

Modeling Affordable Multifamily Housing Retrofit Scenarios

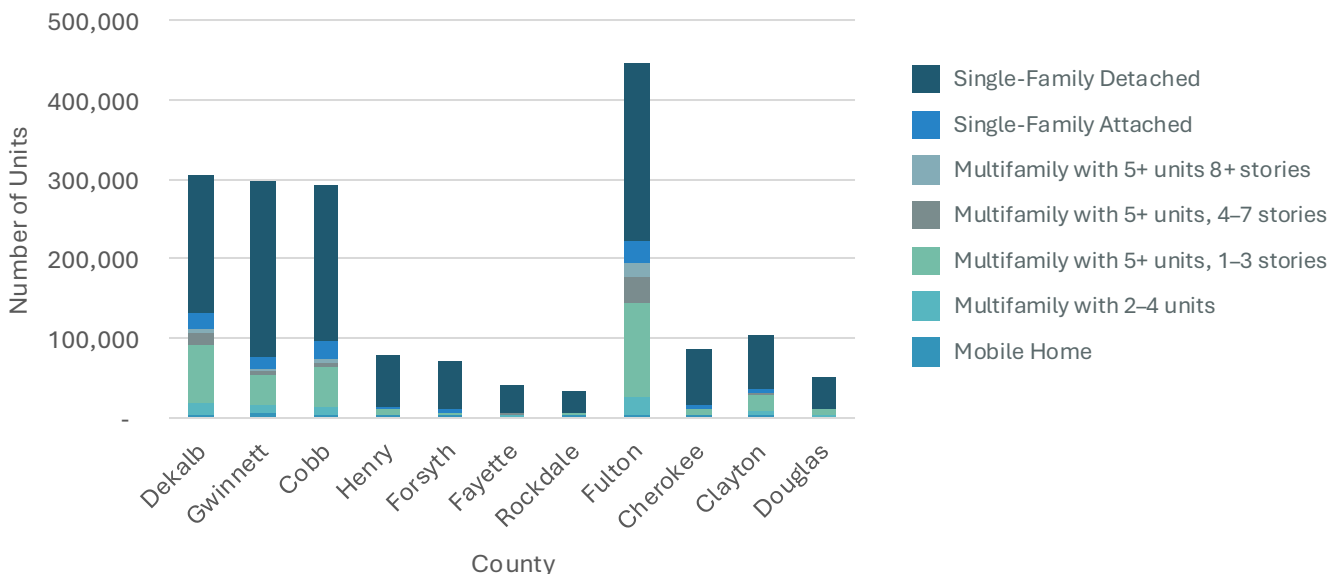
Metro Atlanta

RMI and Wells Fargo Foundation hosted a series of regional workshops to foster collaboration and coordination around decarbonizing the US affordable multifamily housing market. At the Atlanta workshop, RMI presented research and examples to help local stakeholders better understand the characteristics of their housing stock, the market needs, and how retrofit solutions and incentives can apply to different housing typologies. This brief summarizes those findings to help inform stakeholder action in decarbonizing the region’s affordable multifamily housing stock.

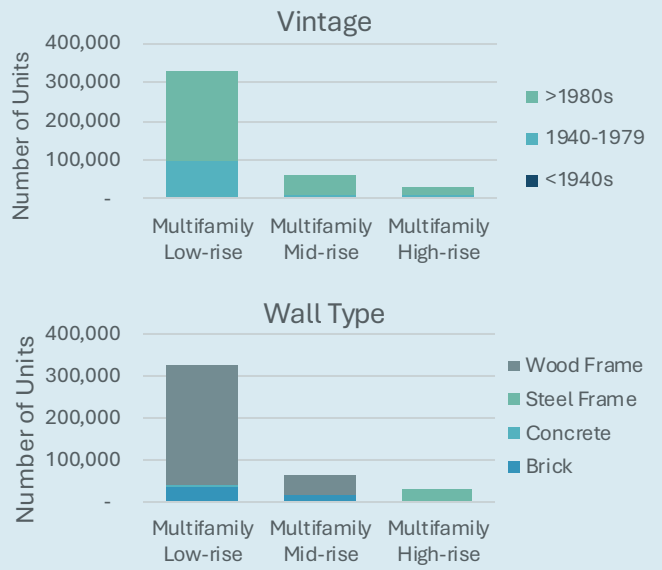
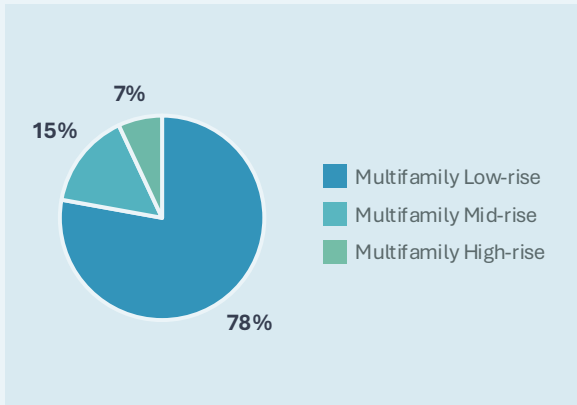
Multifamily Housing Overview

Metro Atlanta contains approximately **1.4 million residential buildings** with **1.8 million dwelling units** (see the breakdown of building types by county below). Multifamily housing with five or more units accounts for about 23% (420,000) of these, with the majority being in low-rise buildings.

Building Types	Number of Units	Percentage
Single-family detached	1,186,442	65%
Multifamily with 5+ units, 1–3 stories	327,361	18%
Single-family attached	106,053	6%
Multifamily with 2–4 units	69,249	4%
Multifamily with 5+ units, 4–7 stories	63,923	4%
Multifamily with 5+ units, 8+ stories	29,298	2%
Mobile home	29,298	2%
Total	1,811,624	100%



MULTIFAMILY BUILDING BREAKDOWN*

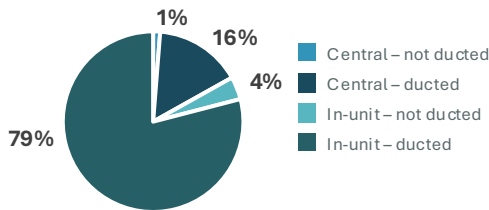


*Excluding multifamily with 2-4 units

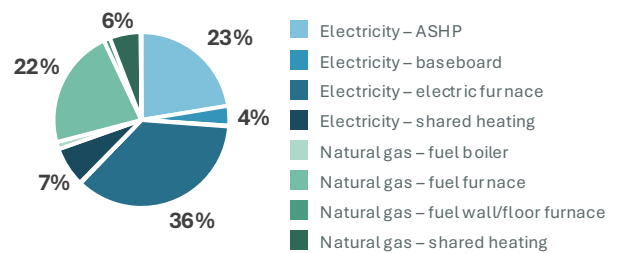
The following graphs show the characteristics of low-rise buildings, the most common multifamily building typology in the Metro Atlanta region. While there is some variation across building types, many major characteristics are similar, indicating that there may be opportunities to streamline retrofit approaches across building types. Most of these buildings already use electric systems for heating, domestic hot water (DHW), and cooking, with many having minimal to light insulation.

LOW-RISE MULTIFAMILY

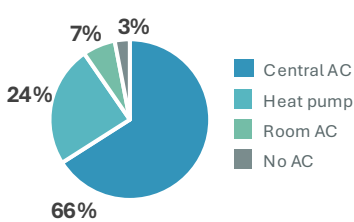
Heating System & Duct Type



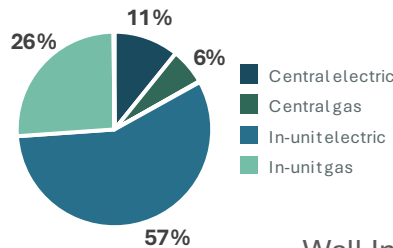
Heating System & Fuel Type



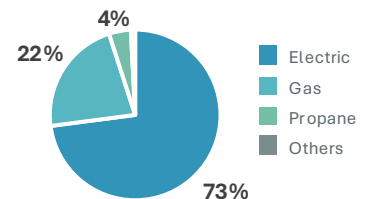
Cooling Type



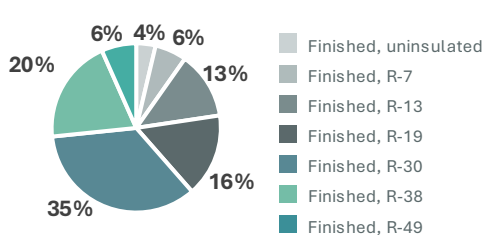
DHW System & Fuel Type



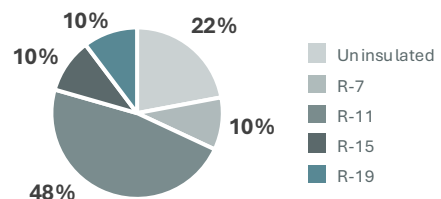
Cooking Fuel



Roof Insulation



Wall Insulation



Source: NREL, [U.S. Building Stock Characterization Study](#)

Scenario Models for Multifamily Retrofits

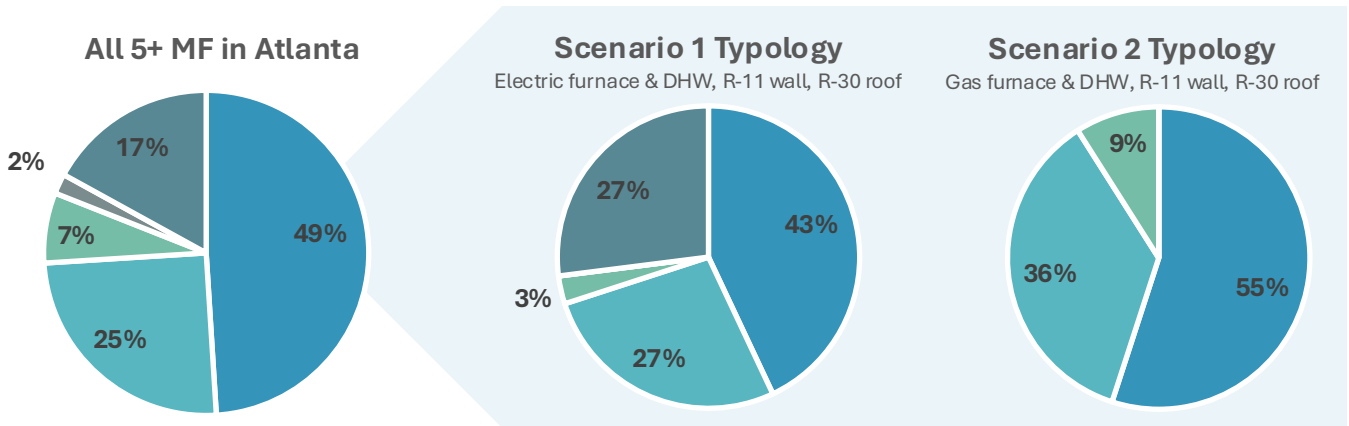
To understand the opportunities for scaling multifamily retrofits in Metro Atlanta, we evaluated two multifamily housing types across both 75% LMI and 100% LMI affordability scenarios.ⁱ These models offer insights into the estimated costs of various recommended retrofit packages, how available incentives stack up to offset these costs, the remaining financial gap, and potential strategies for closing that gap.

For this study, we applied the data and analysis framework from the [Market Guidance Report](#) (MGR) published by the [Advanced Building Construction Collaborative](#). The MGR evaluates four retrofit packages built on NREL’s [2022 U.S. Building Stock Characterization Study](#)ⁱⁱ — All Equipment Swap-Out (Equipment Only), Conventional Envelope (Light Envelope), IECC Envelope, and Plius Envelope. The analysis from this study includes the assignment of these retrofit packages to the US residential building stock, based on the buildings’ existing conditions, outlining a pathway to achieving zero-carbon alignment (ZCA).ⁱⁱⁱ These four retrofit packages represent the minimum level of intervention needed to reach ZCA. However, given the predominance of the Equipment Only and Light Envelope retrofit packages, we focused on these two approaches in the following models.

Based on this data, **49% of multifamily with 5+ units** in Metro Atlanta need an **Equipment Only** retrofit package, with **25%** requiring a **Light Envelope** retrofit package, and 17% not needing an upgrade to meet ZCA.

RETROFIT NEEDS TO ACHIEVE ZCA, BY BUILDING TYPE

■ Equipment Only ■ IECC Envelope ■ No Upgrade
■ Conventional Envelope ■ PHIUS Envelope



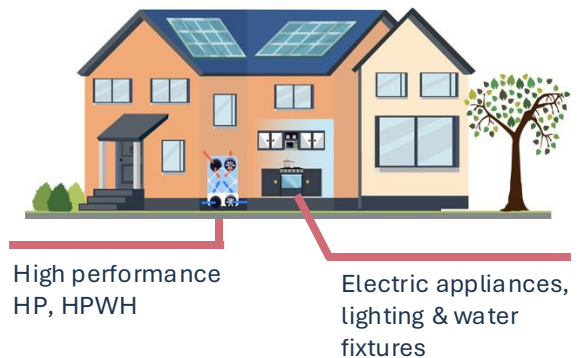
As part of the retrofit solution, we also evaluated the potential of solar PV. Given the split incentive in a tenant metered building with a decentralized HVAC and DHW system, it is less likely for owners to invest in solar PV. We explored the potential of converting in-unit HVAC and DHW systems to a central system with the idea that the solar PV would cover the operating cost of these systems. Our analysis also evaluated both Georgia Power RNR – Monthly Netting (MN) and Georgia Power RNR – Instantaneous Netting (IN) to understand the impacts of the different solar programs.

i. 75% LMI Units (50% LIHTC & 25% Section 8 Housing Choice Voucher) + 25% Market Rate Units; 100% LMI Units (100% LIHTC)
ii. Details of each retrofit package can be found in the Market Guidance Report.
iii. Attributes of zero-carbon aligned (ZCA) buildings include: (1) has no on-site fossil fuel use, (2) has a low baseline power demand, (3) will get all energy from carbon neutral sources, and (4) can minimize grid impact when needed.

Retrofit Packages Explained

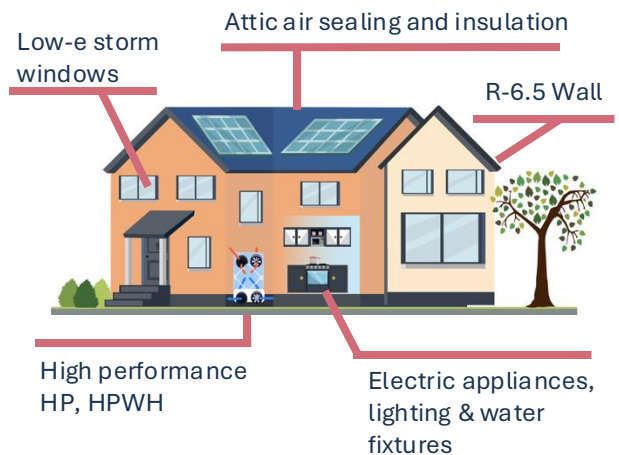
Package 1: All Equipment Swap-Out (Equipment Only)

- Heat pump (ASHP, MSHP or VRF) + duct sealing/insulating
- Heat pump water heater
- Major appliances: all-electric, Energy Star
- 100% LED Lighting



Package 2: Conventional Envelope (Light Envelope)

- All measures included in the Equipment Only package
- Energy/Heat Recovery Ventilator (ERV/HRV)^{iv}
- Attic/roof air sealing and insulation (IECC)
- R-6.5 continuous wall insulation with residing^v
- Low-e storm windows



iv. ERV/HRV are added based on airtightness level. Given the small building size for low-rise, we assumed in-unit ERV for the Light Envelope package to be covered by the tenant (no ERV for Equipment Only). We assumed mid-rise and high-rise receive central ERV.

v. R6.5 continuous insulation only for buildings built before 1990 with existing insulation < R19.

Scenario Models

Scenario 1: Low-rise, Electric Furnace, Electric DHW

OVERVIEW OF BASELINE CONDITION

Building Type	Low-rise
Wall Structure	Wood Frame
Number of Units	8
DHW	In-unit Electric
Heating	In-unit Electric Furnace
Appliances	Electric Cooking
Duct	Ducted
Cooling	With AC
Wall Insulation	R-11
Roof Insulation	R-30
Avg Unit Size	900 sq.ft.
Number of Floors	2
Total Roof Area	4,000 sq.ft.
Metering Type	Tenant Metered

RETROFIT PACKAGE ONLY

	Equipment Only		Light Envelope	
	75% LMI	100% LMI	75% LMI	100% LMI
Capital Impacts				
Efficiency Measure Cost	\$210,313	\$210,313	\$741,841	\$741,841
Efficiency Measure Incentives	\$115,568	\$115,568	\$190,138	\$155,568
Net Capital Cost	\$94,745	\$94,745	\$551,704	\$586,273
Operational Impacts (over 30 years)				
Present Value of Tenant Bill Impacts ^{vi}	\$82,441	\$82,441	\$83,209	\$83,209

RETROFIT PACKAGE WITH SOLAR

	Equipment Only		Light Envelope	
	75% LMI	100% LMI	75% LMI	100% LMI
Capital Impacts				
Efficiency Measure Cost	\$258,386	\$258,386	\$783,206	\$783,206
Efficiency Measure Incentives	\$107,568	\$107,568	\$182,138	\$147,568
Solar System Cost	\$70,400	\$70,400	\$70,400	\$70,400
Solar System Incentive	\$21,120	\$21,120	\$21,120	\$21,120
Net Capital Cost	\$200,098	\$200,098	\$650,349	\$684,918
Operational Impacts (over 30 years)				
Present Value of Tenant Bill Impacts	\$123,044	\$123,044	\$111,813	\$111,813
Present Value of Owner Bill Impacts: MN	\$7,173	\$7,173	\$9,693	\$9,693
Present Value of Owner Bill Impacts: IN	\$3,828	\$3,828	\$13,740	\$13,740
Present Value of Total Project Impacts^{vii}	\$196,270	\$196,270	\$636,609	\$671,179

vi. Bill Impacts: Positive value = bill savings; negative value = increased operation cost.

vii. Present value of total project impacts only considers owner bill impacts from IN program.

FINDINGS: LOW-RISE, ELECTRIC FURNACE, ELECTRIC DHW

Package 1: Equipment Only

- The retrofit costs for both the 75% LMI and 100% LMI scenarios are about \$210K for the 8-unit low-rise building, with incentives stacking up to about \$116K for both scenarios. This equates to roughly \$95K of net capital cost.
- The present value of tenant bill savings over 30 years is approximately \$82K. If the owner can capture the utility savings from the tenants, they can leverage programs such as the [Green House Gas Reduction Fund](#) (GGRF) or the [SEER loan program](#) (for Atlanta Housing landlords) to underwrite the savings to finance the gap and cover the remaining with their reserves.
- Assuming the building can convert to central heating and a DHW system to pair with solar under the owner meter, additional operating costs could be eliminated for the owner and the tenant bill savings could potentially close the gap significantly, if captured. While not significant, the Monthly Netting program would provide double the value from solar to the owner.

Package 2: Light Envelope

- The retrofit costs for both the 75% LMI and 100% LMI scenarios are about \$742K. The incentives for the 75% LMI scenario are about \$190K, including about \$35K from EERB for the two Housing Choice Voucher units, and the incentives for the 100% LMI scenario is close to \$156K. This brings the net capital cost to \$553K for the 75% LMI scenario, and \$588K for the 100% LMI scenario.
- For the Light Envelope Package, even with the tenant bill savings and solar, there is still a large gap to fill. It would make the most sense for the owner to do a Light Envelope retrofit during a substantial rehab when residing and re-roofing are already planned so that the energy efficiency measures are realized as incremental costs.
- There are also many benefits to envelope improvements beyond just energy savings that should be considered as part of this investment, including passive survivability, better thermal comfort, and better indoor air quality.

Scenario Models

Scenario 2: Low-rise, Gas Furnace, Gas DHW

OVERVIEW OF BASELINE CONDITION

Building Type	Low-rise
Wall Structure	Wood Frame
Number of Units	8
DHW	In-unit Gas
Heating	In-unit Gas Furnace
Appliances	Electric Cooking
Duct	Ducted
Cooling	With AC
Wall Insulation	R-11
Roof Insulation	R-30
Avg Unit Size	900 sq.ft.
Number of Floors	2
Total Roof Area	4,000 sq.ft.
Metering Type	Tenant Metered

RETROFIT PACKAGE ONLY

	Equipment Only		Light Envelope	
	75% LMI	100% LMI	75% LMI	100% LMI
Capital Impacts				
Efficiency Measure Cost	\$213,075	\$213,075	\$743,274	\$743,274
Efficiency Measure Incentives	\$114,000	\$116,000	\$215,770	\$191,200
Net Capital Cost	\$99,075	\$97,075	\$527,505	\$552,074
Operational Impacts (over 30 years)				
Present Value of Tenant Bill Impacts ^{viii}	\$71,595	\$71,595	\$76,386	\$76,386

RETROFIT PACKAGE WITH SOLAR

	Equipment Only		Light Envelope	
	75% LMI	100% LMI	75% LMI	100% LMI
Capital Impacts				
Efficiency Measure Cost	\$249,397	\$249,397	\$773,872	\$773,872
Efficiency Measure Incentives	\$108,000	\$108,000	\$209,770	\$183,200
Solar System Cost	\$70,400	\$70,400	\$70,400	\$70,400
Solar System Incentive	\$21,120	\$21,120	\$21,120	\$21,120
Net Capital Cost	\$190,677	\$190,677	\$613,382	\$639,952
Operational Impacts (over 30 years)				
Present Value of Tenant Bill Impacts	\$130,651	\$130,651	\$119,610	\$119,610
Present Value of Owner Bill Impacts: MN	\$3,234	\$3,234	\$6,576	\$6,576
Present Value of Owner Bill Impacts: IN	(\$11,665)	(\$11,665)	\$1,480	\$1,480
Present Value of Total Project Impacts^{ix}	\$202,342	\$202,342	\$611,902	\$638,471

viii. Bill Impacts: Positive value = bill savings, negative value = increased operation cost.

ix. Present value of total project impacts only considers owner bill impacts from IN program.

FINDINGS: LOW-RISE, GAS FURNACE, GAS DHW

Package 1: Equipment Only

- The retrofit costs for both the 75% LMI and 100% LMI scenarios are about \$213K for the 8-unit low-rise building, with incentives stacking up to about \$116K for both scenarios. This equates to about \$98K of net capital cost.
- The present value of tenant bill savings over 30 years is approximately \$71K. If the owner can capture the utility savings from the tenants, they can leverage programs such as the [Green House Gas Reduction Fund](#) (GGRF) or the [SEER loan program](#) (for Atlanta Housing landlords) to underwrite the savings to finance the gap and cover the remainder with their reserves.
- Assuming the building can convert to central heating and a DHW system to pair with solar under the owner meter, while the Instantaneous Netting program increases the operational cost, the tenant bill savings could still potentially close the gap significantly if captured. The Monthly Netting program would provide better values and eliminate any additional operational costs to the owner.

Package 2: Light Envelope

- The retrofit costs for both the 75% LMI and 100% LMI scenarios are about \$743K. The incentives for the 75% LMI scenario are about \$216K, including about \$35K from EERB for the two Housing Choice Voucher units, and the incentives for the 100% LMI scenario are close to \$191K. This brings the net capital cost to \$527K for the 75% LMI scenario, and \$552K for the 100% LMI scenario.
- For the Light Envelope Package, even with the tenant bill savings and solar, there is still a large gap to fill. It would make the most sense for the owner to do a Light Envelope retrofit during a substantial rehab when residing and re-roofing are already planned so that the energy efficiency measures are realized as incremental costs.
- There are also many benefits to envelope improvements beyond just energy savings that should be considered as part of this investment, including passive survivability, better thermal comfort, and better indoor air quality.

Available Incentives

The following tables provide examples of how available federal, state, and local incentives could apply to affordable multifamily decarbonization retrofits in the Metro Atlanta region. For a more in-depth look at how these incentives are applied and the specific requirements for accessing them, please refer to the following page on Incentive Resources.

Scenario 1: Low-rise, Electric Furnace, Electric DHW

Package 1: Equipment Only

Available Incentives per Unit (as of Oct 2024)

Incentives	Measures	In-Unit Systems		Central Systems (Solar Scenario)	
		Low-Income Unit	Market-Rate Unit	Low-Income Unit	Market-Rate Unit
HER	HPWH, major appliances (stove, HP dryer, etc.)	\$4,000	\$4,000	\$4,000	\$4,000
HEAR	HP	\$8,600	\$8,600	\$8,600	\$8,600
179D	All	\$846	\$846	\$846	\$846
GP EASE	Lighting, duct sealing	\$2,000	\$0	\$1,000	\$0
AH EERB	N/A	\$0	\$0	\$0	\$0
Total Incentives		\$16,946	\$14,446	\$15,946	\$14,446

Package 2: Light Envelope

Available Incentives per Unit (as of Oct 2024)

Incentives	Measures	In-Unit Systems		Central Systems (Solar Scenario)	
		Low-Income Unit	Market-Rate Unit	Low-Income Unit	Market-Rate Unit
HER	HPWH, major appliances (stove, HP dryer, etc.)	\$4,000	\$4,000	\$4,000	\$4,000
HEAR	HP, weatherization	\$9,600	\$9,600	\$9,600	\$9,600
179D	All	\$846	\$846	\$846	\$846
GP EASE	Attic insulation, air sealing, duct sealing, lightings, etc.	\$5,000	\$0	\$5,000	\$0
AH EERB	All Level 1-3 measures	\$17,285	\$0	\$17,285	\$0
Total Incentives		\$20,946	\$15,446	\$20,946	\$15,446

Scenario 2: Low-rise, Gas Furnace, Gas DHW

Package 1: Equipment Only

Available Incentives per Unit (as of Oct 2024)

Incentives	Measures	In-Unit Systems		Central Systems (Solar Scenario)	
		Low-Income Unit	Market-Rate Unit	Low-Income Unit	Market-Rate Unit
HER	HPWH, major appliances (stove, HP dryer, etc.)	\$4,000	\$4,000	\$4,000	\$4,000
HEAR	HP, electrical panel, electrical wiring	\$8,600	\$8,600	\$8,600	\$8,600
179D	All	\$900	\$900	\$900	\$900
GP EASE	Lighting, duct sealing	\$2,000	\$0	\$1,000	\$0
AH EERB	N/A	\$0	\$0	\$0	\$0
Total Incentives		\$15,500	\$13,500	\$14,500	\$13,500

Package 2: Light Envelope

Available Incentives per Unit (as of Oct 2024)

Incentives	Measures	In-Unit Systems		Central Systems (Solar Scenario)	
		Low-Income Unit	Market-Rate Unit	Low-Income Unit	Market-Rate Unit
HER	HPWH, major appliances (stove, HP dryer, etc.), weatherization	\$4,000	\$4,000	\$4,000	\$4,000
HEAR	HP, electrical panel, electrical wiring	\$14,000	\$14,000	\$14,000	\$14,000
179D	All	\$900	\$900	\$900	\$900
GP EASE	Attic insulation, air sealing, duct sealing, lightings, etc.	\$5,000	\$0	\$5,000	\$0
AH EERB	All Level 1-3 measures	\$17,285	\$0	\$17,285	\$0
Total Incentives		\$23,900	\$18,900	\$23,900	\$18,900

Incentive Resources

Incentives	Incentive Range (\$ per unit or as noted)		Incentive Types	Ranges and Requirements	Affordability Requirements
	Low	High			
Home Efficiency Rebates (HER)	\$4,000	\$8,000	Federal	Modeled, lesser of \$4,000/unit or 80% of project cost for building-wide savings between 20% and 35%; lesser of \$8,000/unit or 80% of project cost for 35%+ building-wide savings — measures may include insulation, air sealing, windows, DHW.	Not less than 50% of dwelling units are occupied by households <80% AMI
Home Electrification and Appliance Rebates (HEAR)	-	\$14,000	Federal	Energy star appliances: \$8,000 for heat pump HVAC, \$1,750 for heat pump water heater, \$840 for electric stove/cooktop, \$840 for heat pump clothes dryer, \$4,000 for breaker box, \$2,500 for electric wiring, \$1,600 for weatherization (insulation, air sealing, ventilation); \$14,000 max. consumer rebate.	Low Income: <80% AMI for 100% cost coverage Moderate Income: 80%–150% AMI for 50% cost coverage
45L Tax Credit	\$500	\$5,000	Federal	Properties built to qualify for Energy Star standards could garner between \$500 and \$2,500 per apartment depending on whether they are paying prevailing wage. Properties built to qualify for the ZERH standard could earn between \$1,000 and \$5,000 per apartment depending on whether they are pay prevailing wages.	N/A
179D Tax Deduction	\$0.50/ft ²	\$5.00/ft ²	Federal	\$0.50/ft ² for 25% site EUI reduction, plus \$0.02/ft ² for each percentage point of savings above 25%, up to a maximum \$1/ft ² for 50% savings.	N/A
Energy Efficiency Rent Boost (EERB)- Atlanta Housing Landlord Program	\$50/unit/month	\$175/unit/month	Atlanta	Energy Efficiency Rent Boost (EERB) Levels: <ul style="list-style-type: none"> Level 1: Silver (\$50): Lighting, Low Flow Water Upgrades & Insulation Level 2: Gold (\$125): Level 1 items + Air Sealing & Energy Star Appliances (Refrigerator) Level 3: Platinum (\$175): Level 1 and 2 items + HVAC & Windows The Rent Boost associated with each Rent Boost Level will remain in effect indefinitely, as long as the same participant remains in the unit. If a new lease up occurs, the Rent Boost Level must have been certified within the past 5 years for the unit to be eligible for the Rent Boost under the new contract. The maximum rent for any unit will remain capped by the payment standard regardless of eligibility for any rent boost.	Must be a landlord with Atlanta Housing
Multi-family Home Energy Improvement Program (HEIP)- Georgia Power	upto \$1,100/unit	upto \$1,500/unit	Utility	Property residents must be Georgia Power residential customers. 20% Whole House Electric kWh Reduction: 50% of cost up to \$1,100/unit for income-qualified multifamily properties. 35% Whole House Electric kWh Reduction: 50% of cost up to \$1,500/unit for income-qualified multifamily properties.	Must meet Georgia Power's Income Qualifications for Multifamily Properties.
Energy Assistance for Savings & Efficiency (EASE)- Georgia Power	-	upto \$5,000/unit	Utility	Must be a Georgia Power residential customer. Offers up to \$5,000/unit for low-income multi-family properties that implement measures based on an in-home assessment. Improvements covered by the EASE program include: <ul style="list-style-type: none"> Advanced Improvements: attic insulation, air sealing, duct sealing, HVAC servicing Direct Install Improvements: water heater jackets – electric heated only, low flow shower heads – electric heated only, water heater pipe insulation – electric heated only, low flow faucet aerators – electric heated only, smart thermostat, power strips, switch & outlet gaskets, LED (indoor) lightbulbs, dusk to dawn (outdoor) bulbs 	Household income must be 200% or less of the 2023 US Federal Poverty Guidelines.
48F Clean Energy Investment Tax Credit (ITC)	30% of the solar cost	70% of the solar cost	Federal - Solar	The commercial renewable tax credit includes an adder that can stack up to 70% ITC: 30% base tax credit if the project started between 2023 and 2033, 10% bonus for "Domestic Content," 10% bonus for "Energy Communities," 20% bonus for projects financially benefitting low-income communities or 10% bonus for projects in low-income or Tribal communities. To meet the conditions of a Category 3 facility, the financial benefits of the electricity produced by the facility must be allocated equitably among the occupants of a qualified residential property. At least half of the financial value of the energy produced by the facility must be equitably allocated to the property's low-income occupants under the covered housing program or other affordable housing program.	A "qualified low-income residential building project" is defined as a residential rental building which participates in a covered housing program (i.e., HUD-assisted housing for groups in need. See: 24 CFR § 5.2003 for the full definition).

Note: This table provides a high-level overview of all the incentives considered in the scenario models for your reference. It is not meant to be exhaustive nor serve as a complete incentive stacking guide. Each project is unique and will require its own specific analysis.

Key Assumptions and Notes

Scenario Models

- Our scenario models utilize the [data](#) from the MGR. The results and assumptions, including the energy use intensities, energy savings, equipment performance, and building characteristics, etc., are all based on the MGR data. The scenario models are based on the average of all modeled units in the MGR dataset [that meets the scenario models stated typology](#). Energy savings can vary depending on other existing conditions such as number of units, unit sizes, etc. These results serve as a reference and are NOT meant to represent every building and DO NOT capture all the nuances in a project.
- Solar PV potential is estimated based on the MGR data and sized using NREL's [PVWatts](#) Calculator. Solar PV costs are estimated using LBL's [Tracking the Sun 2023 Report](#).
- Utility bill impact is estimated using US EIA's 2022 average residential and commercial [electricity](#) and [natural gas](#) rate in Georgia.
- Retrofit Package cost varies widely depending on location, climate, building type, existing condition, and system type. For the analysis, we assumed a price range of \$25k-\$33k for Equipment Only and \$93k-\$98k for Light Envelope. These are estimation and are not meant for actual project pricing.

Incentives

- This analysis assumes all units receive LMI rebate rates for both HER and HEAR. Whether all units or only LMI units in a multifamily building receive LMI rebates will be determined at the state level.
- Projects are not allowed to stack HER and HEAR for the same measures. This analysis tries to optimize the incentives from HER and HEAR accounting for the energy savings of measures to meet HER's 20% or 35% target. Based on the savings, we are unable to maximize both HER and HEAR in either of the scenario models.
- Only Georgia Power's EASE program is included in our incentive calculation. It is recommended to discuss with Georgia Power to determine if the EASE program or HEIP program is more applicable to your project.
- Energy Efficiency Rent Boost (EERB) program is only applicable for landlords registered with Atlanta Housing and participating in Housing Choice Voucher Program (HCVP). We assumed two low-income units leveraging full rent boost for 10 years.
- We assumed electrical upgrades are not needed for Scenario 1 with existing electric HVAC and DHW system.
- This analysis assumes 100% of the solar outputs goes to the owner meter and the project only receives 30% ITC.