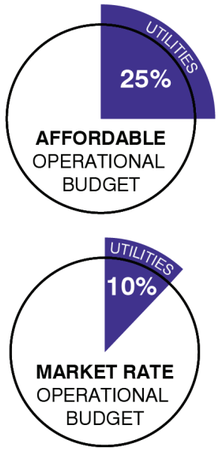
Lowering Utility Costs in Electrified Buildings

ELECTRIFICATION OF MULTI-FAMILY BUILDINGS

In New York City and beyond, fully electrified buildings and a cleaner electric grid play a key role in achieving a carbon neutral future. Building electrification is the subject of several recent local laws, sustainability incentives, and institutional mandates. Local Law 154 mandates most new buildings be electrified and Local Law 97 caps emissions while incentivising a clean grid. **Building electrification must address that electricity is nearly five times as expensive (per unit power) as natural gas.** As buildings - especially multi-family and most specifically affordable housing - move towards full electrification, the cost of electricity will significantly impact utility costs.

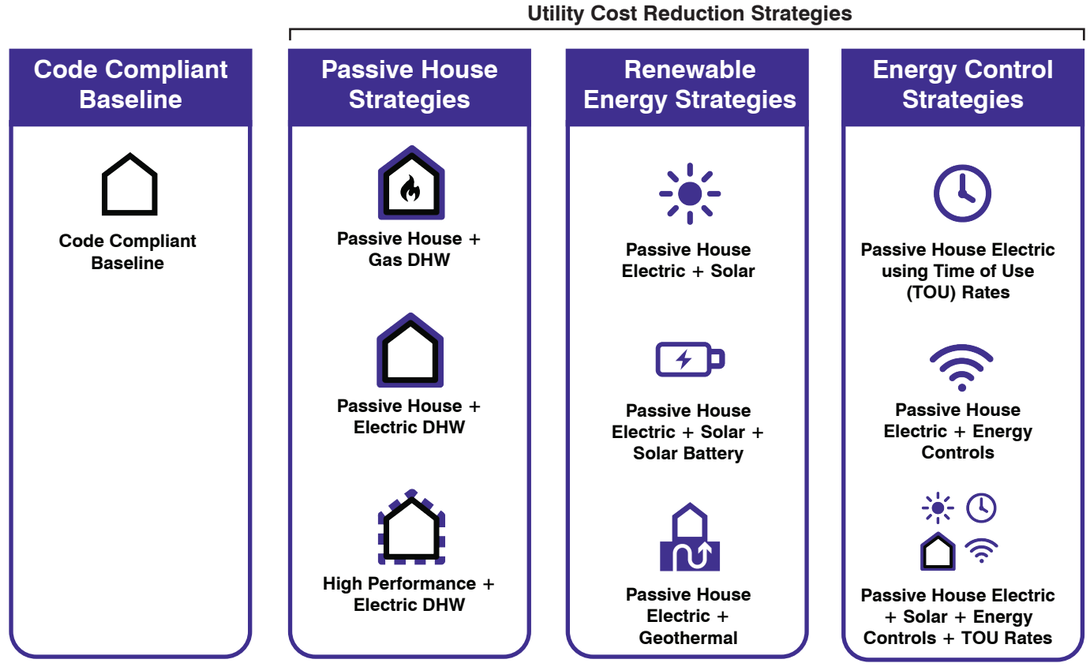


PASSIVE HOUSE SIGNIFICANTLY IMPACTS AFFORDABLE HOUSING

The affordable housing industry has led the way for residential buildings in New York to integrate Passive House and high energy performance strategies. **The deep energy savings associated with Passive House design is especially important for affordable housing: Utilities represent 25% of the operational budget of affordable housing, as compared to 10% for market rate housing.** The Passive House approach - increased building insulation, air sealing, and high performance windows coupled with energy efficient mechanical systems - is very effective in reducing costs for heating, cooling, and building systems outside of resident control. This has incentivized implementing Passive House in affordable housing and other multi-family buildings, locking in long-lasting benefits for occupant

ANALYSIS AND PROCESS

We used The Beacon, a 266 unit new construction affordable housing project, as a case study. We first established a Baseline case representing an all electric NYC Energy Code compliant scope. We then identified nine (9) strategies to study **utility cost, energy consumption, and carbon emissions.** The strategies and Baseline were modeled using both WUFI Passive and eQuest and, where applicable, our consultant's proprietary analytical tools.



THE BOTTOM LINE

Electricity is roughly 5 times as expensive as natural gas in NYC. The Passive House design approach is effective in decreasing utility costs of ***mostly*** electric buildings. As we transition to ***fully*** electric buildings, the utility rates for systems like domestic hot water that are governed by user behavior ***increase***, unlike systems affected by building performance.

The bottom line is that we need new strategies to combine *with* Passive House to lower utility costs in fully electric buildings.

RESULTS

The strongest performing strategies were:

42%
Utility cost reduction from Baseline

Passive House Electric + Solar

48%
Utility cost reduction from Baseline

Passive House Electric + Geothermal

58%
Utility cost reduction from Baseline

Passive House Electric + Solar + Energy Controls + TOU Rates

ADDITIONAL TAKEAWAYS

- *Transparency is needed in ConEd's Time of Use rate program;*
- *Energy control performance variable with building systems and should be studied*
- *Solar batteries need policy and incentive advancements;*

Additional promising strategies include:

- *Engaging building residents through shared saving programs*
- *Active power management to regulate incoming electricity*

Electrification Strategies

Summary of modeled performance of utility cost reduction strategies for fully electric, affordable, multi-family buildings.

The Beacon
New construction affordable housing

ELECTRIFIED	ICON	STRATEGY	DESCRIPTION	ANNUAL PERFORMANCE	COST & SAVINGS		NOTES	
⚡		**BASELINE**	Fully electric building meeting the 2020 NYC Energy Code	Electric 2,098,776 kWh Gas Carbon 606 tCO2e	**ANNUAL UTILITY COST**	**$524,694**	Fully electric buildings that meet code minimum lock the building owner into decades of higher utility costs and subpar energy and carbon performance.	CODE
		PASSIVE HOUSE + GAS DHW	Passive house envelope with high efficiency gas DHW heater	Electric 1,017,400 kWh Gas 2,315,000 kBTU (678,459 kWh) Carbon 417 tCO2e	**ANNUAL UTILITY COST** Cost **Savings** from Baseline:	**$295,058** $229,636 (44%)	This is the industry standard for affordable Passive House housing and serves as the utility cost threshold to exceed for a fully electrific building to be cheaper than a mostly electric building.	PASSIVE HOUSE
⚡		**PASSIVE HOUSE + ELECTRIC DHW**	Passive house envelope with electric heat pump domestic hot water heater	Electric 1,422,452 kWh Gas Carbon 411 tCO2e	**ANNUAL UTILITY COST** Cost **Savings** from Baseline: Cost **Increase** from PH+Gas:	**$355,613** $169,531 (32%) $60,555 (21%)	The standard fully electrified building switches from gas DHW to an electric heat pump hot water heater, reducing savings from the baseline and increasing cost from the gas DHW scope.	
⚡		**HIGH PERFORMANCE + ELECTRIC DHW**	Value-engineered passive house envelope with high performance HPAC window units for heating and cooling	Electric 1,493,587 kWh Gas Carbon 432 tCO2e	**ANNUAL UTILITY COST** Cost **Savings** from Baseline: Cost **Increase** from PH+Gas:	**$373,397** $151,297 (29%) $78,339 (27%)	"Pretty Good House" scope locks in 95% of the energy savings of the PH+Electric strategy with considerable installation cost savings. Special consideration is needed for air tightness at the HPAC in this strategy.	
⚡		**PASSIVE HOUSE + SOLAR**	PH + Electric scope with maximized (168 kW) rooftop solar photovoltaic system	Electric 1,222,420 kWh Gas Carbon 353 tCO2e	**ANNUAL UTILITY COST** Cost **Savings** from Baseline: Cost **Increase** from PH+Gas:	**$306,605** $218,089 (42%) $11,547 (4%)	Implementing a solar roof photovoltaic system recovers 85% of the cost savings difference lost in the switch from PH+Gas to PH+Electric. Solar savings would be applied to owner meter.	RENEWABLE ENERGY
⚡		**SOLAR BATTERIES**	Energy batteries to store solar generation. Replaces emergency generator.	Electric - Gas - Carbon -	**ANNUAL UTILITY COST** Cost **Savings** from Baseline: Cost **Increase** from PH+Gas:	**-** - -	Significant policy and incentive initiatives are required in order for solar battery installation to be commonplace in NYC.	
⚡		**PASSIVE HOUSE + GEOTHERMAL**	PH + Electric scope with closed-loop geothermal system for DHW, heating, & cooling	Electric 1,083,224 kWh Gas Carbon 313 tCO2e	**ANNUAL UTILITY COST** Cost **Savings** from Baseline: Cost **Savings** from PH+Gas:	**$274,370** $300,332 (57%) $70,696 (24%)	Geothermal outperforms the PH+Gas industry standard. This is the first fully electrified scope to lower utility cost from PH+Gas. Initial site feasibility for geothermal is strongly recommended.	
⚡		**PASSIVE HOUSE + TIME OF USE RATES**	PH + Electric scope with Con Edison's optional time of use electric rates	Electric 1,422,452 kWh Gas Carbon 411 tCO2e	**ANNUAL UTILITY COST** Cost **Savings** from Baseline: Cost **Increase** from PH+Gas:	**$387,184** $137,510 (26%) $92,126 (31%)	Time of Use (TOU) Rates without any strategies to reduce peak demand result in utility cost increase. Solar PV works well with TOU rates, but does not overcome the cost increase.	ENERGY CONTROLS
⚡		**PASSIVE HOUSE + TIME OF USE + ENERGY CONTROLS**	PH + Electric scope with energy management controls for peak energy, DHW, and demand control	Electric 1,419,018 kWh Gas Carbon 410 tCO2e	**ANNUAL UTILITY COST** Cost **Savings** from Baseline: Cost **Increase** from PH+Gas:	**$296,642** $228,052 (43%) $1,584 (<1%)	Energy management controls in conjunction with time of use rates are a key lever to bringing electrified building utility beneath the PH+Gas threshold. No energy generation is included, so PH+Geothermal still outperforms this scope.	
⚡		**PASSIVE HOUSE + SOLAR + TIME OF USE + ENERGY CONTROLS**	PH Electric scope with solar, time of use rates, and energy management controls	Electric 1,023,536 kWh Gas Carbon 296 tCO2e	**ANNUAL UTILITY COST** Cost **Savings** from Baseline: Cost **Savings** from PH+Gas:	**$221,489** $303,205 (58%) $73,569 (25%)	PH+Electric scope with TOU rates, energy controls, and solar is the highest performing scope, well below the PH+Gas threshold. Before implementing, Con Edison must clarify TOU rates and a custom control strategy should be designed. Exact interaction of building controls and solar may vary.	