons of CO2 emissions (ACEEE, 2020b). The city is now concentrating on *deep*

energy retrofits in 25 specific buildings which should lead to a 40-60% reduction in energy use (NYC, 2019b). NYC initiated a new *Building Energy Efficiency Program* in 2019 which will expand the eligibility of buildings for the city's retrofitting initiatives and provide increased funding (NYC, 2019b). Since 2009, the city has an extensive benchmarking program in place for its' facilities and 95% of city building property is benchmarked (ACEEE, 2020b). The city requires commercial/multifamily residential buildings over a certain size to participate in benchmarking programs and energy audits for buildings over 50000 sq. ft (ACEEE, 2020b).

In 2019 NYC council approved *The Climate Mobilization Act* which applies to 60% of buildings and sets caps on emissions from energy use starting in 2024, leading to a 40% reduction in building emissions by 2040 (Urban Green, 2020a; Capps, 2019). The city is exploring a building carbon trading scheme and an implementation plan is due in 2021 which would allow building owners to trade emissions to better fit under the limits established by the law (Urban Green, 2020a; Capp, 2019). Proponents suggest that carbon trading could incentivize retrofits in low-income communities by offering additional carbon credits to companies working in those communities (Capp, 2019). Landlords/owners could be fined for non-compliance up to $268/carbon tonne, which could result in fines over $1 million per year (Capps, 2019).

The State of New York has created the *2020 Energy Conservation Construction Code of New York State* (ECCCNYS). A stretch energy code, *NYStretch* has been developed by New York States Energy Research and Development Authority (NYSERDA) which serves as a model for jurisdictions in New York to adapt that results in greater energy efficiency than the State code (NY Construction Report Staff Writer, 2020). "The New York State Energy Law allows municipalities to have their own energy code, as long as the municipal code is no less stringent than the State Energy Code," (NYC, 2020). NYC typically maintains a stringent energy code. In 2017, Local Law 32 set parameters that energy codes developed by NYC's Department of Buildings must meet the most stringent state-set codes in the future or become 20% more efficient than the existing state codes (Urban Green Council, 2017; ACEEE, 2020b). In May of 2020, the city enacted the *NYC Energy Conservation Code* which is based on the state code and *NYStretch* but has more stringent requirements for insulation, thermal bridging, lighting, heating, cooling, HVAC, and refrigeration (NY Construction Report Staff Writer, 2020).

The city utilizes a model of financing known as Property Assessed Clean Energy (PACE) (NYC, 2019). PACE allows large loans to be taken out and paid back in small increments over time on property bills and is linked to the property rather than the owner (Capps, 2019; NYC, 2017). NYC also offers low interest loans through the *Green Housing & Preservation Program* and tax incentives for efficiency upgrades in low-income housing (ACEEE, 2020b). NYC engages in Energy Services Agreements (ESA) with third party companies which has led to financing for 57 energy efficiency projects in residential buildings (NYC, 2019b).

Renewable Energy

As of 2020, NYC has installed 10% of the solar capacity on city facilities (ACEEE, 2020b; Zielinski et al., 2016). The city has yet to identify sites for approx. ¾ of the remaining installations (ACEEE, 2020b). The city has seen greater success in community deployment of solar, resulting in 180 MW over 14000 installations as displayed in Figure 6 (NYC, 2019). Proliferation of solar PV is supported by Local Law 24 which "requires the City to identify, and assess the potential of, all solar-ready rooftops at City-owned buildings 10,000 gross square feet and larger," (Zielinski et al., 2016). The city uses building age and roof condition to identify solar-ready rooftops and models potential solar capacity & emissions reduction potential of these spaces (Zielinski et al., 2016). This process has identified 55 MW of rooftop potential for future installations (Zielinski et al., 2016; DCAS, 2019). Local laws 92 & 94 require that solar installations or a green roof be incorporated onto new buildings or when roof decking is being replaced (DCAS, 2019). The city requires that solar-ready infrastructure be integrated into any new single or double family homes (ACEEE, 2020b).

The city has partnered with non-profit organizations to develop the *Community Shared Solar Program*, installing solar panels and heat pumps on low-income housing units (NYC, 2019a). Resident shareholders enrolled in the program receive credits for the power generated on their utility bills (NYC, 2019a). No updates have been provided regarding the city's renewable power storage goals, but City council is implementing the fast tracking of permits (within one year) for small & medium battery storage installation projects (NYC, 2019a). NYC already generates renewable gas from wastewater to provide heat and electricity at its' municipal facilities and is beginning to extract it from organic waste (NYC, 2019a; NYC, 2014).

Electricity

In 2019, 27% of NYC's electricity came from low-carbon sources (NYC, 2019a). NYC has phased out the use of fuel oils and coal from its electricity supply as displayed in Figure 6, but these have largely been replaced by natural gas (NYC., 2014). NYC and New York state are working together to create the infrastructure necessary to obtain carbon free electricity through the import of Canadian Hydro which will be used to provide 100% of the electricity for municipal operations (NYC, 2019a).

Intergovernmental Co-operation

New York State has established similar goals in terms of climate action, including the 2016 Clean Energy Standard (CES) to obtain half of the state's electricity from renewable resources by 2030 (NYC, 2014). The state also intends to reduce emissions 40% below 1990 levels and reduce building energy consumption 23% (NBI, n.d.). To achieve 100% of electricity from renewable sources, NYC's grid infrastructure must be expanded (NYC, 2019a). NYC cannot obtain renewable based power from Northern & Western portions of New York State due to lack of transmission capacity and states it continues to advocate for transmission expansion (NYC, 2017). New York State has

committed to developing 9000 MW of power from offshore wind projects by 2035, some of which will be designated to increasing NYC's power supply (NYC, 2019b).

Community/District Energy

NYC is participating in a community project known as the *Hunt's Point Energy Resiliency Project.* This project involves building a microgrid to support the community's food supply and solar & battery installations on two schools (NYCEDC, 2019). The city is also building a cogeneration *District Energy (*DE) system with a microgrid in two of its public housing complexes (ACEEE, 2020b). NYC participated in a geospatial analysis to identify areas of the city that should be prioritized for installation of community energy resources such as combined heat & power (CHP), combined cooling, heat & power (CCHP), ground & water source heat pumps, renewables (wind/solar) and heat recovery (Zielinski et al., 2014). This analysis resulted in data such as the technical potential for solar PV map in Figure 7 (NYC, 2014).

NYC is utilizing *Demand Response Programs* (DRP) which incentivizes consumers with utility bill credits to reduce energy usage at times of high demand. The city enrolled 40 facilities in a DRP resulting in savings of 100 MW (NYC, 2019b). The city utilizes *Distributed Energy Resources* (DER's) to support more renewable and resilient grids. NYC's primary utility company operates one of the largest steam district scale heating/cooling networks in the country, serving 1700 customers (NYC, 2014). Over the last decade, 230 MW of energy have been added to the grid through CHP unit installation, and although natural gas is utilized, wasted heat is processed more efficiently (NYC, 2014).

Discussion

NYC has invested substantial time, money and effort into energy efficiency & retrofitting initiatives leading to emissions reductions. Toronto can apply these practices to its' large proportion of older, high emitting residential buildings. Like NYC, Toronto has limited physical capacity to build renewable energy infrastructure but rooftop solar provides ample opportunity, particularly on city-owned buildings. Toronto can support energy equity by integrating projects like NYC's energy resiliency projects and community solar programs.

Recommendations for Toronto

- Phase out use of high fossil fuel emitting oils in heating
- Identify, prioritize, and fund *Energy Conservation Measures* most applicable to Toronto context
- Exemplary retrofitting of iconic Toronto buildings e.g. Toronto Old City Hall
- Expand benchmarking program & accelerate retrofitting in city-owned buildings
- Consider applicability of *The Climate Mobilization Act* with carbon trading

- Expand rooftop solar installation & consider *Shared Community Solar Program* in TCHC
- Expand community energy resiliency (i.e. microgrid, solar, battery, and DE cogeneration)
- Conduct geospatial analysis to prioritize distribution of community energy resources
- Design a pilot *Demand Response Program* study

Appendix A: Figures

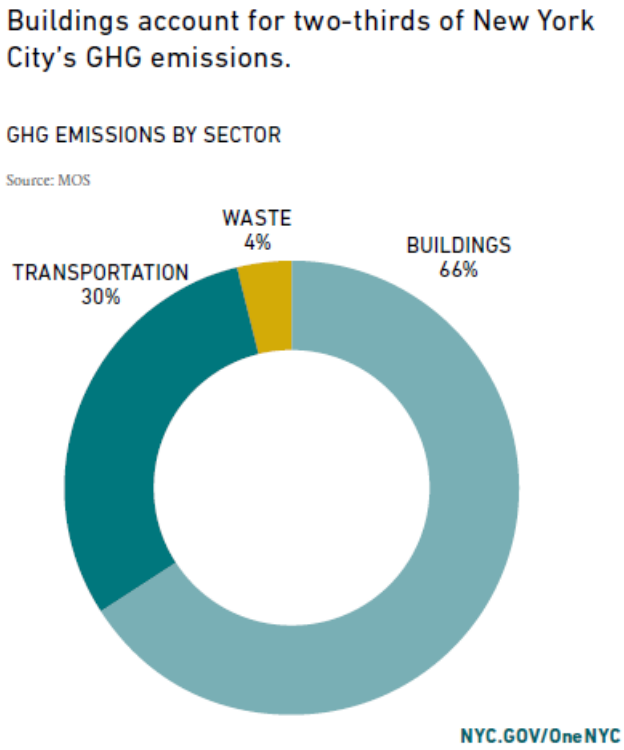

Figure 1: NYC Emissions by Sector (NYC, 2019)

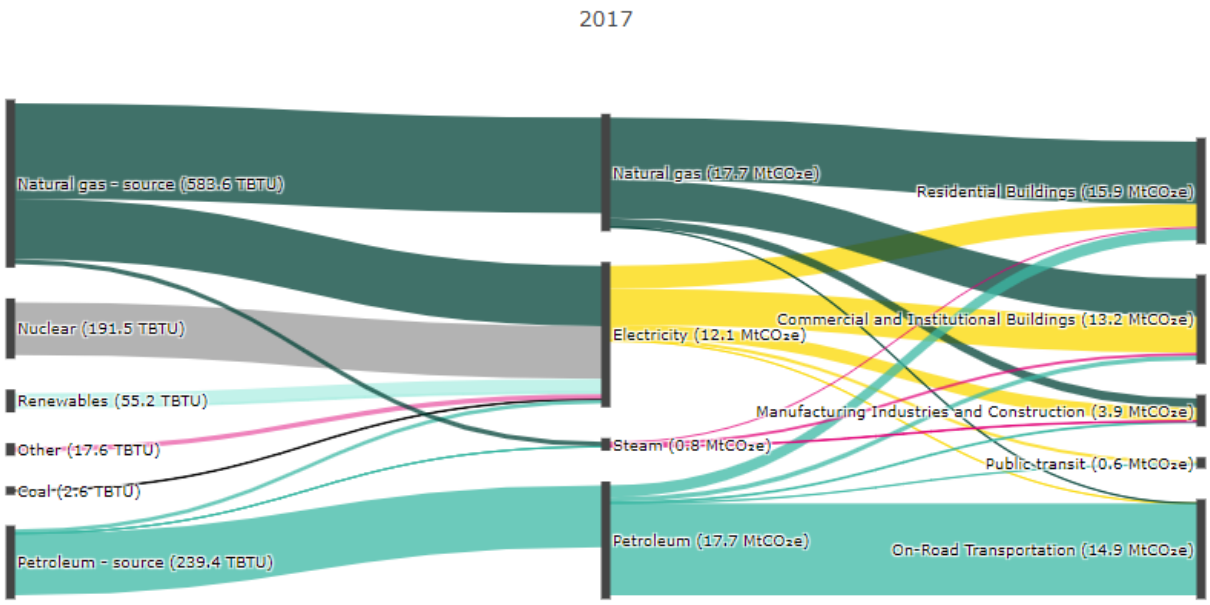

Figure 2: 2017 NYC Primary & Secondary Sources of Energy, and GHG Emissions by Building Type (NYC Mayors Office of Sustainability, 2019)

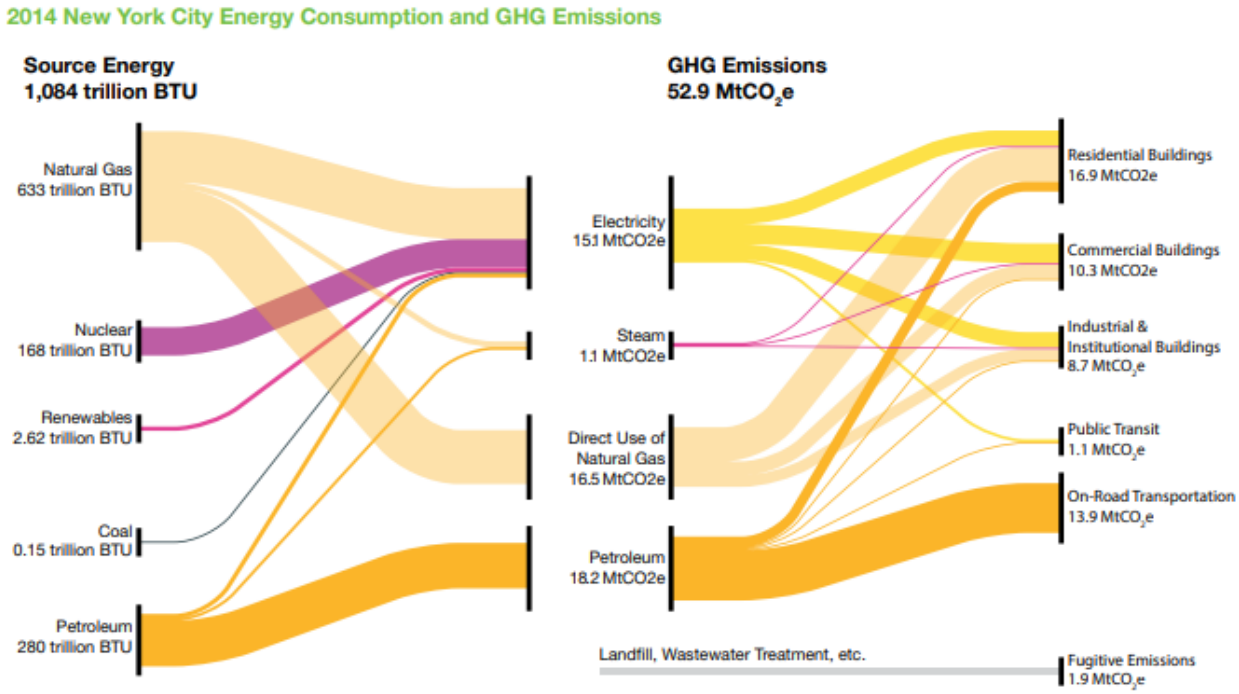

Figure 3: 2014 NYC Primary & Secondary Sources of Energy, and GHG Emissions by Building Type (NYC., 2014)

Technical Working Group ECMs Underway

ECMs within the 2016 Energy Code	Decrease window u-values for punched openings
	Increase wall insulation for one- to four-family homes
	Replace PTAC units with those with a higher energy efficiency rating
	Install an environmental monitoring systems for tenant HVAC equipment
	Install A/C and lighting controls in dormitories and hotels
	Reduce lighting power density and improve lighting controls
	Air seal one- to four-family homes
ECMs Identified for Immediate Action	Seal roof vents in elevator shafts
	Install digital controls for boilers
	Install thermal de-stratification fans in heated industrial spaces
	Improve tenant lighting controls
	Expand LL88 to residential building common areas
	Upgrade exterior lighting to current Energy Code standards
	Restrict open refrigerators in retail stores
ECMs to be Incorporated into Local Law 87 Requirements	Comprehensive upgrade for one-pipe steam heating distribution system
	Comprehensive upgrade for two-pipe steam heating distribution system
	Comprehensive upgrade for PTAC distribution system

Figure 4: Energy Conservation Measures (NYC, 2014)

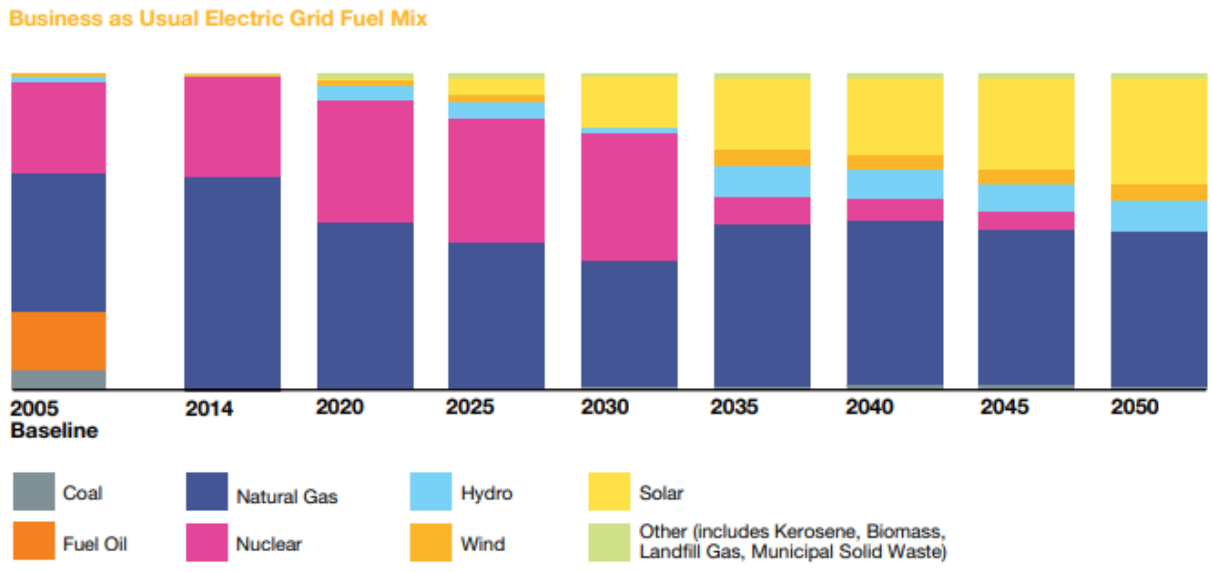

Figure 6: Current and Potential Grid Fuel Mix in NYC (NYC., 2014)

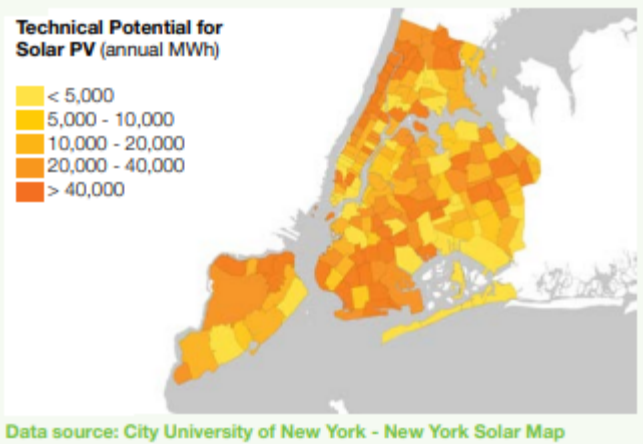

Figure 7: Technical Potential for Solar PV (NYC, 2014)

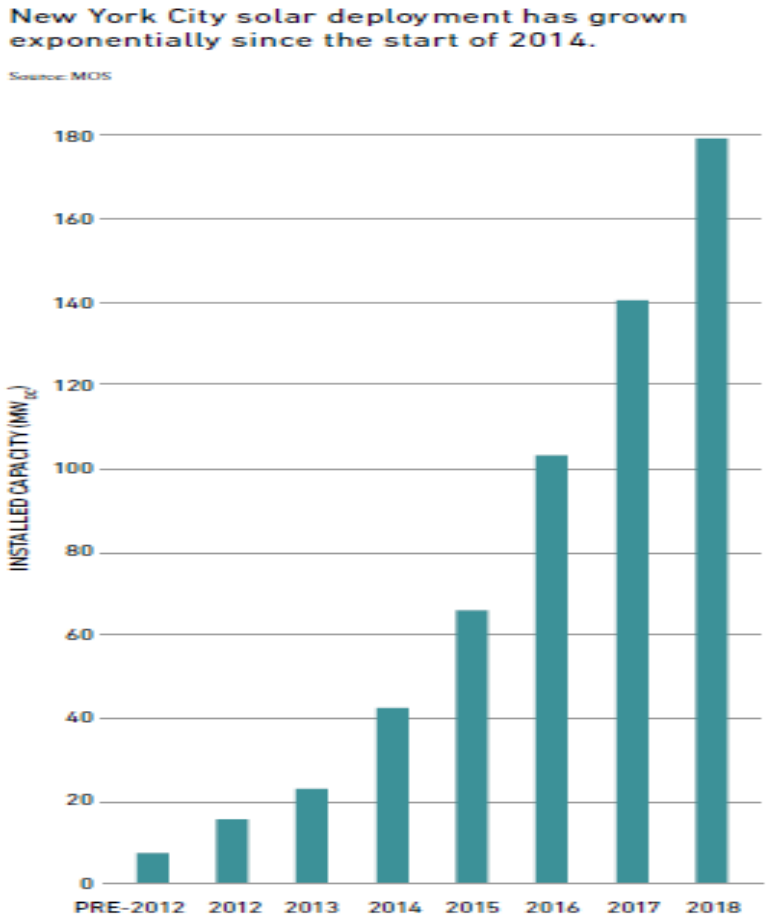

Figure 5: Solar Capacity Expansion NYC (NYC, 2019)

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