BUILDINGENERGY NYC

NYCHA RAD-PACT: Generational Opportunities for Driving Change

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Northeast Sustainable Energy Association (NESEA)
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Understanding PACT Program

To watch more videos about the PACT program, **check out our PACT YouTube Playlist!**

https://www.youtube.com/watch?si=NkGNhEdBFj4G_zjn&v=dWwP0fkd4_k&feature=youtu.be

Overview RAD and PACT Programs

Rental Assistance Demonstration Program (RAD)

- Federal initiative that originated during the Obama administration in 2013.
- Intent behind the program is to inject funding into PHAs across the country to address capital needs and deferred maintenance backlogs.
- The deferred maintenance backlog nationwide is estimated at **$26B** and the total capital funding need for NYCHA alone is approximately **$76B.**

Permanent Affordability Commitment Together (PACT)

- Comprehensive Renovations
- Deep Energy Retrofits
- Enhanced Property Management
- Expanded On-site Social Services

Overview RAD and PACT Programs

PACT Ownership and Operations

- Management of the property transfers from the public housing authority to a private sector entity
- **Public Housing Authorities are funded with Section 9:** During a RAD/PACT conversion, this subsidy switches to Section 8 Project Based Voucher funding. Section 8 is used throughout to country to subsidize affordable housing operations
- **Section 8 is a higher value subsidy stream:** Development teams can then bring in financing to address capital needs
- This capital infusion provides a previously unseen opportunity to not only give properties a facelift and introduce amenities, but to **comprehensively overhaul building systems**

National & Regional Impact

NYCHA’s Need for Investment

NYCHA Portfolio Stats to Know

- Construction years: 1945-1970
- Predominant building systems: Low pressure gas-fired boilers (steam heat and in many cases DHW), gas-reliant appliances, inefficient lighting and water fixtures
- The deferred maintenance backlog suggests these systems are often in st of disrepair
- Capital needs suggest many of these systems are in need of replacement

How has RAD impacted NYCHA?

- Capital raised to-date: ~$3B
- Portfolio size – NYCHA manages more housing units than any PHA. The need to bring in support from outside owners/managers is clear
- NYCHA plans to convert 62,000 units under the RAD/PACT program

PACT: Scale of Rehabilitation

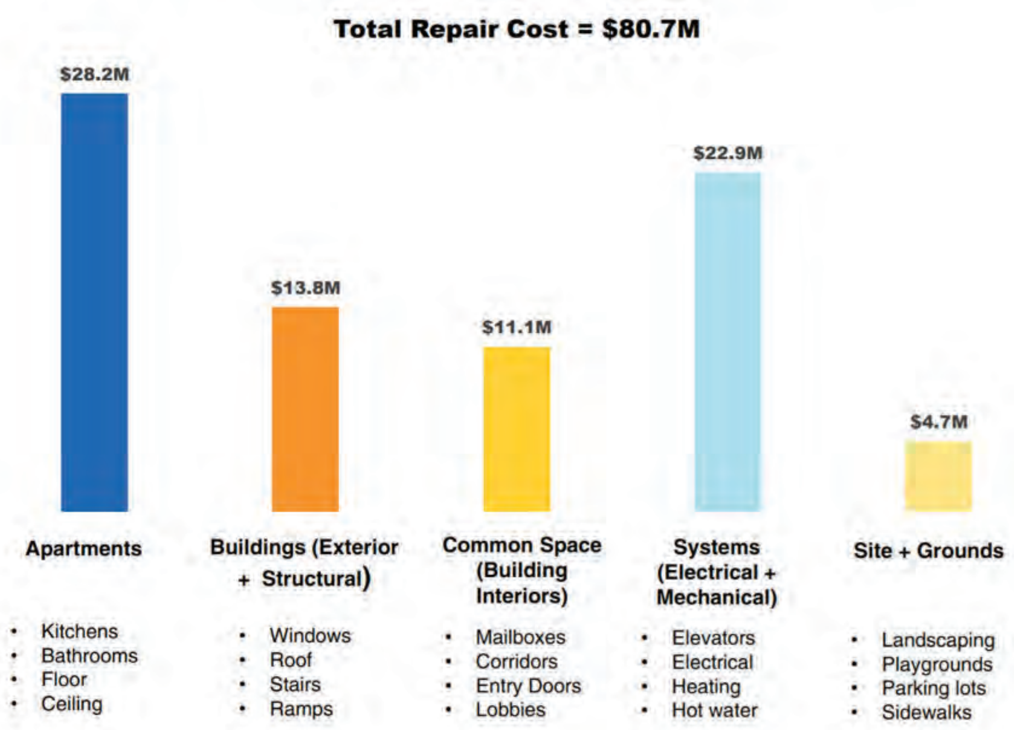
Interior improvements

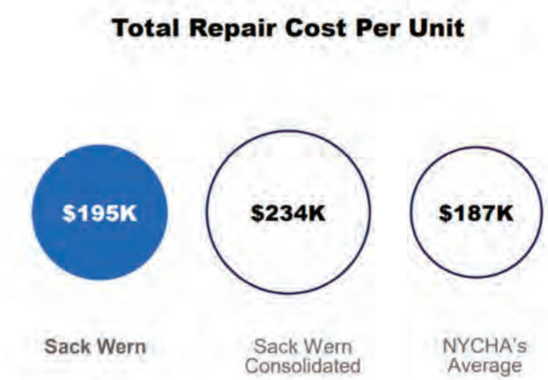
Building System Improvements

Case Study: Sack Wern

Case Study: Sack Wern

Major Repair Costs: Sack Wern

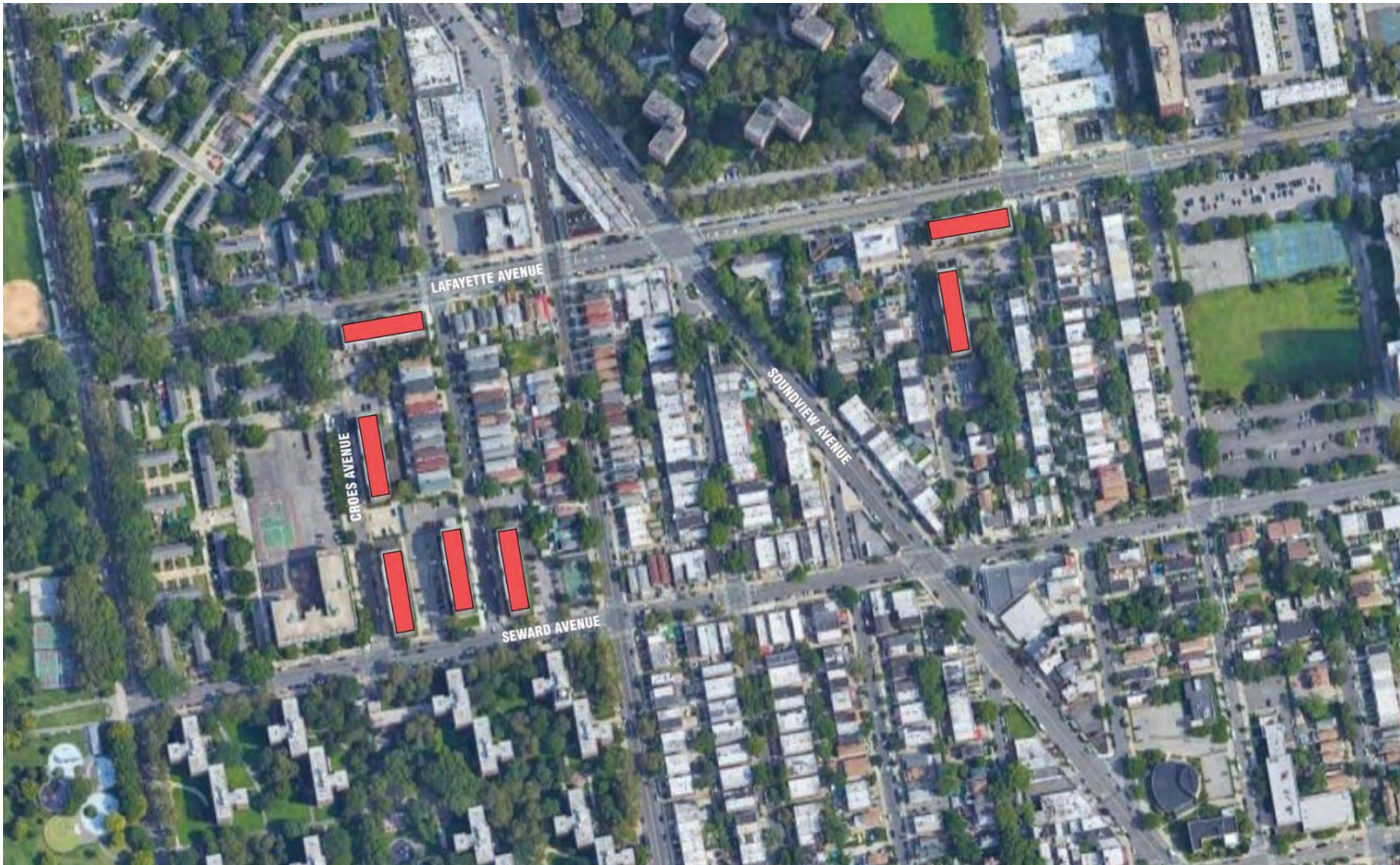




Lead Test: Depending on finding from PACT inspections, a lead abatement plan will be included as part of the PACT project at Sack Wern.

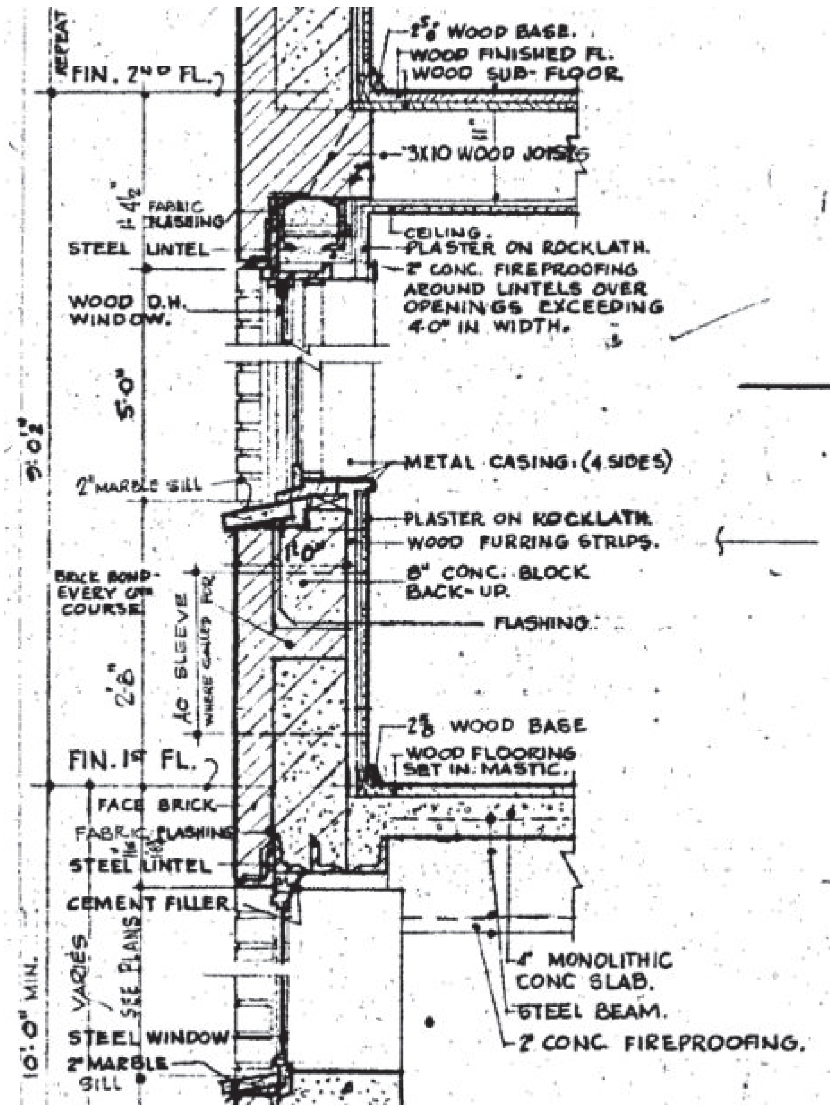
Case Study: Sack Wern

Case Study: Sack Wern - EXISTING CONDITIONS

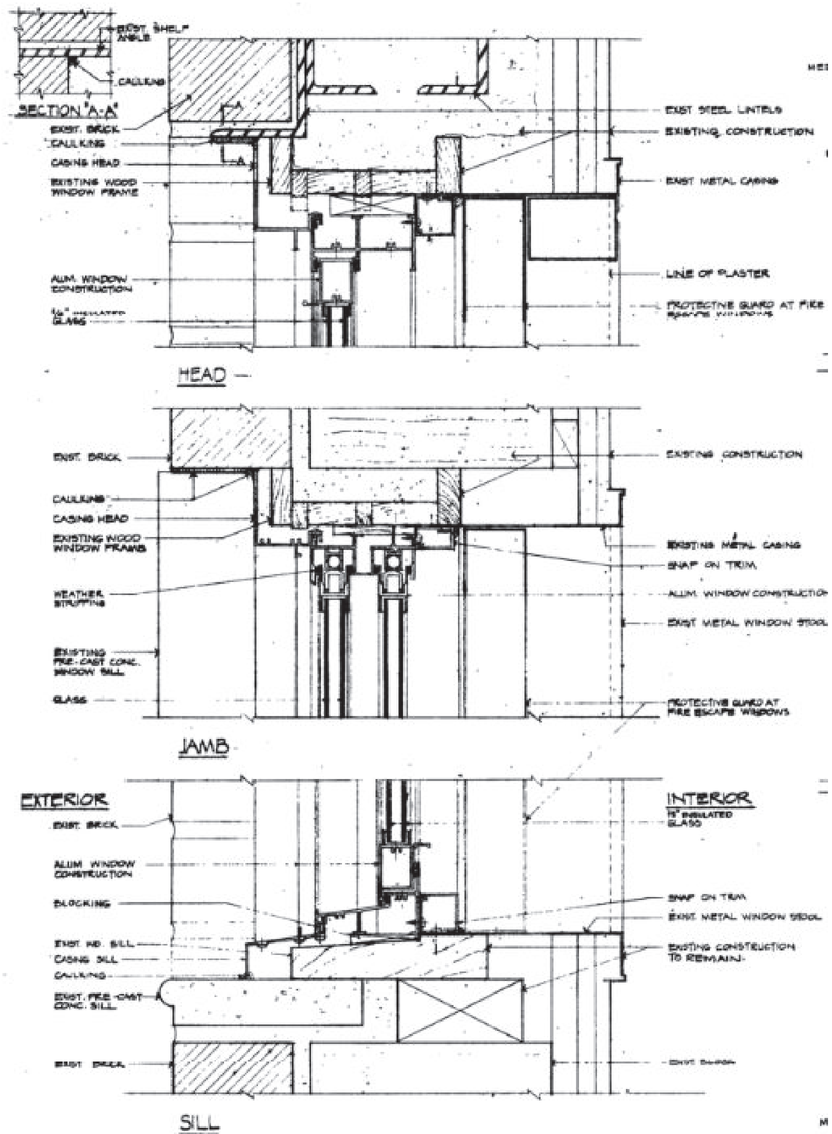


Case Study: Sack Wern

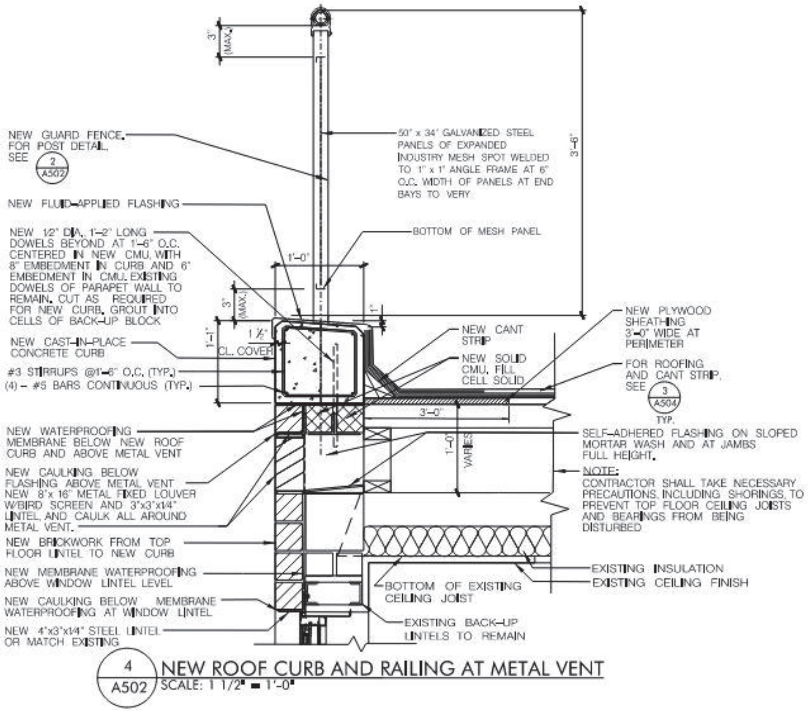
Case Study: Sack Wern - EXISTING CONDITIONS



Case Study: Sack Wern - EXISTING CONDITIONS



Case Study: Sack Wern - EXISTING CONDITIONS



Case Study: Sack Wern - EXISTING CONDITIONS

Case Study: Sack Wern - EXISTING CONDITIONS

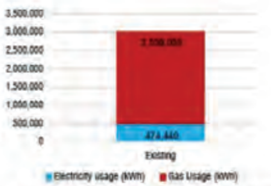
Case Study: Sack Wern - PERFORMANCE GOALS

EXISTING BUILDING PERFORMANCE:

The Sack Wern buildings do not have Energy Grades as can be found in buildings conforming to LL 33 of 2018, and can generally be described as poorly performing existing buildings.

Key drivers of energy performance on the envelope side are air leakage (especially through windows), aluminum double hung windows, thermal bridging, and lack of insulation. On the MEP side, the steam boiler is a driver of poor energy performance.

The existing buildings do not comply with the Local Law 2030 thresholds.



Existing energy use broken down by electricity and gas

KEY PERFORMANCE METRICS

Electricity Usage:	3,314,073 kWh
Gas Usage:	606,599 Therms
Site EUI:	191.81
Annual Utility Cost:	$1,532,288/ year
Annual Carbon:	529 tCO2e / year

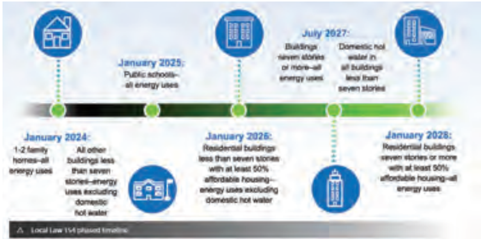
LL97 COMPLIANCE

Standard	Complies?
2030 Threshold (180 tCO2e/yr)	X DOES NOT COMPLY
80% Reduction by 2050	X DOES NOT COMPLY

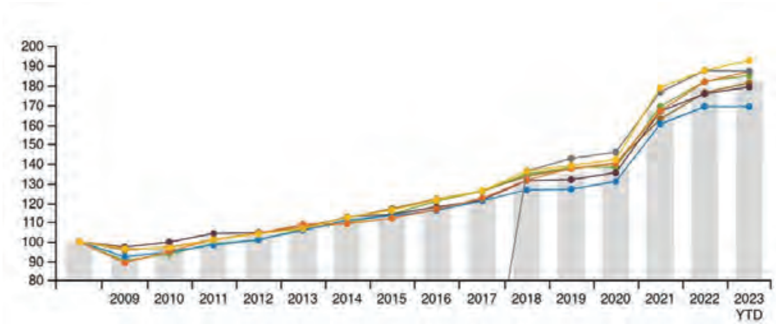
Enterprise green communities[SM]

Building Energy Efficiency Rating

A 91



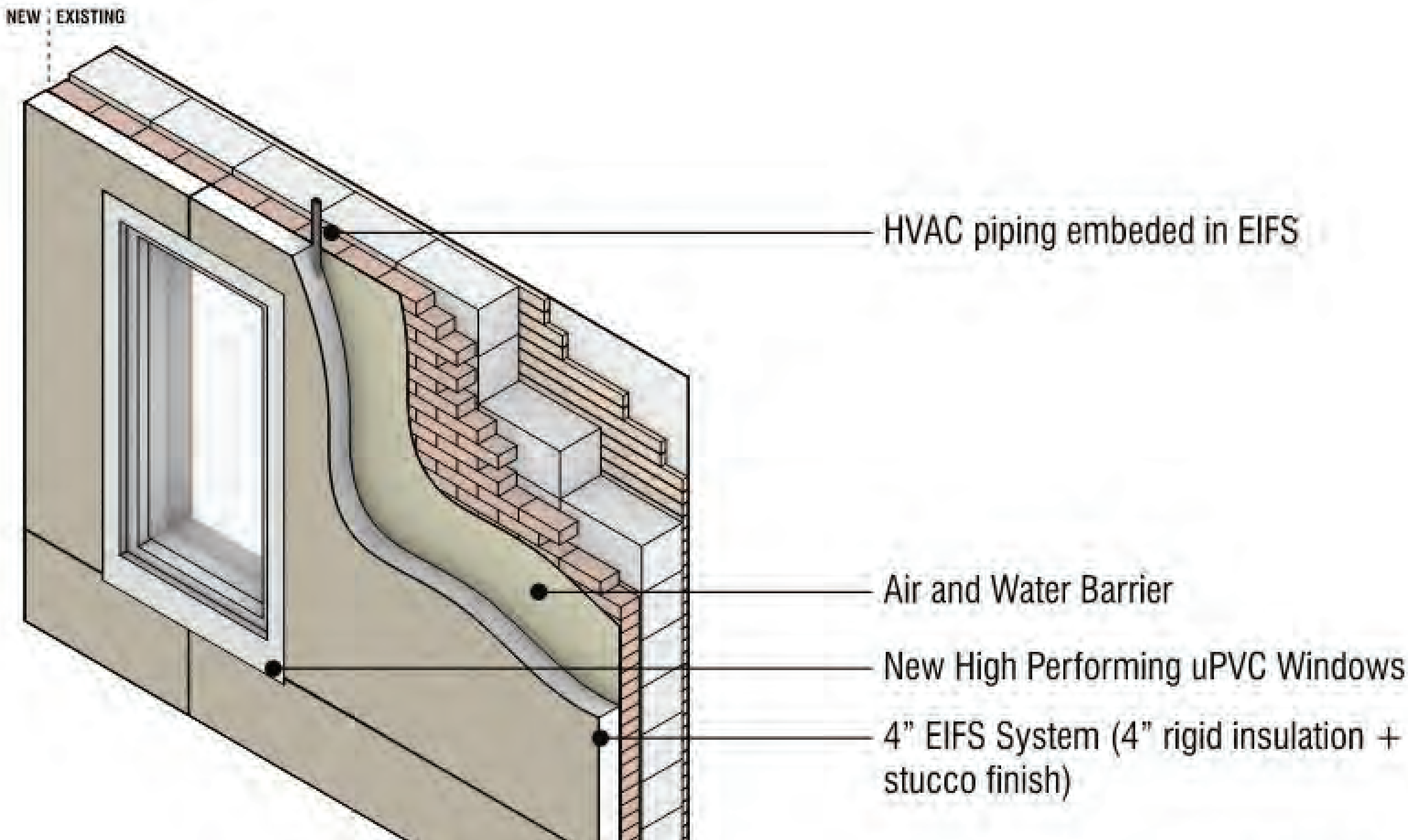
Case Study: Sack Wern - BUDGET & INCENTIVES



NEW YORK STATE OF OPPORTUNITY. | Empire Building Challenge

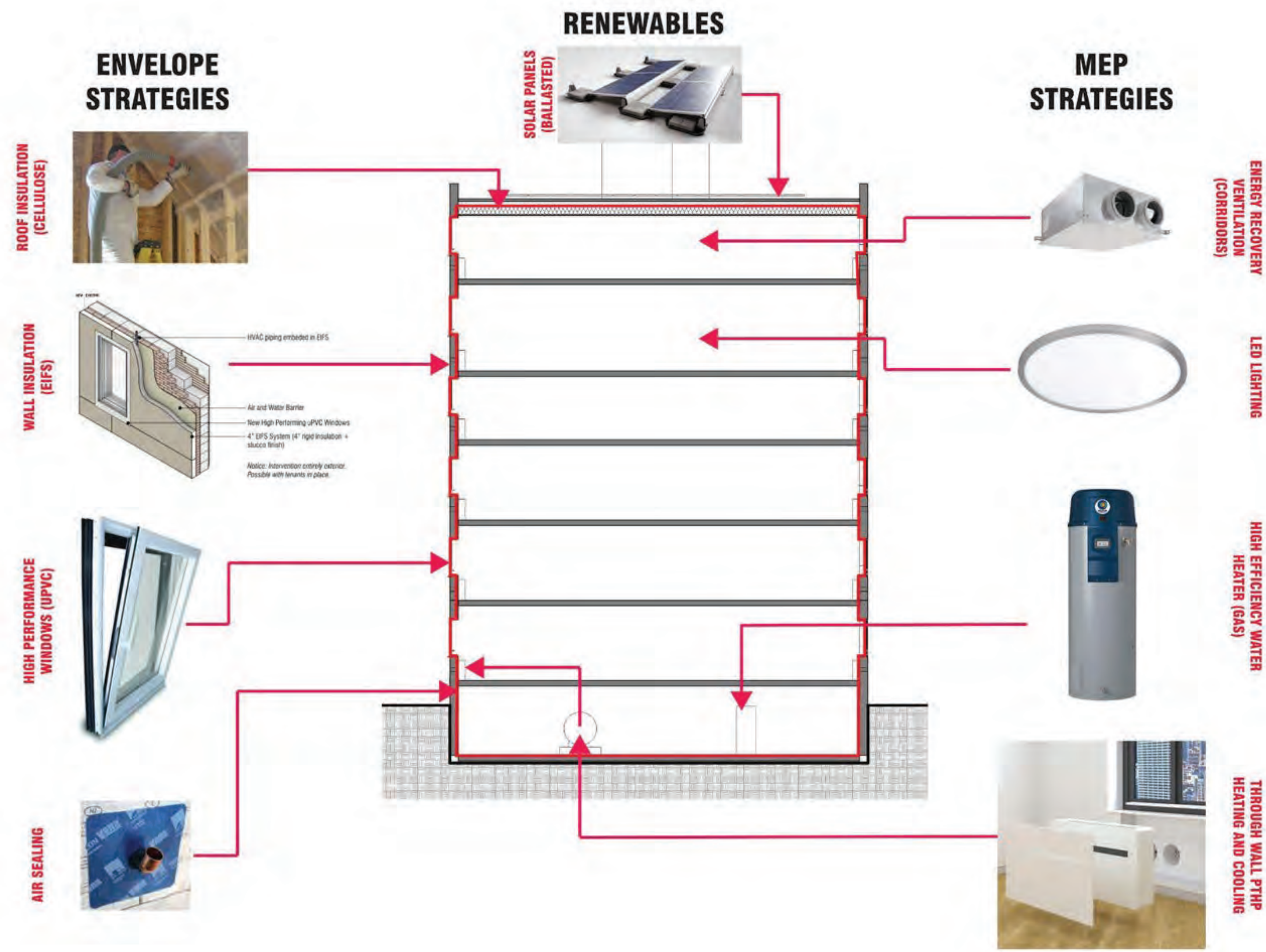
NEW YORK STATE OF OPPORTUNITY. | NYS Clean Heat Program

Case Study: Sack Wern - CODES AND REGULATIONS



Notice: Intervention entirely exterior. Possible with tenants in place.

Case Study: Sack Wern - SCOPE RECOMMENDATIONS

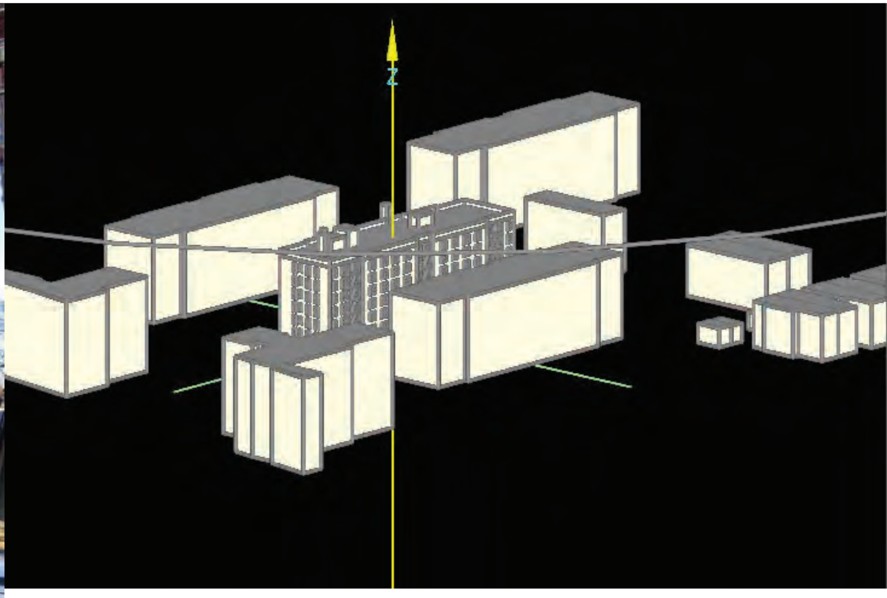


Analysis Scope: ECM Modeling & EGC Compliance

- Enterprise Green Communities
- Existing building utility analysis
- Modeling & Analysis of Energy Conservation Measures
  - Energy
  - Cost
  - Emissions
- Iterative ECM scope testing

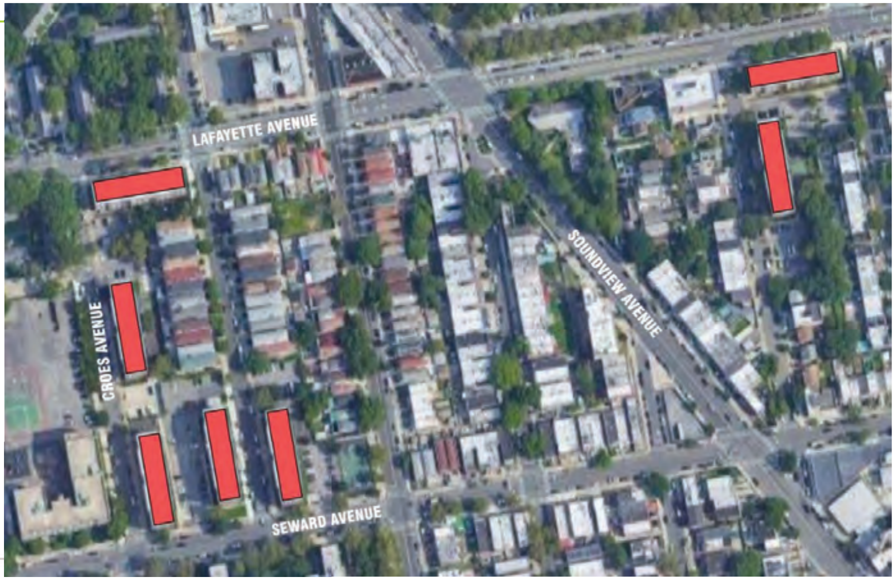
Local Law 97

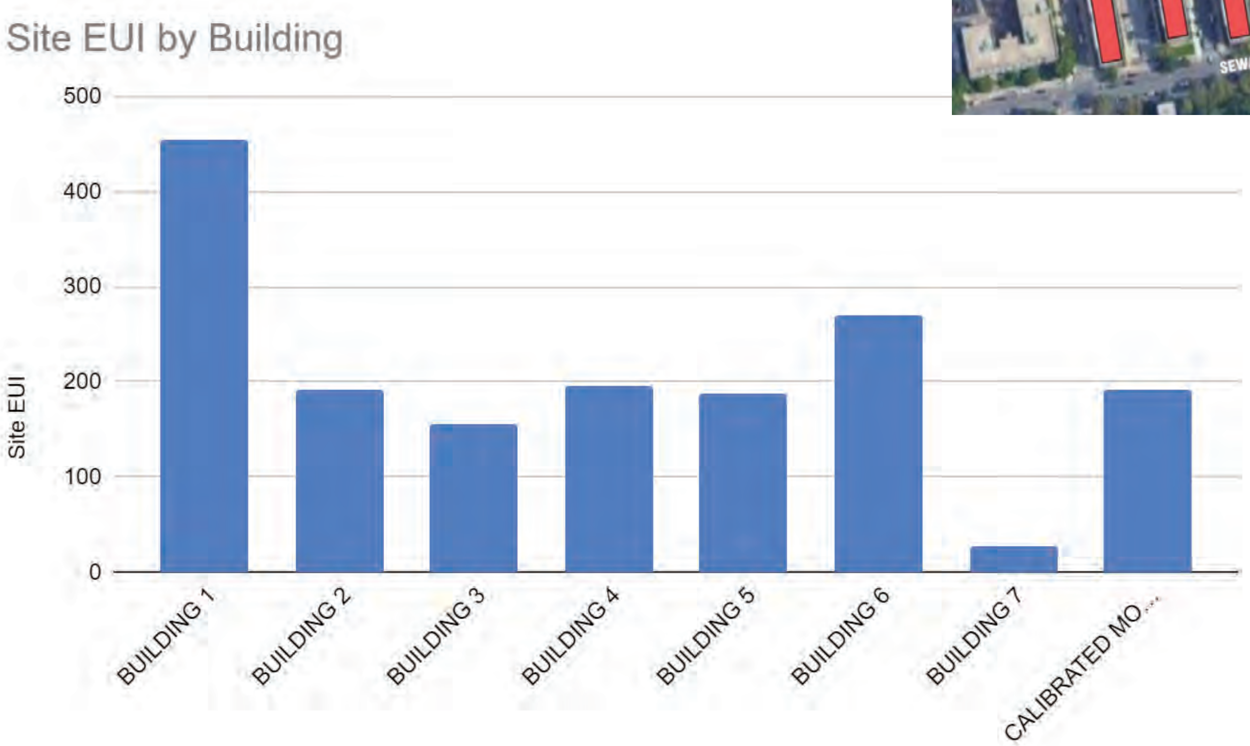
Enterprise green communities℠



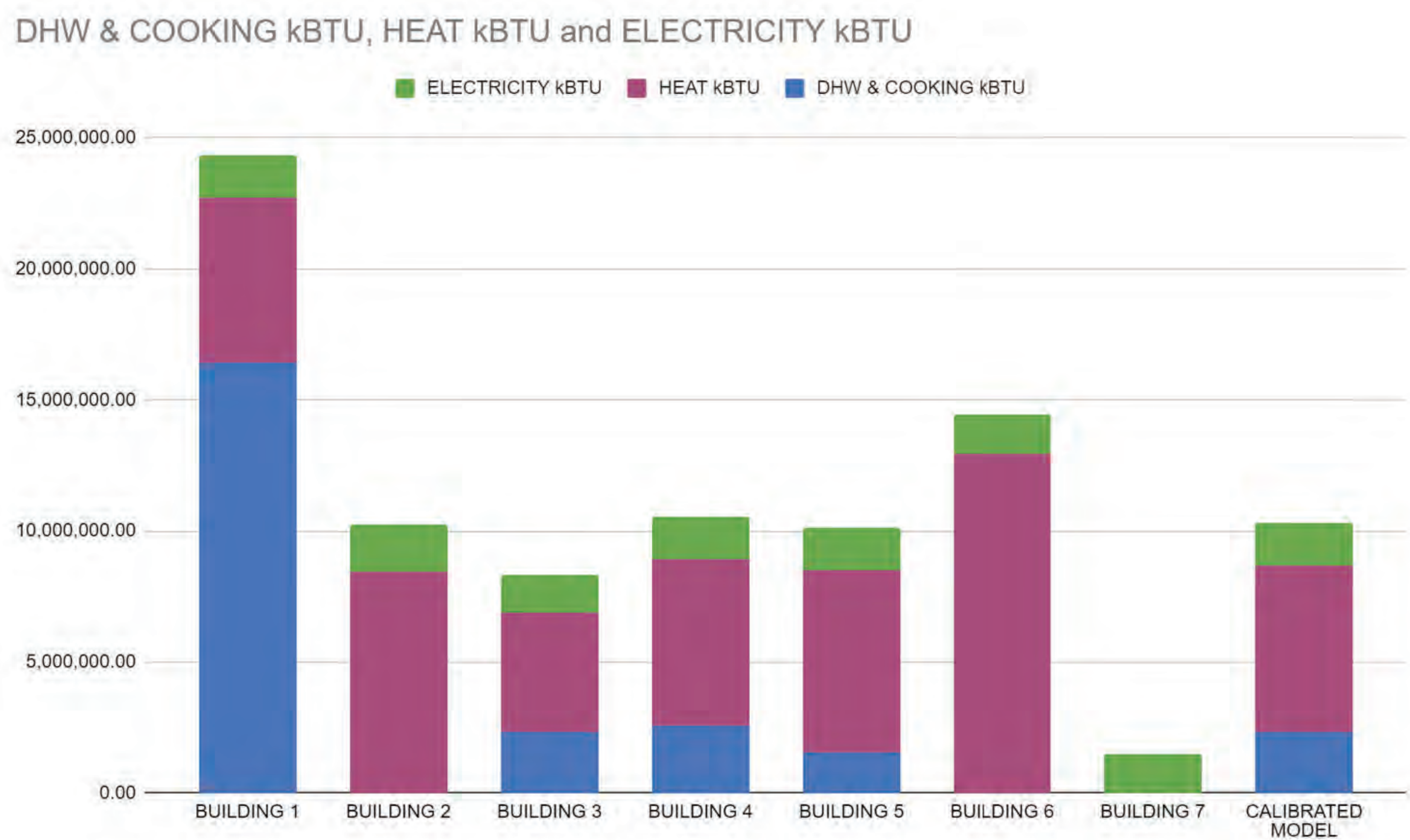
Utility Analysis: A Messy Exercise!

- NYPA Electric & Gas
- Inconsistent meter data
  - Missing months/years
  - Temporary boilers used
  - Outlier building usage
- Wide variability across portfolio



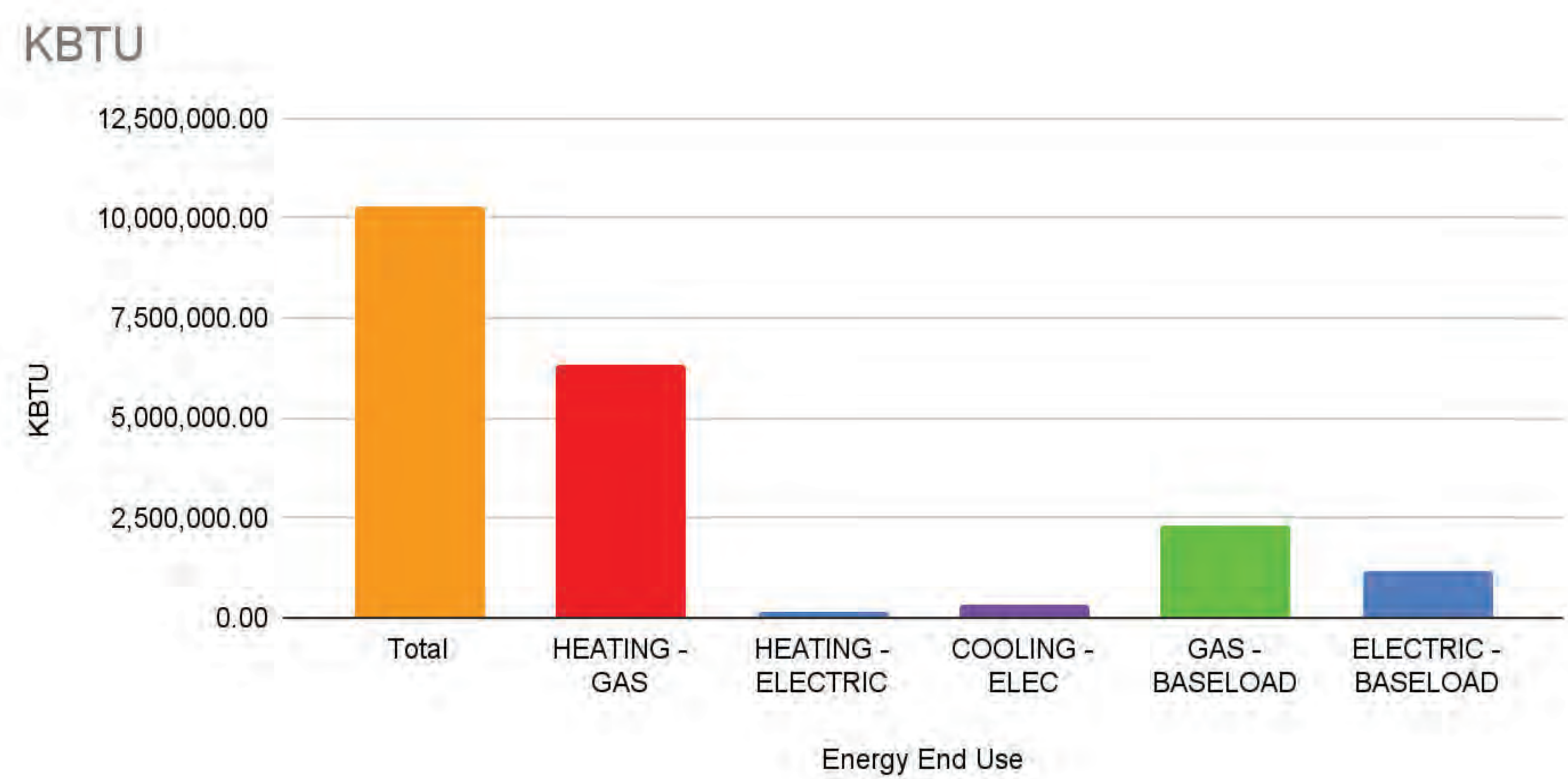


Performance by Building



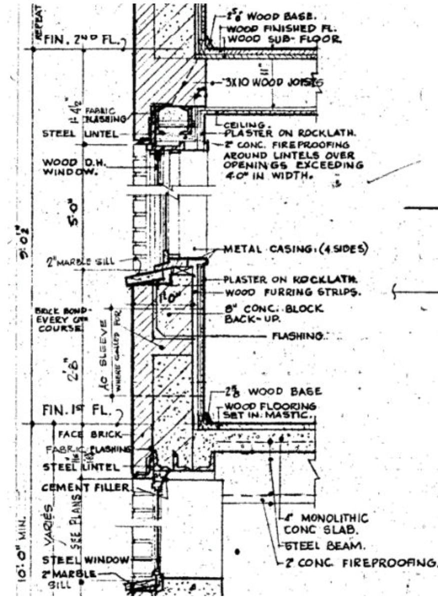
“Clean” building data

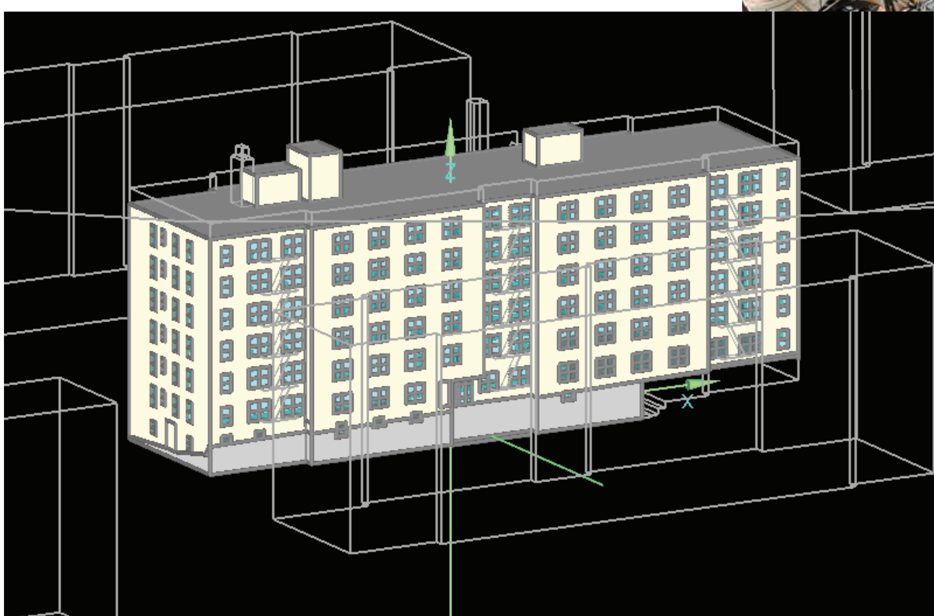
- Based on clean data from Buildings 2 and 4
- Disaggregated end use based on seasonality, meter
- EUI ~191



Creating the Calibrated Existing Building Energy Model

- Calibration following process outlined in 2016 NREL conference paper
    - *"A Method to Test Model Calibration Techniques"*
- Existing building model informed by:
    - Historical utility bill analysis
    - Existing building drawings
    - Historical work completed
    - On-site audits and probes
- Modeled in WUFI Passive





"A Method to Test Model Calibration Techniques" NREL. Judkoff, R. Polly, B. Neymark, J. September 2016

Calibration Process

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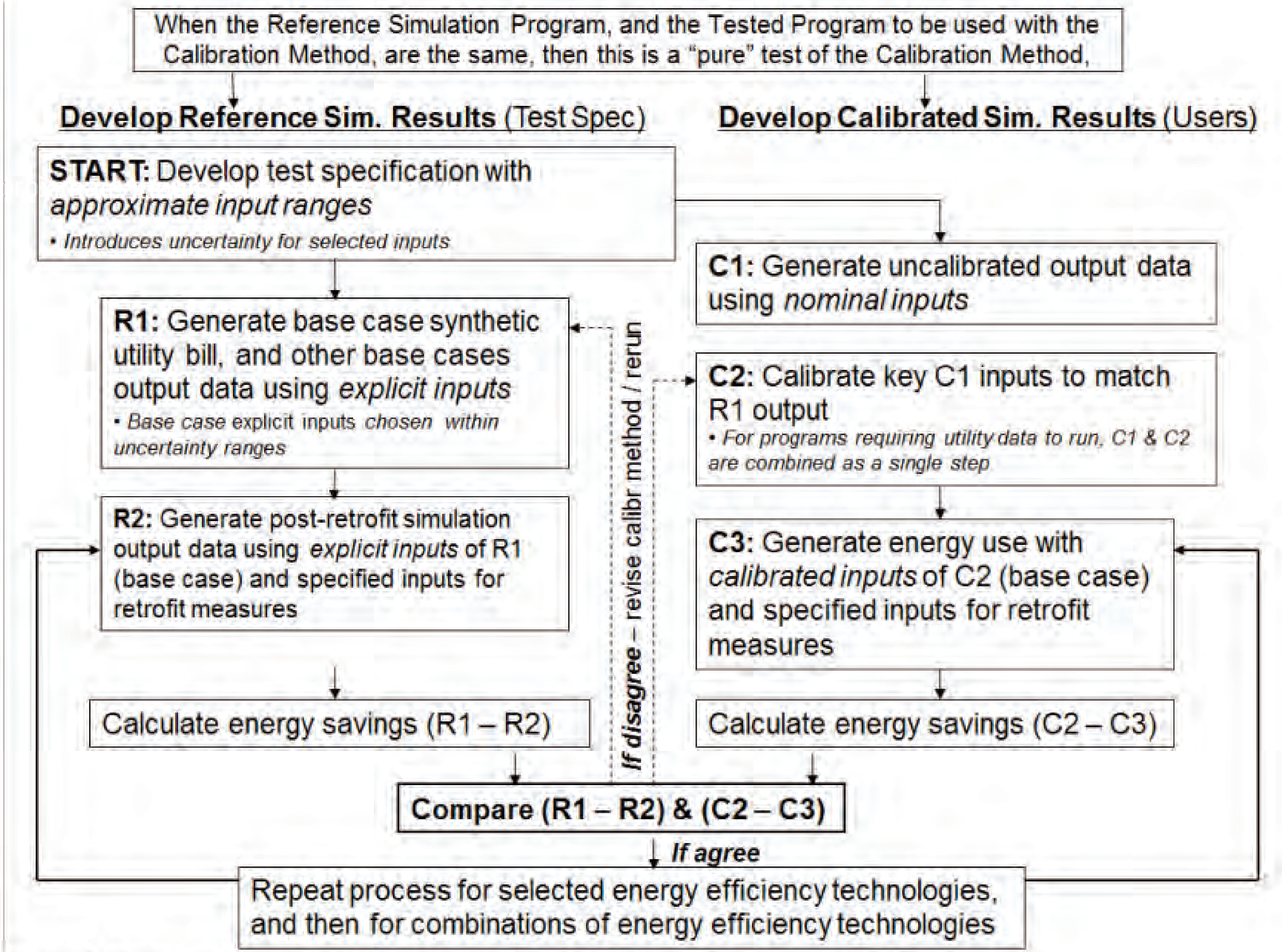
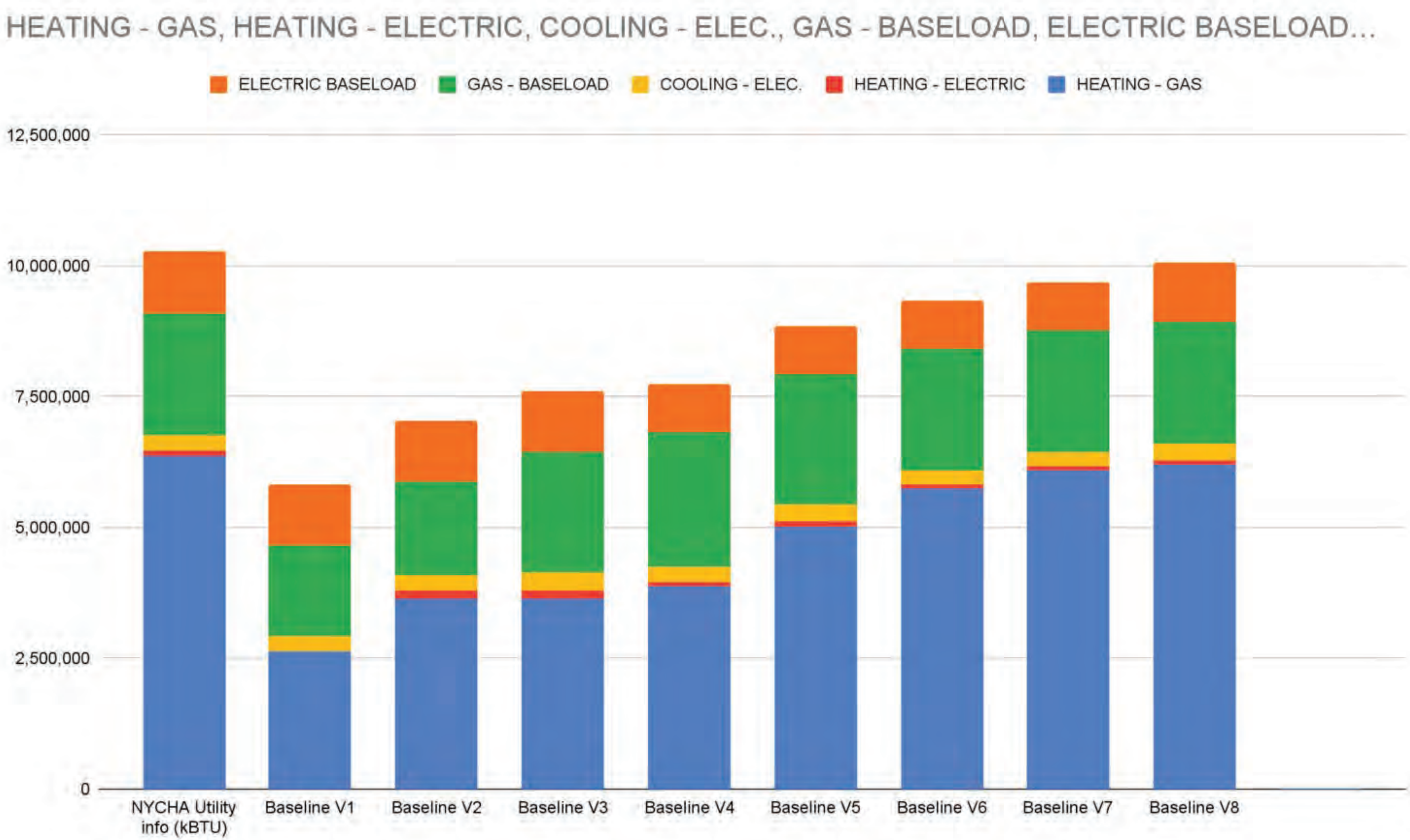


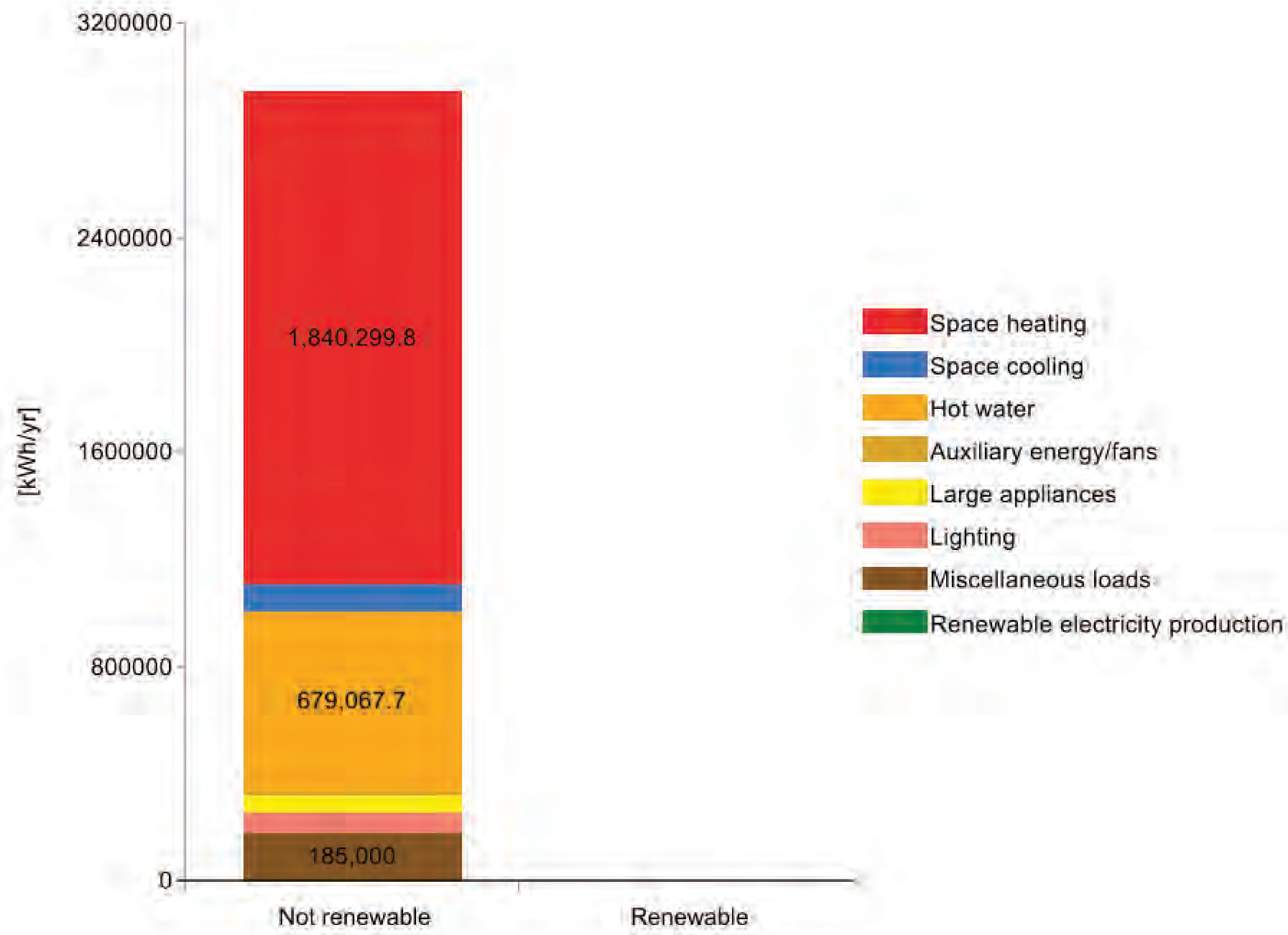
Figure 1. Conceptual Flow of Calibration Test Method. *Source*: Judkoff et al. 2011.

Hot water tap openings per person per day		3	3	5	5					
Airtightness (cfm/sf envelope @50Pa)		1.5	1.5							
DHW consumption 140°F per person per day		15	15	20	20		18			
Average cold water temp		45	45							
Mechanical room temp		72	72							
Component Specs		**Baseline V1**	**Baseline V2**	**Baselinve V3**	**Baseline V4**	**Baseline V5**	**Baseline V6**	**Baseline V7**	**Baseline V8**	
Kitchen Cooking		0.25 kwh/use	0.25 kwh/use							
MELS		65,000 [kWh/Use], dwelling MELS	65,000 [kWh/Use], dwelling MELS		120000				185000	
MELS		10,000 [kWh/Use], common MELs/office	10,000 [kWh/Use], common MELs/office		0					
Lighting interior		65,000 [kWh/Use], interior dwelling	65,000 [kWh/Use], interior dwelling		30630					
Lighting interior		100,000 [kWh/Use], interior common	100,000 [kWh/Use], interior common		40678					
Lighting exterior		42,000 [kWh/Use], exterior	42,000 [kWh/Use], exterior		6000					
Lighting power density W/SF										
Misc Appliances / equipment:		Elevator: 8771 kwh/year	Elevator: 8771 kwh/year							
Systems		**Baseline V1**	**Baseline V2**	**Baselinve V3**	**Baselinve V4**	**Baseline V5**	**Baseline V6**	**Baseline V7**	**Baseline V8**	
Ventilation- ERV/HRV		Efficiency: 0.45 W/cfm	Efficiency: 0.45 W/cfm		efficiency 0.65 w/cfm					
Heating		Winter boiler (DHW & steam heat) Efficiency at nominal output: 0.78 90% of heating Summer boiler Performance Ratio of Heat Generator: 0.8	Heating boiler Efficiency at 30% load: 0.5 Efficiency at nominal output: 0.65 90% of heating				3% electric, 97% gas		standby loss .065	
Cooling		COP: 2.5	COP: 2.5							
Supplemental heating (electric heaters)		10% of heating	10% of heating							
DHW		Winter boiler (DHW & steam heat) Efficiency at nominal output: 0.78 Storage Tank: 200 gal, Specific total thermal storage losses [Btu/hr F]: 5	DHW Bioler: 1.53 performance of heat generator, auxiliary power, 424 btu/hr							
Misc. Mechanical Equipment		Efficiency 1.5 W/cfm	Efficiency 1.5 W/cfm							
Distribution		**Baseline V1**	**Baseline V2**	**Baseline V3**	**Baseline V4**	**Baseline V5**	**Baseline V6**	**Baseline V7**	**Baseline V8**	
Hydronic - Design Flow Temp		212	212							
Hydronic - Length of Distrubution Pipes (ft)		2000 ft	2000 ft							
Hydronic - Heat Loss Coefficent per ft Pipe		1.086 (1.5" pipe at R-0.1 insulation)	1.086 (1.5" pipe at R-0.1 insulation)							
Hydronic - Design System Heating Load		2200 kBtu/hr	2200 kBtu/hr							
DHW - Design Flow Temp		140	140							
DHW - Heat Loss Coefficent per ft Pipe		.6669 (1.5" pipe at R-0.1 insulation)	.6669 (1.5" pipe at R-0.1 insulation)	145	140					
DHW - Length of individual pipes		950	950							
DHW - Length of Recirc Pipes		2000	2000	2400	1800					
Cooling - Min temp of Cooling Coil		45 F	45 F							
Cooling - Recirculation Air Flow rate		30,000	30,000							
Cooling - Recirculation air Cooling Capacity		600	600							
Cooling - Recirc Cooling COP		2.5	2.5							
Leakage/Airtightness		**Baseline V1**	**Baseline V2**	**Baseline V3**	**Baseline V4**	**Baseline V5**	**Baseline V6**	**Baseline V7**	**Baseline V8**	
Ducts: location/insulation, leakage										
		Envelope airtightness at 50 Pa [cfm/ft²]	Envelope airtightness at 50 Pa [cfm/ft²]							
Infiltration		1.5CFM50/Sq.ft enclosure	1.5CFM50/Sq.ft enclosure				2 CFM50/Sq.ft enclosure	2.3	2.4	
kBTU	NYCHA Utility info (kBTU)	**Baseline V1**	**Baseline V2**	**Baselinve V3**	**Baseline V4**	**Baseline V5**	**Baseline V6**	**Baseline V7**	**Baseline V8**	
HEATING - GAS	6,351,095	2,629,682.00	3,645,252.00	3,641,330.00	3,869,552.00	5,017,584.00	5,738,134.00	6,085,503.00	6,195,306.00	98%
HEATING - ELECTRIC	120,375	-	146,687.00	146,403.00	77,075.00	114,312.00	79,095.00	85,410.00	83,437.00	69%
COOLING - ELEC.	302,713	312,853.00	312,510.00	366,385.00	306,874.00	299,729.00	287,491.00	281,807.00	325,184.00	107%
GAS - BASELOAD	2,314,640	1,704,798.00	1,773,715.00	2,287,959.00	2,578,101.00	2,490,034.00	2,316,587.00	2,316,479.00	2,316,846.00	100%
ELECTRIC BASELOAD	1,192,289	1,169,729.00	1,169,239.00	1,169,372.00	913,051.00	914,129.00	914,679.00	914,998.00	1,136,665.00	95%
TOTAL	10,281,112	5,817,062.00	7,047,403.00	7,611,449.00	7,744,653.00	8,835,788.00	9,335,986.00	9,684,197.00	10,057,438.00	98%
EUI	191.1	108.2	131.0	141.5	144.0	164.3	173.6	180.1	187.0	98%

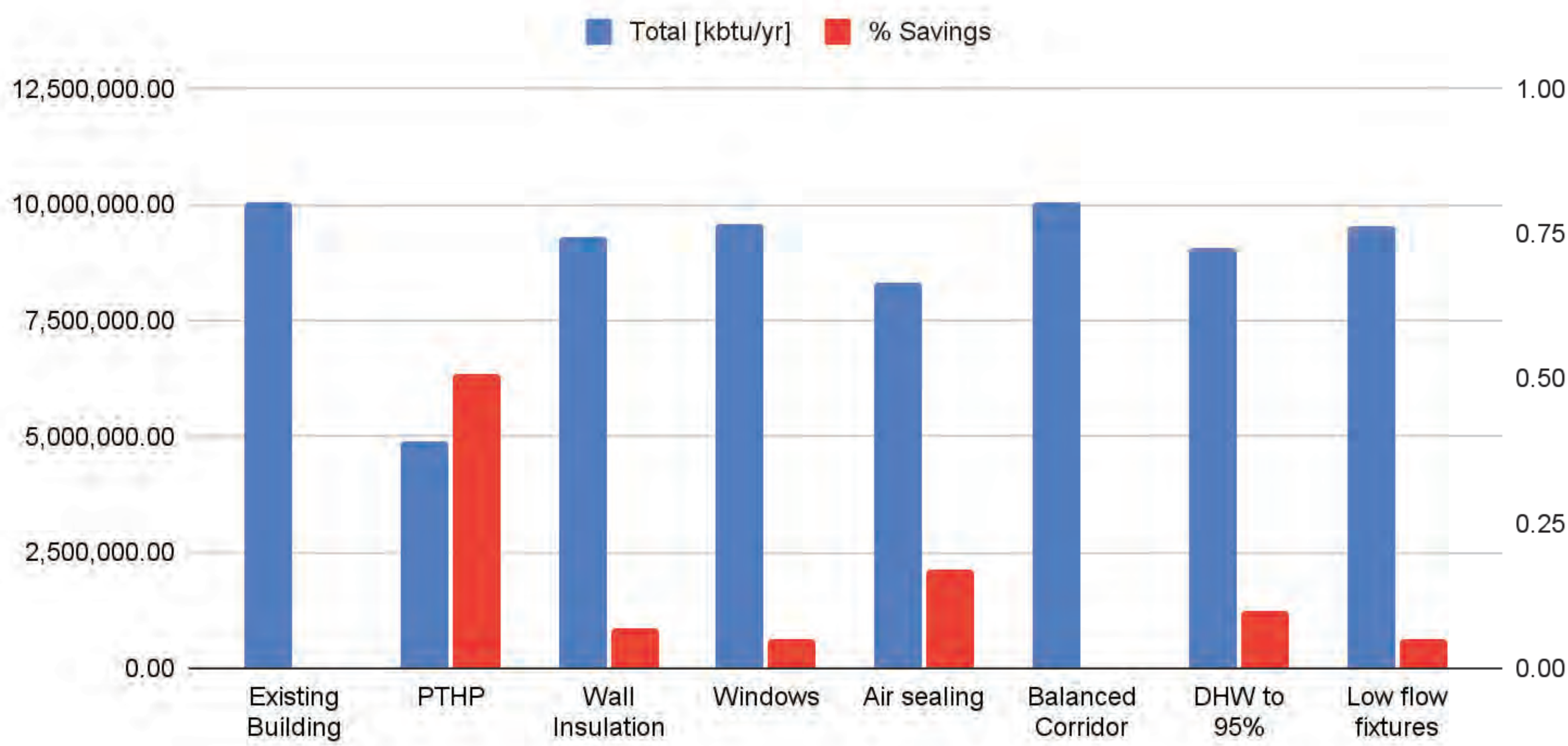
Iterative Calibration Process



Calibrated Existing Building Site Energy



Individual Energy Conservation Measure Testing



OPTION 1 SCOPE IMPROVEMENTS AND PERFORMANCE:

The integrated design and development team identified and analyzed a series of ECMs that could be implemented to improve building energy performance. From this suite of options and review of constructibility, the team selected the following measures to satisfy *Option 1* scope requirements:

ENVELOPE SCOPE

Exterior Walls:	1.5" metal studs @ 16" o.c. furred on the interior face of the walls. 1.5" mineral wool batt insulation in cavity (R6 w/ 20% thermal bridging area due to intervening walls and floors)
Windows:	Metal double hung windows. U-0.4, SHGC 0.3
Entry Doors:	Metal entry doors. U-0.77, SHGC 0.3
Roof:	R-38 cellulose loose fill blown into existing 10" roof joists at 16" o.c., below the existing ventilated cockloft.
Air Sealing:	Air sealing to code 0.6 CFM75/SF Envelope

Metal Stud and mineral wool insulation.

MEP SCOPE:

Heating:	84% efficient gas fired steam boiler (max efficiency for the steam system)
Ventilation:	Corridor balanced ventilation. 100 CFM per floor. ERV, 75% SRE, 40% latent recovery.
Hot Water:	Gas fired 95% efficiency DHW boiler
Plumbing:	Low flow fixtures per EGC. Insulate water and heating piping per energy code, where accessible.
Appliances:	Electric ranges

High efficiency gas boiler.

KEY PERFORMANCE METRICS

Electricity Usage:	3,178,720 kWh	(4% Reduction from Existing)
Gas Usage:	235,333 Therms	(61% Reduction from Existing)
Site EUI:	93.9	(51% Reduction from Existing)
Annual Utility Cost:	$1,275,215/ year	$ $ $ $ $ $ $ $ $ $ $ $ $ (17% Reduction from Existing)
Annual Carbon:	244 tCO2e / year	(54% Reduction from Existing)
Installation Cost:		$ $ $ $

*PRELIMINARY PRICING BASED ON OUTLINE SPEC

LL97 COMPLIANCE

Standard	Complies?
2030 Threshold (180 tCO2e/yr)	X DOES NOT COMPLY
80% Reduction by 2050	X DOES NOT COMPLY

OPTION 2 SCOPE IMPROVEMENTS AND PERFORMANCE:

Based on the results of the *Option 1* scope analysis combined with modeling of potential individual energy improvement measures, the team reviewed an *Option 2* package designed to be the second of two potential just-right balance of energy performance and economic use of project budget

ENVELOPE SCOPE

Exterior Walls:	4" EIFS on the exterior face of exterior walls.
Windows:	Double pane UPVC casements. U-0.27, SHGC 0.3
Entry Doors:	Thermally broken aluminum. U-0.3, SHGC 0.3
Roof:	R-38 cellulose loose fill blown into existing 10" roof joists
Air Sealing:	Air sealing to 0.4 CFM75/SF Envelope

Exterior EIFS

MEP SCOPE:

Heating/Cooling:	Ephoca unitary PTHP, COP@17F 1.64, COP@47F 2.85
Ventilation:	Corridor balanced ventilation. 100 CFM per floor. ERV, 75% SRE, 40% latent recovery.
Hot Water:	Gas fired 95% efficiency DHW boiler
Plumbing:	Low flow fixtures per EGC. Insulate water and heating piping per energy code.
Appliances:	Electric ranges and Energy Star refrigerators

High Performance HPAC

KEY PERFORMANCE METRICS

Electricity Usage:	3,733,082 kWh	(12% Increase from Existing)
Gas Usage:	24,034 Therms	(96% Reduction from Existing)
Site EUI:	57.84	(70% Reduction from Existing)
Annual Utility Cost:	$1,029,407/ year	$ $ $ $ $ $ $ $ $ $ (33% Reduction from Existing)
Annual Carbon:	96 tCO2e / year	(81% Reduction from Existing)
Installation Cost:		$ $ $ $ $ $ $ $ $ $

*PRELIMINARY PRICING BASED ON OUTLINE SPEC

LL97 COMPLIANCE

Standard	Complies?
2030 Threshold (180 tCO2e/yr)	✓ COMPLIES
80% Reduction by 2050	X DOES NOT COMPLY

CONCLUSION: *FUTURE PROOFED OPTION 2* SCOPE

KEY TAKEAWAY

The primary conclusion of this feasibility study is that the *Option 2* scopes is the just-right fit for the Sack Wern project. We note, however, that the *Option 2* scope does not meet the long term goals of electrification and 80% emissions reduction by 2050, and therefore propose implementing *Option 2* with *Future Proofing*. In this scope, the high efficiency gas hot water heaters will be used on Day 1, with a plan to switch heat pump hot water heaters in the future.

ENVELOPE SCOPE

Exterior Walls:	4" EIFS on the exterior face of exterior walls.
Windows:	Double pane UPVC casements. U-0.27, SHGC 0.3
Entry Doors:	Thermally broken aluminum. U-0.3, SHGC 0.3
Roof:	R-38 cellulose loose fill blown into existing 10" roof joists
Air Sealing:	Air sealing to 0.4 CFM75/SF Envelope

Exterior EIFS

MEP SCOPE:

Heating/Cooling:	Ephoca unitary PTHP, COP@17 1.64, COP@47 2.85
Ventilation:	Corridor balanced ventilation. 100 CFM per floor. ERV, 75% SRE, 40% latent recovery.
Hot Water:	Electric heat pump hot water heater *(Installed in future - High efficiency gas hot water heat installed on Day 1)*
Plumbing:	Low flow fixtures per EGC. Insulate water and heating piping per energy code.

High Performance HPAC

KEY PERFORMANCE METRICS

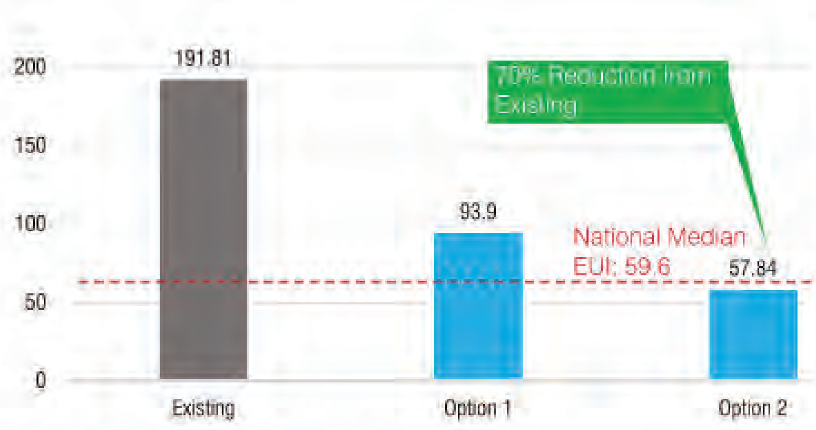
Electricity Usage:	4,600,036 kWh	(38% Increase from Existing)
Gas Usage:	0 Therms	(100% Reduction from Existing)
Site EUI:	41.84	(78% Reduction from Existing)
Annual Utility Cost:	$905,850/ year	(41% Reduction from Existing)
Annual Carbon:	83 tCO2e / year	(84% Reduction from Existing)
Installation Cost:		$ $ $ $ $ $ $ $ $ $ $ $

*PRELIMINARY PRICING BASED ON OUTLINE SPEC // DAY 1 COST INCLUDES HIGH EFFICIENCY GAS BOILER COST. ** ESTIMATED FUTURE COST FOR UPGRADING HWH

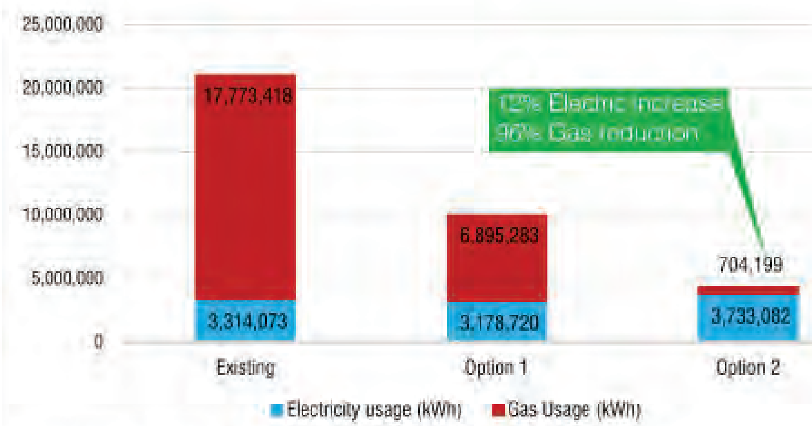
LL97 COMPLIANCE

Standard	Complies?
2030 Threshold (180 tCO2e/yr)	✓ COMPLIES
80% Reduction by 2050	✓ COMPLIES

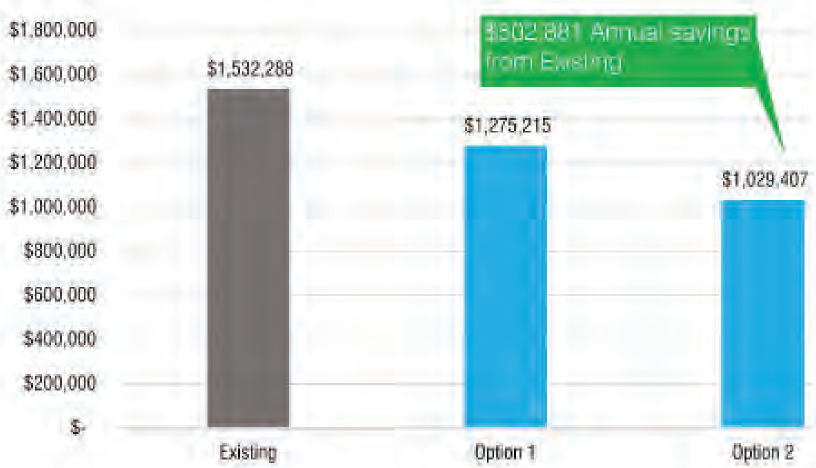
Comprehensive Energy Scope Testing



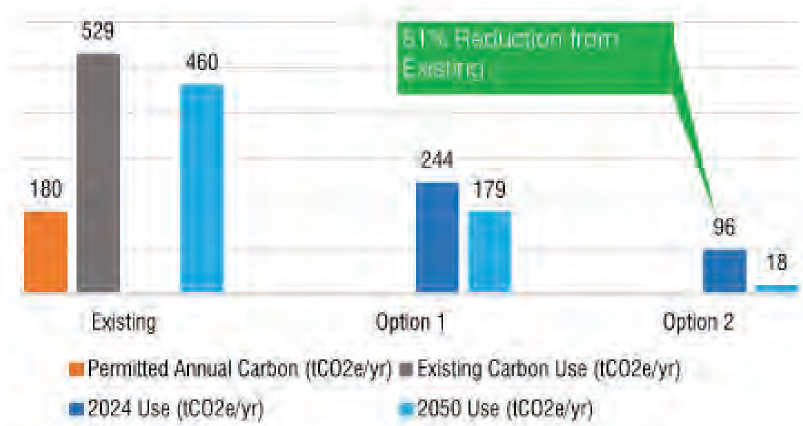
SITE ENERGY USE INTENSITY



ENERGY USE (VS EXISTING)



UTILITY COST (VS OPTION 1 AND EXISTING)



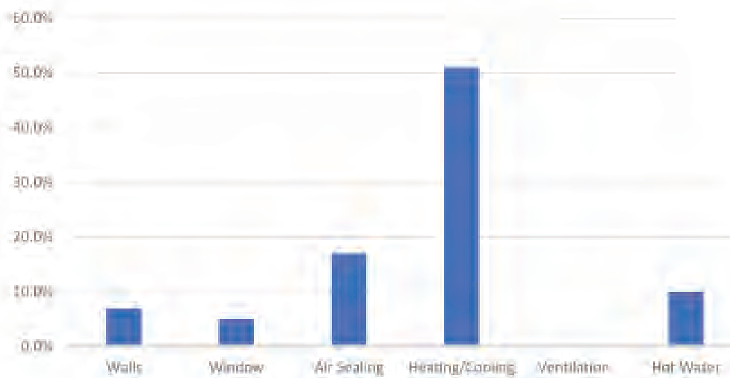
CARBON EMISSIONS (VS OPTION 1 AND EXISTING)

Iterative Scope Cost Exercise

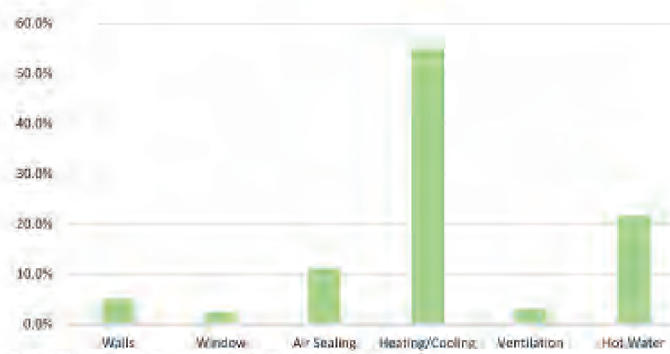
COST/BENEFIT ANALYSIS

SCOPE PACKAGE	ANNUAL UTILITY COST	INSTALLED COST*	ANNUAL UTILITY SAVINGS FROM EXSTG	SIMPLE PAYBACK
Existing	$1,532,288	-	-	-
Option 1	$1,275,215		$257,073	53 YEARS
Option 2	$1,029,407		$502,881	61 YEARS
Option 2 Future Proofed**	$905,850		$626,437	60 YEARS

*PRELIMINARY PRICING BASED ON OUTLINE SPEC
** FUTURE PROOF OPTION 2 INSTALLED COST PAYBACK IS BASED ON THE *FUTURE* COST AND *FUTURE* SAVINGS OF THE HWH. ACTUAL PERFORMANCE WILL BE DEPENDANT ON WHEN IN THE FUTURE THE HEAT PUMP HWH IS INTALLED



SAVINGS PER BUILDING ELEMENT (%)



COST PER BUILDING ELEMENT (%)

KEY TAKEAWAY

The team reviewed the savings of ECM elements versus the installed cost of ECM elements. While the savings generated by the ECMs broadly tracked with their installed cost, the envelope components (wall insulation, air sealing and windows) outperform the MEP components.

The envelope components account for 18% of the installed cost and 29% of the savings. The MEP components accounts for 82% of the cost and 71% of the savings. As noted in the following section, future changes to the power grid may drive larger electric savings for MEP upgrades that can't be accounted for at this time.

Scope Cost Exercise

SACK WERN ELECTRIFICATION PAY BACK STUDY					
	First Cost	Year 0 Utility Cost	Supportable Debt	Net First Cost	Payback Year
EXISTING: BASELINE					-
ELECTRIC (3,314,073 kWh)	**$ 7,000,000**	**$ 1,500,000**	**$ 55,000,000**	**$ 7,000,000**	
GAS (606,599 THERMS)					
COMPARISON TO BASELINE	-	-		-	
OPTION 1					Year 3
ELECTRIC (3,178,720 kWh)	**$ 10,000,000**	**$ 1,300,000**	**$ 58,000,000**	**$ 7,000,000**	
GAS (235,233 THERMS)					
COMPARISON TO BASELINE	$ 3,000,000	$ (200,000.00)	$ 3,000,000	$ -	
OPTION 2					Year 18
ELECTRIC (3,733,082 kWh)	**$ 25,000,000**	**$ 1,000,000**	**$ 61,000,000**	**$ 19,000,000**	
GAS (24,034 THERMS)					
COMPARISON TO BASELINE	$ 18,000,000	$ (500,000.00)	$ 6,000,000	**$ 12,000,000**	
OPTION 2 FUTUREPROOF					Year 26
ELECTRIC (4,600,036 kWh)	**$ 35,000,000**	**$ 900,000**	**$ 62,500,000**	**$ 27,500,000**	
GAS (0 THERMS)					
COMPARISON TO BASELINE	$ 28,000,000	$ (600,000.00)	$ 7,500,000	**$ 20,500,000**	

*Note that above dollar values are demonstrative only.

Thanks! - Q&A

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