Decarbonization Roadmap for Multifamily Affordable Housing

pre-war low-rise rent stabilized rental

Based on the Creston Ave. affordable housing project





This tear sheet shows packages of energy conservation measures that reduce a building's greenhouse gas emissions in an effort to achieve anticipated LL97 emissions limits and to move towards carbon neutrality.

existing building overview

location Bronx, NY

dwelling units 52

building area 44,250 sq. ft

metering gas: master electricity: direct

heating fuel natural gas

heating system hydronic convectors

cooling system window ACs

ventilation system passive via windows

utility payment structure heating: owner-paid cooling: tenant-paid

Local Law 97 2030 emissions limits not compliant



building energy exchange





NYSERDA Supported



baseline building conditions

energy and minimizes operating costs.

This pre-war low-rise building has a brick masonry assembly, no interior insulation, and low performance windows allowing for envelope upgrades. No active ventilation is an opportunity to add exhaust and dedicated fresh air. Lastly, the building utilizes natural gas for heating and window ACs for cooling making it a good candidate for central heat pumps.

low carbon retrofit package

Low Carbon improvements include new hydronic boilers, air and water source heat pump DHW system, LED lighting, and ballasted rooftop solar PV. Envelope upgrades include new roof insulation, windows, air sealing measures, and optional above grade wall R-15 EIFS over-cladding. **GHG savings for this scope** of work are based on the 2030 emissions factor.

GHG savings

no carbon retrofit package GHG savings No Carbon improvements include all 2030 measures plus additional upgrades RELATIVE TO BASELINE BUILDING AND BASED ON THE 2050 EMISSIONS FACTOR which may supersede some 2030 measures. These include central air and water source heat pumps for heating and cooling, and energy recovery for active ventilation resulting in whole building electrification. Envelope upgrades include new high-performance windows and optional above grade wall R-15 EIFS over-cladding. GHG savings for this scope of work are based on the 2050 emissions factor. ESTIMATED TOTAL COST/DU* ESTIMATED COST/DU* \$4,500 0% **** , thermally broken, casement \$7,050 \$7,050 \$1,000 ng, including underside of balconies \$13,800 \$13,800 distribution to existing terminal units 🗲 🕇 \$11,700 \$11,700 59% **** \$1,000 grammable thermostats \$1,000 \$1,150 +0% *** ACs \$2,700 \$2,700 WITH R-15 EIFS OVER-CLADDING nts **T** \$14.900 \$14,900 nt corridors **T** (see above) tairwell corridors asures \$8,600 30%*** \$300 3%*** asures \$800 (see above) \$1,000 \$950 \$2,300 8% 0% \$2,750 asures ution upgrade \$8,750 \$13,850 cluding dunnage, patching, & sealing \$8,450 \$8,750 ESTIMATED \$82,650 100% TOTAL ero-emissions COST/DU ble energy. ESTIMATED TOTAL COST/DU \$96,450 100WITH R-15 EIFS OVER-CLADDING

RELATIVE TO BASELINE BUILDING AND BASED ON THE 2030 EMISSIONS FACTOR Ventila high-p

BUILDING % OF GHG SYSTEM EMISSIONS	SYSTEM COMPONENTS	DESCRIPTION	ENERGY CONSERVATION MEASURES (ECMs)		ESTIMATED COST/DU*		ENERGY CONSERVATION MEASURES (ECM
n/a	Roof Insulation	Concrete deck, no insulation	 R-38 above deck insulation 		\$4,500	12%	
	Windows/Glazing	Aluminum, double hung	 New aluminum, double hung, double pane, lo 	w-e, argon filled	\$5,500	1270	New high performance, uPVC
silvelope	Air Sealing & Weatherization	Unknown	Door & window weatherstripping		\$1,000		
	Above Grade Walls	Uninsulated brick wall assembly	+ Optional R-15 EIFS over-cladding	ver-cladding \$13,8			+ Optional R-15 EIFS over-claddi
III 56%	Heating	Conventional hydronic boilers with Aquastat, baseboards, convector cabinets	 New conventional hydronic boilers Heat Timer boiler controls & zone valves connec Real Time Energy Management (RTEM) 	sted to in-unit thermostats	\$5,450 \$1,250 \$1,150	21% +3%	 Central ASHP & WSHP for HW Zone valves connected to progin apartments
* cooling	Cooling	Thru-wall ACs	New thru-wall ENERGY STAR ACs		\$2,700	WITH R-15 EIFS	New thru-wall ENERGY STAR
	Pumps	None				OVER-CLADDING	
	Pipe Insulation	Some pipe insulation	 New pipe insulation 		\$300		
	Ventilation	Common Area: passive Apt: Passive	 Passive ventilation in existing building 		\$0		 Unitized ERV serving apartmer Unitized ERV serving basemen Window trickle vents serving s
ventilation	Ductwork	No ductwork					
<u>&</u> 27%	DHW	Conventional hydronic boilers & small storage tank	 Central air source heat pump (ASHP)/ waters hybrid system with storage # 1 	ource heat pump (WSHP)	\$8,600	23%	No additional recommended me
domestic not water	Plumbing Fixtures	Standard flow fixtures	 Low flow fixtures (WaterSense where applicable) 		\$300		
ighting	Common Area	Fluorescent/CFL/Incandescent	 LEDs with occupancy/vacancy sensors 	\$8		1%	No additional recommended me
	Exterior	High wattage metal halide	 LEDs with photocells & timeclock LEDs 		(see above)		
	In-unit	Fluorescent/CFL/Incandescent			\$1,000		
<mark>ਦ</mark> 12%	Appliances	Non-ENERGY STAR refrigerators Gas stoves	 ENERGY STAR refrigerators No additional recommended measures 		\$1,350	0%	 Electric stoves # T
ippliances	Central Laundry	None					
enewables	newables None		27kW ballasted rooftop solar system		\$2,750	2%	No additional recommended me
Rough order of magnitude estimated costs based on current information at the time of publication that include material, labor, and mark-up. For more information, see the Decarbonization Roadmap for Multifamily Affordable Housing Best Practices Manual.			 electrical service and distribution upgrades structural/finish upgrades including dunnage, patching, & sealing 		\$5,100 \$300		 electrical service and distribution structural/finish upgrades income
 Due to the interactivity of the energy model, the GHG savings for envelope are attributed to the HVAC category for the 2050 scope. Fully electrified systems in 2030 show a GHG savings increase in 2050 because of 			2030 Emissions Factor The 2030 emissions factor reflects an electric grid powered 20% by renewable energy	ESTIMATED TOTAL COST/DU	\$42,050	59%	2050 Emissions Factor The 2050 emissions factor reflects a ze
New York's electree GHG savings from are electrified an to the building en	New York's electrical grid transitioning to more clean energy sources. GHG savings from envelope upgrades fall to zero once all related building systems are electrified and the electric grid is fully decarbonized. However, improvements to the building envelope will reduce the need for heating and cooling, which saves		gird powered row by renewable energy.	ESTIMATED TOTAL COST/DU WITH R-15 EIFS OVER-CLADDING	\$55,850	62%	ciccult grid powered 100% by fellewa

Decarbonization Roadmap for Multifamily Affordable Housing

calculate

carbon emissions

Calculate the building's annual estimated GHG emissions using the BE-Ex Carbon Calculator: www.be-exchange.org/ calculator

to the LL97 emissions limits

compare

develop a retrofit

master plan

Develop a scope of energy

conservation measures (ECMs) that

with building operational and system needs, and financing cycles.

source of carbon

emissions

Ч.

2030

emissions factor

are selected and phased to align

implement 4

> building decarbonization measures

> > 2050

emissions factor

(no emissions)

Compare the building's current calculated GHG emissions with 1197 limits and determine what reduction is required for compliance.

carbon emissions intensity:

The following graph illustrates the carbon emissions intensity associated with the Low Carbon and No Carbon retrofit packages outlined on the previous pages.

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Emissions Factors

Each scope of work is evaluated against the 2030 and 2050 emissions factors as defined under LL97:

- The 2030 emissions factor reflects an electric grid powered 70% by renewable energy.
- The 2050 emissions factor reflects a zero emissions electric grid powered 100% by renewable energy.

The Baseline Building shows emissions from the existing building conditions based on the 2030 emissions factor.

Emissions per Fuel Type

The graph distinguishes between the carbon emissions associated with each fuel type:

electricity or fossil fuels. In 2050, when the electric grid is powered by 100% renewable energy sources, the emissions from electric equipment will be zero. The No Carbon scopes have zero emissions as a result.

Emissions Caps

The graph includes carbon emissions caps for the LL97 reporting periods. Note the emissions cap for 2050 is at zero.

When the emissions associated with a scope of work exceeds a specific emissions cap, the building may be subject to financial penalties.

key takeaway

Many low-rise rentals can electrify hydronic heating systems without significant tenant disruption. Because the Low Carbon retrofit package would comply with 2030 emissions limits, and electrifying heating will increase utility costs, these buildings should typically focus on insulation and air sealing to improve comfort and reduce utility costs. They should also consider electrifying cooking and/or installing mechanical ventilation to improve comfort and air quality.