



NEW YORK CITY
CARBON CHALLENGE

HANDBOOK FOR CO-OPS AND CONDOS

December 2013

A GREENER, GREATER NEW YORK



The City of New York

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Welcome! This handbook is a tool for co-op and condo residents in New York City to learn how to begin reducing their building's energy use and greenhouse gas (GHG) emissions. By investing in energy efficiency, not only can residents reduce their building's emissions, they will also save money, improve local air quality, and help ensure that building equipment is operating efficiently.

This handbook includes the most important information for co-op and condo board members and residents to start saving energy and reducing emissions. It covers the basics of energy efficiency, the cash incentives and financing available in New York City, and the relevant local laws and regulations aimed at helping the city's buildings become more efficient.

If you and your board are interested in investing in energy efficiency, your building may be eligible to participate in the NYC Carbon Challenge, a voluntary program to reduce your building's GHG emissions by at least 15% over the next ten years. Participants in the Challenge will receive help from a qualified team of professionals to identify cost-saving ways to reduce their building's energy use and begin realizing the benefits of energy efficiency. To be eligible, your property management firm must be signed up for the NYC Carbon Challenge. If you're not sure if your management firm is signed up, you can check directly with your property manager or visit www.nyc.gov/mcc-multifamily for a full list of participants.

NYC Carbon Challenge Handbook for Co-Ops and Condos

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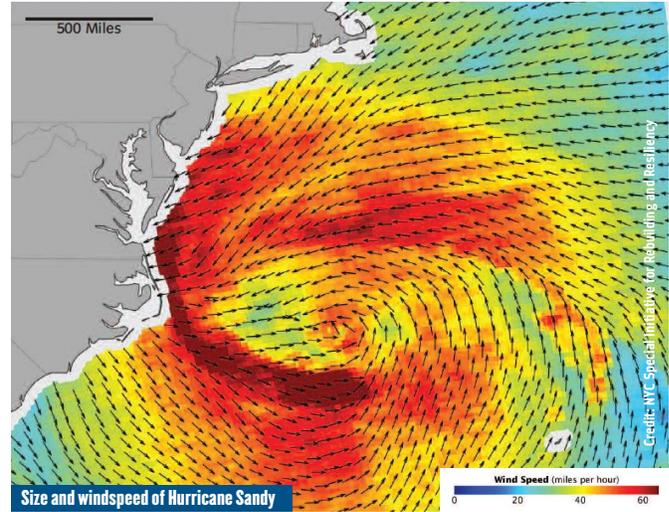
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Background

Climate Change and PlaNYC

Global climate change poses risks to New York City from rising sea levels, increased heat and heat waves, and more frequent and intense storms. The damage from Hurricane Sandy in 2012, which disrupted power for 2 million people, flooded almost 90,000 buildings, and resulted in 43 deaths, provided a devastating snapshot of the the growing challenges New Yorkers face.¹ To address these challenges, New York City must both adapt to a changing climate and take bold action to mitigate the harmful greenhouse gas (GHG) emissions that contribute to climate change.

In 2007, New York City released a comprehensive sustainability plan called PlaNYC that establishes an ambitious goal to reduce citywide GHG emissions 30% by the year 2030. Because nearly 75% of citywide GHG emissions come from the energy used in its buildings, PlaNYC identifies energy efficiency in the city's buildings as the most effective way to reduce these harmful emissions.



The NYC Carbon Challenge

To lead by example, New York City government in 2007 pledged to reduce GHG emissions from municipal buildings and operations by 30% in just ten years. Following this pledge, the City launched the NYC Carbon Challenge (Challenge) as a voluntary program for universities, hospitals, and commercial offices to match that goal. Now, residential cooperatives (“co-ops”), condominiums (“condos”), and rental buildings can also join the Challenge. These buildings will work with their property management firms to reduce GHG emissions by 15-30% over the next ten years, as part of the property management firms’ commitment to reduce GHG emissions from either individual

buildings or a selected portfolio of their buildings by 30% in ten years.



The Challenge is a partnership with the New York State Energy Research and Development Authority (NYSERDA) to provide specialized technical assistance to multifamily buildings about energy efficiency. If your board decides to join the Challenge, you will work with your property manager to reduce your building's energy use and emissions, save money on your energy bills, and improve local environmental quality. For more information, visit www.nyc.gov/carbonchallenges.



The Benefits of Saving Energy

1. Save Money on Your Energy Bills

Using less energy costs less money. Reducing energy use will lower both your energy bills and your building's GHG emissions.

Switching to cleaner fuels can also save money. For example, natural gas is both less expensive and less carbon-intensive than No. 6 and No. 4 heating oil.

2. Hold Down Building Operating Costs

Properly maintaining equipment will reduce energy use and help prevent costly emergencies.

Ensuring that building operators are trained to maximize efficiency of your equipment is another relatively easy way to save both energy and money.

3. Enhance the Comfort of Your Building

Rebalancing your building's air flows will both reduce energy use and make your building more comfortable. If your building is too hot in some areas and cold in others, your heating system may be operating inefficiently.

Sealing cracks in the building and improving insulation allows your building to maintain more stable and comfortable temperatures throughout the year—and will use less energy in the process.

4. Increase Resilience to Extreme Weather

Installing efficient on-site generation, such as combined heat and power (CHP) or solar panels, can help protect against power losses during storms and other emergencies while also reducing a building's overall energy use.

Improving the building's exterior envelope can also protect buildings against flood damage, reduce susceptibility to extreme heat or cold, and reduce energy use for heating and cooling at the same time.

5. Improve the Environment

Lowering your building's energy use reduces GHG emissions, the harmful gases that contribute to global climate change and extreme weather events like Hurricane Sandy.

Switching to cleaner fuels also reduces local air pollution by reducing emissions of fine particulate matter, which contributes to cleaner air in your neighborhood.

Be Sure to Act Soon to Take Advantage of Resources Available Now—Financial incentives and low-interest loans that can drastically reduce the capital costs of upgrades are available now through organizations such as NYSERDA, Consolidated Edison, Inc (Con Edison), and the New York City Energy Efficiency Corporation (NYCEEC). See Appendix A for more information about the financial incentives and loans currently available in New York City.

Did You Know?

Between 2001 and 2009, average rents for multifamily housing in the U.S. rose by 7.5%, but energy costs for renters rose three times more quickly—by nearly 23%.²



Opportunities for Energy Efficiency

Your building is a system that is made up of many sub-systems that function together. Understanding these systems and how they interact will help you identify sources of energy waste, improve building performance, and prioritize investments in energy efficiency. Below is a summary of the most common building systems and some of the key opportunities for efficiency, which are covered in greater depth in this handbook beginning on page 6.

Electrical Systems

Electricity powers most of the appliances in your building, including the lights, elevators, and anything plugged into an electrical outlet. Key opportunities to reduce your building's electricity use include installing lighting upgrades and controls, electric sub-metering in units, building management systems (BMS), or energy efficient appliances.

Building Envelope

A building's envelope consists of everything that separates the inside of the building from the outside, including the roof, walls, windows, and doors. Key opportunities to improve the building envelope include sealing cracks and leaks in the building, adding building insulation, replacing windows, and installing cool roofs or green roofs.

Heating and Cooling Systems

Heating and cooling systems are typically responsible for about half of a multifamily building's total energy use. There are many opportunities to reduce the energy use of these systems, which include implementing heating, ventilation, and air conditioning (HVAC) system upgrades and converting heating oil to less-polluting fuels.

Domestic Hot Water

If your building has a system to heat water that is separate from the HVAC system, there are additional steps you can take to save both energy and water. Key opportunities include installing hot water heater insulation and upgrades, solar hot water heaters, or low flow showerheads and toilets.

On-Site Generation and Renewables

On-site generation technologies can produce some or all of the energy your building consumes, and often use cleaner or more efficient technologies than the energy supplied by your utility. Examples include combined heat and power (CHP) systems, solar photovoltaic systems, and geothermal heat pumps.

Other Energy-Saving Measures

There are also many low- or no-cost strategies to increase your building's efficiency. These include improving operations and maintenance, training building staff, and engaging residents to make simple behavior changes.

How to Get Started

Step 1

Identify Your Team

Identifying an energy team early on to help plan and implement energy efficiency projects is important to help guarantee success. Your team will likely include your property manager, key advocates on your board, and contractors or consultants to help you carry out the work, such as one of NYSERDA's Multifamily Performance Partners. Joining the NYC Carbon Challenge is a great way to help form your team and gain access to the technical assistance and resources to help your building start saving energy. See Appendix A for a link to NYSERDA's list of approved Performance Partners.

Step 2

Look for Incentives and Financing

Lowering your building's energy use will save money in the long run, but it usually costs upfront capital. The good news is that there are programs to help you cover this cost. NYSERDA and Con Edison's multifamily incentive programs, for example, can provide cash incentives and rebates to benchmark your building's energy use, perform an energy audit, and implement energy efficiency measures. In addition, loans are available through NYSERDA and NYCEEC to help finance the additional cost. Identifying programs that will fit your building's needs early on will help ensure you don't miss out on opportunities. Be sure to also take special note of deadlines so you can prioritize these projects as needed. See Appendices A and B for more information about the incentive and financing programs available.

Step 3

Integrate Energy Efficiency into Your Capital Planning

Buildings 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. If your building has to make these investments, why not include energy efficiency in the planning process? Replacing equipment at the end of its useful life with more efficient models will begin saving money almost immediately and has a lower incremental cost than replacing new equipment. Remember to look for financing and incentive programs to help cover any additional cost.

Building Consensus for Energy Efficiency

Building consensus on a board can be difficult, but it's not impossible. Here are some tips to help:

- Research your co-op or condo's bylaws before bringing proposals to the board. This will show that you've done your homework and that you understand the approval process.
- Appeal to those who stand to benefit most from the upgrades, including those who will save the most money on their energy bills.
- Emphasize that energy efficiency is a good investment. For example, buildings that comprehensively address energy use through one of NYSERDA's programs reduce energy costs by at least 15%, with an average annual return on investment of 22%.³

The Whole Building vs. ECM Approach

NYSERDA offers a comprehensive, "whole building" approach to energy savings, while ConEd and National Grid offer incentives for individualized energy conservation measures (ECMs). Because building systems are integrated, a whole building approach will generally provide more savings—but you should consult with your team to decide which approach is right for you.

Step 4

Measure your Building's Energy Use

You can't manage what you don't measure. For this reason, New York City enacted Local Law 84 in 2009 to require the city's largest buildings to measure their annual energy use through a process called "benchmarking." If your building is greater than 50,000 square feet, the good news is that your building has been benchmarking since 2011. For more information about benchmarking and NYC Local Law 84, see Appendix C.

Step 5

Perform an Energy Audit

Energy audits provides more detailed information about a building's energy performance and recommends upgrades or retrofits for particular systems. Your energy team can help you and your board determine the proper scope for the energy audit and find a qualified professional to undertake the work. If your building is required to benchmark under Local Law 84, then you are also 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.

Step 6

Select Projects

Once you have completed the previous steps, it's time to select the energy projects your building will undertake. Your energy audit may include recommendations for lighting retrofits, HVAC upgrades, air sealing, or other measures. The more measures you choose to implement, the more energy your building will save. Your property manager or a professional engineering consultant can help you determine the proper criteria for project selection, which can be based on costs, pay-back times, energy-saving potential, or other factors.

Opportunities for Energy Efficiency

The following sections cover the opportunities and strategies that you and your board may want to consider implementing to begin saving energy and reducing your building's energy costs. However, you should always work with a qualified professional, such as one of NYSERDA's Performance Partners, to understand which of these opportunities will be right for your building.

Benchmarking Energy Use

To benchmark your building's energy use, you will need a year's worth of energy bills for the whole building for each type of fuel your building uses. If you don't keep this information on hand, it is available by request from your local vendors and utilities. You'll also need some basic information about your building, such as its size, age, and the activities it supports. Entering this information into the U.S. EPA's free online tool called Portfolio Manager will provide a snapshot of your building's annual energy use and compare it to similar buildings. If you need help at any stage in the benchmarking process, your property manager or an energy consultant can help.

Three Levels of Energy Audits

The American Society of Heating, Refrigerating & Air-Conditioning Engineers (ASHRAE) develops standards for three levels of energy audits:

The ASHRAE Level 1 Audit, also called a "walk-through audit," involves a review of the building's benchmarking data, short interviews with operating personnel, and a brief walk-through of the building to provide a preliminary analysis of energy use and standout efficiency opportunities.

The ASHRAE Level 2 Audit evaluates individual building systems and recommends a variety of building-specific energy conservation measures (ECMs), general financial costs of these measures, and potential energy and financial savings.

The ASHRAE Level 3 Audit, also called an "investment grade" audit, is the most sophisticated audit. It uses a computer program to create an integrated model of the building systems, which takes into account the interaction of systems that is not generally revealed in the Level 2 audit.



Electricity is what powers most of the conveniences and appliances in your building, including the lights, elevators, and anything plugged into an electrical outlet. Making simple upgrades to the system and appliances that use electricity is one of the best opportunities to save money with measures that can pay for themselves in just a few years. A professional energy audit will identify the improvements best suited for your building, but some examples of cost-effective electrical upgrades are included below.

Lighting

New York City residents spend roughly \$3.4 billion on electricity for lighting every year, which accounts for 27% of total City electric use and 12% of citywide greenhouse gas emissions.⁴ This means that the potential for savings through more efficient lighting and controls is enormous. Below are a few opportunities to consider.

Replace Light Bulbs

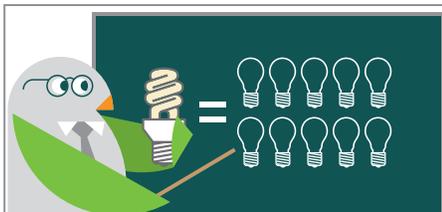
90% of the energy used by a traditional incandescent bulb is wasted by creating heat instead of light.⁵ Replacing these inefficient bulbs with more efficient CFLs, LEDs, or fluorescent lighting in common areas and units is a relatively simple way to begin saving energy. Lighting upgrades also have some of the quickest payback periods, often recouping the upfront cost in two years or less. Many CFL and LED bulbs even work with traditional fixtures—so there’s no reason to wait to start replacing light bulbs in your building.

Did You Know?

CFLs use just a quarter of the energy of traditional incandescent bulbs and last up to ten times longer. LED bulbs are somewhat more expensive, but they also use a quarter of the energy of traditional bulbs and last up to 100 times longer. In fact, replacing a single 60 Watt bulb with a new LED bulb can save up to **\$80 a year per bulb**—and because CFLs and LEDs also last longer, they can save you hundreds of dollars from lower energy and maintenance costs.

Choosing Your Approach

Remember that NYSERDA offers a “whole building” approach to energy savings, while Con Ed and National Grid offer incentives for individual ECMs. Lighting upgrades are just one opportunity to save energy.



SWITCH TO CFLs & SAVE MONEY.

1 compact fluorescent lightbulb lasts as long as 10 standard bulbs.



Birdie, the mascot of New York City’s public engagement arm called GreenNYC, explains the benefits of switching to CFLs. See page 21 for more information about GreenNYC.

Install Lighting Controls and Sensors

How often have you walked into an empty laundry room or basement and found the lights on? In many buildings, common areas are lit around the clock, even when no one is in the room, which wastes both energy and money. Installing lighting controls is a low-cost solution that can help solve the problem. Examples include:

- Occupancy sensors that automatically turn off lights when no one is in a room
- Timers to shut off lights at certain times
- Photocells that dim lights based on natural lighting in the room

Electric Submetering

If your building is “master metered,” each unit pays a set energy charge every month regardless of the energy its residents use. If this is the case, residents might be paying for more energy than they are using, and your building is missing a major opportunity to save energy. Submetering electricity use in individual units charges residents only for the energy they actually use, providing them with a financial incentive not to waste energy. In fact, studies show that submeters can reduce a building’s energy consumption by up to 20% in one year.⁶

Financial Incentives for Submetering

NYSERDA’s Advanced Submetering Program can provide a cash incentive of up to half the installation cost of submeters. See Appendix A for more information.

Building Management Systems

Building management systems combine the latest sensor technology and digital controls to maximize the efficiency and comfort of a building. A typical system allows building managers to monitor temperatures, lighting, building system performance, and electricity demand in a single integrated interface. Through both automated and manual adjustments, this improves resident comfort while minimizing energy waste.

Electrical Plug Loads

Every appliance plugged into an electrical outlet is drawing electricity in a building, including refrigerators, microwaves, air conditioners, televisions, computers, game systems, coffee machines. Creative solutions to reduce your building’s “plug load” can cost little to implement, which include:

- Replacing appliances in common areas with more efficient models to begin reducing energy use in your building immediately. Look for ENERGY STAR®-certified appliances for the greatest energy savings.
- Engaging residents to reduce their own electricity use is another important way to reduce energy use in a building. See more tips for engaging residents on page 19.

Electrical Systems *Online Resources*

- **ENERGY STAR® Lighting:** www.energystar.gov/lighting
- **Green Light New York:** www.greenlightny.org
- **NYSERDA Guide to Home Lighting:** www.lrc.rpi.edu/patternbook
- **NYSERDA Advanced Submetering Program:** www.nyserdera.ny.gov/asp



A building's envelope consists of everything that separates the inside of the building from the outside, including the roof, walls, windows, and doors. Insulating the envelope and preventing air leakage helps keep warm air inside during the winter and cool air inside during the summer. Because heating and cooling are often a building's biggest expenses, improving the envelope will help your building maximize investments in its heating or cooling equipment.

Air Sealing and Insulation

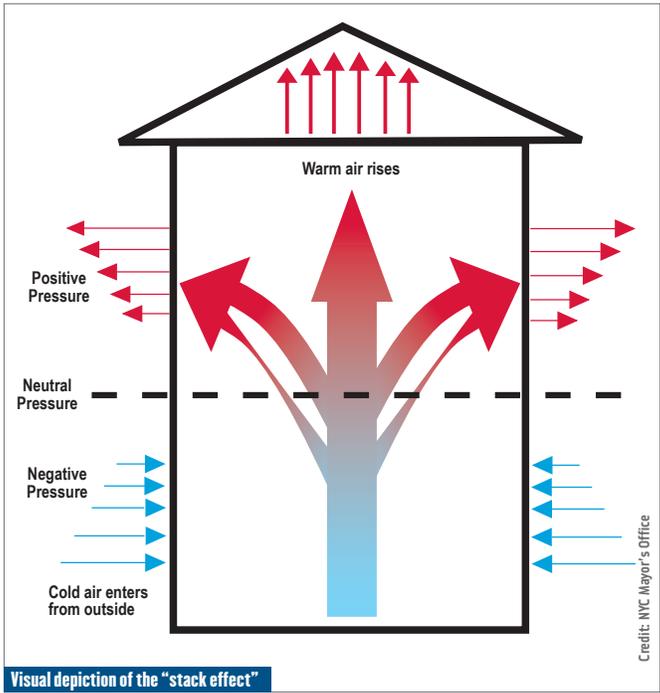
Air sealing and insulation work hand-in-hand. Air sealing plugs the cracks and leaks that cause drafts in the winter and allow cold air to escape during the summer. Insulation provides a barrier, much like a coffee thermos, that prevents the temperature of the air outside from seeping inside the building through the envelope. In combination, improving air sealing and insulation will make a building more comfortable and lower energy costs for heating and cooling.

Air Sealing

Air leakage accounts for about a quarter of heat loss in multifamily residential buildings.⁷ Because heat rises, this can be exacerbated in buildings where a phenomenon called the “stack effect” (see right) causes heat loss through the roof in the winter, forcing the heating system to work harder to keep the building warm. A contractor can use a combination of caulking, spray foam, and weather stripping to seal leaks and prevent energy waste.

Insulation

There are many materials you can use to increase the insulation of your building. Performance of these insulating materials is measured by R-value, or the ability to resist heat flow. Higher R-values indicate the material has greater insulating power. 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 the insulation. Moreover, air sealing prevents moist air from entering a building's insulation in winter, where water will condense and cause mold that can damage both the insulation and the walls. A qualified contractor will be able to make specific recommendations about air sealing and insulation based on an energy audit of your building.



Windows

Windows account for between 10 and 30% of heat loss in multifamily residential buildings, and in some cases account for the greatest heat losses of any part of the building.⁸ The first step to improving window efficiency is to fill in any cracks and holes around the frame using caulk or weather stripping. The efficiency of windows themselves can also be improved by adding special coatings or replacing old windows with newer, more efficient models. The efficiency of windows is measured by U-values. Lower U-values indicate more efficient windows. Replacing windows can realize efficiency gains of 30 to 50%, although these upgrades may have longer payback periods than other measures.⁹ In general, air sealing around windows provides lower efficiency gains, but pays for itself more quickly.

Roofs and Heat Absorption

Your roof also plays an important role in regulating your building's temperature and comfort. In fact, sunlight can heat a flat, black asphalt rooftop up to 190 degrees Fahrenheit in the summer. A hot roof will heat the entire building, forcing the cooling system to work harder than necessary. It also contributes to the "urban heat island" effect, which causes New York City to be up to five degrees hotter than surrounding areas.

Cool Roofs

Fortunately, there is a simple, low-cost solution for your roof. Painting a reflective, white coating on your rooftop can reduce internal building temperatures by up to 30%, making your building more comfortable, saving energy, and extending the life of your rooftop and your building's cooling equipment.¹⁰ The NYC °CoolRoofs program will help you get started, and can even send volunteers to help you paint your roof. See Appendix D for more information about NYC °CoolRoofs.

Green Roofs

Another option is to install a green roof or a rooftop garden, which is a vegetative layer grown on a roof that reduces rooftop temperatures during the summer and provides insulation during the winter, when the roof can account for about 5% of heat loss in a typical multifamily building.¹¹ Green roofs also have additional benefits such as reducing stormwater runoff, filtering pollutants from rainfall, and providing aesthetic value. Estimated installation costs range between \$10 and \$25 per square foot, plus additional costs for upkeep.¹² Not all buildings are suitable for green roof installations, however, so be sure to consult with a professional engineer first about this option.

Did You Know?

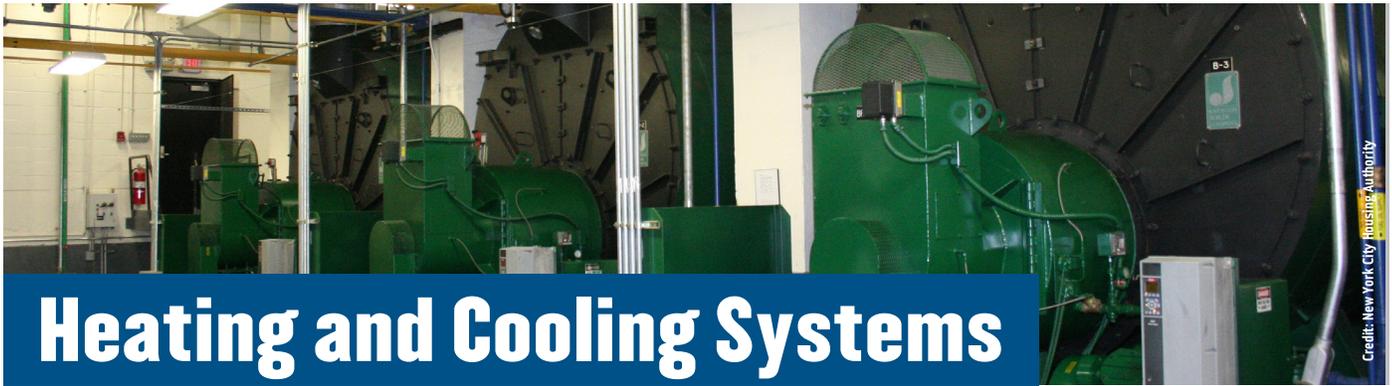
Every 1,000 square feet of roof that is coated with reflective white paint will reduce New York City's carbon footprint by one ton of carbon dioxide equivalent.

NYC Green Infrastructure Grant Program

DEP has allocated up to \$6 million in grants for green roofs and other measures to reduce rain water runoff from buildings, streets, and sidewalks. See below for an online link to this program.

Building Envelope *Online Resources*

- **ENERGY STAR® Air Sealing:** www.energystar.gov/index.cfm?c=home_sealing.hm_improvement_sealing
- **US DOE Windows, Doors & Skylights:** www.energy.gov/public-services/homes/windows-doors-skylights
- **NYC °CoolRoofs:** www.nyc.gov/coolroofs
- **NYC DEP Green Infrastructure Grant Program:** www.nyc.gov/html/dep/html/stormwater/nyc_green_infrastructure_grant_program.shtml



Heating and Cooling Systems

The energy used for space heating and cooling typically amounts to about half of a multifamily building's total energy consumption.¹³ Your building can save money by ensuring the 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 can be complicated, but these investments are critical to saving energy. Options for improving the efficiency of your building's HVAC systems will depend both on the types of systems located within your building and the quality of the operations and maintenance of these systems. An overview of potential opportunities is included below, but only an energy audit by a qualified professional will provide the information you need to identify the individual opportunities available 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. Opportunities for increasing the efficiency of a system may include a retrofit of the existing unit or upgrading to a more efficient model. However, regardless of the system your building uses, it is important to make upgrades using an integrated-system approach rather than simply addressing system components individually. This will help ensure your building has an appropriately sized unit that will result in superior efficiency and greater cost savings in the long run. In addition, an annual maintenance program is essential for keeping

NYC Local Law 87

NYC Local Law 87 of 2009 mandates that all buildings greater than 50,000 gross square feet must undergo energy audits and retro-commissioning measures every 10 years, which will help ensure that HVAC building systems are running efficiently. You can undertake these measures at any time in the four years leading up to your building's Local Law 87 compliance date, which will allow you to begin saving money more quickly. For more information about Local Law 87, see Appendix C.



A boiler performance test

any heating system operating efficiently. See more information about opportunities to save energy through operations and maintenance on page 18.

If your building is considering a longer-term investment, new ENERGY STAR® boilers can achieve a fuel utilization efficiency of at least 85%, compared with 50 to 75% for older boilers.¹⁴ However, there are other high-impact, low-cost energy heating efficiency measures that will improve building comfort and lower your energy costs and maintenance fees. These include:

- Installing burner and draft controls to increase the efficiency of your boiler
- Replacing steam traps to reduce steam leaks and increase comfort
- Regulating heat distribution by adding or replacing radiator shut-off valves
- Installing pipe and boiler insulation to reduce standby losses
- Installing an energy management system, such as indoor temperature sensors with automatic controls

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 cooling system depends on using an integrated approach that may include upgrades to the chiller as well as to the pumps and fans that distribute the chilled air.

**Opportunity for Savings:
Upgrading One-Pipe Heating Oil Systems**

Have you ever wondered what type of system is the least efficient? A recent study of more than 230 multifamily retrofit projects in NYC found that buildings using heavy heating oil with one-pipe steam systems performed worse, on average, than all studied building types. In fact, retrofits to the heating system in these buildings led to average energy savings of nearly 20%.¹⁵



Relatively low-cost measures for a central cooling system that can have a high impact on efficiency include:

- Retrofitting the existing chiller, for example by installing low-friction valves or insulating pipes
- Installing variable fan drives (VFDs) on fans that distribute conditioned air throughout the building
- Retro-commissioning the existing system to improve operations and make maintenance adjustments

Unitary Systems

Unitary systems are generally used in smaller buildings and can consist of a single-packaged unit or a split system with multiple units and can provide both heating and cooling. Examples of unitary systems include in-window 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 an average lifetime of 15 years compared to between 20 and 23 years for chillers.¹⁶ It is not generally feasible to convert a building from a unitary system to a central chilling system, but efficiency can be improved by replacing old units with a more efficient model or system. For example, you may choose to replace a packaged rooftop air conditioner with an air-to-air heat pump. As with any system, proper maintenance is essential for maximizing efficiency and energy savings.

Distribution Systems

The efficiency of your air distribution systems can be just as important for saving energy and money as the efficiency of the unit providing the heating or cooling. For example, if ducts are not sealed and pipes are not insulated, much of the energy used to warm or cool your building will go to waste. For this reason, when you are considering upgrading or retrofitting a central heating or cooling system, your building will achieve the greatest savings by taking an integrated-system approach that addresses the distribution system as well as the central unit.

HVAC Systems *Online Resources*

- **NYSERDA Heating & Cooling:** www.nysersda.ny.gov/energy-star-heating-and-cooling
- **Con Edison Heating & Cooling:** www.coned.com/energyefficiency/residential_HVAC_program.asp
- **US DOE Tips:** www.energy.gov/energysaver/articles/tips-heating-and-cooling

Heating Oil Conversions

Regulations issued by the NYC Department of Environmental Protection (DEP) in 2010 are phasing out the use of No. 6 and No. 4 heating oils in New York City. When burned, these heavy heating oils release significant quantities of fine particulate matter (PM_{2.5}), which causes air pollution that aggravates respiratory diseases and increases the risk of heart disease.

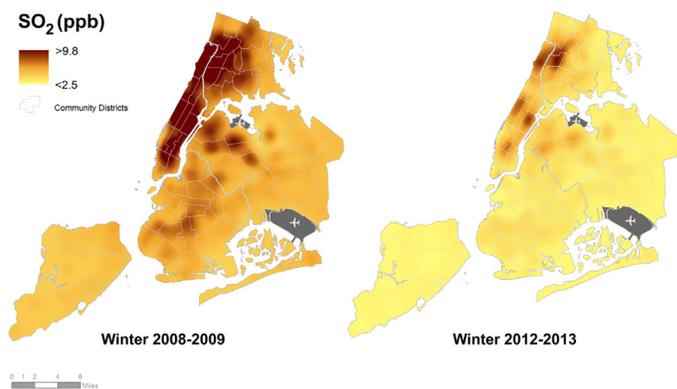
Beginning July 1, 2012, buildings that burn No. 6 heating oil must convert to a cleaner fuel before their three-year certificate of operation expires, and buildings burning No. 4 oil must switch to a cleaner fuel by 2030. Buildings may choose to switch to Ultra-Low Sulfur (ULS) No. 2 oil, biodiesel, natural gas, or steam. The impact of these regulations on human health and air quality will be significant. In fact, within two years of enacting the regulations, New York City's air is now cleaner than it has been in 50 years—preventing over 800 premature deaths and 2,000 hospital visits annually.¹⁷

Converting No. 6 or 4 Oil to Ultra-Low Sulfur No. 2 Oil

Ultra-Low Sulfur (ULS) No. 2 oil is the cleanest available heating oil 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. 6 oil can also burn ULS No. 2 oil and biodiesel, but tanks will need cleaning and in some cases will need to be retrofitted. Still, conversion costs for ULS No. 2 oil are generally minimal unless your building needs a new oil tank.

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% or more will reduce your building's GHG emissions by an amount comparable to converting to natural gas—equaling a potential GHG reduction of 15 to 20%. The conversion process to a biodiesel blend is nearly identical to the process of converting to ULS No. 2 oil, 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.

New York City Concentrations of Sulfur Dioxide
Winter 2008-2009 & 2012-2013



Buildings that have converted their heavy heating oil helped New York City reduce citywide sulfur dioxide (SO₂) levels, an air pollutant linked to respiratory illnesses, by nearly 70%.

Converting to Natural Gas

Natural gas is the cleanest-burning fossil fuel at the point of combustion. In fact, converting from No. 6 heating oil to natural gas can reduce a typical multi-family building's GHG emissions by as much as 15 to 20%.¹⁸ If your building has access to natural gas, converting from heating oil to natural gas can also lead to significant cost savings due to lower fuel prices and reduced boiler maintenance and operating costs. As of 2013, natural gas prices are about 30% lower than No. 6 oil prices, and they are generally predicted to stay lower than oil prices through the next decade.

Because of these cost savings, payback periods for natural gas conversions can be short, but the process of converting to natural gas requires 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 your energy team to determine whether converting to natural gas is the right option for your building.

NYC Clean Heat

To help buildings convert their heavy heating oil to one of the cleanest fuels, New York City and the Environmental Defense Fund (EDF) established NYC Clean Heat, a program that provides a one-stop-shop for resources and technical assistance to building owners, managers, and residents required to convert their heating oil. See Appendices C and D for more information about the NYC Clean Heat program.

What About Converting from No. 6 to No. 4 Heating Oil?

If your building burns No. 6 oil, switching straight to ULS No. 2 oil or natural gas provides significant benefits that make both options better than converting to No. 4 oil first. For one, switching straight to one of the cleanest fuels eliminates the need to convert your building's heating oil twice to comply with the DEP regulations. It will also reduce building operating costs: the price of natural gas is much less expensive than No. 4 oil, while switching to ULS No. 2 oil will increase the efficiency of your boiler and reduce operation and maintenance costs that result from soot buildup. Moreover, using New York's biodiesel tax credit and installing efficiency measures during the conversion process will further increase your building's cost-savings. And of course, switching to one of the cleanest fuels has the added benefits of improving air quality in your neighborhood and lowering citywide GHG emissions—which is good for your health and good for the community.

Does My Building Have Access to Natural Gas?

Two natural gas utilities serve New York City: Con Edison serves Manhattan, the Bronx, and Northern Queens, while National Grid serves Brooklyn, Staten Island, and Southern Queens. You should contact NYC Clean Heat to find out if your utility has identified your building as eligible for a free or low-cost gas connection. If not, Clean Heat staff may be able to assemble a cluster of buildings in your neighborhood and work with the utilities to convert to gas as a group, which can lower or eliminate the upfront costs of connecting to gas.

Heating Oil Conversions *Online Resources*

- **NYC Clean Heat:** www.nyccleanheat.org
- **NYC Clean Heat ULS No. 2 Oil:** www.nyccleanheat.org/content/ultra-low-sulfur-2-oil
- **NYC Clean Heat Natural Gas:** www.nyccleanheat.org/content/converting-natural-gas



Domestic Hot Water

In many multifamily buildings, the boiler system used for space heating is also used to provide hot water. In this case, many of the upgrades described in the *Heating and Cooling* section will also increase the efficiency of heating your domestic hot water. If your building uses a separate system to heat water, however, there are additional steps you can take to save on both energy and water supply costs—and considering that water heating accounts for roughly a third of the energy use in NYC’s largest multifamily buildings, there is significant room for savings.¹⁹

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 from No. 6 heating oil to Ultra Low Sulfur (ULS) No. 2 oil or natural gas. Other steps to improve efficiency of water heating in your building without installing a new boiler include:

- Insulating the water storage tank, boiler, and piping to reduce standby heat losses from the storage tank
- Upgrading to a tankless water heater, which minimizes heat losses from storage water heaters
- Decoupling your hot water from your boiler and installing a separate hot water system, which will avoid the need to fire a large boiler during the summer

Solar Hot Water Heaters

Solar hot water heaters are installed on the roofs of buildings and use the energy of the sun to heat domestic hot water. These systems do not usually cover 100% of domestic hot water heating requirements, but are typically connected to existing hot water systems to provide auxiliary heating that can meet anywhere between 25 to 80% of a building’s hot water needs.²⁰

Solar hot water heaters can also be installed in conjunction with solar photovoltaic (PV) systems to provide the benefits of both, so if your building is considering solar, it is worth discussing with qualified a contractor the optimal combination of solar PV and solar thermal. NYSERDA offers a cash incentive of \$4,000 per site per meter for residential solar thermal systems that displace electrically heated hot water, which typically covers roughly 15 to 20% of installation costs. Once installed, these systems can save between 50 to 80% of domestic hot water costs.²¹

Financial Incentives for Solar Hot Water Heaters

NYSERDA offers a cash incentive for solar hot water heaters of \$4,000 per site per meter, which covers approximately 15 to 20% of installation costs. For more information about NYSERDA incentives, see Appendix A.



Solar Water Heater Installation

To be most effective, solar hot water projects generally require short piping runs, large and unobstructed roof spaces, and easy access to space for storage tanks. These conditions tend to preclude tall, narrow buildings. In general, buildings between one and 12 stories with unobstructed, south-facing roof space provide the best potential for solar hot water systems.²² The cost-effectiveness of these systems depends on the type of fuel being displaced; for example, displacing more expensive sources of energy, such as electricity, will provide greater benefits compared to energy sources with relatively lower costs, such as natural gas.

Low Flow Showerheads and Toilets

Implementing water efficiency measures is another good way for buildings to save money, and conserving water also reduces a building's energy consumption because the less water a building uses, the less water that needs to be heated.

Some simple measures to save both water and energy include:

- Installing low-flow showerheads, which can reduce water use by 2 to 5 gallons per minute while maintaining high water pressure²³
- Using faucet aerators, which reduce water use by up to one gallon per minute while maintaining water pressure²⁴
- Installing high efficiency toilets, which can use as little as 1.28 gallons of water per flush, compared with 3.5 to 7 gallons for standard models²⁵



Low Flow Showerhead

Did You Know?

Low-flow showerheads can reduce water use by **2 to 5 gallons per minute**, which also saves energy by reducing the amount of water your building has to heat.

Domestic Hot Water *Online Resources*

- **ENERGY STAR® Qualified Water Heaters:** www.energystar.gov/index.cfm?c=water_heat.pr_help_me
- **ENERGY STAR® Solar Hot Water Heaters:** www.energystar.gov/index.cfm?c=solar_wheat.pr_how_it_works
- **NYC Department of Environmental Protection Water Saving Tips:** www.nyc.gov/html/dep/html/ways_to_save_water/index.shtml



On-Site Generation and Renewables

If your building is planning major equipment upgrades, wants to guard against future fuel price increases, or must increase its resiliency to extreme weather events, clean on-site and renewable energy generation may be a good option. On-site generation technologies can produce some or all of the energy your building consumes, and often use cleaner or more efficient technologies than the energy supplied by your utility. Many of these technologies require a large upfront investment, but they will typically provide operational savings and provide numerous environmental benefits.

Combined Heat and Power (CHP or Cogeneration)

Combined heat and power (CHP), also known as cogeneration, is the simultaneous production of two or more useful forms of energy from a single device. A CHP system will take fuel—most commonly natural gas—and generate electricity for a 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.

CHP systems operate with up to 80% fuel efficiency, compared to just 15 to 45% for standalone electricity generators. As a result, CHP systems can significantly reduce a building's annual energy costs, particularly if your building is switching from a more expensive fuel, such as heavy heating oil, to a relatively less expensive one, such as natural gas. A CHP system can also allow your building to continue producing electricity during an emergency or a blackout and lowers the demand on New York City's strained electrical grid, allowing the local power supply to operate more efficiently and reduce local air pollution.

Currently, CHP systems provide the greatest benefit to buildings that have electric bills higher than \$100,000 per year and where the system will run continuously. However, smaller systems can also be implemented cost-effectively, particularly when combined with financial incentives of up to 50% of the cost of the system available through NYSERDA.²⁶

Financial Incentives for CHP

NYSERDA can provide financial incentives of up to 50% of the total project cost through its Combined Heat and Power Performance program. See Appendix A for more information about NYSERDA.

Combined Heat & Power *Online Resources*

- **NYSERDA Combined Heat and Power Performance Program:** www.nyserda.ny.gov/chp
- **NYSERDA Net-Metering:** www.nyserda.ny.gov/net-metering
- **US EPA Combined Heat and Power Partnership:** www.epa.gov/chp/basic

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 energy costs by reducing the need to purchase electricity from a utility. Moreover, any excess electricity produced that a building does not use is sold to the utility in a process called net-metering. Solar panels can be expensive to install, but financial incentives from NYSERDA, the federal government, and others can cover 60% or more of the costs. 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 and acquire all necessary permits.



Online Interactive Solar Map Tool:

You can use a free interactive map tool to estimate of your building's solar potential, savings, and pay-back period taking into account financial incentive programs in NYC, available online at: www.nycsolarmap.com

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. These systems operate by exchanging heat energy between a building and the ground, which provides energy efficient 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.²⁷ In addition to providing efficient, low-carbon heating and cooling, the benefits of geothermal heat pumps also include low operating and maintenance costs and long life expectancy.

Property Tax Abatement for Solar PV

New York City offers a property tax abatement of 10% for solar PV systems that are installed in 2013 or 2014, spread over 4 years annually. This can provide up to \$62,500 per system or the building's tax liability, whichever is less.

Solar PV Online Resources

- **NYC DOB Solar Panels:** www.nyc.gov/html/dob/html/sustainability/solar_panels.shtml
- **NYSERDA Renewables:** www.nyserda.ny.gov/renewables
- **NYSERDA Solar:** www.nyserda.ny.gov/solar

Geothermal Heat Pumps Online Resources

- **NYSERDA Geothermal Heat Pumps:** www.nyserda.ny.gov/geothermal
- **US DOE EERE Geothermal Heat Pumps:** www.eere.energy.gov/geothermal/heatpumps.html



Other Energy-Saving Measures

In addition to the capital investments described in previous sections, there are many low- or no-cost strategies you can undertake to save money and increase efficiency. These include optimizing the operations and maintenance of your building's energy systems, training the building operators 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 U.S. Department of Energy (U.S. DOE), well-executed O&M programs can save 5 to 20% on annual energy bills without significant capital investments.²⁸ In fact, some changes may cost nothing at all. Below are ideas to help you get 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. SEIU 32BJ, the largest building service workers union in the country, offers a 40-hour training program in green building operations and maintenance through its 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 also available to non-union members, including Urban Green Council's GPRO Operations & Maintenance Essentials course. See the online resources box below for links with more information.

Retro-Commissioning

Retro-commissioning is the testing and tune-up 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 that are easily corrected and, when implemented, save energy and improve equipment reliability. NYC Local Law 87 of 2009 requires buildings that are 50,000 gross square feet or larger to retro-commission their building systems every ten years and implement identified retro-commissioning deficiencies. Simply by complying with Local Law 87, you will improve the efficiency of your building and save money. For more information, see Appendix C.

Operations & Maintenance *Online Resources*

- **32BJ Green Supers:** www.1000supers.com
- **32 BJ Training Programs:** www.training.32bjfunds.com/NewYorkHome
- **Urban Green Council Green Professional Training Programs:** www.gpro.org/courses/ome
- **Local Law 87:** www.nyc.gov/LL87

Resident Engagement and Behavior 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:

- Turning off lights when leaving a room
- Using a programmable thermostat
- Purchasing ENERGY STAR® rated appliances and light bulbs (see right)
- Setting the thermostat to 68°F in the winter and 78°F in the summer
- Doing full loads of laundry with cold water
- Using a moisture sensor on clothes driers to avoid over-drying
- Waiting to run the dishwasher until it is full
- Setting the refrigerator temperature between 38-40°F and the freezer between 0-5°F
- Using smart power strips or unplug devices to avoid vampire load (see right)

ENERGY STAR® Products

Energy efficient appliances can reduce yearly energy bills by 20 to 30%. To find the most efficient appliances, be sure to look for the US EPA's ENERGY STAR® label.

Vampire Load

Appliances that are turned off and chargers that are plugged in but aren't charging anything create a so-called "vampire load" that continues to suck energy from an outlet. Cable boxes, for example, draw 10 to 50 watts even when turned off. You can avoid vampire load by unplugging appliances when not in use or using smart power strips wherever possible.

GreeNYC

GreeNYC is NYC's public engagement program to help make the city greener and greater. GreeNYC's mascot, Birdie, provides tips to help New Yorkers reduce energy use and choose a more sustainable lifestyle. See more at www.nyc.gov/greenyc

It can be difficult to convince residents that it's easy to make the simple behavior changes that will help save energy. Here are some ideas to help you get started:

Green Committees. Setting up a "green committee" to help engage residents through social media or events can help them learn how to make simple behavior changes that add up to significant energy savings. Look for tips from GreeNYC (see left) to get started.

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

KEEP COOL & SAVE MONEY THIS SUMMER.



TURN UP YOUR THERMOSTAT

Set your air conditioner to 78° and save. For every degree you raise your A/C's thermostat you can cut your electricity bill by 3% or more.

GreeNYC mascot Birdie provides tips to help New Yorkers lower their energy use and save money.

Resident Engagement & Behavior Change Online Resources

- **GreeNYC:** www.nyc.gov/greenyc
- **ENERGY STAR® Products:** www.energystar.gov
- **NYSERDA Residential Energy Saving Tips:** www.nyserda.ny.gov/residential-tips

Success Stories

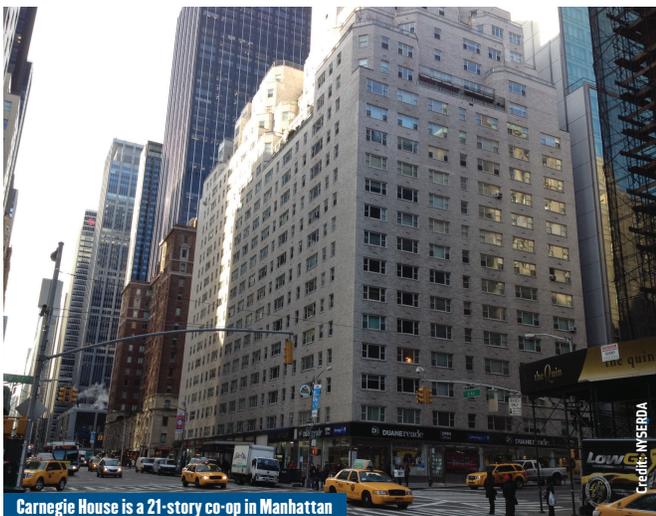
Carnegie House

Aging systems open the door for major energy savings in a Manhattan Co-Op

More than 50 years after Carnegie House was built, the mechanical systems in the 21-story Manhattan co-op were far past their prime. Energy costs had risen, and building manager Chris Kelly realized he had an opportunity to improve Carnegie House's energy efficiency as a whole, rather than simply replacing old equipment.

Mr. Kelly hired a contracting company that works as a Multifamily Performance Partner for NYSERDA, which analyzed the building's energy use and recommended improvements. The board embarked on a top-to-bottom energy efficiency upgrade project, making a range of improvements to the mechanical and lighting equipment. Carnegie House was able to keep its mechanical systems in operation while installing the upgrades, making the conversion virtually invisible to tenants. Through NYSERDA, the building earned \$197,000 in incentives and qualified for a loan at about half the market interest rate.

Carnegie House's upgrades resulted in a 15% reduction in energy use—creating a yearly cost savings of more than \$139,000, which is passed through to unit owners to save money for all. In fewer than six years, the project will have paid for itself in these savings.



Background & Challenges

- Outdated 50-year-old mechanical system was escalating maintenance and energy costs
- Leaky pipes, dated pumps, and inadequate ventilation system created energy waste
- Incandescent bulbs and 24-hour building lighting added to energy costs

Solution

- Upgraded ventilation system, pumps, motors and absorption chiller
- Steamlined leak repair system and added insulation
- Installed efficient lighting and motion sensors in common areas and maintenance room

Benefits

- Reduced energy consumption by 15%
- Received \$197,000 in incentives plus low-interest financing from NYSERDA
- Annual savings of between \$250-475 per unit
- Avoided failure of outdated mechanical system

By the Numbers

Number of Units	317
Total Investment	\$788,818
NYSERDA Incentives	\$197,370
Annual Steam Savings	5,661 million Btu
Annual Electricity Savings	113,472 kWh
Simple Payback Time	5.7 years
Savings to Investment Ratio	2.6
Annual Cost Savings	\$139,000

Success Stories

Park City Estates

From growing costs to big savings, thanks to submetering

Residents of Park City Estates had a relatively common problem for apartment-dwellers: residents all paid the same electricity bill, whether or not they were conservative with their energy use. Because each of the complex's five buildings were master metered, it was impossible to bill residents individually.

When FirstService Residential, formerly known as Cooper Square Realty, took over management of the 1,049-unit Queens co-op in 2010, the complex had been experiencing double-digit maintenance charge increases for five years. To lower maintenance costs and reduce building-wide energy consumption, Park City Estates decided to upgrade to electricity submetering to give residents control over their electricity use. The superintendent and the installation team put residents' minds at ease, explaining that there would be no damage to their living space—and reminded them of the cost savings that they would realize as a result of submetering. The co-op began installation of electricity submeters in each of the complex's units in 2011, and in just five months, nearly all of the units had been converted. The co-op also took advantage of \$265,156 in incentives from NYSERDA's Advanced Submetering Program (ASP), cutting the project cost nearly in half.



Background & Challenges

- 1,049-unit, five-building complex built in 1960, with one master meter for electricity in each building
- All residents paid the same amount for electricity monthly, regardless of their usage

Solution

- Installed electrical submeters in every apartment
- Conversion qualified for \$265,156 in incentives from NYSERDA's ASP program, including \$250 per meter and \$1,500 per master meter

Benefits

- NYSERDA incentives cut project cost in half
- 15% savings in maintenance costs
- Residents only pay for the electricity they use and can make informed decisions to further reduce their energy expenses

Today, Park City Estates residents only pay for the electricity they actually consume. In combination with other energy-saving measures, the building's maintenance costs decreased by 15%, and property values are rising. According to property manager Aubrey Phillibert, "Values were dropping in the down economy, but we started picking up faster than others because of the 15% maintenance reduction. We're also increasing quality of life."

By the Numbers

Number of Units	1,049
Total Investment	\$540,235
NYSERDA Incentives	\$265,156
Projected Annual Electric Savings	113,472 kWh
Project Cost Savings	49%
Reduction in Maintenance Costs	15%

Success Stories

12 East 97th Street

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

In 2010, more than 80 years after it was built, this 11-story classic red brick co-op was still beautiful on the outside, but had outdated base building systems on the inside. Nancy Boyd, the building's board president, and John Slattery, the treasurer, realized they could take advantage of boiler upgrades they were required to undertake under Local Law 43 and energy audits and retro-commissioning under Local Law 87 to pursue an integrated project that would improve the building's efficiency, lower its energy costs, and dramatically reduce its GHG emissions all at the same time. 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 take advantage of the law. Building on these efforts, 12 East 97th Street was also one of the first co-ops to join its property management firm, Douglas Elliman Property Management, to participate in the NYC Carbon Challenge in 2013.



The co-op board hired a consulting firm and an energy engineering and design firm in 2010 to provide the Local Law 87 energy audits and retro-commissioning services to analyze the building's energy use and recommend improvements that began saving energy almost immediately. With the pending expiration of its No. 6 heating oil permit, the board also began exploring other heating fuel options. The co-op's engineering firm designed a new dual fuel system for the building's boiler, which can burn both natural gas and ULS No. 2 oil and provides 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, saving the building additional energy and money. By moving quickly to undertake this work, the building even earned a \$12,114 grant from NYSERDA through a former carbon emission reduction program.

"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

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 that included upgrading the boiler control system, replacing all radiator steam traps, replacing its magnetic ballast T-12 fluorescent light fixtures with more efficient electronic ballast T-8 fluorescent lighting, installing occupancy sensors in the basement, insulating steam and hot water pipes, replacing most of the common area lighting, and distributing over 300 free CFL bulbs to residents.

12 E. 97th Street's completed upgrades have resulted in an impressive 18% reduction in the building's energy use. The building converted its heating oil to natural gas in May 2013 and has not yet realized the full benefits of this conversion. However, once complete, the combination of energy efficiency upgrades and the natural gas conversion is expected to save the building more than \$100,000 in operating costs annually and reduce GHG emissions by about 330 metric tons of carbon dioxide equivalent (CO₂e) per year—or nearly 40% from 2010 levels.



12 East 97th Street's 1981 boiler was refurbished, re-insulated, and converted to dual fuel capacity, allowing it to burn oil or natural gas.

Credit: Jorge Franciso, Resident Manager, 12 E. 97th St.

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 wasted energy and 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

Benefits

- Reduced energy consumption by 18%
- Projected to reduce GHG emissions by 40% once heating oil conversion is complete
- 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

By the Numbers

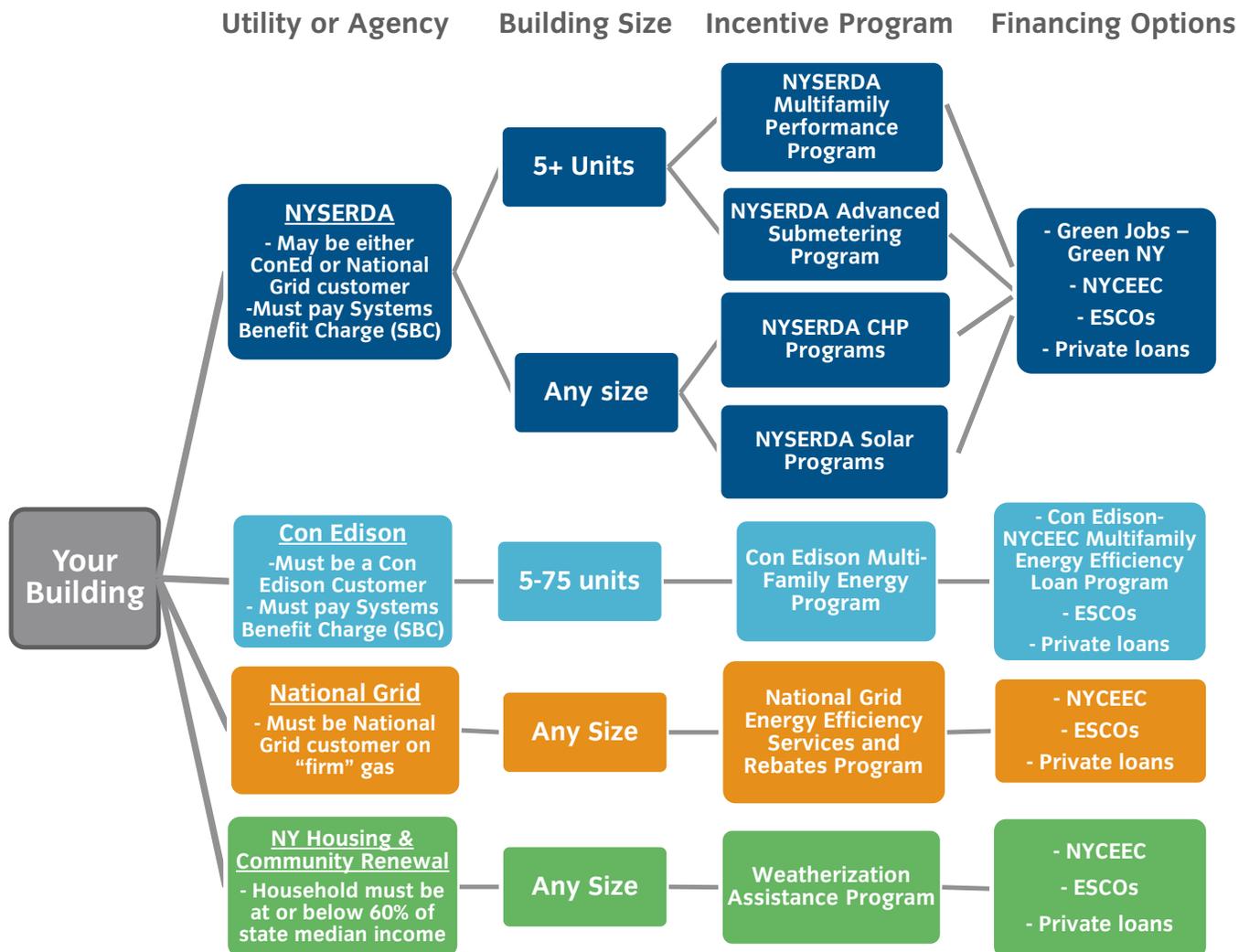
Number of Units	107
Total Investment	\$579,172
NYSERDA Incentives	\$12,114
Annual Fuel Savings	2,211 million Btu
Annual Electricity Savings	29,508 kWh
Projected GHG Reduction	330 tons per year
Simple Payback Time	5.4 years
Current Cost Savings	\$19,831
Projected Cost Savings	\$84,500
Total Cost Savings	\$104,331

Appendix A

Cash Incentives

When it comes to paying for the upfront cost of energy efficiency upgrades, your building has options to help cover this cost. There are several cash incentive programs and financing options currently available to multifamily buildings in New York City that will help buildings begin reaping the savings sooner. These programs often cannot be combined, so it helps to do some research first before deciding which to pursue.

The diagram below illustrates the New York City-specific cash incentive programs and relevant financing options. Note however that these programs may change over the next several years, so be sure to consult with your energy team to see if there have been any updates to these programs and determine which will be right for your building.



NYSERDA

The New York State Energy Research and Development Authority (NYSERDA) offers a suite of financial incentive programs for buildings with 5 or more units that pay into the New York State System Benefits Charge (SBC). You can check your most recent utility bill to see if your building pays this charge. For costs that aren't covered by these incentives, NYSERDA also offers financing at roughly half the market rate through its Green Jobs – Green New York program for any of its programs. For more information about Green Jobs – Green New York, see Appendix B.

- **Multifamily Performance Program (MPP).** The MPP program offers a customized path to major energy savings by improving your building's energy efficiency either one step at a time or through a comprehensive approach. The program provides cash incentives of up to \$1,000 per unit paid out in installments as you complete the process, and energy savings of 20% or more triggers an additional performance payment of between \$150 and \$300 per unit once the project is complete. From application to completion, your building will work with one of NYSERDA's Performance Partners, an expert contractor that makes the process simple and ensures success. When choosing if the MPP program is right for your building, keep in mind that you cannot combine these incentives with incentives from Con Edison.
- **Learn more:** www.nyserdera.ny.gov/mpp
- **Find a NYSERDA Multifamily Performance Partner:** www.nyserdera.ny.gov/multifamily-eb-partner

- **Advanced Submetering Program (ASP).** Submetering allows building residents to monitor their energy use, and because they're responsible for paying their own bill, residents are motivated to take action to reduce energy waste. This program provides incentives of \$1,500 per master meter and \$250 per advanced submeter to pay for up to 50% of the system cost. Additional incentives are available to install ENERGY STAR® appliances. In addition, low-interest financing through NYSERDA's Green Jobs – Green New York can finance the balance not covered by incentives.
- **Learn more:** www.nyserdera.ny.gov/asp

- **NYSERDA Combined Heat and Power (CHP) Programs.** NYSERDA's CHP programs promote clean, efficient on-site heat and electrical power generation for buildings, campuses, and industrial sites. CHP installations also address heat and power reliability, quality, and resiliency while improving energy, environmental, and economic performance.
 - The CHP Acceleration Program, for systems between 50kW and 1.3MW, offers up to \$1.5 million in financial incentives per project. The program employs a streamlined approach that provides the incentives to pre-approved vendors for the installation of pre-qualified and conditionally qualified systems, which should lower the costs of the systems to purchasers.
 - The CHP Performance Program, for systems over 1.3 MW, offers up to \$2.6 million in incentives per project. This program uses performance-based financial incentives that are tied to energy use, environmental performance, and peak demand reduction.
 - The NYSERDA FlexTech Program may also be used to cost-share CHP feasibility studies.
- **Learn more:** www.nyserdera.ny.gov/CHP-systems

- **NYSERDA Solar PV Programs.** NYSERDA has several programs to provide incentives for solar PV installations. The NY-Sun Competitive PV Program (PON 2589) provides incentives for solar PV systems that are larger than 200 kW. NYSERDA's Solar Standard Offer PV Incentive Program (PON 2112) offers incentives to help reduce the installation costs associated with residential PV systems that are 25 kilowatt (kW) and smaller and non-residential PV systems 200 kilowatts and smaller. By combining these incentives with other tax credits and incentives, buildings can save 40 to 70% of the purchase cost of solar PV systems. Excess electricity above what the building uses and produced by a system will also be credited on the customer's utility bill.
- **Learn more:** www.nyserderda.ny.gov/solar
- **NYSERDA Solar Thermal Program.** 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 \$4,000 per site per meter for residential systems and \$25,000 per site per meter for non-residential applications. On average, incentives for a typical system cover about 15 to 20% of the installed cost, which can supply 50 to 80% of hot water needs.
- **Learn more:** www.nyserderda.ny.gov/solar

Consolidated Edison, Inc.

Consolidated Edison, Inc. (Con Edison) also offers an incentive program with financing options for multifamily buildings that have 5-75 units, purchase Con Edison electricity or natural gas, and pay the New York State SBC.

- **Multi-family Energy Program.** This program for buildings with 5-75 units provides a free energy survey by a Con Edison Green Team energy professional who will evaluate your building's lighting and heating equipment and offer energy-saving recommendations. Once your building is enrolled in the program, residents can receive free CFL light bulbs, water-saving devices such as low flow showerheads, and energy-saving smart strips. Incentives are also available for certain energy efficiency upgrades, including lighting fixtures, LED exit signs, HVAC systems, and more. For costs that the incentives and rebates don't cover, program participants also gain access to the Con Edison-NYCEEC Multifamily Energy Efficiency Loan Program to finance the balance. For more information about Con Edison's Energy Efficiency Loan Program, see Appendix B.
- **Learn more:** www.coned.com/energyefficiency/residential_multifamily.asp

National Grid

If your building is located in Brooklyn, Queens, or Staten Island and receives uninterrupted, "firm" gas service from National Grid, you may be eligible for rebates from National Grid on certain equipment.

- **National Grid Metro New York Rebates.** National Grid offers a rebate of up to \$1,000 for a high-efficiency natural gas heating boiler, which can save up to 30% a year on heating-related energy costs. National Grid also offers a rebate of up to \$310 for high-efficiency natural gas indirect water heaters, \$100 for weather-sensitive boiler reset heating controls, and \$25 per thermostat for installing programmable thermostats.
- **Learn more:** www1.nationalgridus.com/EnergyEfficiencyPrograms

New York State Weatherization Assistance Program

The Weatherization Assistance Program (WAP) is a program administered by New York State Homes and Community Renewal (HCR), which administers weatherization services to eligible buildings. 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).

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.

Learn more:

- **Community Environmental Center:** www.cecenter.org/wap-multifamily
- **NY Homes & Community Renewal:** www.nyshcr.org/programs/weatherizationassistance
- **Weatherization Assistance Providers in New York:** www.nyshcr.org/programs/weatherizationassistance/Providers.htm

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.

Green Jobs – Green New York

If your board decides to enroll your building in NYSERDA's Multifamily Performance Program (MPP), you will be eligible to receive low-interest financing through NYSERDA's Green Jobs – Green New York program. The Multifamily Performance Partner you contract will help guide you through this process.

- **Energy efficiency financing at half the market rate.** 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 0%. This effectively reduces the cost of your loan to about half the market rate for loans of up to \$1 million. You'll still make your loan payments directly to your lender, but at a much lower interest rate.
- **Learn more:** www.nyseda.ny.gov/multifamily-financing

New York City Energy Efficiency Corporation (NYCEEC)

The New York City Energy Efficiency Corporation (NYCEEC) is an independent, not-for-profit financial services firm dedicated to clean energy finance. NYCEEC was launched in 2011 by the City of New York to help achieve PlaNYC's green buildings initiatives and meet New York's climate action goals. NYCEEC provides financing for energy efficiency improvements and clean heat conversions in all buildings types throughout the five boroughs of New York City. Below are a few financing options offered by NYCEEC and its partners:

- **Equipment Finance.** NYCEEC can finance clean energy projects in all building types (e.g. multifamily, commercial and industrial, institutional). Projects include energy efficiency improvements, clean heat conversions, co-generation and renewable energy projects. Loan proceeds can be used for both hard and soft costs, including assessment and audit costs, design and engineering, equipment purchases, construction, installation, implementation, commissioning, establishment of monitoring and data protocols, and related activities.
- **Learn more:** Contact NYCEEC for more information at info@nyceec.com

- **NYCEEC Small Multifamily Loan Program.** NYCEEC can finance energy efficiency and clean fuel conversion projects in small multifamily buildings (5 to 75 units). To qualify, buildings must provide an energy survey and/or energy audit. Acceptable surveys or audits include, but are not limited to, those obtained through the Con Ed Multi-family Energy Efficiency Program, National Grid’s energy efficiency programs, NY-SERDA’s Multifamily Performance Program, Local Law 87 audits, or standalone energy audits.
- **Learn more:** www.nyceec.com/apply
- Green Mortgages. NYCEEC has partnered with Fannie Mae and the New York City Housing Development Corporation (HDC) to offer two green mortgage programs:
 1. **Fannie Mae Multifamily Property Improvements to Reduce Energy (M-PIRE) Loan Program.** M-PIRE provides additional mortgage loan proceeds for energy and water efficiency projects and capital improvement by including up to 50% of projected energy and water cost savings to a building’s pro forma net operating income (NOI). M-PIRE is available for both market rate and affordable rentals and co-ops. To learn more, contact one of these participating lenders:
 - Jackie Brooks, Wells Fargo: Jacqueline.B.Brooks@wellsfargo.com
 - Brian Liske, Greystone: BLiske@GreystoneUSA.com
 - Chris McGowan, Beech Street Capital: cmcgowan@beechstcap.com
 - **Learn more:** https://www.fanniemae.com/content/fact_sheet/m-pire-mortgage-loan-product-description.pdf
 2. **NYC Housing Development Corporation’s Program for Energy Retrofit Loans (PERL).** PERL provides additional mortgage proceeds for energy efficiency improvements and clean heat conversions. To be eligible, your building must either be in the HDC loan portfolio or in a loan or development program with the NYC Department of Housing Preservation and Development (HPD).
 - **Learn more:** www.nychdc.com/program-for-energy-retrofit-loans

Please contact NYCEEC at info@nyceec.com to discuss your individual projects. NYCEEC staff is available to answer questions at any stage of the project. Please also note that the financial products that NYCEEC offers are subject to change, so check for updates by visiting www.nyceec.com.

Appendix C

NYC Requirements

While most of the energy efficiency measures described in this handbook are optional, there are some upgrades that are required by law in New York City. The good news is that completing these required upgrades will help your building save more energy and money. 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 greenhouse gas emissions by roughly 5%, 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 U.S. 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.** Local Law 85 closes a loophole in the state energy code and requires all New York City buildings that undergo any renovation or alteration to meet the most current state energy code. Before 2009, buildings were only required to meet the energy code if renovations alter more than half of the building system. Closing this loophole now allows buildings to accrue energy savings from incremental upgrades.
- **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.

- **Local Law 88: Lighting Upgrades & Sub-metering.** Lighting in non-residential buildings accounts for nearly 20% 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 emissions.

Learn more:

- **Local Law 84 Benchmarking:** www.nyc.gov/LL84
- **Local Law 87 Audits and Retro-Commissioning:** www.nyc.gov/LL87
- **Urban Green Council Local Law 87 Checklist:** www.urbangreencouncil.org/Audits
- **NYC DOB Benchmarking:** www.nyc.gov/html/dob/html/sustainability/benchmarking.shtml
- **PlaNYC Green Buildings and Energy Efficiency:** www.nyc.gov/gbee



Local Law 43 and NYC Clean Heat

In April of 2011, the New York City Department of Environmental Protection (DEP) issued regulations that require buildings to convert from heavy forms of heating oil to cleaner fuels, beginning in July of 2012, and will phase out the use of all No. 6 and No. 4 heavy heating oils in New York City by 2030. The regulations were designed to balance near-term pollution reduction while minimizing costs for buildings. The goal is to reduce fine particulate matter (PM_{2.5}) by 50% by the end of 2013, which will save more than 100 lives each year and prevent hundreds of emergency room visits and hospitalizations. The requirements of the regulations include:

- 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.
- Beginning on July 1, 2012, DEP stopped issuing new Certificates of Operations for boilers burning No. 6 heating oil. At a minimum, buildings with expiring permits are now required to convert No. 4 oil, but are encouraged to convert to one of the cleanest fuels.
- All buildings must convert to one of the cleanest fuels upon boiler or burner retirement or by January 1st, 2030, whichever is sooner.

To help building owners and residents undertake the required heating oil conversions, the City established NYC Clean Heat, a program to provide assistance and accelerate the adoption of the cleanest fuels. The program offers assistance related to legal compliance, construction permitting, and technical issues to building owners, managers, and residents. For more information about NYC Clean Heat, see Appendix D.

Learn more:

- **NYC Clean Heat:** www.nyccleanheat.org

Resiliency – SIRR and BRTF Recommendations

In the wake of Hurricane Sandy, Mayor Bloomberg created the Special Initiative for Rebuilding and Resiliency (SIRR) in December 2012 to develop a plan to prepare and protect New York City against the impacts of climate change. On June 11, 2013, Mayor Michael Bloomberg announced the SIRR team's findings in a PlaNYC report called *A Stronger, More Resilient New York*. 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 Mayor Bloomberg and New York City Council Speaker Christine Quinn 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/sirr
- **Building Resiliency Task Force:** www.urbangreencouncil.org/BuildingResiliency

Appendix D

Technical Resources

NYC Carbon Challenge Technical Advisory Group

The NYC Carbon Challenge Technical Advisory Group is a resource for all buildings participating in the NYC Carbon Challenge. The group is made up of experts from the key players in NYC's energy efficiency market, including NYCEEC, NYSERDA, NYC Clean Heat, Urban Green Council, and leading engineering and environmental consulting firms. By joining the NYC Carbon Challenge, your building will gain direct access to the Technical Advisory Group, which will help make the process of saving energy as easy as possible.

Learn more: www.nyc.gov/carbonchallenges

NYC Clean Heat

NYC Clean Heat is a program that seeks to improve air quality and save lives by eliminating the use of heavy heating oil in New York City and accelerating the adoption of the cleanest fuels. The program provides information, technical assistance, and resources to building owners, managers, and residents and works as a liaison between organizations to help buildings make the switch from heavy heating oil to cleaner fuels.

Learn more: www.nyccleanheat.org

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.1000supers.com

GreeNYC

GreeNYC is a public engagement program that is dedicated to helping New Yorkers rise to the challenge of making our city greener and greater. Look for GreeNYC's mascot, Birdie, around the city and online for energy-saving tips!

Learn more: www.nyc.gov/greenyc

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

Appendix E

Online Resources

How to Get Started

- NYC Carbon Challenge: www.nyc.gov/carbonchallenges
- NYC Green Buildings & Energy Efficiency: www.nyc.gov/gbee
- NYSERDA Information for Co-Ops and Condos: www.nyserda.ny.gov/co-op-condo

Lighting Resources

- EPA ENERGY STAR® Lighting: www.energystar.gov/lighting
- Green Light New York: www.greenlightny.org
- GrowNYC CFL Recycling Programs: www.grownyc.org/cfl
- NYSERDA Lighting: www.nyserda.ny.gov/energy-star-lighting
- US DOE Lighting: www.energy.gov/public-services/homes/saving-electricity/lighting

Electrical Plug Load Resources

- ENERGY STAR® Products: www.energystar.gov/find_a_product
- NYSERDA Appliances: www.nyserda.ny.gov/energy-star-appliances

Other Electrical System Resources

- NYSERDA Advanced Submetering Program: www.nysrda.ny.gov/asp
- NYSERDA Power Management: www.nyserda.ny.gov/power-management

Insulation and Air Sealing Resources

- EPA ENERGY STAR® Air Sealing: www.energystar.gov/index.cfm?c=home_sealing.hm_improvement_sealing
- US DOE Air Sealing: <http://energy.gov/energysaver/articles/air-sealing-your-home>

Window Resources

- EPA ENERGY STAR® Windows, Doors, and Skylights: www.energystar.gov/windows
- US DOE Windows, Doors, and Skylights: <http://energy.gov/public-services/homes/windows-doors-skylights>

Roof and Heat Absorption Resources

- NYC °CoolRoofs: www.nyc.gov/coolroofs
- EPA Green Roofs Information: www.epa.gov/heatisland/mitigation/greenroofs.htm
- NYC DEP Green Infrastructure Grant Program: www.nyc.gov/html/dep/html/stormwater/nyc_green_infrastructure_grant_program.shtml

HVAC System Resources

- ENERGY STAR® Heat & Cool Efficiently: http://www.energystar.gov/?c=heat_cool.pr_hvac
- NYSERDA Heating & Cooling: www.nyserda.ny.gov/energy-star-heating-and-cooling

- US DOE Tips on Heating & Cooling: <http://energy.gov/energysaver/articles/tips-heating-and-cooling>

Oil Conversion Resources

- NYC Clean Heat: www.nyccleanheat.org
- NYC Clean Heat ULS No. 2 Oil: www.nyccleanheat.org/content/ultra-low-sulfur-2-oil
- NYC Clean Heat Natural Gas: www.nyccleanheat.org/content/converting-natural-gas

Domestic Hot Water Resources

- ENERGY STAR® Qualified Water Heaters: www.energystar.gov/index.cfm?c=water_heat.pr_help_me
- US DOE Water Heaters: www.energy.gov/public-services/homes/water-heating
- US DOE Solar Water Heaters: www.energy.gov/energysaver/articles/solar-water-heaters
- NYC DEP Water Saving Tips: www.nyc.gov/html/dep/html/ways_to_save_water/index.shtml
- ENERGY STAR® Save Water Save Energy: www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/save-water-save-energy

Combined Heat and Power (CHP) Resources

- NYSERDA Combined Heat and Power Performance Program: www.nyserda.ny.gov/chp
- NYC DOB Combined Heat and Power Systems Manual: www.nyc.gov/html/dob/downloads/pdf/combined_heat_and_power_systems.pdf

Solar PV Resources

- NYC DOB Solar Panels: www.nyc.gov/html/dob/html/sustainability/solar_panels.shtml
- NYSERDA Solar: www.nyserda.ny.gov/solar
- Sustainable CUNY Installing Solar in NYC: www.cuny.edu/about/resources/sustainability/solar-america/installingsolar.html
- NYC Solar Map: www.nycsolarmap.com
- US DOE Solar: www.energy.gov/science-innovation/energy-sources/renewable-energy/solar

Geothermal Heat Pumps Resources

- NYC DDC Geothermal Heat Pump Manual: www.nyc.gov/html/ddc/downloads/pdf/GeothermalHeatPump-Manual.pdf
- NYSERDA Geothermal Heat Pumps: www.nyserda.ny.gov/geothermal
- US DOE EERE Geothermal Heat Pumps: www.energy.gov/energysaver/articles/geothermal-heat-pumps

Operations and Maintenance Resources

- 32BJ Green Supers Training Programs: www.1000supers.com
- 32BJ New York Training Fund Programs: www.training.32bjfunds.com/NewYorkHome
- Urban Green Council Green Professional Training Programs: www.gpro.org/courses/ome/

Behavior Change Resources

- ENERGY STAR® Products: www.energystar.gov/find_a_product
- GreeNYC: www.nyc.gov/greenyc
- NYSERDA Energy Saving Tips: www.nyserda.ny.gov/energy-saving-tips
- NYSERDA Residential Energy Saving Tips: www.nyserda.ny.gov/residential-tips

Glossary

ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers

ASP – NYSERDA Advanced Submetering Program

BRTF – Building Resiliency Task Force

Btu – British thermal unit

CFL - Compact fluorescent light

CHP – Combined heat and power, also known as cogeneration

CO₂e – Carbon dioxide equivalent

Con Edison – Consolidated Edison, Inc.

DHW – Domestic hot water

ECM – Energy conservation measure

EER – Energy Efficiency Report

ESA – Energy services agreement

ESCO – Energy services company

GGBP – Greener, Greater Buildings Plan

GHG – Greenhouse gas

HCR – New York State Homes and Community Renewal

HEAP – Home Energy Assistance Program

HHS – U.S. Department of Health and Human Services

HVAC – Heating, ventilation, and air conditioning

kW or kWh – Kilowatt or Kilowatt Hour

LED – Light-emitting diode

MPP – NYSERDA Multifamily Performance Program

MMBtu – Million British thermal units

MW – Megawatt

NOI – Net Operating Income

NYCDDC – NYC Department of Design and Construction

NYC DEP – NYC Department of Environmental Protection

NYC DOB – NYC Department of Buildings

NYC HDC – NYC Housing Development Corporation

NYC HPD – NYC Department of Housing Preservation and Development

NYCEEC – New York City Energy Efficiency Corporation

NYSERDA – New York Energy Research and Development Authority

O&M – Operations and maintenance

OLTPS – NYC Mayor’s Office of Long-Term Planning and Sustainability

PM_{2.5} – Fine particulate matter

SBC – System benefits charge

SIRR – Special Initiative for Rebuilding and Resiliency

ULS – Ultra-Low Sulfur

US DOE – U.S. Department of Energy

US DOE EERE – U.S. Department of Energy Office of Energy Efficiency and Renewable Energy

US EPA – U.S. Environmental Protection Agency

WAP – Weatherization Assistance Program

Sources and End Notes

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2. Joint Center for Housing Studies at Harvard University, *America's Rental Housing: Meeting Challenges, Building on Opportunities*, online at <http://www.jchs.harvard.edu/sites/jchs.harvard.edu/files/americasrentalhousing-2011.pdf>
3. Analysis provided by NYSERDA.
4. Analysis provided by *Green Light New York*.
5. Analysis by California Energy Commission, online www.consumerenergycenter.org/lighting/bulbs
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
8. 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
9. Duke University, *NYC Co-Op and Condominium Board Guide to Energy Efficiency Upgrades in Buildings*, online at <http://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/5325/BBNY%20Full%20Report%20%28%20Final%29.pdf?sequence=1>
10. Analysis by NYC °CoolRoofs, online at www.nyc.gov/html/coolroofs/html/how/how.shtml
11. 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
12. US Environmental Protection Agency, online at www.epa.gov/heatisland/mitigation/greenroofs.htm
13. Duke University, *NYC Co-Op and Condominium Board Guide to Energy Efficiency Upgrades in Buildings*, online at <http://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/5325/BBNY%20Full%20Report%20%28%20Final%29.pdf?sequence=1>
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15. Deutsche Bank, Living Cities, and HR&A, *The Benefits of Energy Efficiency in Multifamily Affordable Housing*, online at https://www.db.com/usa/docs/DBLC_Recognizing_the_Benefits_of_Efficiency_Part_B_1.10.pdf
16. ENERGY STAR Building Upgrade Manual, online at http://www.energystar.gov/ia/business/EPA_BUM_CH9_HVAC.pdf
17. Analysis by NYC Department of Health and Mental Hygiene.
18. Analysis by Steven Winter Associates and NYC Mayor's Office of Long-Term Planning and Sustainability.
19. Analysis by Con Edison, Keyspan, U.S. Department of Energy, New York State Energy Research and Development Authority, in Building Service 32BJ and Urban Green Council's report *A Blueprint for Greening New York City's Buildings*, online at www.1000supers.com/pdf/Blueprint_for_Greening_NYCs_Buildings.pdf

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27. NYC Department of Design and Construction, *Geothermal Heat Pump Manual*, online at www.nyc.gov/html/ddc/downloads/pdf/GeothermalHeatPumpManual.pdf
28. Analysis by the U.S. Department of Energy and the U.S. Environmental Protection Agency.

For more information, please visit:
www.nyc.gov/carbonchallenges



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