post-war high-rise Mitchell-Lama

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
Brooklyn, NY

dwelling units
182

building area
127,009 sq. ft

metering
gas: master
electricity: submetered

heating fuel
natural gas

heating system
two pipe steam
with baseboards

cooling system
thru-wall ACs

ventilation system
rooftop exhaust fans

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

Local Law 97
2030 emissions limits
not compliant

Based on the Marien Heim affordable housing project

be ex
building energy exchange

BRIGHT POWER

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NYC Department of Housing Preservation & Development

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typology: post-war, high-rise, Mitchell-Lama

baseline building conditions

This post-war high-rise building has a brick masonry assembly, balconies, and no insulation. No connecting buildings makes it ideal for full envelope upgrades, especially insulated over-cladding. Natural gas heating and thru-wall ACs for cooling provide an opportunity for central VRF heat pumps. Master metered electric also makes the building a good candidate for solar on the roof.

low carbon retrofit package

Low Carbon improvements include new steam boilers and thru-wall ACs, an electric air source heat pump DHW system, rooftop post & rail solar PV, and LED lighting. Envelope upgrades include new roof insulation, windows and doors, air sealing measures, and optional above grade wall R-15 EIFS over-cladding that also covers the underside of the balconies. **GHG savings for this scope of work are based on the 2030 emissions factor.**

GHG savings

RELATIVE TO BASELINE BUILDING AND BASED ON THE 2030 EMISSIONS FACTOR

no carbon retrofit package

No Carbon improvements include all 2030 measures plus additional upgrades which may supersede some 2030 measures. These include central VRF heat pumps, electric stoves and dryers, and energy recovery ventilation resulting in whole building electrification. New high-performance windows and doors and optional above grade wall R-15 EIFS over-cladding upgrade the envelope. **GHG savings for this scope of work are based on the 2050 emissions factor.**

GHG savings

RELATIVE TO BASELINE BUILDING AND BASED ON THE 2050 EMISSIONS FACTOR

BUILDING SYSTEM	% OF GHG EMISSIONS	SYSTEM COMPONENTS	DESCRIPTION	ENERGY CONSERVATION MEASURES (ECMs)	ESTIMATED COST/DU*		GHG savings	ENERGY CONSERVATION MEASURES (ECMs)	ESTIMATED COST/DU*	ESTIMATED TOTAL COST/DU*	GHG savings
envelope	n/a	Roof Insulation	Concrete deck, 2" rigid insulation	■ R-49 blown-in insulation	$1,250		2%			$1,250	0% **/****
		Windows/Glazing	Aluminum, double hung	■ New aluminum, double hung, double pane, low-e, argon filled ■ New storefront/entry doors	$6,650			■ New uPVC, thermally broken, casement windows & ENERGY STAR balcony doors	$10,850	$10,850	
		Air Sealing & Weatherization	Leaky windows & doors	■ Door & window weatherstripping	$1,000					$1,000	
		Above Grade Walls	Uninsulated brick wall assembly	+ Optional R-15 EIFS over-cladding, including underside of balconies	$17,250			+ Optional R-15 EIFS over-cladding, including underside of balconies	$17,250	$17,250	
heating cooling	63%	Heating	(2) Scotch Marine steam boilers with baseboards, outdoor air reset and pressure controls	■ New steam boilers with east/west zone valves ■ Heat Timer boiler controls with indoor temp feedback ■ Real Time Energy Management (RTEM)	$3,350 $500 $2,000		24% +8% WITH R-15 EIFS OVER-CLADDING	■ Central VRF with rooftop units ϟ ⍑ ■ RTEM via programmable thermostat	$10,050 $2,000	$10,050 $2,000	67% **/**** +0% **/**** WITH R-15 EIFS OVER-CLADDING
		Cooling	Thru-wall ACs	■ New thru-wall ENERGY STAR ACs	$2,000			(see above) VRFs also provide cooling			
		Pumps	0.75 hp single speed pump	■ No additional measures	$0						
ventilation		Pipe Insulation	Piping mostly insulated	■ New pipe insulation	$300						
		Ventilation	Common Area: passive Apartment, Bath, Kitchen: central exhaust fans	■ Direct drive, variable speed EC motor central exhaust fans with timers & CAR dampers	$1,300			■ Central ERVs serving corridors ϟ ⍑ ■ Central ERVs serving apartments ϟ ⍑	$4,750	$4,750 (see above)	
		Ductwork	In-unit: leaky	■ Clean & seal ducts; conduct testing, adjusting, & balancing	(see above)						
domestic hot water	17%	DHW	Tankless coils in steam boilers	■ Central air source heat pump (ASHP) with storage ϟ ⍑	$6,450		16%	No additional recommended measures		$6,450	20%***
		Plumbing Fixtures	Standard flow fixtures	■ Low flow fixtures (WaterSense where applicable)	$300					$300	
lighting	6%	Common Area	Fluorescent/CFL/Incandescent	■ LEDs with occupancy/vacancy sensors	$800		1%	No additional recommended measures		$800	4%***
		Exterior	Fluorescent/CFL/Incandescent	■ LEDs with photocells & timeclock	(see above)					(see above)	
		In-unit	Fluorescent circline	■ LEDs	$1,000					$1,000	
appliances	14%	Appliances	Non-ENERGY STAR refrigerators Gas stoves	■ ENERGY STAR refrigerators	$1,350		1%	■ Electric stoves ϟ ⍑	$950	$2,300	9%
		Central Laundry	(4) Non-ENERGY STAR washers (4) Electric dryers	■ (4) ENERGY STAR washers	$0 (per equipment lease agreement)			■ (4) Heat pump dryers ϟ ⍑	$0 (per equipment lease agreement)	$0	
renewables		None		■ 65kW post & rail rooftop solar PV system	$1,700		2%	No additional recommended measures		$1,700	0%
		ASSOCIATED UPGRADES		ϟ electrical service and distribution upgrades ⍑ structural/finish upgrades including dunnage, patching, & sealing	$1,600 $10			ϟ electrical service and distribution upgrade ⍑ structural/finish upgrades including dunnage, patching, & sealing	$6,750 $4,200	$8,350 $4,210	
				2030 Emissions Factor The 2030 emissions factor reflects an electric grid powered 70% by renewable energy.	ESTIMATED TOTAL COST/DU	$31,560	46%	2050 Emissions Factor The 2050 emissions factor reflects a zero-emissions electric grid powered 100% by renewable energy.	ESTIMATED TOTAL COST/DU	$55,010	100%
					ESTIMATED TOTAL COST/DU WITH R-15 EIFS OVER-CLADDING	$48,810	54%		ESTIMATED TOTAL COST/DU WITH R-15 EIFS OVER-CLADDING	$72,260	100%

* 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*.

** 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 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 energy and minimizes operating costs.

1 calculate → 2 compare → 3 develop → 4 implement

1 calculate carbon emissions

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

2 compare to the LL97 emissions limits

Compare the building's current calculated GHG emissions with LL97 limits and determine what reduction is required for compliance.

3 develop a retrofit master plan

Develop a scope of energy conservation measures (ECMs) that are selected and phased to align with building operational and system needs, and financing cycles.

4 implement building decarbonization measures

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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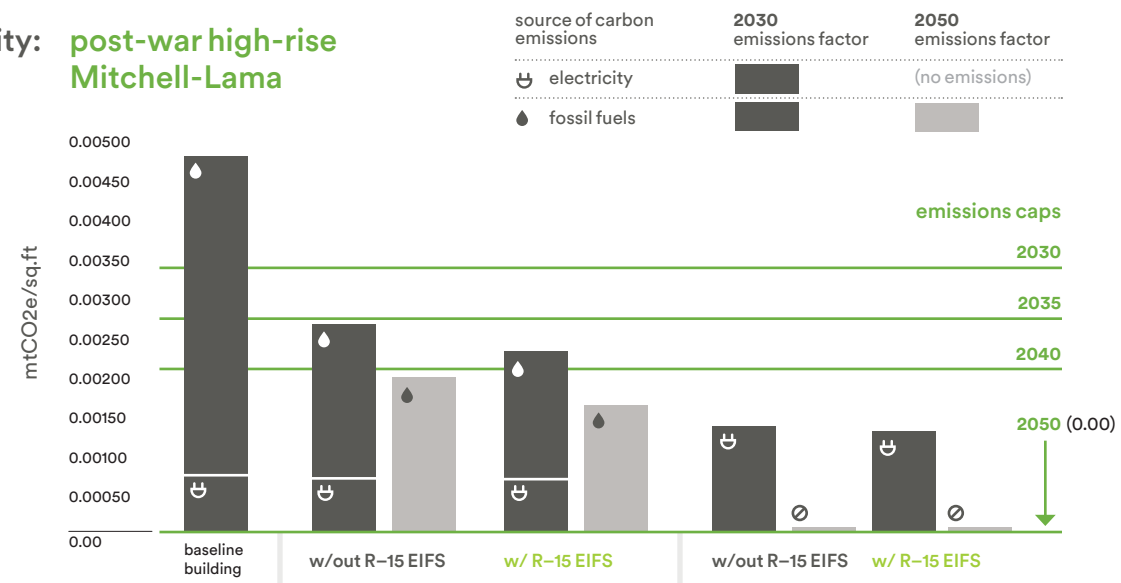

first year estimated savings ($/DU)	Low Carbon Retrofit Package		No Carbon Retrofit Package	
	w/out R–15 EIFS	w/ R–15 EIFS	w/out R–15 EIFS	w/ R–15 EIFS
owners	$300	$350	$0	$50
tenants	$125	$125	$100	$100

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

Most Mitchell-Lamas (ML) have poorly performing steam systems and building envelopes, so the *Low Carbon* retrofit package, which would meet the 2035 emissions limits, may not meet the 2040 limits, leading to penalties within a 15-year financing cycle. However, by phasing in electric heating, after 2035, penalties could be avoided. Leaving the steam system in place provides a temporary backup, until the building can be fully electrified and insulated, before 2050. As a master-metered building, this wouldn't cause a shift in heating costs to the tenants.