



October 2016

# Handbook for Multifamily Buildings



The City of New York  
Mayor Bill de Blasio  
Mayor's Office of Sustainability



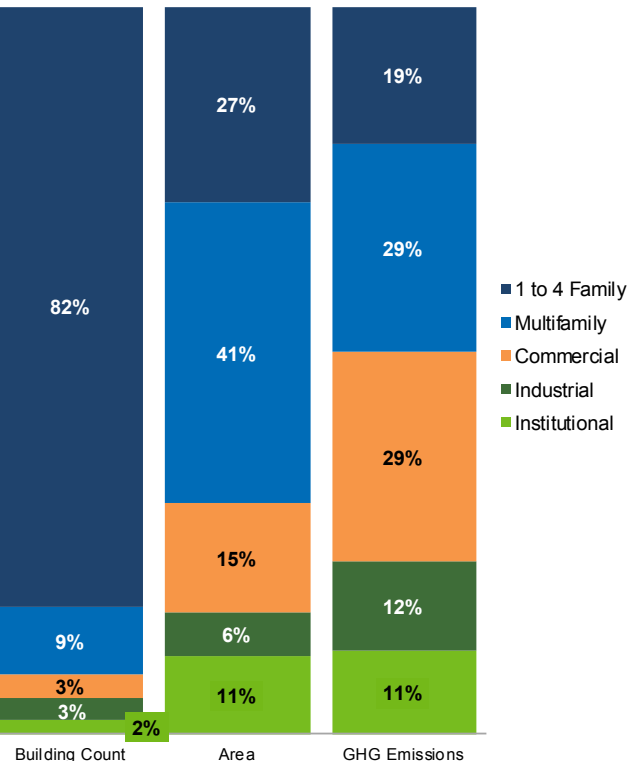
This handbook is a resource for building owners, building staff, co-op and condo board members, property managers, and all other building decision-makers to improve the energy efficiency of their buildings by understanding the most effective energy conservation measures. By investing in energy efficiency, building decision-makers can improve building performance, save on utility and maintenance costs, reduce greenhouse gas (GHG) emissions, improve local air quality, and help ensure resident health and comfort. This resource introduces the basic principles of energy efficiency, incentive programs, available financing, relevant local laws, and technical training programs designed to reduce energy use and GHG emissions in New York City’s diverse multifamily building stock.

There is ample opportunity to increase the energy efficiency in New York City’s one million buildings, of which nearly 100,000 are multifamily properties. While the multifamily sector accounts for nine percent of the absolute number of citywide buildings, it represents more than 40 percent of citywide building area and nearly 30 percent of citywide GHG emissions.

Energy consumption in buildings contributes directly to GHG emissions, which is a major contributing factor to global climate change. Because New York City is built primarily on islands with 520 miles of shoreline, it is particularly vulnerable to rising sea levels and other impacts of climate change. Reducing energy use in residential buildings will help reduce these

impacts, while also mitigating rising housing costs and supporting the City’s affordable housing and sustainability goals.

Reducing citywide GHG emissions is imperative to mitigating the worst effects of climate change and ensuring we are on a path to a more equitable, resilient, and sustainable city. The City has created several programs to work with private sector leaders to improve the energy efficiency of their buildings and reduce GHG emissions. Two of these programs, the NYC Carbon Challenge and NYC Retrofit Accelerator, are outlined on the following page.



Building uses by building count, floor area, and GHG emissions

Source: NYC Mayor’s Office of Sustainability, Buildings Technical Working Group Report



Launched in 2007, the NYC Carbon Challenge is a voluntary leadership program that includes 17 leading universities, 11 hospital organizations, 12 commercial offices, 20 residential property management firms, and 19 hotels in New York City that have committed to reduce their GHG emissions by 30 percent or more over 10 years.

The Carbon Challenge works by inspiring a high-level commitment within organizations, creating a platform for the exchange of information and ideas, and providing simple tools to track progress. Current participants represent more than 265 million square feet of space and seven percent of New York City's building-based GHG emissions. Since the program started in 2007, eight participants have met the 30 percent goal, and all together, participants have collectively reduced their carbon emissions by 160,000 metric tons of carbon dioxide equivalent (tCO<sub>2</sub>e) and saved \$175 million in annual costs.

If you are a multifamily building property manager, owner, or serve on a co-op or condo board and you are interested in being recognized for your commitment to energy efficiency and sustainability, you may be eligible to participate in the Carbon Challenge. Participants in the Carbon Challenge will receive help to identify cost-saving ways to reduce their building's energy use and participate in a platform for the exchange of ideas and best practices with the City's leading residential property management firms and owners. More information about the Carbon Challenge can be found at: [www.nyc.gov/carbonchallenge](http://www.nyc.gov/carbonchallenge).



Launched in 2015, the NYC Retrofit Accelerator is a free program provided by the City of New York that offers advisory services to building owners and operators during the steps required to successfully complete water and energy efficiency projects.

The program builds on the success of the NYC Clean Heat program and includes assistance with local building energy laws, interpreting energy audit recommendations, selecting energy and water efficiency projects, identifying incentives and financing to help cover costs, and providing advisory services through project completion. The NYC Retrofit Accelerator also continues the City's mission to assist all buildings still burning heavy heating oil to convert to cleaner heating fuels.

If you are interested in joining the Carbon Challenge, the NYC Retrofit Accelerator is a resource to provide guidance on how to apply the strategies in this handbook to your building. More information about the NYC Retrofit Accelerator can be found at: [www.nyc.gov/retrofitaccelerator](http://www.nyc.gov/retrofitaccelerator).

# Table of Contents

Introduction	4
Benefits of Saving Energy	6
Opportunities for Energy Efficiency	7
How to Get Started	8
Electrical Systems	11
Building Envelope	13
Heating and Cooling Systems	18
Domestic Hot Water	27
Efficient On-Site Generation and Renewables	29
Other Energy-Saving Measures	33
Success Stories	36
Appendix A: Financial Incentives	42
Appendix B: Financing and Loans	49
Appendix C: NYC Requirements	55
Appendix D: Technical Resources	58
Appendix E: Training Resources	59
Appendix F: Online Resources	61
Acronyms	64
Sources and End Notes	65



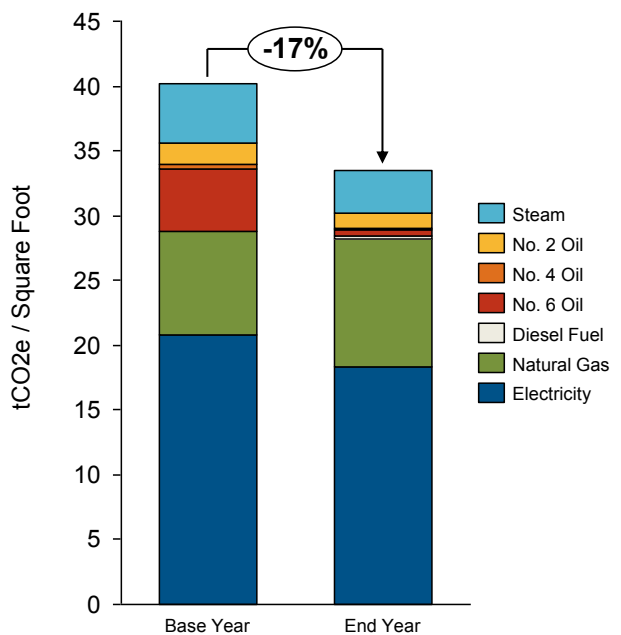
On Earth Day 2015, New York City Mayor Bill de Blasio announced *One New York: The Plan for a Strong and Just City (OneNYC)*, the City’s blueprint for a growing, sustainable, resilient, and equitable city. Recognizing the existential threat that climate change poses to New York City and the world, Mayor Bill de Blasio has set the ambitious goal to reduce citywide GHG emissions by 80 percent from 2005 levels by 2050. As part of the “80 x 50” goal, the City has set interim targets to reduce citywide GHG emissions 40 percent by 2030 and building-based GHG emissions 30 percent by 2025. With these commitments, New York City is continuing its longstanding leadership in addressing global climate change.

In New York City, roughly three-quarters of city-wide GHG emissions come from the energy used to heat, power, and cool buildings. In addition, more than 90 percent of the buildings that exist today in New York City will still exist in 2050. This means that to achieve 80 x 50, nearly all of the city’s existing buildings will need to be retrofitted to become more energy efficient over the next three decades.

New York City launched the NYC Carbon Challenge in 2007 to partner with private and institutional sector leaders across the city to achieve significant GHG reductions from some of the city’s largest buildings. Since then, 17 of New York City’s leading universities, the 11 largest hospital organizations, 12 global companies, 20

residential property management firms, and 19 hotels have accepted the Challenge, pledging to reduce their building-based GHG emissions by 30 percent or more in ten years.

The City launched the NYC Carbon Challenge for Multifamily Buildings in 2013 to work with industry leaders committed to improving building performance through energy efficiency retrofits. Since then, the 20 residential property management firms featured on the following page have accepted the Challenge, pledging to reduce their building-based GHG emissions by 30 percent in ten years.



Carbon Challenge progress to date (GHG emissions intensity for Universities, Hospitals, and Commercial Offices)

Source: NYC Mayor's Office of Sustainability

Participating residential property management firms and owners in New York City have now committed more than 900 buildings to the Carbon Challenge for Multifamily Buildings, pledging to reduce GHG emissions by 30 percent across selected portfolios. All together, these buildings represent over 110 million square feet, or more than six percent of the city's large and mid-sized residential square footage. Participants represent diverse segments of the multifamily building sector, with nearly 60 percent of participating buildings serving low and moderate income households.

The City is committed to expanding participation in the Carbon Challenge for Multifamily Buildings by doubling the size of the program to include additional buildings and property management companies that have demonstrated leadership in energy efficiency and GHG emissions reduction.

Collectively, NYC Carbon Challenge participants across all sectors have cut their annual emissions by 190,000 tCO<sub>2</sub>e and are collectively saving almost \$175 million in lower energy costs. By the end of the program, current participants are projected to reduce citywide emissions by nearly 510,000 tCO<sub>2</sub>e - equivalent to removing more than 100,000 cars from the road.

By joining the Challenge, participants gain access to information on ways to reduce energy use and emissions, save money on energy bills, and improve local environmental quality—all while being recognized by the City for their efforts. The NYC Handbook for Multifamily Buildings highlights some of the best practices employed by multifamily buildings and can be used as a reference manual for any property owner or manager seeking to save money by reducing their utility costs and mitigate their climate impact by reducing building-based energy use and GHG emissions.

### Current Multifamily Participants

- AKAM Associates, Inc.
- Charles H. Greenthal Management Corp.
- Community League of the Heights
- Douglas Elliman Property Management
- FirstService Residential
- Harlem Congregations for Community Improvement, Inc.
- Lott Community Development Corporation
- Marion Scott Real Estate, Inc.
- Milford Management
- New Holland Residences
- Prestige Management
- Riverbay Corporation at Co-op City
- Ridgewick Bushwick Senior Citizens Council
- Riverton Square, LLC
- Rose Associates
- RY Management Co, Inc.
- Selfhelp Community Services Inc.
- Solstice Residential
- StuyTown Property Services
- Urban American



# Benefits of Saving Energy

## Save Money on Your Energy Bills

- *Retrofits to reduce energy and water use saves money*, which can help building owners control operating expenses and maintain affordability.
- *Switching to cleaner fuels* can also lower your energy bills. For example, natural gas is less carbon-intensive and has historically been less expensive than No. 4 and No. 2 heating oils.<sup>1</sup>

## Mitigate Building Operating Costs

- *Properly maintaining equipment* can help reduce energy use and prevent costly emergency replacement and maintenance.
- *Ensuring that building operators are trained* to maximize the efficiency of your equipment can optimize building system energy performance and reduce operating costs.

## Enhance the Comfort of Your Building

- *Sealing cracks in the building and improving insulation* allows your building to maintain a tighter envelope, resulting in more stable and comfortable temperatures throughout the year—and will require less energy to heat and cool in the process.
- *Rebalancing your building's air flows* can reduce energy use and make your building more comfortable.

## Increase Resilience to Extreme Weather

- *Improving the building's exterior envelope* with a vapor barrier, insulation, and properly installed windows can protect your building against severe heat and cold spells, reduce susceptibility to extreme weather events, and decrease energy use for heating and cooling at the same time.
- *Installing efficient on-site energy generation*, such as combined heat and power (CHP) or solar PV coupled with battery storage can reduce your building's energy use while also helping protect against power losses during storms, heat waves, and other emergencies.

## Improve the Environment

- *Lowering energy use reduces GHG emissions*, the harmful gases that contribute to global climate change.
- *Improving energy efficiency and switching to cleaner energy sources also reduces local air pollution* by reducing emissions of fine particulate matter, which will help improve air quality in your home and neighborhood.



## Electrical Systems

Electricity powers most of the systems in your building, including lighting, cooling, pumps, fans, and motors, as well as appliances powered by electrical outlets. Key opportunities to reduce your building's electricity use include installing energy efficient lighting and controls, electric sub-metering in units, and energy efficient appliances.

## Building Envelope

The building envelope consists of everything that separates the conditioned space within the building from the outside environment, including the roof, walls, windows, doors, and foundation. Notable strategies to improve the building envelope include air sealing, weather stripping, adding building insulation, replacing windows, installing door sweeps, and installing cool roofs or green roofs.

## Heating and Cooling Systems

Heating and cooling systems are responsible for the majority of a typical multifamily building's total energy use. There are many opportunities to reduce the energy use of these systems, such as installing variable frequency drives (VFDs), implementing building automation systems (BAS), upgrading steam distribution systems, adding burner combustion controls, rightsizing air distribution components, and converting heating oil to cleaner fuels.

## Domestic Hot Water

Domestic hot water (DHW) refers to conditioned water from faucets and showers for in-unit use. Effective strategies for reducing energy needed to heat this water include further insulating hot water heaters, upgrading to more efficient or solar-powered hot water heaters, separating DHW heaters from steam boilers, using faucet aerators, and installing high-efficiency showerheads.

## Efficient On-Site Generation and Renewables

Efficient on-site generation technologies that are located in or on your building can provide a significant portion of the energy your building consumes. Examples include combined heat and power (CHP) systems, solar PV systems, and geothermal heat pumps. This energy produced is often cleaner and can be less expensive than the energy supplied by your utility.

## Operations and Maintenance

Improving operations and maintenance in your building through staff trainings and education can significantly reduce your energy consumption for low to no cost. A well maintained building extends equipment lifespan, improves building performance, and increases occupant comfort.



# How to Get Started

## Step 1

### Identify Your Team

Identifying a team to help plan and implement energy efficiency projects is an important first step. Your team will likely include your property manager, superintendent, key advocates on a co-op or condo board, consultants, and contractors to help you carry out the work. Contacting the NYC Retrofit Accelerator and joining the NYC Carbon Challenge are great ways to help form your team and gain access to technical assistance and resources to help start saving energy in your building.

## Step 2

### Measure Your Building's Energy Use

Tracking and measuring energy use is critical to identifying the best measures to pursue and understanding their impacts. New York City enacted Local Law 84 in 2009, which requires buildings of at least 50,000 square feet of floor area and multiple buildings on a single lot totaling 100,000 square feet or more to measure their annual energy use through a process called “benchmarking.” For more information about benchmarking and NYC Local Law 84, see **Appendix C**.

The United States Environmental Protection Agency's (US EPA) free online benchmarking tool called Portfolio Manager will provide a snapshot of your building's annual energy use and compare it to similar buildings. To benchmark your building's energy use, you will need a year's worth of energy bills for the whole building. If you don't keep this information on

hand, it is available by request from your local utility. Portfolio Manager will also require some basic information about your property, such as the borough, block, and lot number (BBL), property floor area, year built, number of buildings, and energy and water usage data.

## Step 3

### Perform an Energy Audit

Energy audits provide detailed information about a building's energy performance and recommendations for energy upgrades or retrofits. The NYC Retrofit Accelerator's efficiency advisors can work with your team to help determine the level of energy audit that is right for your building and find a qualified professional to undertake the work. If your building is greater than 50,000 square feet or your property has multiple buildings on a single lot totaling 100,000 square feet or more, you are required by Local Law 87 to undertake an “ASHRAE Level 2” energy audit every ten years. For more information on Local Law 87, see **Appendix C**.



The NYC Mayor's Office of Sustainability has partnered with the City University of New York's (CUNY) Building Performance Lab to launch the NYC Benchmarking Help Center, a free support service for building owners that need help at any stage in the benchmarking process.

Learn more: [www.nyc.gov/l184helpcenter](http://www.nyc.gov/l184helpcenter)

## Step 4

### Identify Incentives and Financing

Lowering your building's energy use will save money in the long run, but it usually requires upfront capital to make these improvements. Programs offered through Con Edison, National Grid, and New York State Energy Research and Development Authority (NYSERDA) can provide financial incentives to cover some of the costs of select energy efficiency measures. City, state, and federal tax incentives are also available to help reduce project costs. In addition, loans are available through New York City's Energy Efficiency Corporation (NYCEEC), New York City's Department of Housing Preservation and Development (HPD), NYSERDA, and some local and commercial banks to help finance these energy projects. Each of these programs and services have specific terms and requirements, so be sure to research financing options before you begin construction. Often it is best to pursue a combination of these programs and services. See **Appendices A and B** for more information about incentives and financing programs available.

## Step 5

### Select Projects and Create an Implementation Plan

Once you have completed the previous steps, it is time to select the upgrades your building will undertake and determine the timing of implementation. Installing all of the recommended measures from your energy audit at the same time might not be feasible or the right decision. Seasons, finances, and interactions between building systems can impact how and when you upgrade your building. Therefore, creating an implementation schedule and sequencing upgrades can improve the implementation

process and maximize your resources and cost savings. The NYC Retrofit Accelerator's team of efficiency advisors can help you determine the proper criteria for project selection and sequencing.

## Step 6

### Integrate Energy Efficiency into Your Capital Planning

A building can last for decades, but most of its equipment will not. All buildings must eventually undertake capital planning to upgrade aging equipment and replace outdated systems. Replacing equipment at the end of its useful life with more efficient models can begin saving money immediately. It is important to know the condition and age of your equipment as emergency replacements can be costly and may not provide you the time to identify a more efficient model.



The NYC Retrofit Accelerator is a free program that offers advisory services to building owners and operators during the steps required to successfully complete water and energy efficiency projects. Efficiency advisors are available to work with building decision-makers to identify and prioritize projects to help reach their goals, connect to incentive and financing opportunities, as well as gain access to educational, training, and other resources to help streamline the process of implementing energy efficiency upgrades. To get started:

E-mail: [RetrofitAccelerator@cityhall.nyc.gov](mailto:RetrofitAccelerator@cityhall.nyc.gov)

Call: 212.656.9202

Visit: [www.nyc.gov/retrofitaccelerator](http://www.nyc.gov/retrofitaccelerator)

### Three Levels of Energy Audits

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) develops standards to determine the performance criteria for three levels of energy audits.

- **ASHRAE Level 1 Audit:** Also known as a “walk-through audit,” this involves an assessment of the property’s utility bills, a brief site survey, identification of low-cost and no-cost energy conservation measures, and a simple cost-benefit analysis.
- **ASHRAE Level 2 Audit:** A more detailed evaluation of a property’s energy use and building systems, this provides a more granular assessment of fuel use and heating, ventilation, and air conditioning (HVAC), distribution, and lighting systems. The Level 2 audit is the minimum requirement for Local Law 87 compliance.
- **ASHRAE Level 3 Audit:** Also known as an “investment grade” audit, this provides an in-depth analysis of performance expectations. Involving longer term data collection and whole building energy modeling, Level 3 audits are typically reserved for more complex projects and projects that require capital loans.

### NYC Energy and Water Performance Map

The NYC Mayor’s Office of Sustainability has partnered with New York University’s Center for Urban Space and Progress (NYU CUSP) to develop this mapping tool to visualize energy and water efficiency performance of more than 26,000 buildings across the five boroughs.

Learn more: [benchmarking.cityofnewyork.us](https://benchmarking.cityofnewyork.us)

## Opportunities for Energy Efficiency: Building Systems

A building is a system made up of many sub-systems that function together. Understanding these sub-systems and how they interact will help you identify sources of energy waste, improve building performance, and prioritize investments in energy efficiency.

The following sections cover the opportunities and strategies that your building may want to consider implementing to begin saving energy and reducing your building’s energy costs. You should always work with a qualified energy professional to implement major energy efficiency or renewable energy projects. The NYC Retrofit Accelerator’s team of efficiency advisors can help you understand the opportunities that are right for your building.

### Building Consensus for Energy Efficiency

Here are a few tips to help build consensus among decision-makers on energy efficiency projects.

- Research your co-op or condo’s bylaws before bringing proposals to the board in order to understand the approval process.
- Identify and appeal to “champions” who are the most passionate about energy use reduction, cost savings, and sustainability.
- Emphasize that energy efficiency is a good investment. For example, buildings that comprehensively addressed energy use through NYSERDA’s Multifamily Performance Program reduced energy costs by an average of 22 percent.<sup>2</sup>



## Electrical Systems

Electricity powers most of the systems in your building including lighting, cooling, pumps, fans, and motors, as well as appliances and plug loads, and is likely one of your building's largest energy expenses. Since a majority of the energy used in New York City is generated from the combustion of fossil fuels, making simple upgrades to the systems and appliances that use electricity offers one of the best opportunities to save money while reducing GHG emissions. A professional energy audit will help you identify the improvements best suited for your building. A few examples of cost-effective electrical upgrades are included below.

### Lighting

In New York City, lighting accounts for five percent of a typical multifamily building's GHG emissions profile.<sup>3</sup> As lighting technologies become increasingly more energy efficient and controls become more sophisticated, the potential for savings from these upgrades is substantial. Below are a few opportunities to consider.

#### Replace Light Bulbs

Incandescent bulbs waste 90 percent of the energy input by creating heat instead of light.<sup>4</sup> Replacing these inefficient bulbs with more efficient LEDs, CFLs, or high efficiency fluorescent lighting in units and common areas, such as hallways, stairwells, and laundry rooms, is a relatively simple way to begin saving energy. Lighting upgrades also have some of the quickest payback periods, often recouping the upfront cost in two years or less.

As of January 2014, incandescent bulbs can no longer be manufactured in the U.S. because they do not meet federal energy efficiency standards, so the time is right to consider replacing them with more efficient technologies.

#### Install Lighting Controls and Sensors

In many buildings, common areas are lit around the clock, even when no one is around. Installing sensors and lighting controls is a low-cost solution that can result in big savings while maintaining safety. When installing sensors and controls, the type of technology that will be implemented is dependent upon the application and occupancy pattern. Examples include:

- Occupancy sensors that automatically switch on lights when someone enters a common area such as a laundry room or recycling room, then automatically switches off after a set period of time.
- Vacancy sensors that require someone to manually switch on lights but automatically shut off after the room is vacant for a set period of time, which can be useful in boiler rooms or basements.
- Timers that switch on and shut off at scheduled times of the day is often best for exterior lighting.

- Bi-level switching that dim lamps by 50 percent or more when full lighting levels are not necessary but the complete absence of light is not desirable, such as in stairwells or corridors.
- Photocells that detect natural daylight and shut off or dim lights accordingly in order to maximize the use of natural lighting.

## ✓ Electric Sub-metering

If your building is “master metered,” each unit pays a set energy charge each month, regardless of the energy its residents use. If this is the case in your building, you might be missing a major opportunity to empower residents with the ability to take control of their utility bill.

Sub-metering electricity use in individual units gives residents greater control over their utility bill, and since they will only be charged for the electricity they actually use, they will have a financial incentive not to waste energy. Recent studies show that by installing sub-meters, buildings consistently reduce energy consumption by as much as 20 percent in the first year alone.<sup>6</sup>



## LED Lighting

LED bulbs use up to 80 percent less electricity than incandescent bulbs and last up to 25 times longer. In fact, replacing a single 60 watt incandescent bulb with a new 12 watt LED bulb can save more than \$80 a year per light bulb—and because LEDs also last longer, changing your lighting can also lower operating expenses through reduced maintenance costs.<sup>5</sup>

## ✓ Electrical Plug Loads

Every appliance plugged into an electrical outlet is drawing electricity in a building, including refrigerators, dishwashers, clothes washers and dryers, air conditioners, microwaves, televisions, and computers. You can reduce your building’s plug load energy consumption by:

- Replacing appliances in common areas with more efficient models. Look for ENERGY STAR<sup>®</sup> certified appliances for the greatest energy savings.
- Engaging residents in energy conservation initiatives such as unplugging appliances that are not in use. See more tips for engaging residents on page 35.



## Electrical Systems Online Resources

- Con Edison, Multifamily Energy Efficiency Program: [www.bit.ly/29Teg7j](http://www.bit.ly/29Teg7j)
- NYSERDA, Multifamily Performance Program: [www.on.ny.gov/2b4xmZs](http://www.on.ny.gov/2b4xmZs)
- Building Energy Exchange, Events and Exhibits on Lighting: [www.be-exchange.org](http://www.be-exchange.org)



A building’s envelope consists of everything that separates the inside of the building from the outside, including the roof, walls, windows, doors, and the foundation. Insulating the envelope helps keep warm air inside during the winter and cool air inside during the summer. Because heating and cooling costs are also one of building’s biggest expenses, improving the envelope will help maximize investments in your building’s heating or cooling equipment. For help in identifying air leaks within your building, consult with an energy auditor about conducting a blower door test, which is a method of testing a building’s air tightness using a specialized fan, temporary door cover, and air pressure gauge.

## ✓ Air Sealing and Insulation

Air sealing and insulation are highly complementary energy efficiency measures. Air sealing eliminates the cracks and air leaks that cause drafts in the winter and allow cold air to escape during the summer, particularly around windows and doors. Insulation provides a barrier that separates the temperature of the outside air from the conditioned space within the building envelope. In combination, improving air sealing and insulation will make your building more comfortable, reduce noise from outside, better control humidity, and lower energy costs for heating and cooling.

### Air Sealing

Air leakage accounts for about a quarter of heat loss in multifamily buildings.<sup>7</sup> Since warm air rises, this can be exacerbated in multi-story buildings where a phenomenon called the “stack effect” (see page 15) causes significant heat loss through roofs, stairwells, and elevator shafts in

the winter, forcing the heating system to work harder to keep the building warm.

One of the biggest sources of heat loss is attributed to air leakage through open vents at the top of elevator shafts and stairwells. On average, multifamily building owners spend an estimated \$3,400 each year to heat air that escapes through the roof. For taller buildings, the cost can amount to well over \$20,000 each year.<sup>8</sup> Some ventilation is required by fire code, but building owners can implement two main retrofit strategies to address open elevator and stairwell vents, which include:

- Cover two-thirds of the vent with annealed glass.
- Install a motorized set of louvers that will remain completely closed until an alarm system or smoke detector will open them in the event of an emergency.

For buildings that do not have central cooling systems, air sealing is particularly important around window air conditioning units, through-wall air conditioning units, and packaged termi-

nal air conditioner (PTAC) units, all of which create window or wall penetrations that can lead to heat loss in the winter. Leakage around room air conditioners in New York City’s multifamily buildings is estimated to be equivalent to a 167,000 square foot hole — an area almost as large as a typical Manhattan block. As a result, owners and residents of multifamily buildings in the city are losing between \$130 and \$180 million in wasted energy per year.<sup>9</sup>

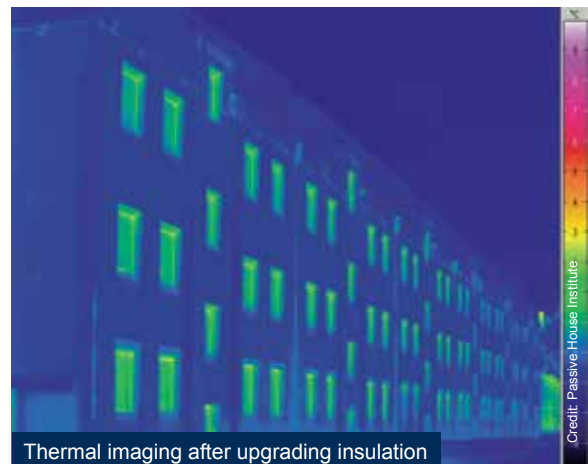
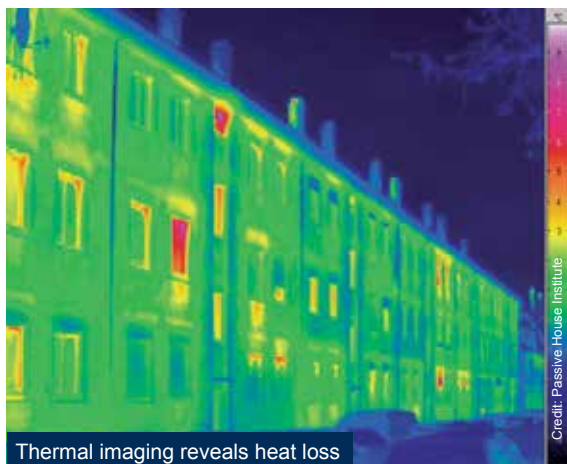
A combination of caulking and weather stripping can seal leaks and prevent this energy waste. Window air condition covers can also offer an inexpensive solution to reduce heat loss during the winter.

## Insulation

There are many materials available to increase the insulation of your building. Insulation performance is measured by R-value, or the ability

to resist heat flow, in which higher R-values mean that the material has more insulating ability. Insulation works best when air is not moving through or around it, so it is important to seal air leaks first to ensure that you get the best performance from your insulation.

Insulation should focus on areas of thermal bridges, or areas in buildings that have significantly higher heat or cold conductivity than surrounding material, typically found around windows and balconies. Since heat flow will follow the path of least resistance, insulating thermal bridges will dramatically improve building envelope performance. A qualified contractor will be able to make specific recommendations about air sealing and insulation based on an energy audit of your building.



## Air Sealing and Insulation Online Resources

- EPA ENERGY STAR®, Information on Air Sealing: [www.goo.gl/l8SgG](http://www.goo.gl/l8SgG)
- Urban Green Council Report, There Are Holes In Our Walls: [www.goo.gl/OqjVwZ](http://www.goo.gl/OqjVwZ)
- Urban Green Council Report, Spending Through the Roof: [www.goo.gl/4c1BJP](http://www.goo.gl/4c1BJP)

## Passive House

Passive House buildings feature superior building envelopes and as a result, use up to 90 percent less energy for heating and cooling, and up to 75 percent less energy overall compared to conventional buildings.<sup>10</sup> Due to super-insulated and airtight envelopes, Passive House buildings retain conditioned air for longer periods of time as compared to typical construction methods. Features of this high performance building standard are listed below and can be incrementally incorporated into a building's retrofit strategy:

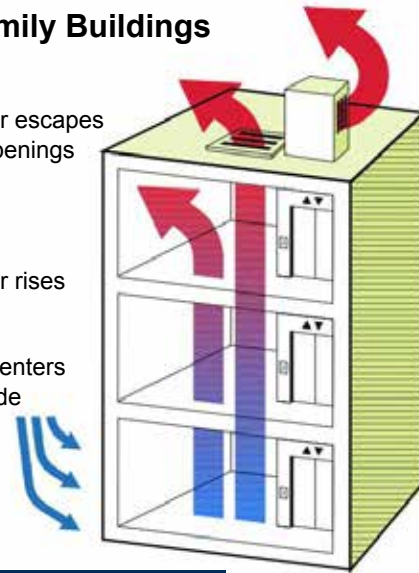
- Super-insulated façades
- Airtight building envelopes
- Minimal thermal bridges
- High performance windows and doors
- Efficient heating and cooling systems
- Energy Recovery Ventilators (ERV) that continuously supplies fresh, filtered outdoor air while recovering energy from ventilated, conditioned air
- Strategic shading and solar gain to maximize passive cooling during summer months and passive heating during winter months

## Stack Effect in Multifamily Buildings

3. warm air escapes through openings in roof

2. warm air rises

1. cold air enters from outside



Visual depiction of the "stack effect"



Knickerbocker Commons, an affordable multifamily Passive House in Brooklyn developed by Ridgewood Bushwick Senior Citizens Council (RBSCC)

## Passive House Online Resources

- NY Passive House Inc, A Developer's Guide to Certified Multifamily Passive House Buildings: [www.bit.ly/1OmrFBk](http://www.bit.ly/1OmrFBk)
- Passive House Institute US: [www.phius.org](http://www.phius.org)
- Passipedia, The Passive House Resource: [www.passipedia.org](http://www.passipedia.org)
- EnerPHit, Energy Retrofits with Passive House Components: [www.bit.ly/2bgZZqC](http://www.bit.ly/2bgZZqC)



## ✓ Windows

Windows can account for 10 to 30 percent of heat loss in multifamily buildings.<sup>11</sup> The efficiency of windows is measured by U-values, in which lower U-values indicate lower heat losses. The first step to improve window efficiency is to install multiple layers of air sealing to eliminate any gaps or cracks around the frame using any combination of caulk, weather stripping, flashing tape, and gaskets. The efficiency of windows themselves can also be improved by adding special coatings or replacing old windows with newer, more efficient models. Replacing windows can realize efficiency gains of 30 to 50 percent, although these upgrades may have longer payback periods than other efficiency measures.<sup>12</sup>

## ✓ Roofs & Heat Absorption

The roof also plays an important role in regulating a building's temperature and comfort. In the summer, sunlight can heat a flat, black asphalt rooftop to temperatures up to 190°F. A hot roof will heat the entire building, causing the cooling system to work harder. This also contributes to the urban heat island effect that causes New York City to be more than five degrees hotter than surrounding areas.<sup>13</sup>

## Cool Roofs

Painting your roof with a high albedo coating, a highly reflective and light colored material, can reduce the amount of energy absorbed by your roof, and in turn helps lower a building's temperature and cooling costs. Cool roofs can cut internal building temperatures by up to 30 percent, making the building more comfortable, saving energy, and extending the life of the roofing material and cooling equipment.<sup>14</sup> Cool roof coatings generally cost between \$0.75 to \$1.50 per square foot, while the cost of single-ply cool roof membranes range from \$1.50 to \$3 per square foot.<sup>15</sup>

### NYC °Cool Roofs

NYC °Cool Roofs is a City initiative that utilizes local talent to coat rooftops throughout the five boroughs. Every 2,500 square feet of roof that is coated with reflective paint can reduce New York City's carbon footprint by one ton of carbon dioxide equivalent annually.<sup>16</sup>



NYC °Cool Roofs volunteers at work

Credit: NYC °CoolRoofs

## Green Roofs

Another way to improve your building envelope is to incorporate a green roof. A green roof is a vegetative layer installed on a roof that reduces rooftop temperatures during the summer, helping to mitigate the heat island effect, and adds insulation during the winter, when roofs account for about five percent of heat loss in typical multifamily buildings.<sup>17</sup> Moreover, green roofs have the added benefits of reducing stormwater runoff, filtering pollutants from rainfall, improving local air quality, and providing aesthetic value. Estimated costs of installing a green roof range between \$10 and \$25 per square foot, with maintenance costs ranging from \$0.75 to \$1.50 per square foot annually.<sup>18</sup> Not all buildings are suitable for green roof installations, so be sure to consult with a professional engineer about this option.



Roof of NYC Parks Department's Five Borough Administrative Office Building

## Blue Roofs

Blue roofs are non-vegetated rooftop features that capture and detain rainfall by creating temporary ponding with a system of weirs placed inside roof drain inlets. Captured stormwater is then gradually released into the sewers, helping to mitigate combined sewer overflows and improving the quality of the City's waterways. This process has the added benefit of rooftop cooling, and costs approximately \$5 per square foot to install.<sup>19</sup>

### Green Infrastructure Financial Incentives

The NYC Department of Environmental Protection (DEP) has allocated up to \$6 million in grants in its Green Infrastructure Grant program for green roofs and other measures to reduce stormwater runoff from buildings, streets, and sidewalks. See below for an online link to this program. Additionally, there is a New York City green roof tax abatement that offers a one-year property tax abatement of \$4.50 per square foot of installed green roof through March of 2018.

## Roofs & Heat Absorption Online Resources

- NYC °CoolRoofs: [www.nyc.gov/coolroofs](http://www.nyc.gov/coolroofs)
- NYC DEP, Green Infrastructure Grant Program: [www.goo.gl/6MnuCD](http://www.goo.gl/6MnuCD)
- NYC Green Roof Tax Abatement: [www.on.nyc.gov/2dZEGYU](http://www.on.nyc.gov/2dZEGYU)
- US DOE, Cool Roofs: An Easy Upgrade: [www.bit.ly/2arnlrV](http://www.bit.ly/2arnlrV)



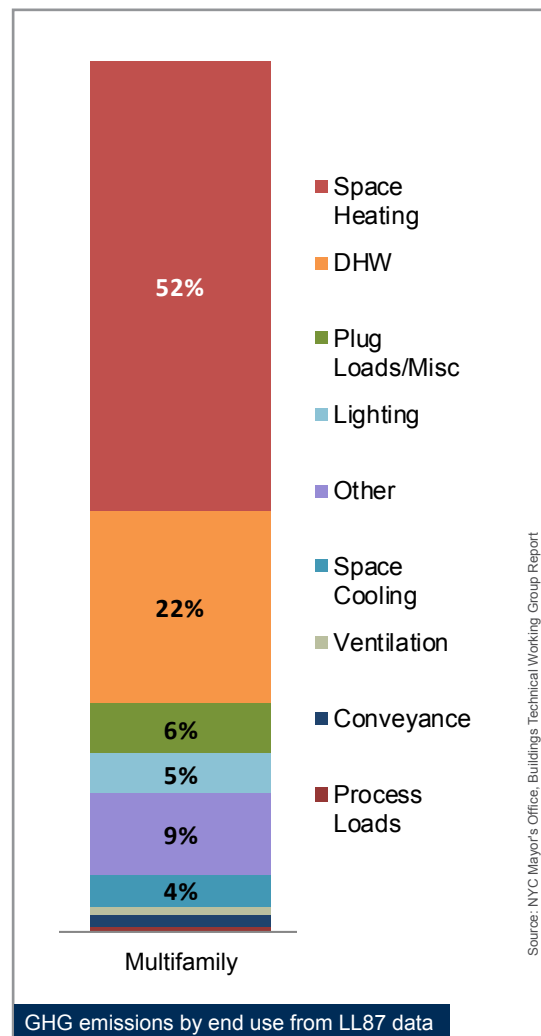
The energy used for space heating and cooling typically accounts for over half of a multifamily building’s total energy consumption.<sup>20</sup> Your building can save money by ensuring your heating, ventilation, and air conditioning (HVAC) systems are properly maintained, or in some cases, by upgrading to more efficient equipment. Additionally, switching to cleaner-burning heating fuels can save energy and money while also reducing local air pollution.

## ✓ HVAC System Upgrades

Addressing the efficiency of HVAC systems is critical to saving energy, improving comfort, and can often yield major reductions in GHG emissions. Options for improving the efficiency of your HVAC systems will depend both on the types of systems located in your building and the quality of operations and maintenance of these systems.

The energy used to create heat accounts for over half of GHG emissions in large multifamily buildings, while cooling accounts for roughly five percent of GHG emissions. Addressing a multifamily building's HVAC system represents the greatest opportunity for energy use and GHG reductions.

An overview of potential opportunities is included on the following pages. If you are interested in pursuing any of these opportunities in your building, be sure to reach out to an NYC Retrofit Accelerator efficiency advisor and work with a qualified professional to identify and implement HVAC opportunities in your building.



## Central Heating Systems

Boilers are the most common type of central heating system in New York City, which produce hot water or steam that is distributed throughout a building to provide space heating. Opportunities for increasing the efficiency of a building's heating system may include a retrofit or tune-up of an existing unit or upgrading to a more efficient model.

Regardless of the system your building uses, an integrated-system approach is typically more effective than addressing system components individually. This helps ensure your ventilation, distribution, and other system components are running efficiently and have an appropriately sized heating system, all of which will result in greater efficiency and cost savings in the long run. In addition to the retro-commissioning required for large buildings by Local Law 87, an annual maintenance program is important for keeping any heating system operating efficiently. For more information about operations and maintenance training programs for building staff, please refer to **Appendix E**.

If you are considering a longer-term investment for your building, or your boiler is at the end

of its useful life, installing a new ENERGY STAR<sup>®</sup> boiler will achieve annual fuel utilization efficiency of at least 85 percent, compared with 50 to 70 percent for an older boiler.<sup>21</sup> Additionally, installation and operation of a new, more efficient boiler can often be more cost-effective than repairing an older, less efficient one. There are other high-impact, low-cost energy heating efficiency measures that will improve resident comfort, lower energy costs, and reduce maintenance fees. These include:

- Installing smart thermostats to allow for automated temperature set points.
- Installing a BAS with indoor temperature sensors with automatic controls to better balance and optimize building systems.
- Installing pipe and boiler insulation to reduce standby losses.
- Installing a linkageless burner and draft controls to increase the efficiency of the boiler.
- Installing VFDs on motors to reduce fan speed, extend the life of system components, and save energy.
- For buildings burning fuel oil, increasing the biodiesel blend to five percent or higher to use less fuel oil, improve local air quality, and extend the life of boiler components.

## Central Cooling Systems

If you live in a large building with a central cooling system, it is likely using a chilled-water system or “chiller”. These systems feature separate central water chillers and air handlers, connected by a network of pipes and pumps. Increasing



the efficiency of your building’s central cooling system will yield the greatest results with an integrated approach that may include upgrades to the chiller as well as to the pumps and fans that distribute the chilled air. Effective measures to improve the efficiency of a central cooling system include:

- Installing variable refrigerant flow (VRF) heat pumps to allow for more precisely controlled temperatures.
- Replacing chiller plant including systems, controls, and optimization software.
- Upgrading the chiller, typically when it is at the end of its useful life, to a higher efficiency model.
- Optimizing existing chilled water plant temperature sensors.
- Installing BMS monitoring for supplemental HVAC equipment.
- Retrofitting the existing chiller by installing low-friction valves or insulating pipes.
- Installing VFDs on motors that distribute conditioned air throughout the building as well as primary and secondary water pump.

## Non-Central Cooling Systems

Non-central or “unitary” systems are generally used in smaller buildings and can consist of a single-packaged cooling unit or a split-system with multiple units that provide both heating and cooling. Examples of unitary systems include in-window or through-wall air conditioners, roof-top air conditioners, and heat pumps. Compared to central chiller plants, unitary systems are less



efficient and do not last as long, with a median lifetime of 15 years compared to 20 to 23 years for chillers.<sup>22</sup> As with any system, regular maintenance is essential for maximizing efficiency and energy savings. With unitary cooling systems, efficiency can be improved by:

- Replacing old units with newer, more efficient models.
- Replacing a packaged rooftop air conditioner unit with an air source heat pump.
- Using smart, automated controls such as temperature-based sensors and timers.



## Air Source Heat Pumps (ASHP)

Air source heat pumps (ASHP) are highly efficient, electrically powered systems that can provide both heating and cooling for small and mid-sized buildings. These systems use an outdoor unit, also known as a condenser, and an indoor air handling unit, also known as the evaporator, to absorb heat from one place and release it at another. A properly installed ASHP can provide up to three times more heat energy to a space than the electric energy it consumes.<sup>23</sup> Air source heat pumps have been used for many years in warmer climates and recent advancements in ASHP technology make it a viable heating and cooling system option for colder climates like New York City's. Types of ASHP systems include:

- **Split:** The most common variety of ASHP, split systems feature a condenser coil that releases heat outside of the building and an interior air handling unit that provides conditioned air. The supply and return ducts connect the outdoor and indoor units.
- **Packaged:** Packaged ASHP systems contain both coils and fan in one unit and are positioned outside the building. Heated or cooled air is delivered to the interior through ductwork that protrudes through a wall or roof.
- **Ductless:** Also known as ductless mini-split systems, these connect the outdoor and indoor units through a conduit, which houses the power cable, refrigerant tubing, suction tubing, and condensate drain. Ductless systems are generally good retrofit strategies since a three inch hole is the only building envelope penetration required for the conduit, reducing the potential for air

leaks. Many ductless mini-split systems can have up to four indoor air handling units for each outdoor unit.



## ✓ Building Automation Systems

Building Automation Systems (BAS), a type of Building Management System (BMS) with control features, facilitate the centralized management of various building systems through a combination of sensors and controls. BAS enable building managers to remotely monitor, control, and schedule building systems, with the objective of improving both building efficiency and tenant comfort.

Features of a typical BAS include a visual representation of the building systems (e.g. chiller plant, condenser water loop, central heating plant, hot water system, air handling units, and other HVAC distribution systems), display of system parameter values (e.g. temperature, valve and damper positions, fan speeds, air flow volume),

and the sequences of operations that control the interconnected building systems.

Finally, building automation systems allow building managers the ability to adjust set points and schedules from a central location. Despite these benefits, there are still many buildings in New York City that do not have a BAS or BMS in place. Roughly 35 percent of large multifamily buildings reported having one in their Local Law 87 energy audit.<sup>24</sup>

Energy Information Systems (EIS) can further increase efficiency by providing real time, historic, and projected energy use data through a network of web-based software, data monitoring hardware, and communication systems used to analyze and display building energy performance. This enables the building operator to better monitor and anticipate changes in building systems operations. EIS and BAS technologies are increasingly becoming integrated to maximize building performance.

## HVAC System Online Resources

- NYSEDA Multifamily Performance Program, Existing Buildings: [www.bit.ly/1cmPqGh](http://www.bit.ly/1cmPqGh)
- Con Edison Multifamily Energy Efficiency Program: [www.bit.ly/29Teg7j](http://www.bit.ly/29Teg7j)
- National Grid Multifamily Energy Saving Programs: [www.ngrid.com/2afGHPP](http://www.ngrid.com/2afGHPP)
- US DOE Air Source Heat Pumps: [www.bit.ly/2bLPOGL](http://www.bit.ly/2bLPOGL)

## Distribution Systems

The efficiency of your distribution system can be just as important for saving energy as the efficiency of the equipment providing the heating or cooling. If you are considering upgrading or retrofitting your building's central heating or cooling system, an integrated approach that gives consideration to the distribution system as well as the central unit presents the greatest opportunity for savings.

Heating distribution systems include one-pipe steam, two-pipe steam, hydronic, and forced air systems. Variations in cooling distribution methods include central chilled water systems and ductless, ducted, and short-run split systems. It is important to know the type of heating or cooling distribution system in your building, because different efficiency measures exist for different types of systems.

### Types of Distribution Systems

**One-Pipe Steam** systems are often older systems that use a single pipe for steam delivery and condensate return. These systems are found in over half of large multifamily buildings and use more energy per square foot on average than other systems in multifamily buildings (see chart on page 23).

**Two-Pipe Steam systems** run steam delivery and condensate return through separate pipes. Buildings over six stories in height and newer multifamily buildings constructed after 1980 are typically equipped with two-pipe steam systems.

**Forced Air** systems use a furnace or heat pump and mechanical ventilation to circulate heated air through ductwork and vents.

**Hydronic** systems use hot water rather than steam as the heat transfer medium.

## Steam Heating Distribution Systems

One-pipe and two-pipe steam heating systems are particularly prevalent in New York City, providing heat for more than 70 percent of large buildings. The proportion is even greater in large multifamily buildings, where steam heating distribution is present in over 80 percent of these buildings.<sup>25</sup> In steam heated buildings, water is boiled on-site usually by burning fossil fuels such as fuel oil or natural gas, or the steam can be sourced from the City's district steam system.

Implementing a comprehensive steam system upgrade has the potential to reduce the fuel used for heating by 15 to 20 percent in a typical multifamily building, and can help eliminate problems of overheating and clanging pipes commonly experienced in poorly maintained systems. Implementing these upgrades across all of New York City's steam heated buildings is a tremendous energy saving opportunity that would result in projected annual savings of nearly \$150 million in fuel use and maintenance costs and citywide GHG emissions by as much as five percent.<sup>26</sup>

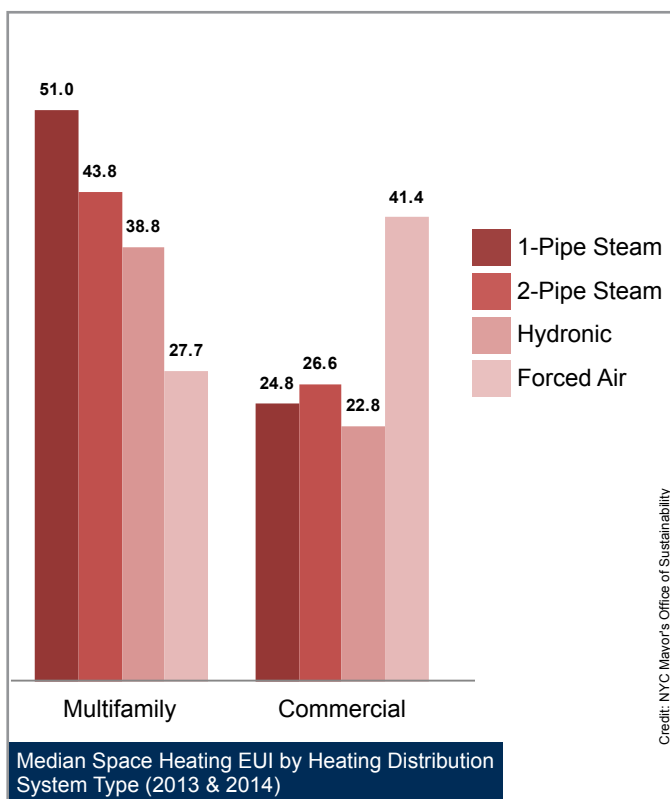
Upgrades to one-pipe steam heating systems can include:

- Master venting to release air from pipes and balance the system.
- Installing both indoor and outdoor controls to better monitor and balance steam distribution throughout the building.
- Installing thermostatic radiator valves (TRVs), which use self-regulating valves to control heat flow from radiators, to give residents control over indoor room temperature settings.

- Installing radiant barriers to redirect heat from the radiator towards occupied space.

In addition to the upgrades above, additional strategies for two-pipe steam heating systems can include:

- Regularly maintaining all steam traps to ensure proper operation and system balance.
- Installing orifice plates to continuously remove condensate and regulate steam flow.





## Forced Air Distribution Systems

Forced air distribution systems use a furnace or heat pump and mechanical ventilation to circulate heated air through ductwork and vents. This is a versatile distribution method but ductwork needs to be carefully designed, installed, and maintained for the system to operate efficiently. A few ways to improve the performance of forced air distribution systems include:

- Sealing loose connections in ductwork with mastic tape to prevent air leaks.
- Installing ductwork with a smoother interior surface to minimize friction losses.
- Straightening out bent ventilation panels to improve exhaust flow.
- Ensuring the air filter is properly installed and free of debris to improve efficiency.
- Adjusting ventilation to match occupancy levels.
- Programming the air handler to cycle off during unoccupied periods.
- Balancing the air handler system to ensure that each zone receives designed air flow.
- Testing the ducts for air leakage using a duct blaster or blower door.

## Hydronic Distribution Systems

Hydronic distribution systems use hot water rather than steam as the medium to transfer heat. For this reason, hydronic systems are inherently more efficient than similarly maintained steam distribution systems. A few upgrades to hydronic distribution systems include:

- Installing pipe and boiler insulation to reduce standby losses.
- Performing a combustion analysis on the boiler to ensure optimal proportion of oxygen and fuel.
- Utilizing the outdoor temperature reset control to recalibrate boiler water temperature.
- Installing smart thermostats to allow for automated temperature set points.

## Steam Distribution Systems Online Resources

- Con Edison, Multifamily Energy Efficiency Program: [www.bit.ly/29Teg7j](http://www.bit.ly/29Teg7j)
- Con Edison, Steam Incentive Programs: [www.bit.ly/2aaSrBF](http://www.bit.ly/2aaSrBF)
- National Grid, Multifamily Energy Saving Programs: [www.ngrid.com/2afGHPP](http://www.ngrid.com/2afGHPP)
- Steven Winter Associates, Upgrading NYC Steam Systems: [www.bit.ly/2aLkGac](http://www.bit.ly/2aLkGac)

## ✓ Heating Oil Conversions

In April of 2011, NYC DEP issued regulations requiring buildings with boilers that produce more than 350,000 British thermal units (Btu) per hour, typically found in buildings 40,000 square feet or larger, to convert from No. 6 and No. 4 heavy heating oils to cleaner fuels. The deadline for the phase out of all No. 6 heating oil was June 30th, 2015. The City achieved 100 percent compliance with the regulation, due in part to direct assistance provided through the City’s NYC Clean Heat program.

Between 2012 and 2015, more than 5,300 buildings that were registered as burning No. 6 heating oil have converted to No. 4 oil or a cleaner fuel, the majority of which were provided assistance by NYC Clean Heat. As a result, fine particulate matter (PM 2.5) emissions from buildings previously burning these heavy heating oils have been reduced by 65 percent, or 1,200

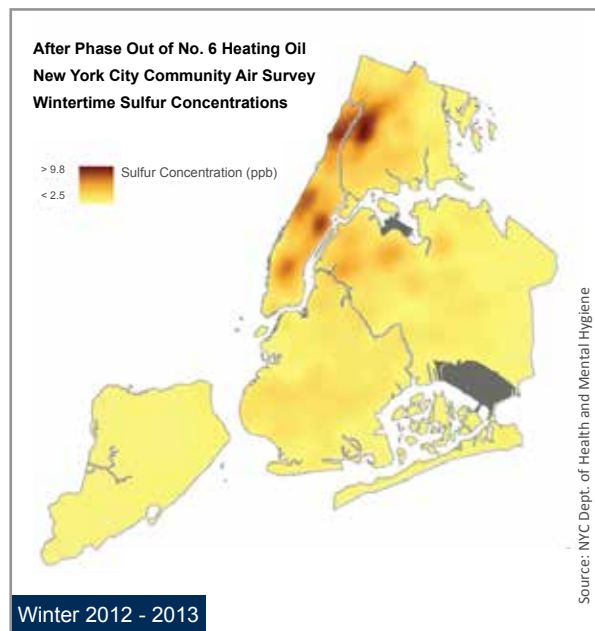
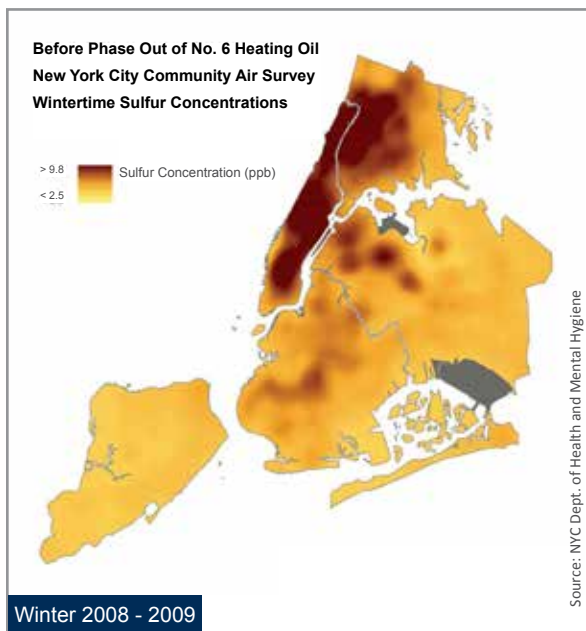
tons annually. The impact of these regulations on human health and air quality has been significant. In fact, after five years of enacting the regulations, New York City’s air is now cleaner than it has been in 50 years—preventing over 210 premature deaths and 540 hospital visits annually.<sup>27</sup>

### NYC Clean Heat and the NYC Retrofit Accelerator

Building off the success of the NYC Clean Heat program, the City launched the NYC Retrofit Accelerator, a free program provided by the City that offers advisory services to building owners and operators during the steps required to successfully complete energy efficiency, water conservation, and clean energy upgrades. See **Appendix D** for more information about the NYC Retrofit Accelerator.

### Converting from No. 4 Oil to Ultra-Low Sulfur No. 2 Oil

Buildings still burning No. 4 oil must switch to



a cleaner fuel by 2030, or upon boiler or burner replacement, whichever is sooner. Buildings may choose to switch to Ultra-Low Sulfur (ULS) No. 2 oil, biodiesel, natural gas, or district steam.

ULS No. 2 oil is the cleanest heating oil available and typically involves less upfront investment than converting to natural gas. However, it is still important to plan ahead. Most boilers that can burn No. 4 oil can also burn ULS No. 2 oil and biodiesel, but tanks will need cleaning and in some cases, retrofitting. Still, conversion costs for ULS No. 2 oil are typically minimal unless your building needs a new oil tank.

### **Biodiesel**

ULS No. 2 oil can also be made even cleaner by blending it with biodiesel, which is a renewable distillate fuel primarily derived from waste vegetable and soybean oil. In fact, ULS No. 2 Oil with a biodiesel blend of 20 percent or more will reduce your building's GHG emissions by an amount comparable to converting to natural gas—reducing GHG emissions in a typical multifamily building by up to 15 to 20 percent. The conversion process is nearly identical regardless

of whether biodiesel is included, and as an added benefit, users of biodiesel are eligible for a tax refund from New York State of up to \$0.20 per gallon, until December 31st, 2016.

### **Converting to Natural Gas**

Natural gas is the cleanest fossil fuel at the point of combustion, with the potential to reduce a typical multifamily building's GHG emissions by 15 to 20 percent.<sup>28</sup> If your building has access to natural gas, converting to gas can also lead to significant cost savings due to potentially lower fuel prices and reduced boiler maintenance costs.

Because of these cost savings, payback periods for natural gas conversions can be short, but the process of converting does require significant advanced planning. Most buildings will need between six and twelve months to evaluate internal conversion costs, coordinate with utilities to access a gas line, develop a construction timeline, and determine financing for the conversion. You should work with a NYC Retrofit Accelerator efficiency advisor to determine whether converting to natural gas is the right option for your building.

## **Heating Oil Conversions Online Resources**

- Con Edison, Area Growth Zones: [www.bit.ly/RkYHLM](http://www.bit.ly/RkYHLM)
- National Grid, Natural Gas Conversions: [www.ngrid.com/2bY4SQi](http://www.ngrid.com/2bY4SQi)
- NYC Heating Oil Regulations: [www.on.nyc.gov/2cfsEko](http://www.on.nyc.gov/2cfsEko)
- NYC DEP, Heating Oil: [www.on.nyc.gov/2cISbKZ](http://www.on.nyc.gov/2cISbKZ)



In many multifamily buildings, the boiler system used for space heating is also used to heat domestic hot water. In this case, many of the upgrades described in the Heating and Cooling Systems section will also increase the efficiency of your domestic hot water system. If your building uses a separate system to heat water, there are additional steps you can take to save both energy and water. In New York City, water heating accounts for 22 percent of GHG emissions from multifamily buildings, so improving the efficiency of a building's domestic hot water system is a tremendous opportunity to cut GHG emissions and save money on energy and water bills.<sup>29</sup>

## ✓ Water Heaters and Boilers

If your building's domestic hot water is heated by the same boiler system that provides space heating, the first step is to ensure that this boiler is operating efficiently and has converted away from heavy heating oil, as described in the Heating and Cooling Systems section. Other steps to improve efficiency of heating domestic hot water include:

- Insulating the boiler, water storage tank, and piping to reduce standby losses.
- Decoupling your hot water heater from your boiler and installing a separate hot water system for summer months, which will avoid firing a large boiler throughout the year.
- Upgrading to a tankless water heater, which minimizes stand-by heat losses associated with water storage tanks (typically better for smaller buildings with less hot water demand).

## ✓ Solar Hot Water Heaters

Solar hot water heaters are installed on the roofs of buildings and utilize the energy of the sun to heat domestic hot water. These systems are typically connected to existing hot water systems to provide auxiliary heating that can meet up to 70 percent of a building's hot water needs.<sup>30</sup> Solar hot water heaters can also be installed in conjunction with solar PV to provide the benefits of both. If your building is considering solar, it is worth discussing with a contractor to find the optimal use of solar PV and solar thermal to meet your building's electricity and hot water needs.

To be most effective, solar hot water projects generally require short piping runs, large and unobstructed roof spaces with easy accessibility, and space for storage tanks. These conditions tend to preclude tall, narrow buildings. In general, buildings between one and twelve stories with unobstructed, south-facing roof space typically provide the best potential for

solar hot water heaters.<sup>31</sup> The cost-effectiveness of these systems depends largely on the type of fuel being displaced. If your building uses an expensive source of energy to heat your water, such as electricity, you will receive greater benefits compared to a customer using a lower cost fuel, such as natural gas. Similarly, the GHG reduction potential of these systems also depends on the type of fuel being replaced. If your building uses a carbon-intensive source of energy to heat its water, such as heavy heating oil, installing a solar thermal system will result in a larger reduction in your building's GHG emissions compared to a customer using a cleaner fuel, such as natural gas.

## Water Efficiency Measures

Implementing water efficiency measures can greatly reduce water consumption and its associated costs. In addition, regular inspections and sub-metering water systems can allow for the early detection of leaks and excessive usage in order to fix the issue quickly. Conserving water also reduces energy consumption by decreasing the amount of water that must be heated and pumped through the building. Simple measures to save both water and energy include:

- Installing high-efficiency WaterSense® label showerheads, which can save 0.5 gallons per minute while maintaining high water pressure.<sup>32</sup>
- Installing WaterSense® faucet aerators to reduce water use by up to one gallon per minute while maintaining high water pressure.<sup>33</sup>
- Installing high-efficiency WaterSense® toilets, which can use as little as 1.28 gallons of water per flush, compared with 3.5 gallons or more for older models.<sup>34</sup>
- Using ENERGY STAR® clothes washers, which use 25 percent less energy and 40 percent less water compared with standard domestic washing machines.<sup>35</sup>
- Using ENERGY STAR® certified dishwashers save over 10 gallons of water per cycle and are up to four times more energy efficient than dishwashers manufactured before 1999.<sup>36</sup>

In addition to water efficiency measures, another way to conserve water is to inspect all water-using appliances and building equipment for leaks. A running toilet with a leaking flapper or malfunctioning fill valve can waste 3 to 5 gallons per minute or 4,000 gallons per day, costing as much as \$44 daily.<sup>37</sup>

Another way to better monitor and control water use and costs is to install water sub-metering. Similar to electricity sub-metering, water sub-metering allows residents to take greater control over their utility bill by being charged only for the water they actually consume, providing tenants an incentive to not waste water.

### Domestic Hot Water Online Resources

- Con Edison, Equipment Rebates for Multifamily Buildings: [www.bit.ly/29Teg7j](http://www.bit.ly/29Teg7j)
- National Grid, Multifamily Energy Saving Programs: [www.ngrid.com/2afGHPP](http://www.ngrid.com/2afGHPP)
- NYSERDA, Solar Thermal (Hot Water): [www.on.ny.gov/2bd3qz1](http://www.on.ny.gov/2bd3qz1)

### Water Efficiency Online Resources

- NYC DEP, Water Conservation and Cost Management: [www.on.nyc.gov/2aWHRO1](http://www.on.nyc.gov/2aWHRO1)
- US EPA, WaterSense® Products: [www.goo.gl/ddJTC4](http://www.goo.gl/ddJTC4)



## Efficient On-Site Generation and Renewables

On-site energy generation may be a good option for your building if you are planning major equipment upgrades to your building, want to guard against future fuel price increases, or increase your building’s resilience to extreme weather events. On-site generation technologies can produce some or all of the energy your building consumes, and are typically cleaner and more efficient than the energy supplied by your utility. Many of these technologies require a large upfront investment, but they will typically provide operational savings and numerous environmental benefits. There are also financial incentives, financing, and alternative financing agreements available to help make these projects more economically feasible.

### Combined Heat and Power

Combined Heat and Power (CHP), also known as cogeneration, is the simultaneous production of two or more useful forms of energy from a single fuel source. A CHP system will take fuel—most commonly natural gas—and generate electricity for your building. The CHP system then captures the excess heat from this process, which is typically wasted, and uses it to provide space or hot water heating to the building. In multifamily buildings, CHP systems are typically sized to fulfill the building’s domestic hot water load.

NYSERDA incentives typically cover 30 to 50 percent of project costs.<sup>38</sup> Buildings that typically work best for CHP have a centralized hot water distribution loop and a year-round, simultaneous need for thermal energy and electricity. The heat created by the CHP system can also be used for laundry facilities, pool heating, and with an absorption chiller, central air conditioning.

CHP systems can operate with up to 80 percent

fuel efficiency, compared to just 15 to 45 percent for standalone electricity generators. As a result, CHP systems can significantly reduce your building’s annual energy costs and GHG emissions, particularly if you are switching from a fuel such as No. 2 oil to a relatively less expensive and less carbon-intensive one like natural gas.

CHP systems also lower the demand on New York City’s electrical grid, which helps prevent blackouts and allows the local power supply to operate more reliably. In the event of power loss, CHP systems can add to your building’s resiliency by providing enough electricity to operate your building’s critical functions such as



A 60 kW CHP system

elevators, water pumps, and emergency lighting. Generally, powerful storms that compromise the electrical grid do not interrupt natural gas service, allowing the continued delivery of fuel necessary

to maintain resident safety and comfort. To determine whether CHP may be right for your building, be sure to contact one of the NYC Retrofit Accelerator’s efficiency advisors.

## Combined Heat & Power Online Resources

- NYSERDA Combined Heat and Power Program: [www.nyserda.ny.gov/chp](http://www.nyserda.ny.gov/chp)
- US DOE CHP Technical Assistance Partnerships: [www.northeastchptap.org](http://www.northeastchptap.org)
- US EPA Combined Heat and Power Partnership: [www.epa.gov/chp](http://www.epa.gov/chp)

## Solar PV

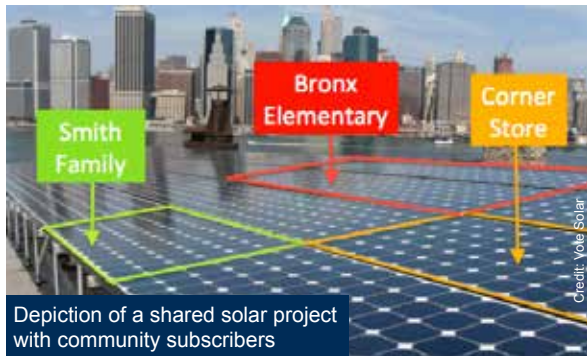
Solar electric systems, also known as solar photovoltaic (PV) systems or solar panels, convert sunlight into electricity. Installing solar PV can help save on energy costs by reducing the need to purchase electricity from a utility. Moreover, any excess electricity produced that your building does not use is credited to your building’s utility bill in an arrangement called net energy metering. Solar panels typically require an investment to install, but financial incentives from NYSERDA coupled with tax incentives from the city, state, and federal governments can cover as much as 80 percent of the costs. Financing products and leasing arrangements are also available for customers wishing to install solar with little or no capital outlay. Before installing a solar PV system, be sure to hire a Professional Engineer (PE) or Registered Architect (RA) to ensure your building’s structural system can maintain the weight of the equipment.

### Community Solar

Community solar models utilize community aggregation or group purchasing initiatives to help make the process of installing a solar system easier to navigate and more affordable. Two examples that exist in New York City are:

**Solarize NYC:** Solarize NYC brings together groups of potential solar customers through widespread outreach and education. The program allows “communities” to use group purchasing power to reduce prices as a result of lower customer acquisition costs and economies of scale. The program allows applicants to self-define their community, such as a neighborhood, group of buildings, or an affinity group/association such as a labor union or property management firm. Once a community is defined, the Solarize NYC campaign will work with the community partner to choose a solar installation company or companies that offer competitive, transparent pricing. Participants in the Solarize NYC campaign are expected to receive a 10 to 20 percent discount on solar pricing relative to individual purchase pricing.

**Community Shared Solar:** Also known as “Shared Renewables” or “Community Distributed Generation”, this model allows building owners and renters in multifamily buildings without adequate solar access the opportunity to subscribe to portions of a large solar array located on- or off-site and managed by a third party. Each individual subscriber’s share of production will appear as a credit on their utility bill, offsetting their monthly electricity charges. If the solar array generates more electricity than subscribers use, the excess generation credits will be distributed to individual subscribers on an annual basis.



Depiction of a shared solar project with community subscribers

### Online Interactive Solar Map Tool

The NY Solar Map tool is a free interactive map that displays every building in New York State’s solar potential, possible savings, and relevant financial incentive programs available. The tool is available online at:

Learn more: [www.nysolarmap.com](http://www.nysolarmap.com)

### Solar Incentives in New York City

NYSERDA’s NY-Sun incentive program covers a portion of the cost for systems up to 200 kW, with incentive amounts decreasing over time under the “MW Block” program as more capacity comes on-line statewide.

For solar PV systems that are installed and placed into service before December 31st, 2016, New York City offers a Property Tax Abatement of 20 percent (five percent of the installed cost of the system per year, for four years) after factoring in the NY-Sun incentive. This can provide either up to \$62,500 per year (capped at \$250,000 total) or the building’s tax liability, whichever is less.

Additionally, in December 2015, US Congress extended the 30 percent Investment Tax Credit (ITC) for solar installations, with the current incentive rate of 30 percent lasting through 2019, before stepping down to 10 percent in 2022, where it will remain for commercial projects. For more information on financial incentive programs and tax incentives, see **Appendix A**.

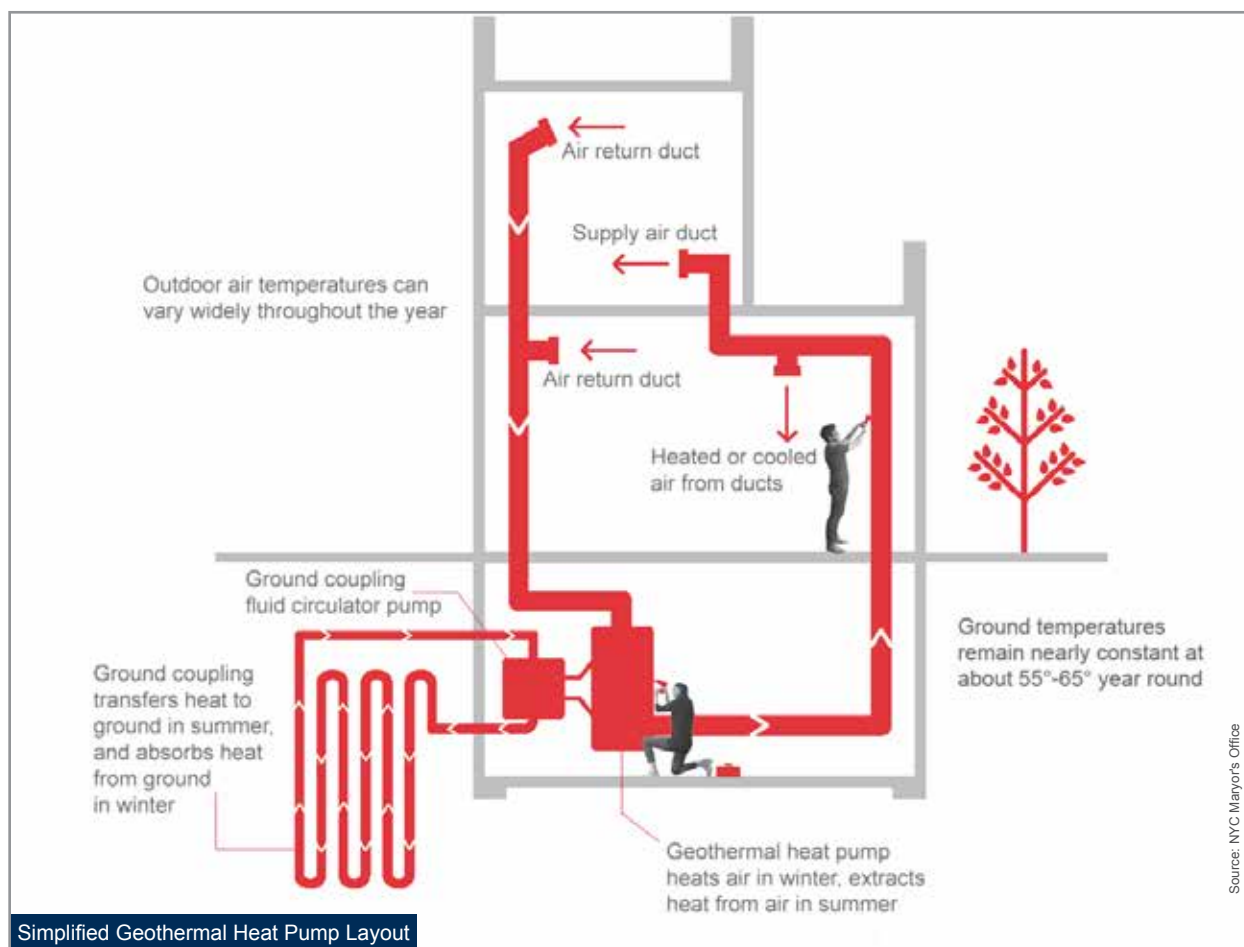
## Solar PV Online Resources

- NY-Sun: [www.ny-sun.ny.gov](http://www.ny-sun.ny.gov)
- Solarize NYC: [www.solarizenyc.com/](http://www.solarizenyc.com/)
- Sustainable CUNY. NYC Multifamily Solar Guide: [www.goo.gl/sRADgX](http://www.goo.gl/sRADgX)
- Here Comes Solar: [www.herecomessolar.nyc](http://www.herecomessolar.nyc)
- Con Edison. Distributed Generation: Solar Energy: [www.goo.gl/4xKcEw](http://www.goo.gl/4xKcEw)
- Federal Investment Tax Credit (ITC): [www.goo.gl/wztfYP](http://www.goo.gl/wztfYP)
- New York State Solar Sales Tax Exemption: [www.on.ny.gov/2dNgrhO](http://www.on.ny.gov/2dNgrhO)
- NYC Solar Panel Tax Abatement: [www.on.nyc.gov/2bcvcf0](http://www.on.nyc.gov/2bcvcf0)



## ✓ Geothermal Heat Pumps

Geothermal heat pump systems, also known as ground source heat pumps, tap into the constant temperature of the earth beneath a building to provide efficient heating and cooling, which can reduce reliance on boilers, cooling towers, and other conventional HVAC equipment. Additional benefits include low operating and maintenance costs and long operating life. These systems operate by exchanging heat energy between a building and the ground, providing heating in the winter and cooling in the summer, which is then distributed throughout the building. Geothermal heat pumps can be installed in all New York City boroughs, but feasibility depends on the location of your building and the specifics of the heating and cooling systems.<sup>39</sup>



### Geothermal Heat Pumps Online Resources

- Geothermal Systems and their Application in New York City: [www.goo.gl/9qP0my](http://www.goo.gl/9qP0my)
- NYSERDA, Geothermal Heat Pumps: [www.nyserda.ny.gov/geothermal](http://www.nyserda.ny.gov/geothermal)
- US DOE EERE, Geothermal Heat Pumps: [www.goo.gl/c8C3UQ](http://www.goo.gl/c8C3UQ)



## Other Energy Saving Measures

In addition to the investments described in previous sections, there are many low- or no-cost strategies your building can undertake to save money and boost efficiency. These include improving the operations and maintenance of your building's energy systems, training the building staff in energy efficiency, and engaging your building's residents to inspire simple behavior changes to minimize wasteful energy practices.

### Operations and Maintenance

Operations and maintenance (O&M) encompasses all the services required to ensure that a building's systems and equipment perform the way they were originally designed and constructed. According to the US Department of Energy (DOE), well-executed O&M programs can save 5 to 20 percent on annual energy bills without significant capital investments.<sup>40</sup> In fact, some changes may cost nothing at all. Below are some ideas to help get your building started on a successful O&M program.

#### Building Operator Training Programs

There are numerous training programs available to building superintendents and operators in New

York City that teach methods for improving a building's operating efficiency. Energy efficiency training programs are available through local unions such as SEIU 32BJ, the largest building service workers union in the country, which offers an intensive 40-hour Green Supers Training program as well as shorter courses on specific topics such as CHP, green roofs, and energy use benchmarking. If your building's superintendent or operators are eligible members of 32BJ, they can participate in these programs free of charge. Other O&M training programs are available to non-union members such as Green Professional (GPRO) Operations & Maintenance Essentials course available through local non-profits such as Urban Green Council and Solar One, Building Operator Certification available through the City University of New York's Building Performance Lab, and a new Green Building operator's training available from the NYC Department of

### Operations & Maintenance Online Resources

- 32BJ Green Supers Training Programs: [www.bit.ly/2eD39GD](http://www.bit.ly/2eD39GD)
- CUNY Building Performance Lab: [www.cunybpl.org/training](http://www.cunybpl.org/training)
- Solar One, Green Workforce Training Programs: [www.solar1.org/green-workforce](http://www.solar1.org/green-workforce)
- Urban Green Council, Green Professional Training Programs: [www.bit.ly/2eflUfE](http://www.bit.ly/2eflUfE)

Small Business Services beginning in the fall of 2016. The NYC Retrofit Accelerator also offers less time-intensive training programs for building staff in New York City on specific building systems.

## Retro-Commissioning

Retro-commissioning is the testing and fine-tuning of existing building systems to confirm they are operating as designed, and as efficiently as possible. Retro-commissioning commonly identifies maintenance, calibration, and operations errors within a building that are easily corrected and, when implemented, save energy and improve equipment reliability. NYC Local Law 87 of 2009 requires owners of buildings 50,000 gross square feet or larger to retro-commission building systems every ten years and implement identified retro-commissioning deficiencies. Learn more about Local Law 87 in **Appendix C**.

## NYC Local Law 87 Retro-commissioning

NYC Local Law 87 of 2009 mandates that all buildings greater than 50,000 gross square must undergo energy audits and retro-commissioning measures once every ten years, which will help ensure that HVAC building systems are running efficiently.

Retro-commissioning is a process that seeks to improve how building equipment and systems function together by testing and fine-tuning existing building systems to confirm they are operating as efficiently as possible. Buildings can complete the energy audit and retro-commissioning measures at any time in the four years leading up to the compliance date, which will allow your building to begin saving money more quickly.



## ✓ Resident Engagement and Behavioral Change

Engaging the residents of your building to make simple behavior changes can make a big difference when it comes to saving energy. Best of all, it requires little or no upfront investment. Simple behavior changes include:

- Use a programmable thermostat to turn off heating or cooling when apartment is not occupied.
- Set the thermostat to 68°F or lower in the winter and 78°F or higher in the summer.
- Use smart power strips or unplug devices when not in use to avoid using standby power.
- Only wash full loads of laundry using cold water whenever possible.
- Purchase ENERGY STAR® rated appliances and light bulbs, which typically use 20 to 30 percent less energy than products that meet the minimum efficiency requirements.

### GreeNYC

GreeNYC is New York City's public engagement program dedicated to helping New Yorkers make behavior choices that will help make our city greener and greater. GreeNYC's mascot, Birdie, provides tips to help New Yorkers reduce energy use and choose a more sustainable lifestyle.

There are numerous ways to engage residents to make the simple behavior changes that will help save energy. Here are some simple ideas to get started:

**Green Committees.** Setting up a “green committee” to help engage residents through social media or events can help residents learn how to make simple behavioral changes that can add up to significant energy savings.

**Coordinated Appliance Purchasing.** Many vendors will offer significant discounts for large orders of appliances, such as refrigerators or air conditioning units. Organizing a building-wide purchase of energy efficient appliances can provide residents with savings on new appliances and their individual energy bills.

**SAVE MONEY  
DON'T COOL AN  
EMPTY HOME**

If you're away for 8 hours a day, turning off your A/C can save you at least a third on cooling costs.

Want to save even more? When you are home, don't air condition an empty room.

 **SMALL STEPS, BIG STRIDES.**  
nyc.gov/greenyc  Birdie\_NYC

Credit: Mayor's Office of Sustainability

GreeNYC campaign

## Resident Engagement & Behavior Change Online Resources

- GreeNYC: [www.nyc.gov/greenyc](http://www.nyc.gov/greenyc)
- Enterprise Green Communities, Resident Engagement: [www.bit.ly/1VwbiXz](http://www.bit.ly/1VwbiXz)
- NYSERDA, Residential Energy Saving Tips: [www.nyserda.ny.gov/residential-tips](http://www.nyserda.ny.gov/residential-tips)

# Success Stories

# Roosevelt Landings

*Pioneering energy services agreement (ESA) approach unlocks clean energy and major savings for large multifamily complex*



By the Numbers	
Number of Units	1,003
Total Project Cost	\$7.4 million
NYSERDA Incentives	\$747,900
Con Edison Incentives	\$236,500
Federal Grant	\$186,117
NYSERDA 0% Loan	\$500,000
Annual Electricity Savings	3,801,000 kWh
Annual Source Energy Savings	35,000 MMBtu
Annual Savings	\$756,000
Simple Payback	9.8 years
Annual CO <sub>2</sub> Emission Reduction	1,670 tCO <sub>2</sub> e

Built in 1969, Roosevelt Landings is a large mixed-income multifamily rental complex on Roosevelt Island, Manhattan. The complex completed an efficiency retrofit in 2008 that included lighting, ventilation fan controls, ENERGY STAR® refrigerators, low-flow water fixtures, and new windows throughout the complex.

In 2012, the building owner, Urban American, an NYC Carbon Challenge participant, decided to pursue a deeper energy retrofit and resiliency project to further modernize the complex and better manage operating costs. The project included whole-building air sealing, smart controls, high-efficiency boilers, and CHP that enables the complex to continue to provide hot water and electricity in the event of prolonged blackouts.

Roosevelt Landings had limited funds to cover the upfront costs associated with the renovation and the projects had an extended payback period, meaning that standard commercial loans were not available. Furthermore, Roosevelt Landings’ primary lender had the right to approve additional secured lending arrangements, a common energy efficiency barrier. Given this circumstance, Urban American approached the New York City Energy Efficiency Corporation (NYCEEC) to provide debt financing for Roosevelt Landings.

In November 2012, NYCEEC closed a \$7.4 million loan with Urban Greenfit, Urban American’s energy services company (ESCO) subsidiary, financial advisor, and project developer. This loan included \$4.5 million to

fund a combined energy services agreement (ESA) in which a Urban Greenfit agreed to pay Urban American’s utility bill for a fee and guarantees energy savings over a set period of time. NYCEEC also guaranteed Roosevelt Landings’ efficiency measures and power purchase agreement (PPA) for the cogeneration system. Third-party investors, including an owner affiliate, invested equity in the project at a market rate of return. NYSERDA and Con Edison incentives completed the funding for the project.

NYCEEC’s flexibility was critical in unlocking the financial incentives that were necessary to enable the project to move forward but were not available until after project completion. NYCEEC bridged the incentives payments to match the construction milestones, allowing this project to achieve its full potential.

Roosevelt Landings is now outperforming projections for energy savings and financial performance. As of 2016, the project has generated cumulative energy savings of 23 percent—exceeding its 18 percent savings projection.



*“Not only did NYCEEC funding help get our project off the ground, but it eliminated all upfront costs so we could pay through the savings.”*

— Josh Eisenberg, Executive Vice President and General Counsel, Urban American (Building owner)



*“NYCEEC was a patient and proactive lender and advocate in structuring this transaction. They rolled up their sleeves and worked hard to move the project forward”*

— David Davenport, Managing Principal, Urban Greenfit (ESCO)

## Background & Challenges

- Outdated and inefficient building systems
- Storm vulnerability. Hurricane Sandy led to flooding of subterranean electrical room
- Project’s technical complexity and long payback meant that traditional loans were unavailable
- Building’s primary lender had approval right over additional secured lending

## Solution

- CHP to provide efficiency and resiliency to blackouts
- Whole-building air sealing
- Floor slab insulation
- Networked programmable thermostats
- High-efficiency boilers
- \$4.5 million loan from NYCEEC to fund a combined ESA and PPA and help secure mortgage lender consent

## Benefits

- Project completed with no upfront cost to building owners and no additional debt
- Project saves \$756,000 in annual energy costs
- Building’s cash reserves preserved
- Reduced energy utilization by 18%
- Projected to reduce GHG emissions by 18%

Case study prepared by Jessica Luk of NYCEEC

# Success Stories

# Franklin Plaza

*Green mortgage enables large affordable housing complex to save money and improve tenant comfort by including energy upgrades as part of larger capital project*



Built in 1960, Franklin Plaza is an affordable multifamily co-op in East Harlem with fourteen 20-story buildings and 1,632 units. Prestige Management, Inc. took over management of Franklin Plaza after the building had accrued years of deferred maintenance. The building had inefficient and outdated systems, including a heating plant that was burning No. 6 fuel oil and running year-round to produce domestic hot water.

In 2013, Prestige Management, Inc. began the process of refinancing Franklin Plaza’s mortgage with the NYC Housing Development Corporation (HDC) and was interested in the potential to include energy upgrades as part of a larger capital investment project. To make this happen, Prestige Management, Inc. engaged NYCEEC, who partnered with HDC to offer the Program for Energy Retrofit Loans (PERL), which provides financing for capital improvements that assist building owners to comply with LL87 and the City’s heating oil regulations. By enhancing the borrower’s credit with a loan loss reserve, NYCEEC empowered

By the Numbers	
Number of Units	1,632
Total Project Cost	\$3.8 million
Annual Source Energy Savings	38,978,000 kBtu
Annual PM 2.5 Reduction	5,222 Lbs
Annual Cost-Savings	\$2,200,000
Annual GHG Reductions	6,743 tCO <sub>2</sub> e

HDC to offer additional loan proceeds for clean energy improvements. Through PERL, HDC provided an additional \$3.8 million specifically for the efficiency upgrades, as part of a larger \$36.7 million loan for renovation and refinancing.

As a result of this energy efficiency and fuel conversion project, Franklin Plaza, an NYC Carbon Challenge participant, has achieved significant cost savings and GHG reductions. The project also preserved the co-op’s affordability and improved building comfort for residents.

## Background & Challenges

- Outdated building systems
- Lack of technical expertise
- Limited financial resources

## Solution

- No. 6 oil to natural gas conversion
- Separation of heat and hot water systems
- Steam distribution improvements
- \$3.8 million loan from NYCEEC combined with technical guidance to finance energy efficiency as part of a comprehensive building upgrade and preserved affordability

## Benefits

- Project saves \$2,200,000 in annual energy costs
- Co-op included energy efficiency upgrades as part of larger capital project
- Preserved affordable housing
- Improved building comfort for residents



*“Beyond their financial assistance, NYCEEC’s technical expertise has helped us to encourage borrowers to incorporate important cost-saving capital improvements into their final scopes of work.”*

— Diana Glanternik, Assistant VP, HPD

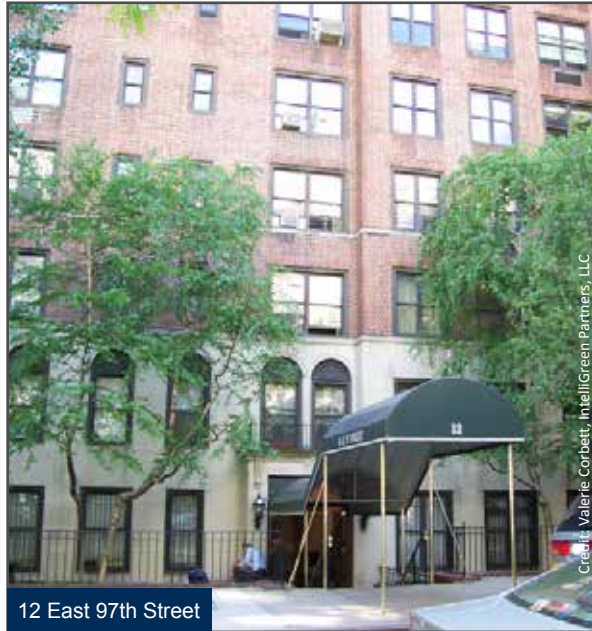
Case study prepared by Jessica Luk of NYCEEC



## Success Stories

# 12 East 97th Street

*Two New York City Laws Lead to Major Energy and Cost Savings for a Manhattan Co-Op*



12 East 97th Street

In 2010, more than 80 years after it was built, the mechanical systems of 12 East 97th were far past their prime. Nancy Boyd, the building's board president, and John Slattery, the treasurer, decided to take advantage of the City's Local Law 87 energy audit and retro-commissioning requirements and heating oil regulations to pursue an integrated project to improve the building's efficiency, lower its energy costs, and dramatically reduce its GHG emissions.

Although not required to comply with Local Law 87 until 2022, the board was intrigued by the benefits of early compliance, and became one of the first New York City co-ops to adhere to the law. Building on these efforts, 12 East 97th Street was also one of the first co-ops to join the NYC Carbon Challenge in 2013 with its property management firm, Douglas Elliman Property Management.

### By the Numbers

Number of Units	107
Total Investment	\$579,172
NYSERDA Incentives	\$12,114
Annual Source Energy Savings	2,583,003 kBtu
Annual Cost-Savings	\$62,000
Simple Payback	9.3 years
Annual GHG Reduction	333.65 tCO <sub>2</sub> e

The co-op board hired a consulting firm and an energy engineering and design firm in 2010 to complete the Local Law 87 energy audit and retro-commissioning services, which analyzed the building's energy use and identified areas for improvements that, when implemented, began saving energy almost immediately. With the pending expiration of its No. 6 heating oil permit, the board hired an engineering firm that designed a new dual fuel system for the building's boiler, which can burn both natural gas and ULS No. 2 oil, providing fuel choice flexibility for the future.

In addition, the system includes a separate domestic hot water (DHW) heater and storage tank that allows the boiler to be shut down during the non-heating season. By moving quickly to undertake this work, the building even earned a \$12,114 grant from NYSERDA through a former GHG emission reduction program.

Capitalizing on the opportunity to combine the boiler upgrade with other improvements recommended by its Local Law 87 energy audit, the board undertook additional energy efficiency

measures, including upgrading the boiler control system, replacing all radiator steam traps, upgrading its common area lighting, installing occupancy sensors in the basement, insulating steam and hot water pipes, and distributing over 300 free CFL bulbs to residents. The board is now considering participating in the Con Edison Multifamily Energy Efficiency Program to install efficient LEDs and water conservation measures such as efficient showerheads and faucet aerators.

Resident Manager Jorge Francisco took over the conversion project prior to completion and continues to manage the Board's energy efficiency mandate. "Properly balancing the system, resolving tenants' heating issues quickly, and fixing steam leaks immediately are critical to running an efficient heating system," he says. To hone his green building skills, Jorge earned the BPI Multifamily Building Operator and Multifamily Building Analyst certifications through 32BJ SEIU. He has also earned the GPRO O&M and GPRO Mechanical-Electrical-Plumbing certifications from the Urban Green Council.

12 East 97th Street's completed upgrades have resulted in an impressive 25% reduction in the building's energy use. Combined with its natural gas conversion, the board has saved the building more than \$62,000 in operating costs annually and reduced GHG emissions by over 333 metric tons of carbon dioxide equivalent (CO<sub>2</sub>e) - or a 42% reduction from 2011 levels.

Case study prepared by Valerie Corbett of Intelligreen Partners, LLC

## Background & Challenges

- 30-year-old boiler with immersion coil and a 1928 boiler were outdated and costly to operate
- 40-year old "buried" No. 6 oil tank created energy waste and needed to be replaced
- Incandescent bulbs, 24-hour building lighting, and uninsulated steam and water pipes added to energy costs
- Original 1928 radiator steam traps caused heating distribution problems

## Solution

- Upgraded boiler with new dual fuel burner
- Removed old oil tank and standby boiler
- Installed new gas-fired DHW heater and storage tanks
- Insulated steam and water pipes
- Installed energy-efficient lighting fixtures and motion sensors in common areas
- Replaced all radiator steam traps

## Benefits

- Reduced energy consumption by 25% (2015 vs 2011)
- Reduced GHG emissions by 42%
- Able to turn off the main boiler in summer, reducing energy waste and unnecessary maintenance costs
- Received \$12,114 in financial incentives from a former NYSERDA program by acting quickly to undertake the upgrades



*"In 2010 we were heating the building with No. 6 oil and we wanted to reduce our carbon emissions and have fuel flexibility in the future. Some of our heating equipment was obsolete and inefficient, but the boiler was worth upgrading to dual fuel, with a new gas-fired domestic hot water heater. By refinancing our mortgage and obtaining a grant from NYSERDA we were able to fund the fuel conversion project and a number of low cost energy efficiency measures that produced immediate cost savings."*

—John Slattery, Treasurer of the Board

# Appendix A: Financial Incentives

When it comes to paying for energy efficiency upgrades, your building has options to help cover the upfront cost. There are several cash incentive programs, financing options, and tax abatements currently available to multifamily buildings owners in New York City.

The table below illustrates the New York City-specific cash incentive programs. Note, however, that these programs are current as of September 2016 and may change over the next several years, so be sure to consult with an NYC Retrofit Accelerator efficiency advisor to see if there have been any updates to these programs and determine which will be right for your building.

NYSERDA		
Energy Efficiency & Renewable Energy Programs	System Opportunities	Description
NY-Sun	On-site Generation	<p>NYSERDA's Solar Standard Offer PV Incentive Program (PON 2112) offers incentives to help reduce the installation costs for multifamily building PV systems 200 kilowatts and smaller. By combining these incentives with other tax credits and incentives, buildings can save 40 to 80 percent of the purchase cost of solar PV systems. Excess electricity above what the building uses and produced by its PV system will also be credited on the customer's utility bill.</p> <p><a href="http://www.nyserderda.ny.gov/solar">www.nyserderda.ny.gov/solar</a></p>
	On-site Generation	<p>NYSERDA also offers incentives for new end-use solar thermal water heating systems to help fund the installation cost if the system displaces electrically-heated water. Incentives are capped at \$5,000 per site per meter for residential systems and \$75,000 per site per meter for nonresidential applications. On average, solar hot water systems can reduce the electric portion of your energy bill up to 20 percent and can supply up to 70 percent of your hot water needs.</p> <p><a href="http://www.nyserderda.ny.gov/Solar-Hot-Water">www.nyserderda.ny.gov/Solar-Hot-Water</a></p>

# NYSERDA

Energy Efficiency & Renewable Energy Programs	System Opportunities	Description
<b>Multifamily Performance Program: Existing Buildings</b>	Appliances Building Envelope Cooling Controls Domestic Hot Water Heating Motors & Drives Submetering	<p><b>Targeted Option</b>—provides cash incentives up to \$150 per affordable unit and up to \$100 per market rate unit. Incentives are calculated on a per-MMBtu and per-kWh basis using the Savings and Incentives Calculator. Affordable units qualify for \$5.00 per-MMBtu and \$0.05 per-kWh. Market rate units can receive \$3.00 per-MMBtu and \$0.03 per-kWh. This option does not require the use of a Multifamily Building Solutions Provider (a NYSERDA-approved contractor).</p> <p><a href="http://www.nyserda.ny.gov/All-Programs/Programs/MPP-Existing-Buildings/MPP-Targeted">www.nyserda.ny.gov/All-Programs/Programs/MPP-Existing-Buildings/MPP-Targeted</a></p>
	Whole Building Upgrade	<p><b>Comprehensive Option</b>—provides cash incentives of up to \$150 per unit for affordable buildings that have projected energy savings of at least 25% and up to \$500 per unit for buildings that have projected energy savings of 36% or more. This option also features a performance payment of \$75 to \$325 per unit if the building realizes its projected energy savings target. This option requires the use of a Multifamily Building Solutions Provider.</p> <p><a href="http://www.nyserda.ny.gov/All-Programs/Programs/MPP-Existing-Buildings/Comprehensive-Option">www.nyserda.ny.gov/All-Programs/Programs/MPP-Existing-Buildings/Comprehensive-Option</a></p>
	Whole Building Upgrade	<p><b>High Performance Option</b>—provides cash incentives of \$3,500 per affordable unit and \$2,500 per unit for market rate units for projects seeking to achieve high-energy performance standards such as Passive House. Awards will be distributed based on a competitive solicitation process through a Request for Proposals that is anticipated to be released in late 2016.</p>

NYSERDA		
Energy Efficiency & Renewable Energy Programs	System Opportunities	Description
Combined Heat and Power (CHP) Program	Cooling Heating On-site Generation	<p><b>Catalog Approach</b>—approved CHP vendors act as a single point of responsibility for the entire project and provide a minimum 5-year maintenance/warranty agreement on the CHP system. Under this approach, NYSERDA will only accept applications from, and will only contract with, approved CHP vendors.</p> <p><a href="http://www.nyserderda.ny.gov/All-Programs/Programs/Combined-Heat-and-Power-Program">www.nyserderda.ny.gov/All-Programs/Programs/Combined-Heat-and-Power-Program</a></p>
		<p><b>Custom Approach</b>—NYSERDA will accept applications from the site owner, the CHP System owner, or any member of the project team that is willing and capable of taking responsibility for the proper design, integration, installation, commissioning and maintenance of the CHP System. NYSERDA will contract only with the applicant. The Custom Approach is available for projects 1MW and larger in size.</p> <p><a href="http://www.nyserderda.ny.gov/All-Programs/Programs/Combined-Heat-and-Power-Program">www.nyserderda.ny.gov/All-Programs/Programs/Combined-Heat-and-Power-Program</a></p>
		<p>Additional 10% bonus available for projects located within CHP Targeted Zones.</p> <p>Additional 10% bonus available for facilities designated as Critical Infrastructure by the American Red Cross or local Office of Emergency Management.</p>
Con Edison		
Energy Efficiency & Renewable Energy Programs	System Opportunities	Description
Multifamily Energy Efficiency Program	Building Envelope Controls Domestic Hot Water Energy Management Heating Lighting	<p>This program provides a free energy survey by a Con-Edison energy efficiency professional. Once your building is enrolled in the program, residents can receive free LED light bulbs, thermostatic radiator valves, as well as water-saving devices such as low flow showerheads and faucet aerators. Incentives are also available for certain energy efficiency upgrades, including lighting fixtures and controls, LED exit signs, HVAC systems, and more.</p> <p><a href="http://www.coned.com/energyefficiency/residential_multifamily.asp">www.coned.com/energyefficiency/residential_multifamily.asp</a></p>

National Grid		
Energy Efficiency & Renewable Energy Programs	System Opportunities	Description
Multifamily Energy Saving Programs	Controls Domestic Hot Water Heating Water Efficiency	<p>National Grid offers energy efficiency services for multifamily dwellings such as apartment buildings, condominiums, and housing complexes. If you are a building owner or property manager, you can take advantage of National Grid's programs to weatherize your facilities or make other energy-saving improvements. These rebate rates can change, so check with the utility or the NYC Retrofit Accelerator for the current incentives.</p> <p><a href="http://www.nationalgridus.com/NY-Business/Energy-Saving-Programs/Multifamily">www.nationalgridus.com/NY-Business/Energy-Saving-Programs/Multifamily</a></p>
New York State Homes and Community Renewal (HCR)		
Energy Efficiency & Renewable Energy Programs	System Opportunities	Description
New York State Weatherization Assistance Program	Appliances Building Envelope Heating Lighting	<p>The Weatherization Assistance Program (WAP) assists households with incomes at or below 60% of state median income by paying for energy efficiency measures including air sealing, wall and ceiling insulation, heating system replacements or retrofits, lighting system upgrades, hot water tank and pipe insulation, and refrigerator replacements with ENERGY STAR® units. Household energy and cost savings from the program are significant, with an average savings of more than 20%. Individual households can apply by contacting the local provider that serves their area.</p> <p>Funding is provided by the U.S. Department of Energy (US DOE) and the U.S. Department of Health and Human Services (HHS), through New York's Home Energy Assistance Program (HEAP).</p> <p>Homes and Community Renewal: <a href="http://www.nyshcr.org/programs/weatherizationassistance">www.nyshcr.org/programs/weatherizationassistance</a></p> <p>Weatherization Assistance Providers in New York: <a href="http://www.nyshcr.org/programs/weatherizationassistance/Providers.htm">www.nyshcr.org/programs/weatherizationassistance/Providers.htm</a></p>

NYC Department of Environmental Protection (DEP)		
Energy Efficiency & Renewable Energy Programs	System Opportunities	Description
Toilet Replacement Program	Domestic Water	<p>This program offers eligible property owners that have been enrolled in the DEP Multifamily Conservation Program a \$125 voucher that can be redeemed at participating vendors for the purchase of high-efficiency toilets.</p> <p><a href="http://www1.nyc.gov/nyc-resources/service/2619/toilet-replacement-program">www1.nyc.gov/nyc-resources/service/2619/toilet-replacement-program</a></p>
Green Infrastructure Grant Program for Private Property Owners	Building Envelope Stormwater	<p>NYC DEP offers a grant program for private property owners in combined sewer areas of New York City. The minimum requirement is to manage 1 inch of stormwater runoff from the contributing impervious area. If selected, DEP will provide funds for the design and construction of the green infrastructure system. Eligible projects include blue roofs, rain gardens, green roofs, porous pavement, and rainwater harvesting on private property in combined sewer areas.</p> <p><a href="http://www.nyc.gov/html/dep/html/stormwater/nyc_green_infrastructure_grant_program.shtml">www.nyc.gov/html/dep/html/stormwater/nyc_green_infrastructure_grant_program.shtml</a></p>
NYC Small Business Services (SBS)		
Energy Efficiency & Renewable Energy Programs	System Opportunities	Description
NYC °CoolRoofs	Building Envelope	<p>This program supports local jobseekers in building high-demand skills while cooling New York City rooftops with a white reflective coating to reduce building energy consumption.</p> <p><a href="http://www.nyc.gov/html/coolroofs/html/home/home.shtml">www.nyc.gov/html/coolroofs/html/home/home.shtml</a></p>

# Tax Incentives

Federal, state, and city government tax incentives are available to support the investment of solar systems, energy efficiency projects, and green roofs for your building.

## **Federal Investment Tax Credit (ITC):**

Building owners who install solar PV systems are eligible for a tax credit worth 30 percent of the installed cost, after factoring in the NY-Sun incentive. Individual shareholders of a cooperative or condominium are both eligible for their proportionate share of this tax credit when their buildings purchase solar PV systems. The 30 percent ITC has been extended through 2019, before decreasing to 26 percent in 2020, 22 percent in 2021, and finally down to 10 percent in 2022 where it will remain for commercial projects.

- Learn more: [www.energy.gov/savings/business-energy-investment-tax-credit-itc](http://www.energy.gov/savings/business-energy-investment-tax-credit-itc)

## **New York State Sales Tax Exemption:**

Commercial solar energy systems are exempt from state sales taxes.

- Learn more: [www.energy.gov/savings/solar-sales-tax-exemption](http://www.energy.gov/savings/solar-sales-tax-exemption)

## **New York City Property Tax Abatement:**

For solar PV systems that are installed and placed into service before December 31st, 2016, New York City offers a Property Tax Abatement (PTA) of 20% (5% of the installed cost of the system per year, for 4 years) after factoring in the NY-Sun incentive. This can provide up to \$62,500 per year (capped at \$250,000) or the building's tax liability, whichever is less.

- Learn more: [www.energy.gov/savings/new-york-city-property-tax-abatement-photovoltaic-pv-equipment-expenditures](http://www.energy.gov/savings/new-york-city-property-tax-abatement-photovoltaic-pv-equipment-expenditures)

## **Modified Accelerated Cost Recovery System (MACRS) + Bonus Depreciation:**

Building owners that invest in solar energy systems may be eligible for federal income tax deductions through MACRS. The Internal Revenue Service (IRS) allows qualifying solar PV system owners a deduction of 85% of their tax basis. In December 2015, Congress passed a 5-year extension of the bonus depreciation on qualifying capital equipment. The 50% bonus depreciation will be available through 2017, at which point it will decrease to 40% through 2019, 30% in 2020, and 0% thereafter.

- Learn more: [www.irs.gov/publications/p946/ch04.html](http://www.irs.gov/publications/p946/ch04.html)



## **J-51 Exemption and Abatement:**

An update to the Certified Reasonable Cost (CRC) schedule now includes energy efficiency, aligning the value of the abatement to offset the cost of the energy efficiency upgrades in rent regulated housing.

- Learn more: [www1.nyc.gov/site/finance/benefits/benefits-j51.page](http://www1.nyc.gov/site/finance/benefits/benefits-j51.page)

## **Green Roof Tax Abatement:**

The City of New York and New York State passed legislation in 2008 to provide a one-year tax abatement, or tax relief, of \$4.50 per square foot (up to \$100,000 or the building's tax liability, whichever is less). Amended in 2013, the tax abatement is now available through March 15, 2018.

- Learn more: [www1.nyc.gov/nycbusiness/description/green-roof-property-tax-abatement-program](http://www1.nyc.gov/nycbusiness/description/green-roof-property-tax-abatement-program)

# Appendix B: Financing and Loans

Investments in energy efficiency can provide quick paybacks and long-term savings, but even with incentive programs, financing and loans may be required to cover the upfront cost. Participating in NYSERDA or Con Edison incentive programs will provide access to low-interest financing and new products are in the process of being rolled out to help buildings begin realizing the benefits of energy efficiency as soon as possible.

## City, State, Federal Financing and Loans

### NYC Department of Housing Preservation and Development

NYC Department of Housing Preservation and Development's (HPD) Preservation Finance programs provide financing to facilitate the physical and financial sustainability and affordability of privately owned multifamily buildings throughout New York City.

- The Participation Loan Program (PLP) provides low-interest loans and/or tax exemptions to multifamily building owners to facilitate the moderate or substantial rehabilitation and affordability of housing for low-to-moderate income households. For inquiries related to this program, contact [hpdrehabloans@hpd.nyc.gov](mailto:hpdrehabloans@hpd.nyc.gov).
- The Multifamily Housing Rehabilitation Program (HRP) provides rehabilitation loans to help owners undertake improvements to existing buildings. Rehabilitation is generally limited to the upgrading or replacement of major building systems, including but not limited to roof replacement, Local Law 11 work including pointing, and upgrades to the heating, electrical, and/or plumbing systems. For inquiries related to this program, contact [hpdrehabloans@hpd.nyc.gov](mailto:hpdrehabloans@hpd.nyc.gov).
- The Green Housing Preservation Program (GHPP) provides forgivable and no- and low-cost financing for energy efficiency and water conservation improvements, along with moderate rehabilitation work, for small- to mid-sized multifamily buildings that are greater than 5 units and less than 50,000 square feet. For inquiries related to this program, contact [hpdgreen@hpd.nyc.gov](mailto:hpdgreen@hpd.nyc.gov).
- The Low Income Housing Tax Credit Portfolio Preservation ("Year 15") Program ensures the future financial and physical viability and preserves the long-term affordability of Low Income Housing Tax Credit properties that are reaching or have reached the end of the initial tax credit compliance period. The program works with the owner to evaluate the needs of each project and develop a repositioning strategy to address the project's financial and capital needs as part of the Year 15 tax credit investor exit review. For inquiries related to this program, contact [hpdyear15@hpd.nyc.gov](mailto:hpdyear15@hpd.nyc.gov).
- Learn more: [www1.nyc.gov/site/hpd/developers/private-site-preservation.page](http://www1.nyc.gov/site/hpd/developers/private-site-preservation.page)

## NYC Housing Development Corporation

HDC is a public benefit corporation created by the New York state legislature to provide financing for multifamily affordable housing. Contact Diana Glanternik at [dglanternik@nychdc.com](mailto:dglanternik@nychdc.com) for more information.

- Program for Energy Retrofit Loans (PERL), a partnership between HDC and NYCEEC, offers financing for energy efficiency improvements and fuel conversions for multifamily properties currently in HDC and HPD's portfolio. The program provides financing for capital improvements that assist building owners in their efforts to comply with LL87 and LL43. At least 50 percent of the loan must be used for eligible energy efficiency measures, the remaining balance may be used for other necessary capital improvements.

## New York City Energy Efficiency Corporation (NYCEEC)

NYCEEC is a non-profit, mission-based finance company that provides loans and alternative financing solutions for clean energy projects. NYCEEC provides financing for energy efficiency improvements, fuel conversions, and renewable energy in all building types throughout New York City. NYCEEC has financed over \$80 million dollars of energy efficiency and clean energy projects across 5.2 million square feet in New York City.

NYCEEC works directly with building owners, contractors, project developers, ESCOs and partner lenders to provide financing solutions for energy efficiency projects. NYCEEC is an active partner lender with NYSERDA's Green Jobs – Green New York program, allowing building owners to take advantage of below market-rate financing incentives and finance 100 percent of project costs.

NYCEEC borrowers benefit from our financial capabilities and technical guidance, including:

- Flexible and innovative loan structures (construction loans, capitalized interest, multiple draws, bridge incentive payments)
- Financing to cover equipment costs, construction and eligible soft costs, such as energy surveys
- Engineering quality assurance and technical guidance to help borrowers maximize cost and energy savings
- Contact NYCEEC today at [info@nyceec.com](mailto:info@nyceec.com) or 646-797-4630 to learn how you can finance your clean energy project. The NYCEEC team is available to answer questions at any stage.
- Learn more: [www.nyceec.com](http://www.nyceec.com)

## **NYSERDA: Green Jobs – Green New York (GJGNY)**

Multifamily building owners can receive low-interest financing at half the market rate through NYSERDA's Green Jobs – Green New York program. The Multifamily Building Solutions Provider you contract will help guide you through this process. When your board has a loan approved to finance the balance of energy efficiency projects not covered by NYSERDA's cash incentives, Green Jobs – Green NY will advance up to 50% of the principal borrowed (up to \$5,000 per unit or up to \$500,000 per project) directly to your lender at an interest rate of 2%. This effectively reduces the cost of your loan to about half the market rate for loans of up to \$1 million. Payments go directly to the lender, but at a much lower interest rate.

- Learn more: [www.nyserda.ny.gov/multifamily-financing](http://www.nyserda.ny.gov/multifamily-financing)

## **New York State Homes and Community Renewal (HCR)**

HCR preserves housing affordability and works with many private, public and nonprofit sector partners to create inclusive, safe, green, and resilient places to live in New York State.

- Housing Financing Agency (HFA) creates and preserves affordable multifamily rental housing across the State. HFA offers financing to developers to build and preserve affordable housing.
- Learn more: [www.nyshcr.org/topics/developers/multifamilydevelopment/](http://www.nyshcr.org/topics/developers/multifamilydevelopment/)

## **Fannie Mae Multifamily Green Financing**

The Fannie Mae Multifamily Green Financing Business provides mortgage financing to apartment buildings and cooperatives to finance energy and water efficiency property improvements. Fannie Mae also serves the multifamily market by integrating sustainability considerations into the underwriting, asset management and securitization processes.

With Green Financing, owners of multifamily properties can invest in smart, strategic, energy and water saving improvements. These improvements improve the property's bottom line with lower utility costs, improve the quality and affordability of housing for tenants, and increase the property's environmental sustainability.

- Learn more: [www.fanniemae.com/multifamily/green-initiative](http://www.fanniemae.com/multifamily/green-initiative)
- Green Financing Fact Sheet: [www.bit.ly/1BZ8go6](http://www.bit.ly/1BZ8go6)

# US Department of Housing and Urban Development (HUD)

Multifamily Housing: HUD supports the development, rehabilitation and maintenance of multiple-unit affordable housing through FHA mortgage insurance programs. We provide capital grants to nonprofits for the construction and support of affordable housing for the elderly and persons with disabilities.

- Learn more: [portal.hud.gov/hudportal/HUD?src=/states/shared/working/northeast/mf](https://portal.hud.gov/hudportal/HUD?src=/states/shared/working/northeast/mf)

In July of 2007 HUD introduced its Green Initiative, a nationwide pilot initiative to encourage owners and purchasers of affordable, multifamily properties to rehabilitate and operate their properties using sustainable Green Building principles. These principles comprise sustainability, energy efficiency, recycling, and indoor air quality, and incorporate the Healthy Housing approach pioneered by HUD. The Green Initiative will focus on properties within HUD's Section 8 portfolio, specifically properties in the Mark to Market (M2M) Program administered by the Office of Affordable Housing Preservation (OAHP).

- Learn more: [portal.hud.gov/hudportal/HUD?src=/program\\_offices/housing/mfh/presrv/presmfh/greenini](https://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/mfh/presrv/presmfh/greenini)
- For more information, contact: [m2minfo@hud.gov](mailto:m2minfo@hud.gov)

## Non-profit Financing and Loans

### Community Preservation Corporation

As a leading non-profit affordable housing and community revitalization finance company, CPC utilizes deep, strategic relationships with government agencies, local community groups, banks, and other lenders to create customized loan opportunities for customers. CPC provides innovative capital solutions, fresh thinking, and a collaborative approach to the often complex challenges that owners and developers of multifamily housing face.

- Construction Loans - CPC provides construction financing for all multifamily housing types, with a streamlined approval process. This includes lending for the acquisition/refinancing and rehabilitation of multifamily occupied properties, gut renovation of vacant buildings into multifamily properties, and new construction of multi-and single-family properties.

- Supportive Housing Financing - CPC provides residential property financing to non-profit agencies serving people with physical and/or mental disabilities. Working closely with federal, State, and City agencies, CPC offers capital funds and expertise to improve the housing situation for some of New York's most vulnerable citizens. This includes financing for up to 100% of the project (including land, housing purchase, rehab costs, and closing costs), as well as financing for related expenses such as equipment, construction interest, taxes, and working capital for training, inventory, and staff costs.
- Equity Investments – Responsible, long-term ownership of multifamily buildings can ensure that they will remain financially strong and physically sound. In underserved or changing neighborhoods this can help preserve affordability, reduce displacement, and serve as a force for stabilizing and revitalizing the community.
- Permanent Financing - CPC provides permanent financing for all types of multifamily buildings, working with borrowers to tailor-fit loans to specific needs. CPC offers both fixed and adjustable rate loans and can forward rate-lock up to 24 months with loan terms up to 30 years.

## Private Financing and Loan Partners

### New York Green Bank

NY Green Bank makes investments into eligible technologies consistent with its investment criteria. As a prerequisite to NY Green Bank participation, transactions must include private sector financial parties and capital. While various transaction sizes and participation levels are considered, typical investments usually fall within the range of \$5 million to \$50 million. Below is a list of private sector financial parties currently partnering with NY Green Bank.

GreenCity Power, LLC – Small-scale CHP investments

Sustainable Development Capital, LLP- ESAs for distributed generation projects

Renewable Funding – Residential energy efficiency loans

First Niagara Bank – Mid-sized commercial solar project financing

M&T Bank - Mid-sized commercial solar project financing

Deutsche Bank – ESAs for commercial real estate properties

Bank of America Merrill Lynch – Energy equipment financing

Ameresco, Inc – Energy efficiency and distributed generation

# NYC Retrofit Accelerator RFQ for Lender Participation

The NYC Department of Environmental Protection, in collaboration with the Mayor's Office of Sustainability is requesting Statements of Qualification from banks, mortgage lenders, finance companies, CDFIs, energy services companies and others that offer loans, energy services agreements, or other forms of financing for the purpose of providing capital to buildings located in New York City to fund energy efficiency, water conservation, resiliency retrofits, on-site clean or renewable generation, and conversions from No. 4 heating oil to the cleanest fuels including natural gas, No. 2 oil, biodiesel, or steam.

The NYC Retrofit Accelerator also aims to facilitate a number of deeper energy retrofits which are expected to be more capital intensive than typical retrofit projects, and more likely to require external financing.

A list of participating lenders has been posted on the NYC Retrofit Accelerator resources page.

- Learn more: [www.nyc.gov/retrofitaccelerator](http://www.nyc.gov/retrofitaccelerator)

## Alternative Financing Agreements

### Energy Services Agreement (ESA)

Energy Service Agreements are contracts in which a third party company provides energy savings for a fee. This model guarantees savings for an agreed upon period of time in exchange for set fees that are less than the borrower's average utility bills. ESA financing is generally useful for tax purposes since terms are often off the balance sheet. In most instances, no upfront costs are required from the building owner.

### Energy Savings Performance Contract (ESPC)

Energy Savings Performance Contracts are financial contracts in which a third party company pays all upfront costs related to energy efficiency project implementation then recoups these costs through realized energy savings over a set term. At the end of the ESPC, the property owner owns all of the improvements and receives all of the savings.

### Power Purchase Agreement (PPA)

Power Purchase Agreements are financial agreements in which a developer installs a system (typically solar or CHP) on a client's property at little or no upfront cost. The client then agrees to purchase electricity from the installed system at a fixed rate for a set term that is typically lower than the local utility's retail rate.

With this financial agreement the developer is responsible for the operation and maintenance of the system, and receives any tax credits associated with the installed system which is especially beneficial to non-profit organizations. At the end of the PPA term, typically ranging from 10-25 years, the client has the option to extend the PPA, remove the system, or purchase the system from the developer.

# Appendix C: NYC Requirements

While most of the efficiency upgrades described in this handbook are optional, there are some measures that are required by law in NYC. Completing these requirements will help your building save energy and money while supporting the City's goals. Below is a summary of energy-related codes and laws that are meant to help your building begin operating more efficiently.

## **Greener, Greater Buildings Plan**

To reach its aggressive sustainability goals, New York City enacted the Greener, Greater Buildings Plan (GGBP) in 2009, a comprehensive set of laws to increase the energy efficiency of large existing buildings. GGBP consists of four laws that are designed to provide information about buildings' energy use and requires the implementation of some cost-effective upgrades. These laws are expected to reduce New York City's GHG emissions by roughly 5 percent, save building owners \$7 billion, and will create about 17,800 construction-related jobs over 10 years.

GGBP includes:

### **Local Law 84: Benchmarking**

The first step to making a building more efficient is to understand how much energy it uses and how this energy use compares with similar buildings. Local Law 84 requires owners of buildings greater than 50,000 gross square feet or located on a lot with more than 100,000 gross square feet of built space to annually measure their energy consumption through a process called "benchmarking." Building owners must submit this information to the NYC Department of Buildings (DOB) annually using a free online tool provided by the US EPA called Portfolio Manager. This information is publicly disclosed online to provide transparency about the energy use of New York City's largest buildings.

### **Local Law 85: NYC Energy Conservation Code**

NYC Local Law 85 now requires buildings to meet the most current energy code for any renovation or alteration project. Before 2009, buildings were only required to meet code if renovations affect more than half of the building system, so closing this loophole allows buildings to accrue the energy savings from their incremental upgrades. To strengthen the scope of the NYC Energy Conservation Code, a set of amendments enacted as Local Law 91 will go into effect on October 3rd, 2016. These amendments include the adoption of recent changes made to the State energy code as well as several enhancements that will make New York City's energy code more stringent than the State energy code. For example, new buildings 25,000 square feet and greater will be required to perform air barrier testing to identify air leakages in the building envelope.



## Local Law 87: Energy Audits & Retro-commissioning

NYC Local Law 87 of 2009 requires buildings to undertake energy audits and retro-commissioning to reveal the most cost-effective energy reduction strategies and optimize performance of existing systems. Owners of buildings required to perform Local Law 84 benchmarking must also perform an ASHRAE Level 2 or higher energy audit, undergo retro-commissioning of the base building systems, and submit an Energy Efficiency Report (EER) to DOB electronically every ten years. Building owners must implement all of the common sense, low- or no-cost measures recommended in the retro-commissioning process to optimize their building's performance. They are not required to implement the measures recommended in their energy audits, although this information will help owners understand the opportunities for energy efficiency that are available in their buildings.

- Urban Green Council Local Law 87 Checklist: [www.urbangreencouncil.org/sites/default/files/ll87\\_checklist\\_v6\\_15.05.11.pdf](http://www.urbangreencouncil.org/sites/default/files/ll87_checklist_v6_15.05.11.pdf)

## Local Law 88: Lighting Upgrades & Sub-metering

Lighting in non-residential buildings accounts for nearly 20 percent of energy use in New York City buildings and lighting upgrades often pay for themselves in two years or less. Additionally, many commercial buildings still depend on a single meter to monitor electricity consumption, meaning many commercial tenants pay a standard rate for their energy use regardless of their consumption. Local Law 88 of 2009 requires lighting upgrades and energy use sub-metering in all commercial buildings by 2025, allowing for upgrades to be made when the lease turns over. This is unlikely to affect your co-op or condo building, but will have a significant impact on citywide energy use and emission

- Learn more: Greener Greater Buildings Plan: [www.nyc.gov/html/gbee/html/plan/plan.shtml](http://www.nyc.gov/html/gbee/html/plan/plan.shtml)
- NYC DOB Benchmarking: [www1.nyc.gov/site/buildings/business/benchmarking.page](http://www1.nyc.gov/site/buildings/business/benchmarking.page)

## DEP Heating Oil Regulations

In 2011, the New York City Department of Environmental Protection (DEP) issued Local Law 43, a requirement for all buildings to convert from heavy forms of heating oil to cleaner fuels. The regulations were designed to balance near-term pollution reduction while minimizing costs for buildings.

The requirements of the regulations include:

- All buildings still using No. 4 oil must convert to one of the cleanest fuels upon boiler or burner retirement or by January 1st, 2030, whichever is sooner.
- All new boiler or burner installations must use one of the cleanest fuels, which include natural gas, Ultra-Low Sulfur (ULS) No. 2 oil, biodiesel, or steam.

Building off the success of the NYC Clean Heat program, the City launched the NYC Retrofit Accelerator, a free comprehensive technical assistance resource designed to help private building owners reduce operating costs through energy efficiency, water conservation, and clean energy upgrades. The program is anticipated to reduce citywide GHG emissions by roughly one million metric tons by 2025 and save New Yorkers an estimated \$350 million a year in utility costs.

- Learn more: NYC Retrofit Accelerator: [www.nyc.gov/retrofitaccelerator](http://www.nyc.gov/retrofitaccelerator)

## **Resiliency – SIRR and BRTF Recommendations**

In the wake of Hurricane Sandy, the Special Initiative for Rebuilding and Resiliency (SIRR) was created in December 2012 to develop a plan to prepare and protect New York City against the impacts of climate change. The comprehensive plan contains more than 250 actionable recommendations both for rebuilding the communities impacted by Sandy and increasing the resilience of infrastructure and buildings citywide.

In addition, in June 2013 the City released the recommendations of the Building Resiliency Task Force (BRTF) and expert panel that put forward 33 concrete proposals that expand on initiatives outlined in “A Stronger, More Resilient New York.” The 33 proposals include steps to fortify New York’s buildings and strengthen building standards, including new building codes, recommendations, and upgrades for multifamily buildings to improve resiliency.

- Learn more: Special Initiative for Rebuilding and Resiliency: [www.nyc.gov/html/sirr/html/home/home.shtml](http://www.nyc.gov/html/sirr/html/home/home.shtml)
- Building Resiliency Task Force: [www.urbangreencouncil.org/BuildingResiliency](http://www.urbangreencouncil.org/BuildingResiliency)

# Appendix D: Technical Resources

## NYC Retrofit Accelerator

The NYC Retrofit Accelerator is a one-stop resource provided by the City of New York to help owners and operators of privately owned buildings reduce operating costs and increase the sustainability of their properties through energy and water upgrades.

- Learn more: [www.nyc.gov/retrofitaccelerator](http://www.nyc.gov/retrofitaccelerator)

## Community Retrofit NYC

The Community Retrofit NYC program is a dedicated outreach and assistance program to help owners and operators of small and mid-sized multifamily buildings in Central Brooklyn and Southern Queens implement energy and water efficiency upgrades. This is a complementary program to the NYC Retrofit Accelerator, which is geared towards larger buildings that must comply with the City's existing building energy laws. Community Retrofit NYC will develop a community-driven approach to scaling up investments in energy and cost-saving measures, provide technical guidance to building owners and decision-makers interested in pursuing retrofits, and develop resources for these smaller buildings that can be replicated in other neighborhoods. In addition, the program will help building owners connect with the NYC Department of Housing Preservation and Development's (HPD's) new Green Housing Preservation Program or other financing and incentive programs to help cover the costs of upgrades.

- Learn more: [www.nyc.gov/communityretrofitnyc](http://www.nyc.gov/communityretrofitnyc)

## NYC Benchmarking Help Center

Launched in 2011, the Help Center aims to support the real estate industry's compliance with Local Law 84, a mandate requiring annual benchmarking reports to be filed with the NYC Dept. of Buildings each year.

- Learn more: [www.nyc.gov/l184helpcenter](http://www.nyc.gov/l184helpcenter)

## NYC °CoolRoofs

NYC °CoolRoofs is an NYC Service initiative, in collaboration with the NYC Department of Buildings (DOB) to promote and facilitate the cooling of New York City's rooftops. Working with non-profits, City agencies, and building owners, NYC °CoolRoofs engages volunteers to apply white, reflective surfaces to NYC's rooftops to reduce cooling costs, cut energy usage, and lower GHG emissions.

- Learn more: [www.nyc.gov/coolroofs](http://www.nyc.gov/coolroofs)

# Appendix E: Training Resources

## Green Supers

Since 2005, the Green Supers 32BJ training fund has been greening New York City's buildings by training building service professionals who are members of 32BJ, the largest property service workers union in the country. Property managers send their supers to a rigorous 40-hour core course that covers all aspects of green building operations and maintenance.

- Learn more: [www.training.32bjfunds.com/en-us/newyorkhome.aspx](http://www.training.32bjfunds.com/en-us/newyorkhome.aspx)

## NYSERDA

In collaboration with a variety of organizations, NYSERDA offers a wide variety of clean energy courses with programs ranging from basic technical training to advanced levels.

- Learn more: [www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Workforce-Development](http://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Workforce-Development)

## Urban Green Council (New York Chapter of US Green Building Council)

In our effort to build a more sustainable city, Urban Green is committed to training architects, engineers, building owners and managers, tradespeople and other professionals in the latest developments and best practices for creating and maintaining sustainable buildings. Urban Green Council offers relevant, comprehensive educational opportunities across a range of industry sectors:

GPRO: A comprehensive national training and certificate program for trades and contractors. Modules include Operations and Maintenance, Plumbing, Electrical Systems, Construction Management and HVACR. Additionally, Urban Green offers separate trainings for architects, engineers, and other individuals on how to comply and get the most out of New York State's energy code, as well as Local Law 87 and 88.

- Learn more: [www.urbangreencouncil.org/content/education](http://www.urbangreencouncil.org/content/education)

## Solar One

Solar One's Green Workforce Training Program offers green hard skills technical training and industry recognized certifications tied to green building operations and maintenance and energy efficiency. Solar One delivers courses in active, hands-on formats at a state of the art training lab located in Queens.

- Learn more: [www.solar1.org/green-workforce/](http://www.solar1.org/green-workforce/)

## **CUNY Building Performance Lab**

With the support of the New York State Energy Research and Development Association (NYSERDA) and the NYC Department of Citywide Administrative Services (DCAS), BPL has trained over 2,000 building operators and engineers — representing municipal, commercial, and hospital facilities — in the energy-saving BOC curriculum. In addition, BPL offers a 5-week course on Building Re-Tuning, an innovative protocol for energy optimization and monitoring to improve building performance. For the commercial property management level, BPL and the Steven L. Newman Real Estate Institute developed an online certificate program in Advanced Energy Performance with the support of the US Department of Energy.

- Learn more: [www.cunybpl.org](http://www.cunybpl.org)

# Appendix F: Online Resources

## How to Get Started

- NYC Retrofit Accelerator: [www.nyc.gov/retrofitaccelerator](http://www.nyc.gov/retrofitaccelerator)
- NYC Carbon Challenge: [www.nyc.gov/carbonchallenges](http://www.nyc.gov/carbonchallenges)
- OneNYC Green Buildings & Energy Efficiency: [www.nyc.gov/gbee](http://www.nyc.gov/gbee)

## Benchmarking

- Benchmarking Help Center: [www.nyc.gov/1184helpcenter](http://www.nyc.gov/1184helpcenter)
- US EPA Portfolio Manager: [www.bit.ly/1cFe0SS](http://www.bit.ly/1cFe0SS)

## Lighting

- Con Edison Multifamily Energy Efficiency Program: [www.bit.ly/29Teg7j](http://www.bit.ly/29Teg7j)
- NYSERDA Multifamily Performance Program: [www.on.ny.gov/2b4xmZs](http://www.on.ny.gov/2b4xmZs)
- Building Energy Exchange: [www.be-exchange.org/](http://www.be-exchange.org/)

## Electrical Plug Load and Systems

- Con Edison Energy Management: [www.bit.ly/2aXUY2h](http://www.bit.ly/2aXUY2h)
- Con Edison Marketplace: [www.marketplace.coned.com](http://www.marketplace.coned.com)
- ENERGY STAR® Products: [www.energystar.gov/products](http://www.energystar.gov/products)
- NYSERDA Power Management: [www.nyserda.ny.gov/power-management](http://www.nyserda.ny.gov/power-management)
- NYSERDA Energy Saving Tips: [www.on.ny.gov/2bxSPLI](http://www.on.ny.gov/2bxSPLI)

## Air Sealing and Insulation

- EPA ENERGY STAR® Air Sealing: [www.goo.gl/g1JIJb](http://www.goo.gl/g1JIJb)
- Urban Green Council Report, There Are Holes In Our Walls: [www.goo.gl/OqjVwZ](http://www.goo.gl/OqjVwZ)
- Urban Green Council Report, Spending Through the Roof: [www.goo.gl/4c1BJP](http://www.goo.gl/4c1BJP)

## Passive House

- NY Passive House Inc, A Developer's Guide to Certified Multifamily Passive House Buildings: [www.bit.ly/1OmrFBk](http://www.bit.ly/1OmrFBk)
- Passive House Institute US: [www.phius.org](http://www.phius.org)
- Passipedia, The Passive House Resource: [www.passipedia.org](http://www.passipedia.org)
- EnerPHit, Energy Retrofits with Passive House Components: [www.bit.ly/2bgZZqC](http://www.bit.ly/2bgZZqC)
- Affordable Passive House: [www.zehnderamerica.com/wp-content/uploads/2014/01/pr\\_2012\\_06.pdf](http://www.zehnderamerica.com/wp-content/uploads/2014/01/pr_2012_06.pdf)

## Windows

- EPA ENERGY STAR® Windows, Doors and Skylights: [www.energystar.gov/windows](http://www.energystar.gov/windows)
- U.S. DOE Windows, Doors and Skylights: [www.goo.gl/hFB33t](http://www.goo.gl/hFB33t)
- Fentrend: [www.fentrend.com](http://www.fentrend.com)

## Roofs and Heat Absorption

- NYC °CoolRoofs: [www.nyc.gov/coolroofs](http://www.nyc.gov/coolroofs)
- NYC DEP Green Infrastructure Grant Program: [www.goo.gl/6MnuCD](http://www.goo.gl/6MnuCD)
- NYC Green Roof Tax Abatement: [www1.nyc.gov/site/finance/benefits/landlords-green-roof.page](http://www1.nyc.gov/site/finance/benefits/landlords-green-roof.page)
- U.S. DOE Cool Roofs: An Easy Upgrade: [www.bit.ly/2arnlrV](http://www.bit.ly/2arnlrV)

## HVAC Systems

- NYSERDA Multifamily Performance Program: Existing Buildings: [www.bit.ly/1cmPqGh](http://www.bit.ly/1cmPqGh)
- Con Edison Multifamily Energy Efficiency Program: [www.bit.ly/29Teg7j](http://www.bit.ly/29Teg7j)
- National Grid Multifamily Energy Saving Programs: [www.ngrid.com/2afGHPP](http://www.ngrid.com/2afGHPP)
- U.S. DOE Air Source Heat Pumps: [www.energy.gov/energysaver/air-source-heat-pumps](http://www.energy.gov/energysaver/air-source-heat-pumps)

## Steam Distribution Systems

- Con Edison Multifamily Energy Efficiency Program: [www.bit.ly/29Teg7j](http://www.bit.ly/29Teg7j)
- Con Edison Steam Incentive Programs: [www.bit.ly/2aaSrBF](http://www.bit.ly/2aaSrBF)
- National Grid Multifamily Energy Saving Programs: [www.ngrid.com/2afGHPP](http://www.ngrid.com/2afGHPP)
- Steven Winter Associates, Upgrading NYC Steam Systems: [www.bit.ly/2aLkGac](http://www.bit.ly/2aLkGac)

## Heating Oil Conversions

- Con Edison Area Growth Zones: [www.bit.ly/RkYHLM](http://www.bit.ly/RkYHLM)
- NYC Clean Heat: Converting to ULS No. 2 Oil: [www.goo.gl/Js5DiH](http://www.goo.gl/Js5DiH)
- NYC Clean Heat: Converting to Natural Gas: [www.goo.gl/ChxKVP](http://www.goo.gl/ChxKVP)
- NYC Clean Heat: Biodiesel: [www.nycleanheat.org/content/biodiesel](http://www.nycleanheat.org/content/biodiesel)

## Domestic Hot Water

- Con Edison Equipment Rebates for Multifamily Buildings: [www.bit.ly/29Teg7j](http://www.bit.ly/29Teg7j)
- National Grid Multifamily Energy Saving Programs: [www.ngrid.com/2afGHPP](http://www.ngrid.com/2afGHPP)
- NYSERDA Solar Hot Water (Thermal) Program: [www.goo.gl/kALV7C](http://www.goo.gl/kALV7C)

## Water Efficiency

- NYC DEP Water Conservation and Cost Management: [www.nyc.gov/html/dep/pdf/wccseminar.pdf](http://www.nyc.gov/html/dep/pdf/wccseminar.pdf)
- US EPA WaterSense Products: [www.epa.gov/watersense/about\\_us/watersense\\_label.html](http://www.epa.gov/watersense/about_us/watersense_label.html)
- US DOE: [www.energy.gov/energysaver/reduce-hot-water-use-energy-savings](http://www.energy.gov/energysaver/reduce-hot-water-use-energy-savings)

## Combined Heat and Power

- NYSERDA Combined Heat and Power Program: [www.nyserda.ny.gov/chp](http://www.nyserda.ny.gov/chp)
- US DOE CHP Technical Assistance Partnerships: [www.northeastchptap.org](http://www.northeastchptap.org)
- US EPA Combined Heat and Power Partnership: [www.epa.gov/chp](http://www.epa.gov/chp)

## Solar PV

- NY-Sun: [www.ny-sun.ny.gov](http://www.ny-sun.ny.gov)
- Solarize NYC: [www.solarizenyc.com/](http://www.solarizenyc.com/)
- Sustainable CUNY. NYC Multifamily Solar Guide: [www.goo.gl/sRAdgX](http://www.goo.gl/sRAdgX)
- Con Edison: Distributed Generation: Solar Energy: [www.goo.gl/4xKcEw](http://www.goo.gl/4xKcEw)
- Business Energy Investment Tax Credit (ITC): [www.goo.gl/wztfYP](http://www.goo.gl/wztfYP)
- NYC Department of Buildings. Solar Panels: [www1.nyc.gov/site/buildings/business/solar-panel.page](http://www1.nyc.gov/site/buildings/business/solar-panel.page)

## Geothermal Heat Pumps

- NYC DDC Geothermal Heat Pump Manual: [www.goo.gl/Qv2xTO](http://www.goo.gl/Qv2xTO)
- NYSERDA Geothermal Heat Pumps: [www.nyserda.ny.gov/geothermal](http://www.nyserda.ny.gov/geothermal)
- US DOE EERE Geothermal Heat Pumps: [www.goo.gl/MkurRT](http://www.goo.gl/MkurRT)

## Operations and Maintenance

- 32BJ Green Supers Training Programs: [training.32bjfunds.com/en-us/newyorkhome.aspx](http://training.32bjfunds.com/en-us/newyorkhome.aspx)
- CUNY Building Performance Lab: [www.cunybpl.org/training](http://www.cunybpl.org/training)
- Solar One, Green Workforce Training Programs: [www.solar1.org/green-workforce](http://www.solar1.org/green-workforce)
- Urban Green Council, Green Professional Training Programs: [gpro.urbangreencouncil.org/](http://gpro.urbangreencouncil.org/)

## Resident Engagement and Behavior Change

- GreeNYC: [www.nyc.gov/greenyc](http://www.nyc.gov/greenyc)
- Enterprise Green Communities Resident Engagement: [www.bit.ly/1VwbiXz](http://www.bit.ly/1VwbiXz)
- NYSERDA Energy Saving Tips: [www.nyserda.ny.gov/energy-saving-tips](http://www.nyserda.ny.gov/energy-saving-tips)
- NYSERDA Residential Energy Saving Tips: [www.nyserda.ny.gov/residential-tips](http://www.nyserda.ny.gov/residential-tips)

## Historic Buildings

- Landmarks Preservation Commission: [www.nyc.gov/html/lpc/html/home/home.shtml](http://www.nyc.gov/html/lpc/html/home/home.shtml)
- Municipal Art Society of New York: [www.mas.org/preservation/greenmanual/](http://www.mas.org/preservation/greenmanual/)
- National Park Service, Technical Preservation Services: [www.nps.gov/tps/sustainability.htm](http://www.nps.gov/tps/sustainability.htm)
- National Trust for Historic Preservation, Greening Older and Historic Buildings: [www.bit.ly/29TnssB](http://www.bit.ly/29TnssB)
- State Historic Preservation Office: [www.nysparks.com/shpo/](http://www.nysparks.com/shpo/)



# Acronyms

ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers	equivalent
BAS – Building Automation System	MOS – Mayor’s Office of Sustainability
BBL – Borough, Block, and Lot	MW – Megawatt
BMS – Building Management System	NOI – Net Operating Income
BRTF – Building Resiliency Task Force	NYC DDC – NYC Department of Design and Construction
Btu – British thermal unit	NYC DEP – NYC Department of Environmental Protection
CFL – Compact Fluorescent Light	NYC DOB – NYC Department of Buildings
CHP – Combined Heat and Power	NYC HDC – NYC Housing Development Corporation
CO <sub>2</sub> e – Carbon dioxide equivalent	NYC HPD – NYC Department of Housing Preservation and Development
Con Edison – Consolidated Edison, Inc.	NYCEEC – New York City Energy Efficiency Corporation
DHW – Domestic Hot Water	NYSERDA – New York State Energy Research and Development Authority
ECM – Energy Conservation Measure	O&M – Operations and Maintenance
EER – Energy Efficiency Report	PM <sub>2.5</sub> – Fine particulate matter
EIS – Energy Information System	SBC – System benefits charge
ESA – Energy Services Agreement	SIRR – Special Initiative for Rebuilding and Resiliency
ESCO – Energy services company	TRV – Thermostatic Radiator Valve
GGBP – Greener, Greater Buildings Plan	ULS – Ultra-Low Sulfur
GHG – Greenhouse Gas	US DOE EERE – US Department of Energy Office of Energy Efficiency and Renewable Energy
HCR – New York State Homes and Community Renewal	US EPA – US Environmental Protection Agency
HEAP – Home Energy Assistance Program	VFD – Variable Frequency Drive
HVAC – Heating, Ventilation and Air Conditioning	VRF – Variable Refrigerant Flow
ITC – Investment Tax Credit	WAP – Weatherization Assistance Program
kW / kWh – Kilowatt / Kilowatt Hour	
LED – Light Emitting Diode	
MCP – Multifamily Conservation Program	
MPP – Multifamily Performance Program	
MMBtu – Million British thermal units	
MtCO <sub>2</sub> e – Million metric tons carbon dioxide	

# Sources and End Notes

1. Analysis provided by Buildings Technical Working Group, 2015 average: Natural Gas \$3.23/MMBTU, Oil No. 4 \$9.48/MMBTU, Oil No. 2 \$11.06/MMBTU
2. Analysis provided by NYSERDA
3. One City Built to Last Buildings Technical Working Group Report: [www.nyc.gov/twg](http://www.nyc.gov/twg)
4. Analysis by California Energy Commission, [www.consumerenergycenter.org/lighting/bulbs](http://www.consumerenergycenter.org/lighting/bulbs)
5. US DOE, How Energy-Efficient Light Bulbs Compare with Traditional Incandescents: [www.energy.gov/energysaver/how-energy-efficient-light-bulbs-compare-traditional-incandescents](http://www.energy.gov/energysaver/how-energy-efficient-light-bulbs-compare-traditional-incandescents)
6. Analysis provided by NYSERDA
7. Canada Mortgage and Housing Corporation, Air Leakage Control Manual: Existing Multi-Unit Residential Buildings, online at [www.cmhc-schl.gc.ca/odpub/pdf/65847.pdf](http://www.cmhc-schl.gc.ca/odpub/pdf/65847.pdf)
8. Urban Green Council, Spending Through the Roof, [http://urbangreencouncil.org/sites/default/files/sttr\\_2015.05.12.pdf](http://urbangreencouncil.org/sites/default/files/sttr_2015.05.12.pdf)
9. New York Passive House: [www.nypassive-house.org/what-is-passive-house/](http://www.nypassive-house.org/what-is-passive-house/)
10. Canada Mortgage and Housing Corporation, Air Leakage Control Manual: Existing Multi-Unit Residential Buildings, online at: <http://www.cmhc-schl.gc.ca/odpub/pdf/65847.pdf?fr=1451909668161>
11. Canada Mortgage and Housing Corporation, Air Leakage Control Manual: Existing Multi-Unit Residential Buildings, online at: <http://www.cmhc-schl.gc.ca/odpub/pdf/65847.pdf?fr=1451909668161>
12. Duke University, NYC Co-Op and Condominium Board Guide to Energy Efficiency Upgrades in Buildings, <http://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/5319/BBNY%20Full%20Report%20%28Final%29.pdf?sequence=1>
13. USA EPA, Heat Island Effect: [www.epa.gov/heat-islands](http://www.epa.gov/heat-islands)
14. Analysis by NYC °CoolRoofs, online at [www.nyc.gov/html/coolroofs/html/how/how.shtml](http://www.nyc.gov/html/coolroofs/html/how/how.shtml)
15. US EPA, Using Green Roofs to Reduce Heat Islands: [www.epa.gov/heat-islands/using-green-roofs-reduce-heat-islands](http://www.epa.gov/heat-islands/using-green-roofs-reduce-heat-islands)
16. Analysis by NYC °CoolRoofs, online at [www.nyc.gov/html/coolroofs/html/about/about.shtml](http://www.nyc.gov/html/coolroofs/html/about/about.shtml)
17. Canada Mortgage and Housing Corporation, Air Leakage Control Manual: Existing Multi-Unit Residential Buildings, online at: [www.cmhc-schl.gc.ca/odpub/pdf/65847.pdf](http://www.cmhc-schl.gc.ca/odpub/pdf/65847.pdf)
18. US EPA, Using Green Roofs to Reduce Heat Islands: [www.epa.gov/heat-islands/using-green-roofs-reduce-heat-islands](http://www.epa.gov/heat-islands/using-green-roofs-reduce-heat-islands)
19. NYC DEP, Rooftop Detention: [www.nyc.gov/html/dep/pdf/rooftop\\_detention.pdf](http://www.nyc.gov/html/dep/pdf/rooftop_detention.pdf)
20. NYC Co-op and Condominium Board Guide to Energy Efficiency Upgrades in Buildings, Duke University, [dukespace.lib.duke.edu/dspace/bitstream/handle/10161/5319/BBNY%20Full%20Report%20%28Final%29.pdf?sequence=1](http://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/5319/BBNY%20Full%20Report%20%28Final%29.pdf?sequence=1)

- edu/dspace/bitstream/handle/10161/5319/BBNY%20Full%20Report%20%28Final%29.pdf?sequence=1
21. Canada Mortgage and Housing Corporation, Air Leakage Control Manual: Existing Multi-Unit Residential Buildings, online at: [www.cmhc-schl.gc.ca/odpub/pdf/65847.pdf](http://www.cmhc-schl.gc.ca/odpub/pdf/65847.pdf)
  22. ENERGY STAR Building Upgrade Manual, online at [http://www.energystar.gov/ia/business/EPA\\_BUM\\_CH9\\_HVAC.pdf](http://www.energystar.gov/ia/business/EPA_BUM_CH9_HVAC.pdf)
  23. US DOE, Air-Source Heat Pumps: [energy.gov/energysaver/air-source-heat-pumps](http://energy.gov/energysaver/air-source-heat-pumps)
  24. Analysis provided by Buildings Technical Working Group, Energy Use in Space Heating and DHW Systems
  25. Analysis provided by Buildings Technical Working Group, Heating Systems in New York City Buildings
  26. Steven Winter Associates, Clanging Pipes and Open Windows: Upgrading NYC Steam Systems for the 21st Century: [www.energysaver.org/sites/default/files/EEFA-Upgrading%20NYC%20Steam%20Systems.pdf](http://www.energysaver.org/sites/default/files/EEFA-Upgrading%20NYC%20Steam%20Systems.pdf)
  27. Analysis by NYC Department of Health and Mental Hygiene
  28. Analysis by Steven Winter Associates and NYC Mayor's Office of Sustainability
  29. Technical Working Group Report, Building GHG Emissions by End Use
  30. New York City Solar Water Heating Roadmap: [www.cuny.edu/about/resources/sustainability/solar-america/solarthermal/CUNY\\_NYC\\_Solar\\_Thermal\\_FINAL.pdf](http://www.cuny.edu/about/resources/sustainability/solar-america/solarthermal/CUNY_NYC_Solar_Thermal_FINAL.pdf)
  31. New York City Solar Water Heating Roadmap: [www.cuny.edu/about/resources/sustainability/solar-america/solarthermal/CUNY\\_NYC\\_Solar\\_Thermal\\_FINAL.pdf](http://www.cuny.edu/about/resources/sustainability/solar-america/solarthermal/CUNY_NYC_Solar_Thermal_FINAL.pdf)
  32. US EPA WaterSense® : [www3.epa.gov/watersense/products/showerheads.html](http://www3.epa.gov/watersense/products/showerheads.html)
  33. NYC DEP, Residential Water Use: [www.nyc.gov/html/dep/html/residents/wateruse.shtml](http://www.nyc.gov/html/dep/html/residents/wateruse.shtml)
  34. NYC DEP, Residential Water Use: [www.nyc.gov/html/dep/html/residents/wateruse.shtml](http://www.nyc.gov/html/dep/html/residents/wateruse.shtml)
  35. ENERGY STAR Clothes Washers: [www.energystar.gov/products/appliances/clothes\\_washers](http://www.energystar.gov/products/appliances/clothes_washers)
  36. ENERGY STAR Clothes Washers: [www.energystar.gov/products/appliances/dishwashers](http://www.energystar.gov/products/appliances/dishwashers)
  37. NYC DEP: [www.nyc.gov/html/dep/pdf/ways\\_to\\_save\\_water/toilet\\_brochure.pdf](http://www.nyc.gov/html/dep/pdf/ways_to_save_water/toilet_brochure.pdf)
  38. NYC DOB, Installing Natural Gas-fueled Combined Heat and Power (CHP) Systems, online at [www1.nyc.gov/assets/buildings/pdf/combined\\_heat\\_and\\_power\\_systems.pdf](http://www1.nyc.gov/assets/buildings/pdf/combined_heat_and_power_systems.pdf)
  39. NYC DDC, Geothermal Heat Pump Manual, online at [www.nyc.gov/html/ddc/downloads/pdf/geotherm.pdf](http://www.nyc.gov/html/ddc/downloads/pdf/geotherm.pdf)
  40. Analysis by the US DOE and the US EPA
  41. NRDC, Set Top Boxes: [www.nrdc.org/energy/files/settopboxes.pdf](http://www.nrdc.org/energy/files/settopboxes.pdf)

# Acknowledgements

The NYC Carbon Challenge Handbook for Multifamily Buildings was developed by the Mayor's Office of Sustainability in collaboration with city agencies and partner organizations. The City of New York would like to thank the following for their valuable assistance in producing the original handbook released in April 2013 and updated released in October 2016:

Daniel Zarrilli – Senior Director, Climate Policy and Programs and Chief Resilience Officer, NYC Mayor's Office  
John H. Lee – Deputy Director for Buildings & Energy Efficiency, NYC Mayor's Office of Sustainability

Siena Chiang  
Mary C. Chick  
Michael Colgrove  
Valerie Corbett  
Christopher Diamond  
Noah Dubin  
Sophia Hill  
Benjamin Huff  
Laura Humphrey  
Jeffrey Irvine  
Stacy Lee  
Richard Leigh  
Ali Levine  
Aaron Lewis  
Matthew Lockwood  
Patrick Love

Jessica Luk  
Samuel Man  
Benjamin Mandel  
Ann R. Mantha  
Joseph Musso  
Heather Nolen  
Jeffrey Perlman  
Paul Reale  
Lindsay K. Robbins  
Cecil Scheib  
Margot Schloss  
Alessandra Stoffo  
Laura Tajima  
Jenna Tatum  
Davetta Thacher  
Marc Zuluaga

City agencies and other partners:

Building Energy Exchange  
Bright Power Inc  
Con Edison  
CUNY Building Performance Laboratory  
Energy & Resource Solutions  
IntelliGreen Partners LLC  
National Grid  
New York City Energy Efficiency Corporation (NYCEEC)  
New York State Energy Research Development Authority (NYSERDA)  
NYC Department of Environmental Protection (DEP)  
NYC Small Business Services (SBS)

Prestige Management  
Steven Winter Associates  
The Cooperative Board of 12 East 97th Street  
Urban American  
Urban Green Council

**#ONENYC**

