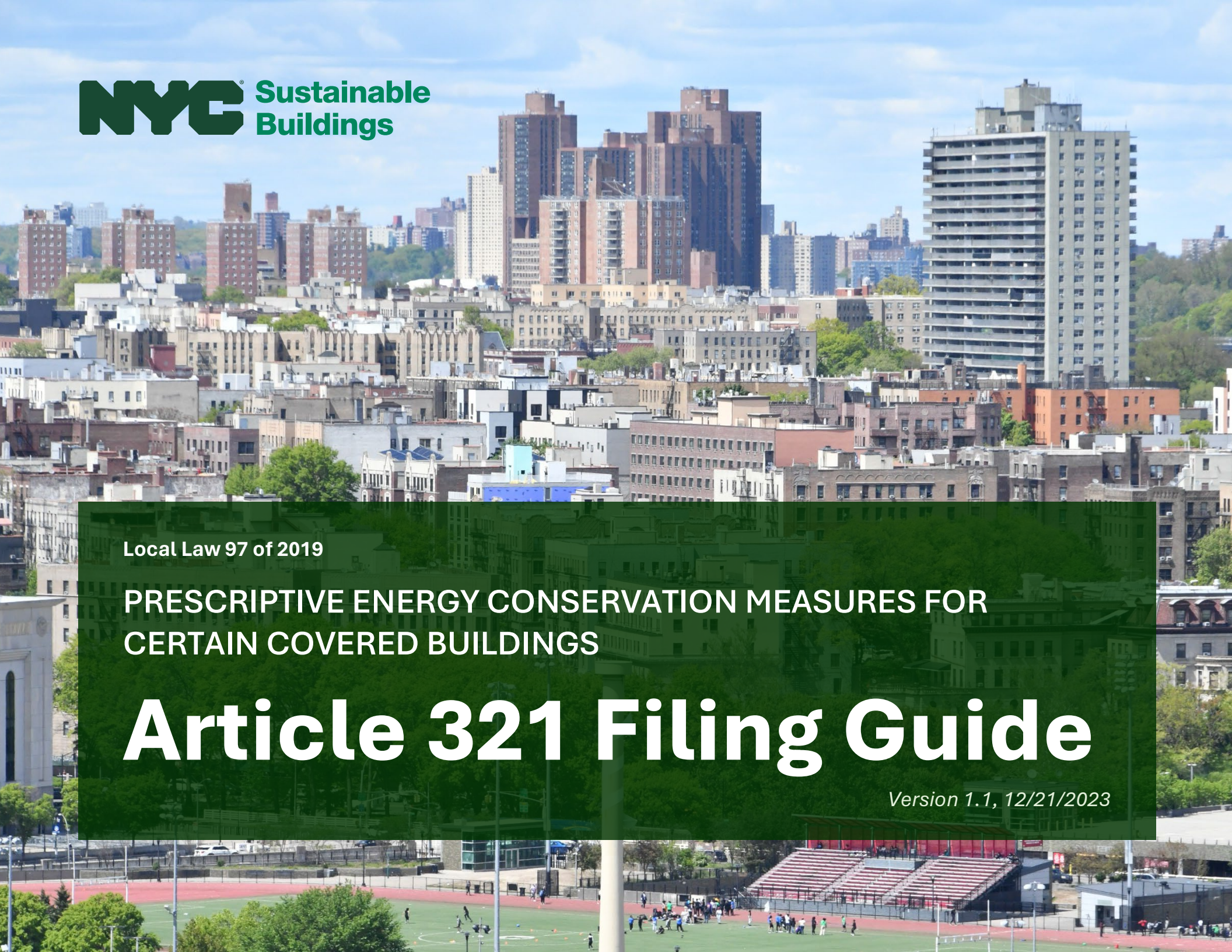

NYC Sustainable Buildings

Local Law 97 of 2019

PRESCRIPTIVE ENERGY CONSERVATION MEASURES FOR CERTAIN COVERED BUILDINGS

Article 321 Filing Guide

Version 1.1, 12/21/2023

I. Background

Greenhouse gas ("GHG") emissions – which are not limited to carbon dioxide but are often collectively referred to as "carbon emissions" or simply "carbon" – greatly alter climate and weather patterns when concentrated in Earth's atmosphere. Therefore, to slow the increasing frequency of extreme temperature and precipitation events, it is imperative to reduce the production of GHG emissions through a strategy of decarbonization.

Local Law 97 of 2019 ("LL97") is designed to greatly reduce building carbon emissions. To understand LL97 as a whole, please see this presentation from the Department's Office of Building Energy and Emissions Performance as well as the citywide strategy outlined here by the New York City ("NYC") Mayor's Office.

LL97 was first enacted in 2019 as part of a package known as the Climate Mobilization Act. The original LL97 text was later modified by LL147 of 2019, LL95 of 2020, LL116 of 2020, LL117 of 2020, LL126 of 2021 and LL77 of 2023; the composite law is still referred to as LL97. It is made up of Articles, which are primary legislation enacted by City Council, and supported by Rules, which are secondary legislation enacted by the Department.

LL97's Articles pertaining to privately-owned buildings are Article 320 and Article 321 of Title 28 of the NYC Administrative Code. Article 320's corresponding Rule is 1 RCNY §103-14; Article 321's corresponding rule is 1 RCNY §103-17.

Articles 320 and 321 only apply to certain structures categorized as **covered buildings**, as described in section I(A) of this guide. Two types of covered building are allowed to follow Article 321:

- **Rent regulated accommodations**
- **Houses of worship**

When Article 321 applies to a building, it applies to all portions of that building – even those that are neither rent regulated accommodations nor houses of worship. However, separate buildings on the same lot could be subject to Article 320 instead.

This Article 321 Filing Guide has been developed through collaboration between the Department of Buildings ("the Department") and members of the design, auditing, and energy services communities. Comments and questions related to the Guide can be sent to the Department at GHGEmissions@buildings.nyc.gov.

I(A) Covered Buildings

The size threshold for LL97 is 25,000 gross square feet ("GSF") for a single building or 50,000 GSF for multiple buildings that are either on a single lot or governed by the same condominium board; see chart on page 5 of this guide for details and exceptions.

Covered buildings lists ("CBLs") reflecting the Department's records for which tax lots are subject to LL97 are downloadable here. The CBLs are compiled using Department of Finance ("DOF") data and are intended as a preliminary reference only; the absence of a property from the list cannot be construed to mean relief from LL97 or any other applicable law. Conversely, the presence of a property on the list can be challenged (instructions here), with the list being revised upon evidence of more accurate/current information. Building owners should consult with legal representatives and registered design professionals ("RDPs") if there are any perceived discrepancies. In some cases, the Department will work with partner agencies to identify buildings that qualify for alternative compliance paths.

CBLs are broken out by BBL (Borough-Block-Lot), meaning that the entire tax lot is flagged even if individual buildings on the tax lot may not be "covered" for various reasons. Because LL97 compliance reports are submitted per BBL, the report contents would have to do the work of substantiating why certain buildings within the BBL should be excepted.

Covered buildings that require upgrades to comply with LL97 are eligible for various types of incentives, financing, and technical assistance. The NYC Accelerator helpdesk, described in more detail in Section V of this Guide, has a list of financing options here. The New York State Energy Research and Development Authority ("NYSERDA") has a guide to financial and technical support options here.

Notes on GSF vs. GFA:

- GSF = *Gross Square Feet or Gross Square Footage*, as defined in 1 RCNY §103-06 (the benchmarking Rule corresponding to Article 309 of Title 28 of the Administrative Code), is the "total square footage as provided in Department of Finance records." The CBLs provided by DOF to the Department use recorded GSF to determine which BBLs end up on the list.

- GFA = *Gross Floor Area*, as defined in 1 RCNY §103-06, 1 RCNY §103-14(a), and Section 202 of the NYC Building Code ("BC"), includes "all floors and spaces in a covered building" and may be different than the building's GSF as recorded by DOF. GFA should be calculated by an RDP to calculate allowable GHG emissions under LL97.

	Definitions of "covered building"	**General exceptions** (for more specific exceptions, see the law)
Article 320 / 1 RCNY §103-14, Building Energy and Emissions Limits (Local Law 97)	- Single building > 25,000 GSF; - Multiple buildings, either on the same tax lot or governed by the same condo board, which are in aggregate > 50,000 GSF (even if individual buildings are < 25,000 GSF). *Not covered until 2026:* - Buildings with at least one, but no more than 35%, rent-regulated dwelling units. *Not covered until 2035:* - Certain categories of affordable housing not subject to Article 321, as per the rightmost (green) column in this flowchart. Annual lists here.	- Certain utilities; - Certain garden-style apartments; - City buildings, except for the eleven CUNY senior (4-year) colleges; - Buildings covered under Article 321.
Article 321 / 1 RCNY §103-17, Energy Conservation Measure Requirements for Certain Buildings (Local Law 97)	Buildings meeting the same size thresholds as Article 320 that: - Are mainly used as the assembly space for a house of worship; - Are certain categories of affordable housing (see next page of this guide). Annual list here.	- Certain utilities; - Certain garden-style apartments.

I(B) Rent Regulated Accommodation

If a residential structure is a covered building, it is subject to Article 321 when it contains the specific type and amount of affordable housing prescribed in the definitions of "covered building" and "rent regulated accommodation" as defined in §28-321.1, this includes:

1. Buildings in which more than 35% of dwelling units are subject to rent regulation based upon:

    a. The Emergency Tenant Protection Act of 1974; or
    b. The Rent Stabilization Law of 1969; or
    c. The Local Emergency Housing Rent Control Act of 1962.

    NOTE: if the percentage of rent regulated units is more than 35% in 2024, but later falls to fewer than 35%, the building will become subject to Article 320 starting on January 1st of the year following the change. Should the percentage decrease happen before the end of 2025, the building will likely be subject to the Article 320 delayed compliance path (§28-320.3.10.1) with the initial building emissions report due on 5/1/2027.

2. Housing Development Fund Company co-ops (HDFC co-ops, incorporated under the Business Corporation Law and Article 11 of the Private Housing Finance Law)

3. A building that participates in a project-based federal housing program, such as:

    a. Section 8 Project-Based Rental Assistance ("PBRA"); or
    b. NYCHA Permanent Affordability Commitment Together ("PACT"); or
    c. Section 202 financing (supportive housing for the elderly); or

d. Section 811 financing (supportive housing for persons with disabilities); or
e. Continuum of Care ("CoC") leases serving formerly homeless individuals and families.

*NOTE: Buildings with dwelling units rented using federal assistance that is not project-based but tenant-based, such as Section 8 Housing Choice Vouchers ("HCVs"), are **not** subject to Article 321 and may be a covered building under Article 320. This is because tenant-based assistance is attached to the occupant and not the building.*

Categories of affordable housing not listed above are subject to **Article 320**, though the date of initial LL97 compliance can be delayed in certain cases. For another resource on LL97's applicability to various categories of affordable housing see the Department of Housing Preservation and Development's ("HPD") flowchart and FAQ.

I(C) Houses of Worship

Article 321 applies to covered buildings "whose main use or dominant occupancy is classified as occupancy group A-3 religious house of worship." The CBL identifies these properties through DOF records that indicate whether greater than 50% (dominant use) of the parcel has qualified for the Not-for-Profit property tax exemption, pursuant to Section 420-a of the NY State Real Property Tax Law ("RPTL"), under the religious exemption for house of worship.

Because this is a BBL or tax lot analysis, rather than a building analysis, the Department is aware that this is not a complete list of every building in NYC that is subject to LL97 and meets the House of Worship definition under the law. The Department asks building owners to self-identify if they believe a building is missing from the CBL or a building is erroneously included on the CBL; the steps for opening a case are the same as those described in section I(A) of this guide.

I(D) Definitions

The following terms are used throughout this guide and may benefit from additional information:

Common Areas

Common areas are spaces that are made use of by multiple tenants in a building. The term includes lobbies, amenity spaces, and shared storage rooms; it also includes non-occupiable space such as corridors, stairwells, janitorial closets, and equipment rooms.

Condensate

In steam heating systems, the liquid formed when steam releases heat energy and condenses into water mixed with dissolved gases. Condensate must be drained out of the system, so it does not cool the remaining steam, leak onto floors, or create water hammer.

NOTE: To improve efficiency, the condensate water and remaining heat energy can be recovered. And while it typically does not happen in residential applications, whenever hot condensate is discharged into a zone of lower pressure it can flash back into steam which can also be harnessed.

Electric Resistance Heating

A type of heating that results from passing electrical current directly through a conductor and capturing the heat released thereby. It is less energy-efficient than using electricity to power a process, such as in an electric heat pump or induction cooktop.

Hydronic Heating

A heating system that works by running hot water through a series of pipes and radiators.

Instrumentality

An independent entity that serves the public good and is sponsored / overseen by government but is not a government agency. Instrumentalities are exempt from taxation by other levels of government – e.g., federal instrumentalities like the Federal Reserve and Fannie Mae cannot be taxed by states, and local instrumentalities like port authorities and public universities / hospitals / libraries cannot be taxed by the federal government.

Non-Common Owner Areas

Non-common owner areas are spaces that are not made use of by tenants but only by ownership. The term includes management offices, staff locker rooms, and non-tenant storage rooms.

Non-Common Tenant Areas

Non-common tenant areas include dwelling units, community facilities, and retail stores, both leased and unleased.

One-Pipe vs Two-Pipe Heating

One-pipe steam / hydronic heating means that the same riser or branch pipe both supplies steam / hot water to radiators and collects the condensate / return water from those radiators. Two-pipe steam / hydronic heating means that the supply pipe is separate from the return pipe, resulting in more evenly distributed and temperature-controllable heating. One-pipe steam radiators are recognizable by being served by a single pipe, whereas two-pipe steam and all hydronic radiators have both a supply pipe and a return pipe.

Qualified Retro-Commissioning (RCx) Agent

See 1 RCNY §103-17(a) for required qualifications/credentials.

I. Background
   A. Covered buildings
   B. Rent regulated accommodation and other affordable housing
   C. Houses of worship
   D. Definitions

II. Article 321 compliance pathways

(includes RCx agent verification procedures – General)

III. Clarification of the Article 321 PECMs

(includes RCx agent verification procedures – Specific)

IV. Penalty mitigation
   A. Unexpected or unforeseeable event
   B. Eligible energy conservation project
   C. Mediated resolution

V. NYC Accelerator service types

II. Article 321 compliance pathways

Article 321 compliance for calendar year 2024, as outlined in §28-321.3 and 1 RCNY §103-17(b), can be achieved by submitting a report that follows one of two pathways:

- The Performance-based Pathway requires the report to be certified by an RDP and to describe the building as if it were subject to Article 320. In this report, the building emissions for **2024** must be shown to be under the emissions limit for calendar year **2030**, as described in §28-320.3.2 and expanded upon in 1 RCNY §103-14.

- The Prescriptive Pathway requires the report to be certified by a qualified retro-commissioning ("RCx") agent and to demonstrate the completion (or non-applicability) of the 13 Prescriptive Energy Conservation Measures ("PECMs") listed in §28-321.2.2 and further detailed in this guide.

From here through Section IV, this Guide focuses on the second compliance pathway (the "Prescriptive Pathway").

RCx agent verification procedures - General

1. To be considered "in good standing", the qualified RCx agent's credentials must be valid at both the time of inspection(s) and the time of report submission.

2. The qualified RCx agent must maintain a record of inspections performed, deficiencies identified, and re-inspections after repairs. Such records may be requested by the Department at any time.

3. Report formatting is described in 1 RCNY §103-17(b).
    a. Required attestations will be submitted in the *DOB NOW* system.
    b. Four of the PECMs (indicated with an asterisk throughout this guide) require more than attestations; they must be documented in worksheets following Department-provided templates:
        - **(#4) Radiator temperature controls***
        - **(#7) Indoor / outdoor temperature sensors***
        - **(#8) Steam traps***
        - **(#9) Master steam system venting***

4. Documentation that was used for utility incentive/rebate programs may be acceptable to demonstrate compliance with the PECM requirements. Examples:
    a. Advanced boiler clean and tune **(#3)**
    b. Steam trap replacement / orifice plate installation **(#4)(#8)**
    c. TRV and/or thermostat installation **(#4)**
    d. Insulation – piping or building envelope **(#5)(#11)**
    e. Air sealing – building envelope **(#11)**
    f. Lighting upgrades, as long as compliance with the applicable NYC Energy Conservation Code year is shown **(#10)**

I. Background
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V. NYC Accelerator service types

If an owner of a property that is subject to Article 321 chooses the Prescriptive Pathway rather than the 2030 emissions limit path, they must complete all PECMs (or indicate that the PECM does not apply) by the end of 2024.

To help with planning, the chart on the next page shows which PECMs apply to various kinds of heating systems. While different components are not necessarily addressed by the same contractor (see chart in Section V of this guide), it is important to implement the PECMs in a coordinated manner as addressing them one-by-one could compromise building systems.

- Coordinated PECM installation can also help with applying for incentives and other financial assistance.
- Even the three PECMs that do not directly adjust the heating system (lighting, building envelope, exhaust fan timers) are important to do in conjunction with the others, as they affect how much space heating is required.

Type of heating system	*Article 321 Prescriptive Energy Conservation Measures ("PECMs")*												
	1	2	3	4	5	6	7	8	9	10	11	12	13
	Temp. set points	*Repair leaks*	*Heating system function*	*Radiator temperature controls**	*Piping insulation*	*Water tank insulation*	*Indoor / outdoor temp. sensors**	*Steam traps**	*Master steam system venting**	*Lighting*	*Building envelope*	*Exhaust fan timers*	*Radiant barriers*
One-pipe steam	●	●	●		●	●	●		●	●	●	●	●
Two-pipe steam	●	●	●	●	●	○	●	●	○	●	●	●	●
Hydronic	●	●	●	●	●	●	●			●	●	●	●
Forced air	●		●				●			●	●	●	
Heat pump	●	●	●		●					●	●	●	
Electric resistance	●		●	●						●	●	●	●

○ = not applicable to vacuum pump systems

(#1) Temperature set points (#2) Repair leaks (#3) Heating system function (#4) Radiator temperature controls* (#5) Piping insulation (#6) Water tank insulation
(#7) Indoor/outdoor temp. sensors* (#8) Steam traps* (#9) Master steam system venting* (#10) Lighting (#11) Building envelope (#12) Exhaust fan timers (#13) Radiant barriers

(#1) Temperature set points

"Adjusting temperature set points for heat and hot water to reflect appropriate space occupancy and facility requirements"

Why necessary:

A building must provide its users with sufficient heating and domestic hot water. However, providing excessively heated air and water can cause discomfort and is an inefficient use of energy.

Requirements:

Set points must be verified for all central heating and hot water equipment. For buildings that have no central heating or hot water systems, set points must be verified for:

- 100% of heating and hot water systems serving common areas
- at least 20% of such equipment serving non-common owner areas
- at least 10% of such equipment serving non-common tenant areas

Scope does not apply to unitized systems with individual thermostats.

For this PECM, a Local Law 87 of 2009 ("LL87") Energy Efficiency Report ("EER") accepted by the Department includes the necessary work for compliance, as long as the audit and retro-commissioning work was completed not more than four years prior to the submission of the LL97 PECM report.

Minimum set points:

- Hot water must generally be delivered at a minimum of 110 °F and a maximum of 120 °F, per the 2022 NYC Plumbing Code.
- Interior temperature minimums for various occupancies generally fall within a range of 50 °F to 75 °F, as listed in BC Section 1204.

  - During off-hours, interior temperature minimums may be relaxed per Section C403.4.2 of the 2020 NYC Energy Conservation Code ("NYC ECC").
- Multifamily residential buildings have more detailed mandatory temperature minimums, as listed in Article 8 of the NYC Housing Maintenance Code:
  - Between 6 AM and midnight, residential sinks must deliver hot water at a minimum of 120 °F.
  - During heating season (October 1 to May 31), minimum interior temperature is 68 °F during the day (6 AM to 10 PM) and 62 °F overnight.

Selected best practices and other guidance:

a. This video, sponsored by the U.S. Department of Energy ("DOE"), provides a good overview of heating, ventilation, and air conditioning ("HVAC") control systems.

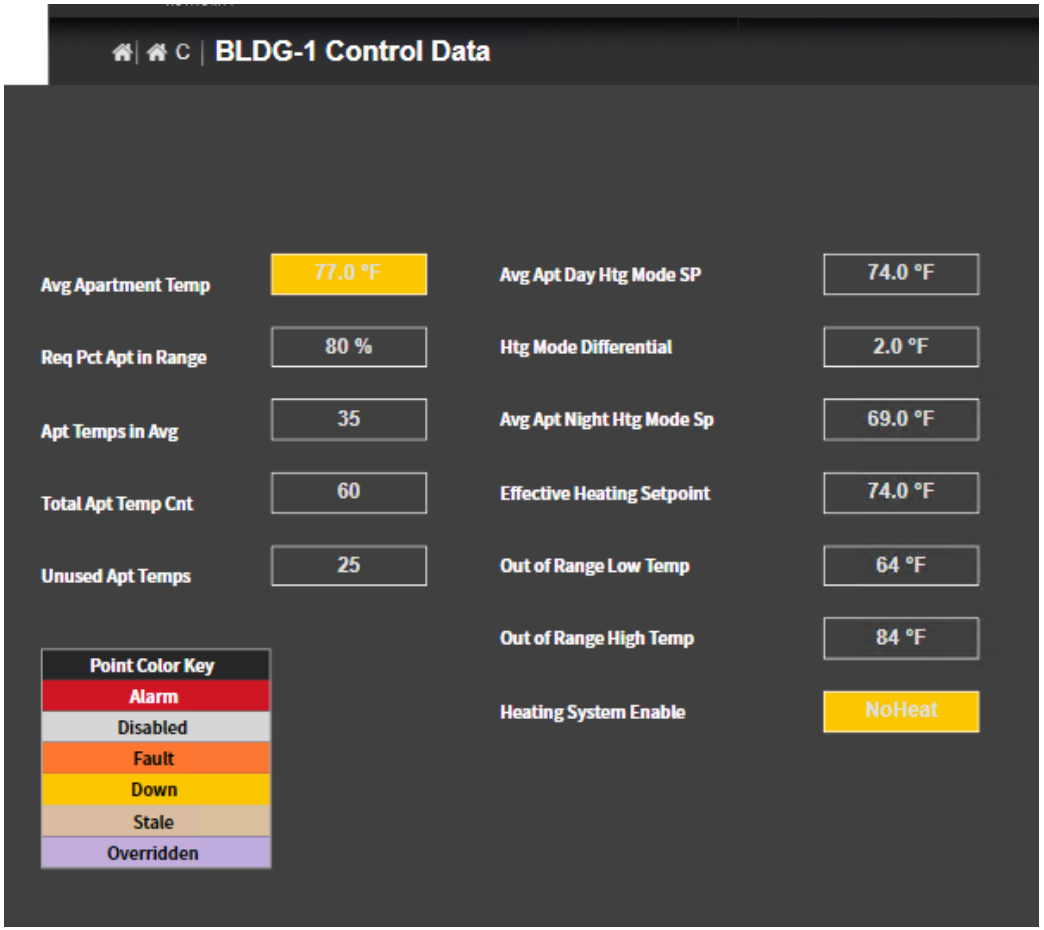
b. When building heating and cooling set points are not calibrated in relation to each other, there can be an overlap where both systems operate simultaneously in the same space. Such inefficient use of energy can be avoided through spacing the set points apart by an interval, or "deadband", where no heating or cooling takes place.
   - For new buildings and alterations subject to the NYC ECC, a 5 °F deadband is mandatory (C403.4.1.2).
   - When the heating and cooling are on separate thermostatic controls, the deadband can be achieved via limit switch, mechanical stop, or direct digital control system with software programming (C403.4.1.3).

c. DOE's Building America Solution Center, Adding Boiler Controls to an Existing Boiler in Multifamily Buildings.

d. DOE guide to programmable thermostats, including limitations when used with heat pumps.

e. DOE list of Energy Star-certified smart thermostats.

f. This measure should be verified in conjunction with **(#4) Radiator temperature controls*** and **(#7) Indoor / outdoor temperature sensors***. Verification may need to wait until after **(#3) Heating system function** and **(#11) Building envelope** are implemented.



Temperature setpoints in Building Management System ("BMS")

Image courtesy of the New York City Housing Authority ("NYCHA")

(#2) Repair leaks

"Repairing all heating system leaks"

Why necessary:

Leak detection and repair should be a part of regular system maintenance, since (water, steam, oil, and/or refrigerant) leaks have cascading detrimental effects, such as reducing heating system operating efficiency, damaging surrounding interior finishes, and increasing stress on heating system components. Leaks out of a closed-loop steam or hydronic heating system necessitate adding feedwater, which has more dissolved solids and gases than water that has been heated through and will exacerbate scale buildup and metal corrosion.

Requirements:

Readily accessible leaks should be identified through visual inspection and review of maintenance records / tenant complaints, with all leaks repaired by the end of 2024. Inspection must cover:

- 100% of common areas
- at least 20% of non-common owner areas
- at least 10% of non-common tenant areas

For this PECM, an LL87 Energy Efficiency Report accepted by the Department includes the necessary work for compliance, as long as the audit and retro-commissioning work was completed not more than four years prior to the submission of the LL97 PECM report.

System components not subject to this PECM:

- Ducts
- Distribution piping concealed within walls, ceilings, or floors
- Forced-air systems

- Electric resistance heating systems

Selected best practices and other guidance:

a. DOE Steam System Survey Guide produced by the Oak Ridge National Laboratory

b. DOE guide to leak-detection technologies, including sensors, thermal imaging, and listening sticks

Water leak requiring repair

Image courtesy of NYCHA

(#3) Heating system function

"Maintaining the heating system, including but not limited to ensuring that system component parts are clean and in good operating condition"

Why necessary:

Dirty/clogged and inaccurate/inoperable components can reduce heating system operating efficiency and increase stress on the rest of the system, thereby leading to higher energy use and shortening the system's overall lifespan. Besides cleaning or replacement of components, maintenance also includes calibrating processes (e.g., damper/valve/burner modulation, boiler/heat exchanger/fan coil sequence control, short cycling prevention).

Requirements:

Proper function can be verified through field observation combined with review of historical data. Investigation may include: interviews with facility staff, managers, and tenants; trend analysis; dedicated data loggers; or review of available operations, maintenance (including Department of Building ("DOB") inspections and internal maintenance as per manufacturer's requirements), and complaints records. For this PECM, an LL87 Energy Efficiency Report ("EER") accepted by the Department includes the necessary work for compliance, as long as the audit and retro-commissioning work was completed not more than four years prior to the submission of the LL97 PECM report.

NOTE: While forced-air systems and electric resistance heating systems are exempt from PECM #2 (Repair leaks), they are not exempt from this PECM.

Sample maintenance procedures (including, but not limited to):

Check filters and vents, clean or replace as needed. Check condensate drains and clean as needed. Remove sediment and limescale from tanks, skim oily residue and flush dirty boiler water, optimize waterlines, and replace anode rods (in

non-cast-iron boilers). Clean heat pump evaporator coils and condenser coils. Verify accuracy of sensors and gauges. Check that equipment sequences of operation are functioning properly.

Selected best practices and other guidance:

a. DOE maintenance guides:
   - Furnaces and boilers
   - Steam or hydronic radiators

b. DOE Standard Work Specifications, Heating and Cooling section.

c. DOE Operations & Maintenance Best Practices, Section 9.2, Boilers.

d. NYC Accelerator steam system tech guides (also applicable to other PECMs):
   - Two-pipe steam optimization
   - One-pipe steam optimization

e. ASHRAE Standard 100 Annex D provides guidance on energy efficient building operations and maintenance.

Visual inspection of boiler firetubes

Image courtesy of NYCHA

(#4) Radiator temperature controls*

"Installing individual temperature controls or insulated radiator enclosures with temperature controls on all radiators"

Why necessary:

Opening a window is the least energy-efficient method of dealing with an overheated radiator, but sometimes the only option many people have. Proper controls provide a better option. Steam and hydronic radiators all have at least one valve with a knob on it, but that knob generally serves more as an on/off switch than a temperature control, unable to prevent radiators from overheating a room.

Requirements:

At least 80% of all radiators must be surveyed to confirm whether temperature controls are installed and functioning. Refer to 1 RCNY §103-17(c)(4) for specific reporting requirements based on type of heating system. For wireless ("smart") systems, real-time and historical data may be reviewed as part of the survey.

Retrofit options for existing radiators:

a) Thermostatic radiator valves ("TRVs")
   - For two-pipe steam systems, TRVs should be installed. To maximize efficiency, radiators should also have either new steam traps or orifice plates properly sized to prevent steam from entering the return piping (see PECM #8).
   - TRVs or insulated radiator enclosures are not mandatory for one-pipe systems where the distribution piping has proper system-wide venting and where wireless sensors have been installed in at least 25% of the dwelling units (such sensors must provide operational feedback to the boiler).

b) Thermostatic radiator enclosures ("TREs")
   - TREs are boxes that store heat and use electric fans to deliver hot air into the room as needed. These may be installed for radiators in lieu of TRVs where records indicate overheating.
   - Currently manufactured for steam systems only.

c) Thermostats
   - For electric radiators, confirm a functioning thermostat is installed.

d) Hydronic radiators
   - For hydronic radiators, confirm that controls are functioning where present.

Selected best practices and other guidance:

a. For one-pipe steam systems, TRVs or insulated radiator enclosures with a thermostatically controlled fan may be helpful on radiators that are located nearest the boiler and where they regularly overheat the room.

b. TRVs may not function properly unless the system is balanced and tuned, including verification of **(#1) Temperature set points**, **(#7) Indoor / outdoor temperature sensors***, and **(#13) Radiant barriers**.
In steam systems, TRVs should be installed in conjunction with **(#8) Steam traps*** and **(#9) Master steam system venting***, and care should be taken to not over-pressurize the system.

c. Detailed guidance for TREs, and additional guidance for TRVs, in the NYS Department of Public Service ("DPS") Technical Resource Manual ("TRM"), are updated yearly.

d. DOE's Building America Solution Center, Thermostatic Radiator Valves on Steam Heating Systems.

e. For new buildings and alterations subject to the NYC ECC, thermostatic controls are mandatory (C403.4.1).

Two-pipe steam radiator with a TRV

Image courtesy of NYCHA

Thermostatic radiator enclosure

Image courtesy of the manufacturer

(#5) Piping insulation

"Insulating all pipes for heating and/or hot water"

Why necessary:

While some steam/hot water pipes are intentionally left uninsulated to warm the space that they pass through, most other distribution piping in heating and domestic hot water systems should be insulated. The main benefit of piping insulation is reduction of heat loss, allowing the boiler and/or water heater to operate more efficiently and use less energy. Secondary benefits include:

- Reduced risk of burns and fires from hot pipe surfaces
- Improved steam quality (less condensation)
- Reduced wait time for domestic hot water
- Reduced risk of freezing when ambient temperature drops below the freezing point

Requirements:

Pipes, fittings, and valves that are part of steam or hot water distribution systems should be visually inspected in:

- 100% of common areas
- at least 20% of non-common owner areas
- at least 10% of non-common tenant areas

Any missing or degraded piping insulation must be installed, replaced, or repaired by the end of 2024.

NOTE: compliance with this PECM does not require owners to remove wall, floor, or ceiling assemblies. Owners are also not required to disturb asbestos-containing materials ("ACMs"), which were once a popular material for piping insulation – and one reason why insulation may have been removed over the years.

Selected best practices and other guidance:

a. It may not be advisable to insulate condensate piping in pumped-return steam systems, as overly hot condensate can increase the risk of cavitation and thereby damage the pump(s). As such, this measure is NOT mandatory for pumped-return steam piping.

b. While beyond the scope of LL97, piping whose surface temperatures are lower than their surrounding environment should ideally also be insulated. The benefits of insulating low-temperature piping are similar to those of insulating high-temperature piping, with the additional benefit of reduced condensation on the pipe surface. Refrigerant piping in heat pump systems should also be insulated to optimize the heat exchange process.

c. In renovations, whenever wall, floor, or ceiling assemblies are removed and uninsulated piping is exposed, the piping must be insulated in accordance with Article 316 of Title 28 of the Administrative Code.

d. In new buildings and alterations subject to the NYC ECC, piping insulation is mandatory:
   - Minimum pipe insulation thicknesses are listed in Table C403.11.3.
   - For piping that is part of a heating and/or cooling system, requirements for weather protection and exceptions where insulation is not required are listed in C403.11.3.
   - For piping that is part of a service hot water system, detailed requirements and exceptions where insulation is not required are listed in C404.4.

e. DOE guide to insulating hot water pipes.

Insulated and labeled water pipes

Image courtesy of NYCHA

(#6) Water tank insulation

"Insulating the steam system condensate tank or water tank"

Why necessary:

Newer tanks for boilers and hot water heaters often come with a layer of rigid insulation integrated into the tank shell itself, but older tanks may need to be insulated in the field with a flexible blanket. Insulation reduces standby heat loss, thereby lowering energy use by reducing the need for continual reheating. However, field-applied insulation must be done very carefully to avoid common pitfalls (see the DOE guide under "Selected best practices" below).

Insulating condensate tanks can also improve system efficiency, since condensate often has a high level of heat energy that can be reused. But as stated under PECM #5, condensate water that is too hot can damage pumps, so condensate tank insulation is not recommended in pumped-return systems.

Requirements:

Feedwater, condensate, and hot water tanks should be reviewed for the presence of insulation, including review of specification sheets, and feeling for heat loss at the tank enclosure. Insultation should meet the requirements of the NYC ECC to the extent feasible given existing clearances.

NOTE: compliance with this PECM does not require owners to disturb ACMs, which were once a popular material for tank insulation – and one reason why insulation may have been removed over the years.

Selected best practices and other guidance:

a. DOE guide to insulating water heater tanks.

b. In new buildings and alterations subject to the NYC ECC, unfired storage tanks (i.e. not boiler or hot water heater tanks that contain heating elements) have a minimum insulation requirement of R-12.5 (Table C404.2).

Insulated hot water tank

Image courtesy of NYCHA

(#7) Indoor/outdoor temperature sensors*

"Installing indoor and outdoor heating system sensors and boiler controls to allow for proper set-points"

Why necessary:

Steam and hydronic boilers are sized to provide sufficient warmth on the coldest day of the year but running them at full capacity on warmer days can cause discomfort and is an excessive use of energy. Unfortunately, many systems are either manually set or have only primitive outdoor sensors that result in short cycling.

Upgrading the heating system sensors to be more weather responsive is an effective way to modulate boiler output. There are both indoor and outdoor components:

- Wireless sensors at radiators can tell the boiler precisely how much heat is needed.
- Outdoor reset ("ODR") control, in steam systems and hydronic systems with non-condensing boilers, can optimize on-off cycling length based on outside temperature.

For forced-air systems, sensors that measure outside air temperature, supply and return air temperature, air flow rate, and zone temperature can help modulate heat output and control of wireless duct dampers.

Requirements:

All boilers must be inspected, and any missing or non-functioning indoor or outdoor reset temperature sensors identified during inspection should be installed or repaired by the end of 2024. Refer to 1 RCNY §103-17(c)(7) for the percentage of dwelling units to be checked for indoor sensors, as well as for reporting requirements.

System components not subject to this PECM:

- Central heat pumps (because sensors are integral to system)
- Unitized heating (e.g., mini-splits, PTACs, PTHPs)
- Radiant heating
- Electric resistance heating

Selected best practices and other guidance:

a. When used with non-condensing hydronic boilers, outdoor reset ("ODR") must be calibrated so that the return water is hot enough (130 to 140 °F) for the flue gases to not condense. Flue gas condensation in a non-condensing boiler has a corrosive effect and will damage boiler components.

b. DOE guide on ODR control (aka "modulating aquastats") for gas-fired boilers and oil-fired boilers.

c. DOE list of heating system sensor types.

d. Other useful boiler-related sensors include supply temperature, return water/condensate temperature, makeup water temperature, and stack temperature.

e. In new buildings and alterations subject to the NYC ECC, outdoor temperature setback control is mandatory for all hydronic heating systems (C403.4.1.5), and indoor sensors are required at each thermal zone (C403.4.1).

f. Should be verified in conjunction with **(#1) Temperature set points** and **(#4) Radiator temperature controls***.

Outdoor temperature sensor

Image courtesy of NYCHA

(#8) Steam traps*

"Replacing or repairing all steam traps such that all are in working order"

Why necessary:

Steam traps are located at the return pipe of every radiator in a two-pipe steam system, and their purpose is to contain valuable steam while allowing condensate, air, and non-condensable gases to escape. They are small but mighty, and when even a single trap fails it can result in cascading system-wide failures – this is why steam trap maintenance must be routine. Specific impacts:

I. A steam trap that fails in the open position will leak steam into the condensate return, resulting in more steam production and energy use than would otherwise be needed. If there are pumps in the system, the leaked steam will likely damage the pumps.
II. A steam trap that fails in the closed position (a "cold trap") will allow air and condensate to build up within the radiator, resulting in less heat output and accelerating corrosion.
III. Both types of steam trap failure can result in water hammer and other adverse effects that are both noisy and damaging to the entire system.

Most steam traps are generally easier to replace than to repair. Orifice plates have longer lifespans than other types of steam trap since they have no moving parts; however, they require precise calculations/calibration and constant pressure to function effectively.

Testing requirements:

Visual observation, temperature testing, and/or ultrasonic testing of all steam traps and orifice plates in the system should be used to identify steam traps for repair/replacement. Remedial work must be completed by the end of 2024.

For two-pipe steam distribution systems:

- The main supply and main return piping surface temperatures must have a differential of 30 °F or more.
- If a two-pipe steam distribution system has a differential between the main supply and main return piping surface temperatures of less than 30 °F, all steam traps in the common areas, at least 20% of steam traps in the non-common owner areas, and at least 10% of steam traps in the non-common tenant areas served by the major equipment must be tested to verify proper functionality.
- If more than 20% of the sample set for each sample size is found to be not functioning properly then all respective areas served by the two-pipe steam distribution must be tested to verify the steam traps are functioning properly and all steam traps found to be functioning improperly must be replaced or repaired.

Documentation requirements:

A detailed schedule should be created to record each device's location, condition, date of initial inspection, whether installation, replacement, or repair was performed, and date of re-inspection. Refer to 1 RCNY §103-17(c)(8) for additional inspection and reporting requirements.

Selected best practices and other guidance:

a. As new steam traps can be damaged immediately by malfunctioning ones elsewhere in the system, it is best to replace all faulty steam traps at once while the boiler is off. In larger buildings, this may only be possible outside of heating season.

b. Another way to avoid damaging new steam traps is to install them after performing other PECMs to get the system into shape: **(#2) Repair leaks**, **(#3) Heating system function**, **(#4) Radiator temperature controls***, and **(#9) Master steam system venting***.

c. A typical steam trap has a lifespan of anywhere from 3 to 10 years. There are different types of steam traps (thermostatic, mechanical, thermodynamic, orifice plate), and an owner should consult with a qualified service provider to select the best type for each location in the system.

d. Steam traps (along with valves, flanges and other fittings) can have removable insulation jackets (refer to PECM #5 for benefits of insulation); however, not all types can be insulated.

e. DOE review of steam trap types, with a focus on the advantages / disadvantages of orifice plates.

f. DOE review of steam trap performance assessment methodologies.

g. DOE Operations & Maintenance Best Practices, Section 9.3, Steam Traps.

Thermostatic steam trap in a dwelling unit

Image credit DOB

(#9) Master steam system venting*

"Installing or upgrading steam system master venting at the ends of mains, large horizontal pipes, and tops of risers, vertical pipes branching off a main"

Why necessary:

Steam distribution systems fill with air when they are turned off, and this air must then be pushed out when the steam turns back on. Individual radiators are vented by steam traps (in two-pipe systems) and air vents (in one-pipe systems), but those should ideally let air out slowly and will hiss if forced to take on system venting duties. To flush air out quickly so the steam can reach all the radiators at around the same time, master venting should be installed at the ends of the supply piping – and in two-pipe systems, also near the ends of the return piping.

- Without master venting, the radiators farthest away from the steam source can take a long time to heat up, making the spaces served seem underheated.
- Master vents may have been removed from the system at some point, or they may exist but be poorly functioning. In these cases, the vents should be re-installed or repaired/replaced.

NOTE: Master venting should not be used in two-pipe steam systems with vacuum pumps.

Requirements:

Refer to 1 RCNY §103-17(c)(9) for inspection and reporting requirements. Partial sampling is not sufficient; the entire system must be checked.

Selected best practices and other guidance:

a. Higher boiler pressure is not more effective at pushing air out of the system, as it decreases steam velocity. With proper master venting, the system should fill more quickly under lower boiler pressure.

b. On down-feed systems, the master vents should be installed at the base of the risers. On up-feed systems, some master vent locations may end up being inside the top-floor dwelling units.

c. Filters can be installed ahead of each vent to reduce the risk of debris buildup and clogging.

d. DOE guide to master steam system venting in one-pipe systems.

e. DOE guide to steam system balancing for multifamily buildings.

f. Some of the ways in which air negatively affects steam system performance include:
   - Air mixed with steam reduces the steam's heat energy
   - Air is a thermal barrier, so it can block heat conduction between steam and a radiator wall
   - When air (e.g., oxygen, carbon dioxide) dissolves into condensate water, the conductivity of the water is increased, accelerating the electrochemical process of corrosion on surrounding metal components

g. Also see the steam resources under **(#3) Heating system function**.

(#10) Lighting

"Upgrading lighting to comply with the standards for new systems set forth in section C405 of the New York city energy conservation code and/or applicable standards referenced in such energy code on or prior to December 31, 2024. This provision is subject to exception 1 in section 28-310.3"

Why necessary:

Upgrading a building's lighting to current energy conservation standards is often the most cost-effective way to reduce energy use. Some upgrades, like lamp replacements and lighting power calculations, can even be done by building staff as part of routine maintenance.

Requirements:

The lighting system upgrade report required to be submitted by 5/1/2025 for Local Law 88 of 2009 ("LL88") compliance (Article 310 of Title 28 of the Administrative Code and the corresponding 1 RCNY §103-18) shall be used to document this PECM. Such report is prepared by a licensed electrician or a registered design professional ("RDP"), not by the qualified RCx agent, and must demonstrate compliance with the 2009 NYC ECC at a minimum. If the lighting was installed after 7/1/2010, then it must follow a later NYC ECC, as indicated in the chart on page 43 of this guide. Note that landmarked buildings are not exempt from these requirements except where historic lighting is deemed to be part of the historic fabric.

Selected best practices and other guidance:

a. Links to free online versions of the 2020, 2016, 2014, and 2011 NYC ECCs are here. A link to the 2009 NYC ECC is here; note that it references the 2007 New York State ("NYS") energy code which must be purchased.

b. DOE guide to lighting controls.

c. How-to guide, published by the Department, for lighting power calculations and lighting control programming.

d. DOE Operations & Maintenance Best Practices, Section 9.12, Lighting.

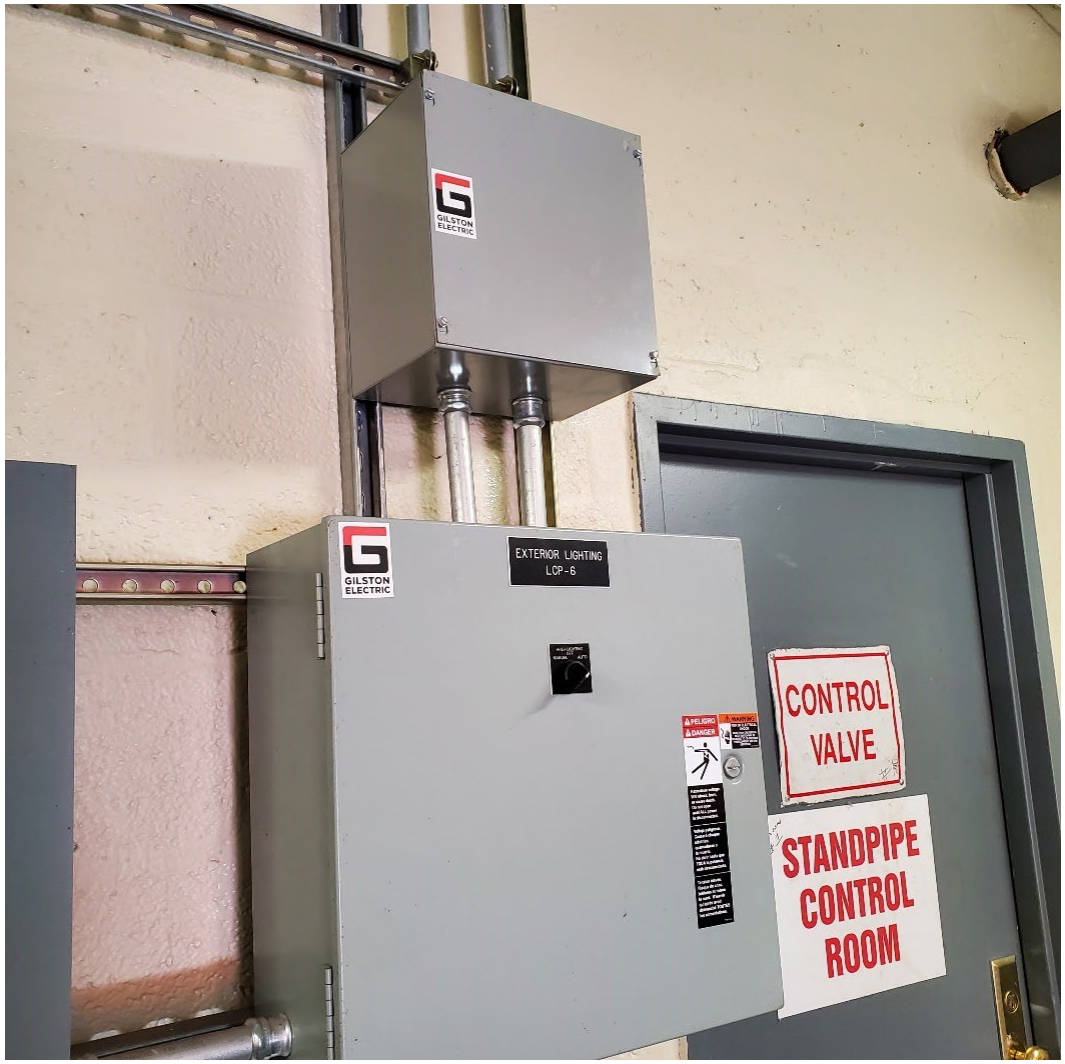
e. NYSERDA guide to different types of LEDs.

f. Detailed calculations for how to determine energy savings resulting from lighting upgrades can be found in the "Lighting" section of the NYS DPS TRM, updated yearly.

g. In multifamily buildings or lots, LL88 only applies to common/base building spaces, not to individual dwelling units. It is recommended that property managers of such covered buildings encourage unit owners and tenants to perform lighting upgrades within their units, perhaps by sharing the links listed above.

Applicable NYC Energy Conservation Code for lighting upgrades required by Article 321 **(Also applies to § 28-310.3, exception 1)**	*Lighting system filed* or otherwise documented as having been installed on or after*				
	July 1, 2010	**December 28, 2010**	**January 1, 2015**	**October 3, 2016**	**May 12, 2020**
2009 NYC Energy Conservation Code ("ECC") Local Law 85 of 2009, based on: - 2007 Energy Conservation Construction Code of NY State ("ECCCNYS") - 2004 International Energy Conservation Code ("IECC") - ASHRAE 90.1-2001					
2011 NYC ECC section 505, based on: - 2010 ECCCNYS - 2009 IECC - ASHRAE 90.1-2007					
2014 NYC ECC section C405, based on: - 2014 ECCCNYS - 2012 IECC - ASHRAE 90.1-2010					
2016 NYC ECC section C405, based on: - 2016 ECCCNYS - 2015 IECC - ASHRAE 90.1-2013					
2020 NYC ECC section C405, based on: - 2020 ECCCNYS with NYStretch-2020 supplement - 2018 IECC - ASHRAE 90.1-2016					

**in accordance with the completeness standards listed in Buildings Bulletin 2020-002*



Exterior Lighting Controls

Image courtesy of NYCHA

(#11) Building Envelope

"Weatherizing and air sealing where appropriate, including windows and ductwork, with focus on whole-building insulation"

Why necessary:

Weatherizing a building makes the indoor conditioned space more resistant to changes in outdoor temperature and humidity. This effectively makes heating and cooling systems more efficient as the systems can run at lower intensities and use less energy to maintain a comfortable indoor environment. Weatherizing by plugging cracks and holes in the building thermal envelope slows convective heat transfer, which is the movement of air and moisture. Weatherizing by insulating walls/floors/ceilings slows conductive heat transfer, which is when temperature changes pass through solid materials.

Requirements:

Visual inspection for air leakage at envelope openings (including doors, windows, PTACs, skylights, roof curbs, vents, elevator and stair bulkheads, and loading docks) and penetrations between conditioned and unconditioned spaces (including piping, ducting, conduits and other wiring, chimneys, flues, and dropped soffits). Missing or damaged gaskets, sealant, caulking, weatherstripping, etc. must be installed, repaired, or replaced by the end of 2024.

Interior visual inspection must cover:

- 100% of common areas
- at least 20% of non-common owner areas
- at least 10% of non-common tenant areas

Exterior visual inspection can be limited to easily accessed areas of the building envelope; specialized façade access is not necessary. For this PECM, an LL87 Energy Efficiency Report (EER) accepted by the Department includes the

necessary work for compliance, as long as the audit and retro-commissioning work was completed not more than four years prior to the submission of the LL97 PECM report.

Selected best practices and other guidance:

a. To comply with this PECM, owners are not required to disturb potential ACMs, nor to replace broken fenestration.

b. DOE general guide to air sealing, covering topics like detecting leaks, caulking, weatherstripping, and insulation.

c. DOE's Building America Solution Center, all "Air Seal" and "Building Science Introduction" topics.

d. NYC Mayor's Office's Carbon Challenge Handbook for Multifamily Buildings, which has an illustrated overview of "Air Sealing and Insulation" topics.

e. NY State Department of Homes and Community Renewal ("DHCR")'s Weatherization Assistance Program ("WAP"), which provides no- and low-cost weatherization for income-eligible homeowners and owners of multifamily rental buildings with income-eligible tenants.

f. NYSERDA's Multifamily Buildings Low-Carbon Pathways Program offers financial incentives to building owners to perform more comprehensive envelope upgrades.

g. In new buildings and alterations subject to the NYC ECC, allowable air leakage rates are listed in section C404.5.

h. ASHRAE Standard 100 Annexes D and E provide guidance on energy efficient building envelope upgrades and maintenance.

(#12) Exhaust fan timers

"Installing timers on exhaust fans"

Why necessary:

Exhaust fans are critical for removing moisture, pollutants, and stale/overheated air from areas like bathrooms, kitchens, and laundry rooms. Some fans are designed to run continuously and quietly at low speeds; these should not have timers / occupancy sensors / humidistats (humidity sensors). On the other hand, fans that are designed to run intermittently at higher speeds are sometimes left on even when they are not needed; this is an excessive use of energy, both to run the fan motor and to replace the conditioned air that is needlessly exhausted.

Requirements:

Refer to 1 RCNY §103-17(c)(12) for inspection requirements. Interior visual inspection must cover:

- 100% of common areas
- at least 20% of non-common owner areas
- at least 10% of non-common tenant areas

Selected best practices and other guidance:

a. DOE guide to intermittent fan installation.

b. In new buildings and alterations subject to the NYC Mechanical Code ("MC"), Table 403.3.1.1 lists Minimum Ventilation Rates for various occupancies and space types.

c. For fans with two speeds, the timer or sensor can be used to switch back to the lower speed.

Exhaust fan with timer

Image courtesy of NYCHA

(#13) Radiant barriers

"Installing radiant barriers behind all radiators"

Why necessary:

Reflective, insulated surfaces placed on the wall behind a (steam, hydronic, or electric) radiator can prevent heat from escaping through the wall, thereby improving the efficiency of the radiator and reducing energy use.

Radiators transfer heat primarily via two mechanisms: 1) by heating surrounding air that then rises up to displace cooler air and fill the room (convection); and 2) by sending out infrared radiation to heat up objects in the line of sight without affecting the intervening air (radiant heat). In addition, when heated air touches a wall, it transfers heat into the wall (conduction). A radiant barrier's reflective surface can bounce radiant heat away from a wall and back into a room, and its insulation can slow conductive heat transfer to preserve the heat energy of the inside air.

Requirements:

Refer to 1 RCNY §103-17(c)(13) for inspection requirements. It is recommended that installation of radiant barriers occur in conjunction with **(#4) Radiator temperature controls***.

Selected best practices and other guidance:

a. Radiant barriers work best when they maintain an air gap between themselves and the radiator surface. This prevents heat transfer via conduction and also allows for more efficient convection.

b. DOE description of radiant barriers.

I. Background
   A. Covered buildings
   B. Rent regulated accommodation and other affordable housing
   C. Houses of worship
   D. Definitions

II. Article 321 compliance pathways
   (includes RCx agent verification procedures – General)

III. Clarification of the Article 321 PECMs
   (includes RCx agent verification procedures – Specific)

IV. Penalty mitigation
   A. Unexpected or unforeseeable event
   B. Eligible energy conservation project
   C. Mediated resolution

V. NYC Accelerator service types

IV. Penalty Mitigation

A covered building subject to Article 321 must be shown in calendar year 2024 to be under the emissions limit for calendar year 2030 as described in §28-320.3.2 and expanded upon in 1 RCNY §103-14, or demonstrate the completion (or non-applicability) of the 13 Prescriptive Energy Conservation Measures ("PECMs") as described in the law, rule, and in this guide. However, where an owner is unable to fully comply under either path, penalty mitigation may be possible. An owner may pursue penalty mitigation in consultation with the Department under the following circumstances:

IV(A) Unexpected or unforeseeable event

An unexpected or unforeseeable event or condition out of the control of the owner has precluded compliance, where a building was damaged as a result of a disaster. Such owner must submit in DOB NOW photographic documentation and a description of how such damage has prevented compliance.

For example, a building is damaged in a flash flood storm event, displacing tenants on a lower floor and requiring use of a temporary fuel oil-based boiler, until such time as the owner can finance and complete a permanent boiler replacement. Such an event might require the owner to consider an electrification project sooner than they were prepared, requiring time and additional capital. Such an event might also temporarily lower an owner's revenue generation for the property, further complicating needed repairs and improvements. Due to the disruptions in normal operations, the owner may be unable to complete the PECMs to comply with Article 321 by January 1, 2025.

IV(B) Eligible energy conservation project

An owner may demonstrate that a property received a commitment from a state or local agency (or instrumentality), no earlier than November 15, 2019, to receive governmental assistance to engage in an eligible energy conservation rehabilitation project that would comply with the annual building emissions limit described in §28-321.2.1 of the Administrative Code or the PECMs identified in §28-321.2.2 of such Code. For owners that have undertaken an eligible project, they must provide verification to the Department from the partner entity documenting the commitment for assistance from such entity and demonstrating that such project will result in the building complying with one of the Article 321 compliance options.

For example, an owner has planned for a partial electrification of their heating system and has undertaken the project with assistance from HPD, such as a project in HPD's Retrofit Electrification Pilot program. Such owner should submit an attestation that HPD has committed to support the project, including documentation from a Registered Design Professional ("RDP") that demonstrates that the building will comply with 2030 emissions limits after the project is completed.

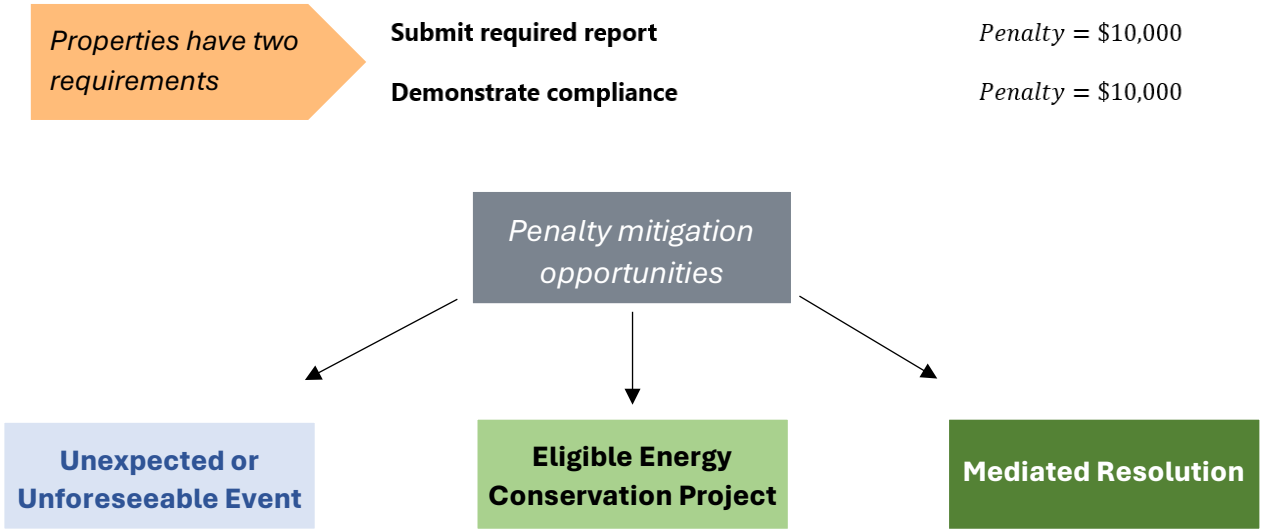
IV(C) Mediated Resolution

An owner who can demonstrate they are working to achieve compliance but needs additional time to comply with the requirements of Article 321 may seek a mediated resolution with the Department by providing the following by May 1, 2025:

1. An attestation submitted in DOB NOW that the property is neither in compliance with §28-321.2.1 nor §28-321.2.2 (despite efforts taken by/before such time). Such submission to the Department must indicate either:

a. The owner's plan to achieve compliance with §28-321.2.1 including by providing such building's 2024 annual emissions and emissions limit(s); or
b. The owner's plan to achieve compliance with §28-321.2.2 including by providing the compliance status for each applicable PECM.

2. The required annual energy benchmarking report as per Article 309 of Title 28 of the Administrative Code for calendar year 2024. If a building is not subject to Article 309, the owner must still submit the building's annual energy benchmarking as if the owner were required by the law. If the building has not provided a report pursuant to the City's Energy Benchmarking law for 2024, request for a mediated resolution may be declined.
3. A plan for achieving compliance with either §28-321.2.1 or §28-321.2.2 of the Administrative Code. Such plan, submitted by a qualified individual as per §28-321.3, would require the owner to identify either:
    a. The measures necessary for the building to comply with the 2030 emissions limits, along with an estimate for the potential carbon savings for each measure, and a plan for financing and implementing such alterations prior to 2030; or
    b. The measures necessary for the building to comply with §28-321.2.2 prior to December 31, 2025.



(#1) Temperature set points (#2) Repair leaks (#3) Heating system function (#4) Radiator temperature controls* (#5) Piping insulation (#6) Water tank insulation
(#7) Indoor/outdoor temp. sensors* (#8) Steam traps* (#9) Master steam system venting* (#10) Lighting (#11) Building envelope (#12) Exhaust fan timers (#13) Radiant barriers

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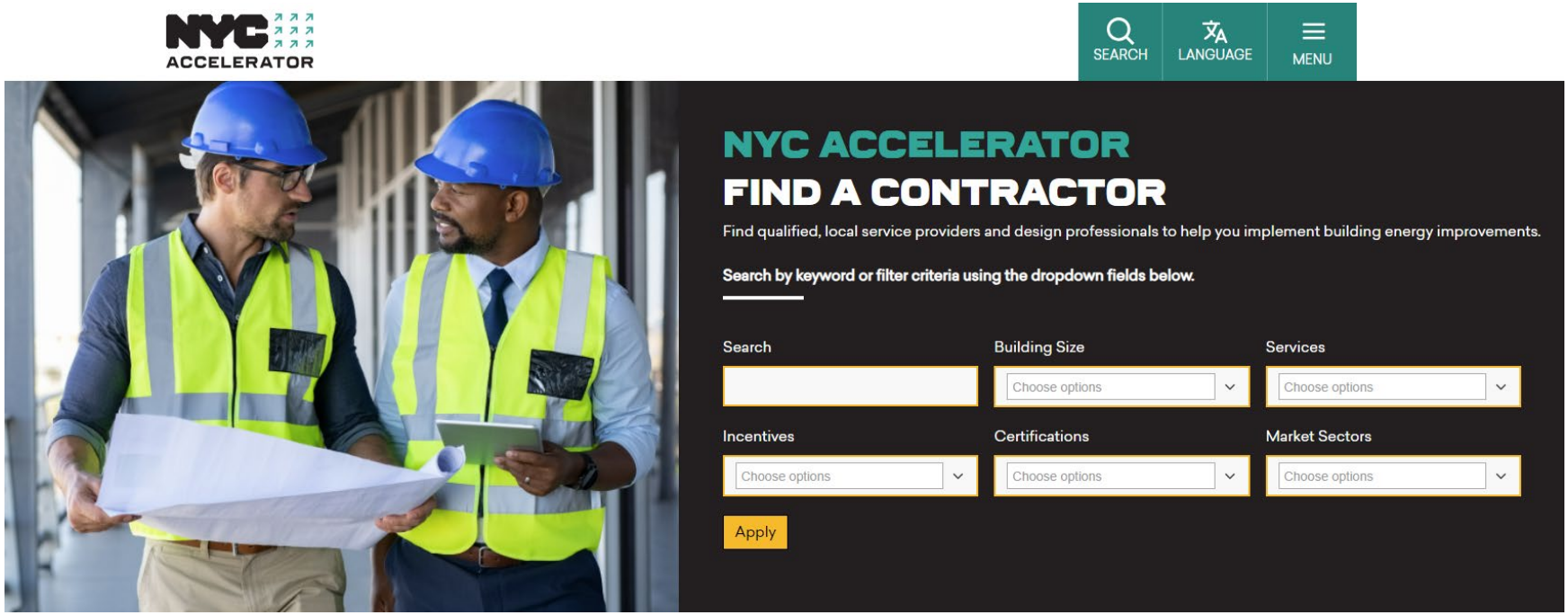

Once building owners have familiarized themselves with what is required by Article 321 and 1 RCNY §103-17, a good resource to begin with is the NYC Accelerator website. Here you can find links to LL97 information, lists of financing and grant opportunities, directories of service providers, case stories of successful building upgrades, and more – along with contact info to receive personalized one-on-one assistance on any of these topics.

The chart on the following page shows which of the "Services" you can select in NYC Accelerator's "Find a Contractor" search engine to find a suitable service provider. The search engine is reachable via either the "Service Providers" link on the homepage or the "Building Resources" link in the main drop-down menu.

- Service providers often work in teams, so they will likely be able to refer you to other providers when different specialized expertise is required.

(#1) Temperature set points (#2) Repair leaks (#3) Heating system function (#4) Radiator temperature controls* (#5) Piping insulation (#6) Water tank insulation
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			NYC ACCELERATOR SERVICE PROVIDER TYPE						
Article 321 Prescriptive Energy Conservation Measures ("PECMs")		Can building owner do themselves?	**Boiler Services**	**Building Envelope/ Roof Services**	**Chilled Water Hot Water and Steam Distribution Systems**	**Controls/ Energy Management Systems**	**HVAC**	**Lighting**	**Maintenance**
1	*Temperature set points*	Y	↗				↗		
2	*Repair leaks*	N	↗		↗		↗		↗
3	*Heating system function*	Y and N	↗		↗		↗		↗
4	*Radiator temperature controls*	N	↗		↗	↗	↗		
5	*Piping insulation*	Y	↗	↗	↗		↗		
6	*Water tank insulation*	N	↗	↗	↗		↗		
7	*Indoor/outdoor temp. sensors*	N	↗			↗	↗		
8	*Steam traps*	N			↗		↗		
9	*Master steam system venting*	N	↗		↗		↗		
10	*Lighting*	Y						↗	
11	*Building envelope*	N		↗					
12	*Exhaust fan timers*	N				↗	↗		
13	*Radiant barriers*	N			↗		↗		

(#1) Temperature set points (#2) Repair leaks (#3) Heating system function (#4) Radiator temperature controls* (#5) Piping insulation (#6) Water tank insulation
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