



ARCHITECTURE

ACTIVISM

*THE NEW GRAVITY*

ONION  
FLATS

Tim McDonald

[tim@onionflats.com](mailto:tim@onionflats.com)

215.783.5591

CTPH

CONNECTICUT PASSIVE HOUSE





1997



2023

-





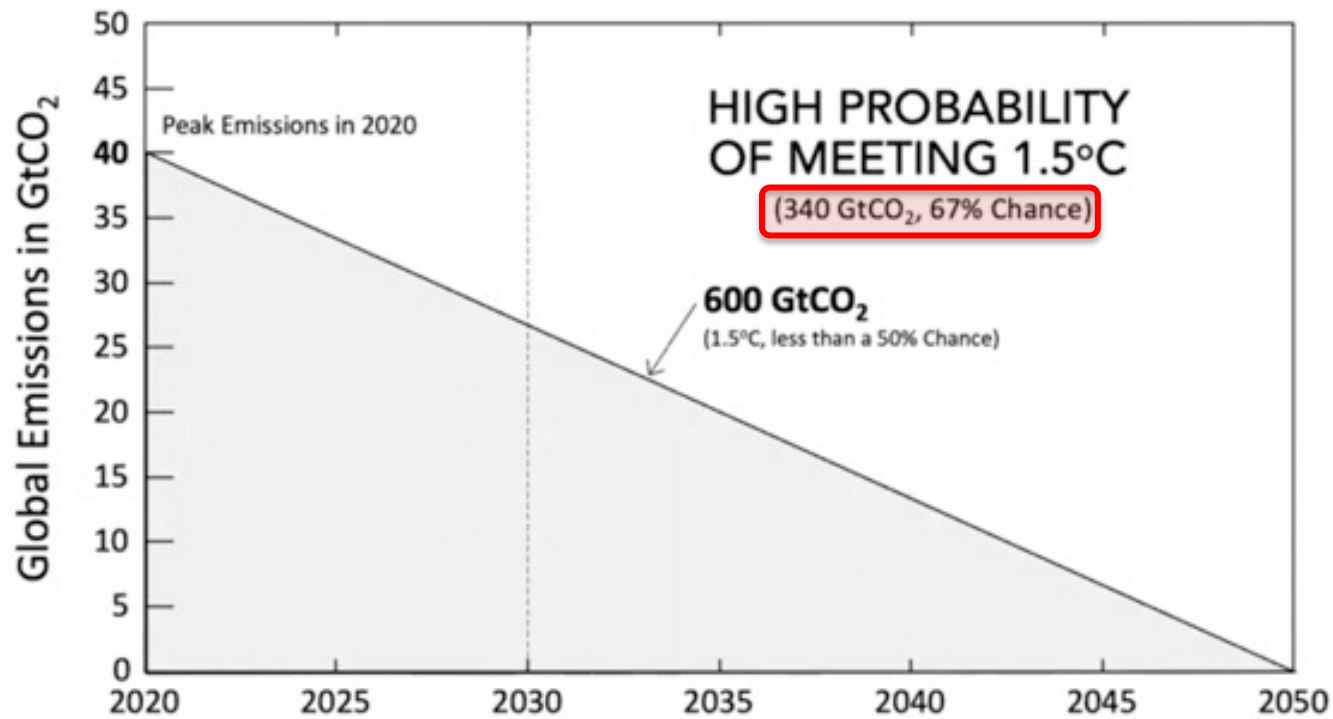




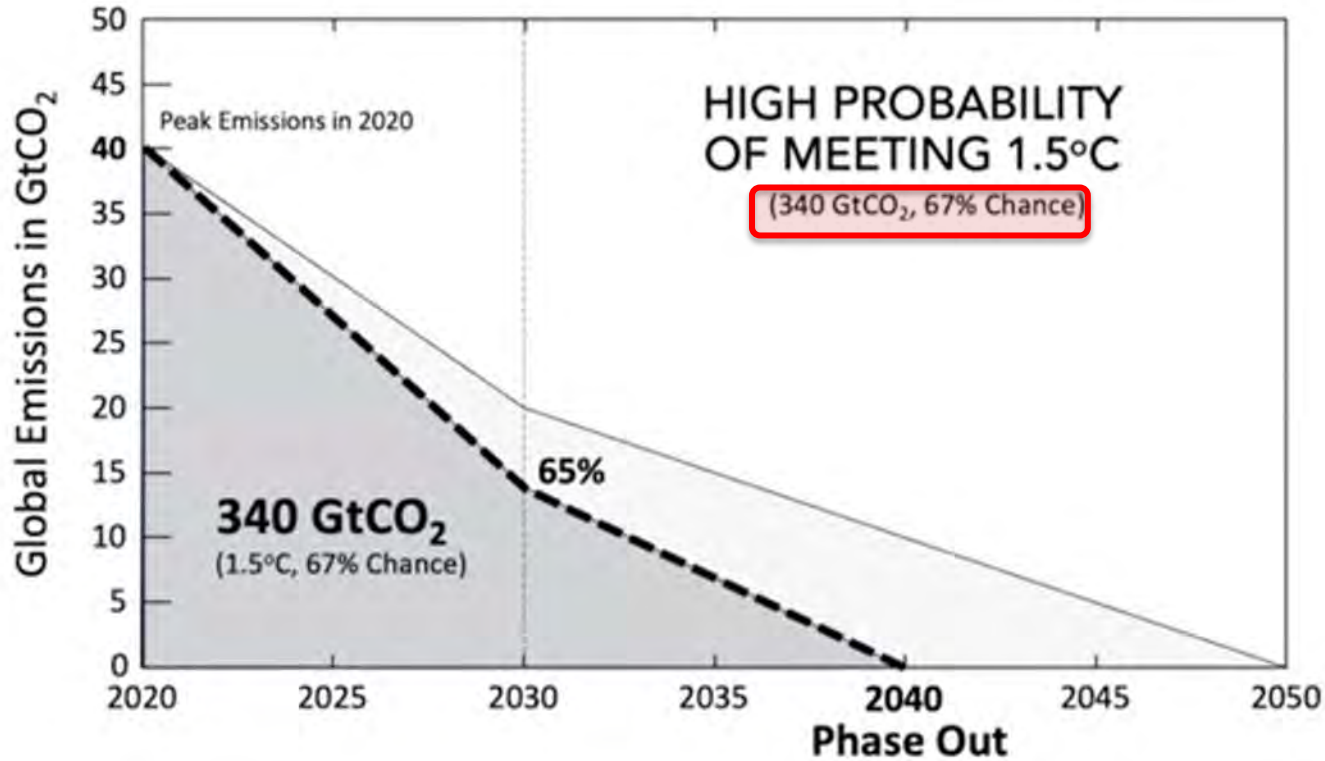


# *THE NEW GRAVITY*











17 YEARS!!!

CARBON NEUTRAL BUILDINGS by 2040



<https://www.mcc-berlin.net/en/research/co2-budget.html>



6 YEARS!!!

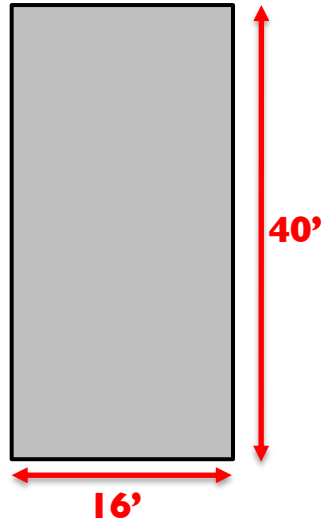
CARBON NEUTRAL BUILDINGS by 2029



6 YEARS!!!

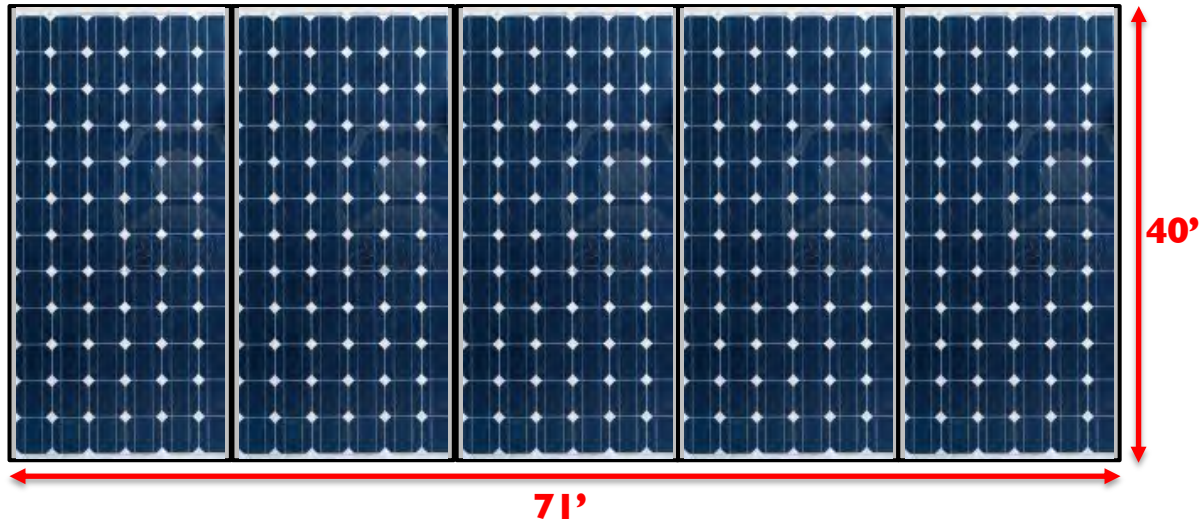
BUILDINGS MUST GENERATE WHAT THEY NEED  
CARBON NEUTRAL BUILDINGS by 2029  
ON THEIR OWN SITE WITH RENEWABLE ENERGY





**1900 sf home**  
**39,000 kWh/yr**





**1900 sf home**  
**39,000 kWh/yr**  
**2832 sf roof**





40'



16'

**80% REDUCTION**

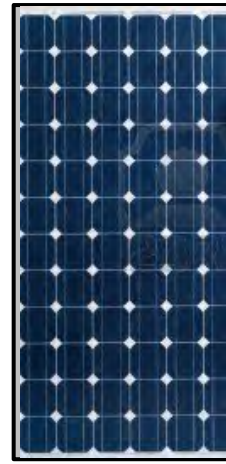
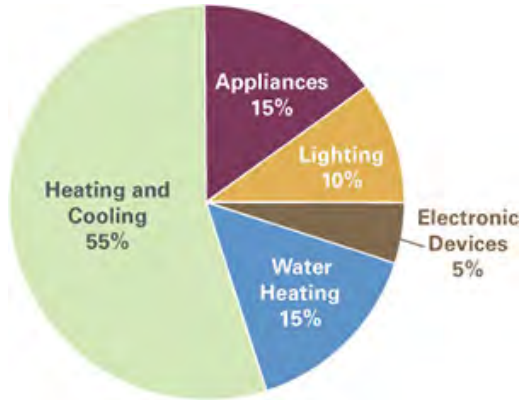
**4.5 kWh/sf/yr**

8550 kWh/yr

615 sf roof







16'

40'



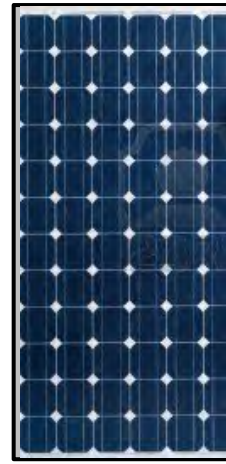
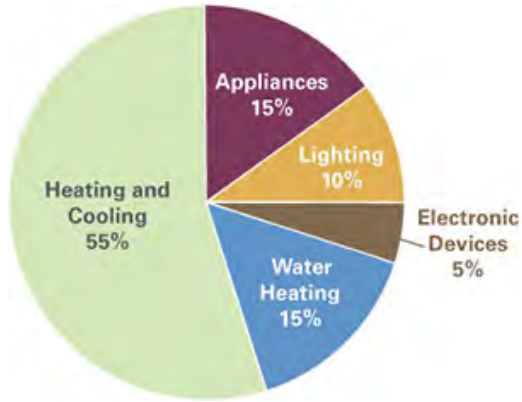
**80% REDUCTION**

**4.5 kWh/sf/yr**

8550 kWh/yr

615 sf roof





16'

40'

**80% REDUCTION**

**4.5 kWh/sf/yr**

8550 kWh/yr

615 sf roof







## **“Fabric First” approach**



16'

40'

**80% REDUCTION**

**4.5 kWh/sf/yr**

8550 kWh/yr

615 sf roof







Photo Credit: [www.SGBUILD.com](http://www.SGBUILD.com)



# Passive House Principles



airtightness



continuous insulation



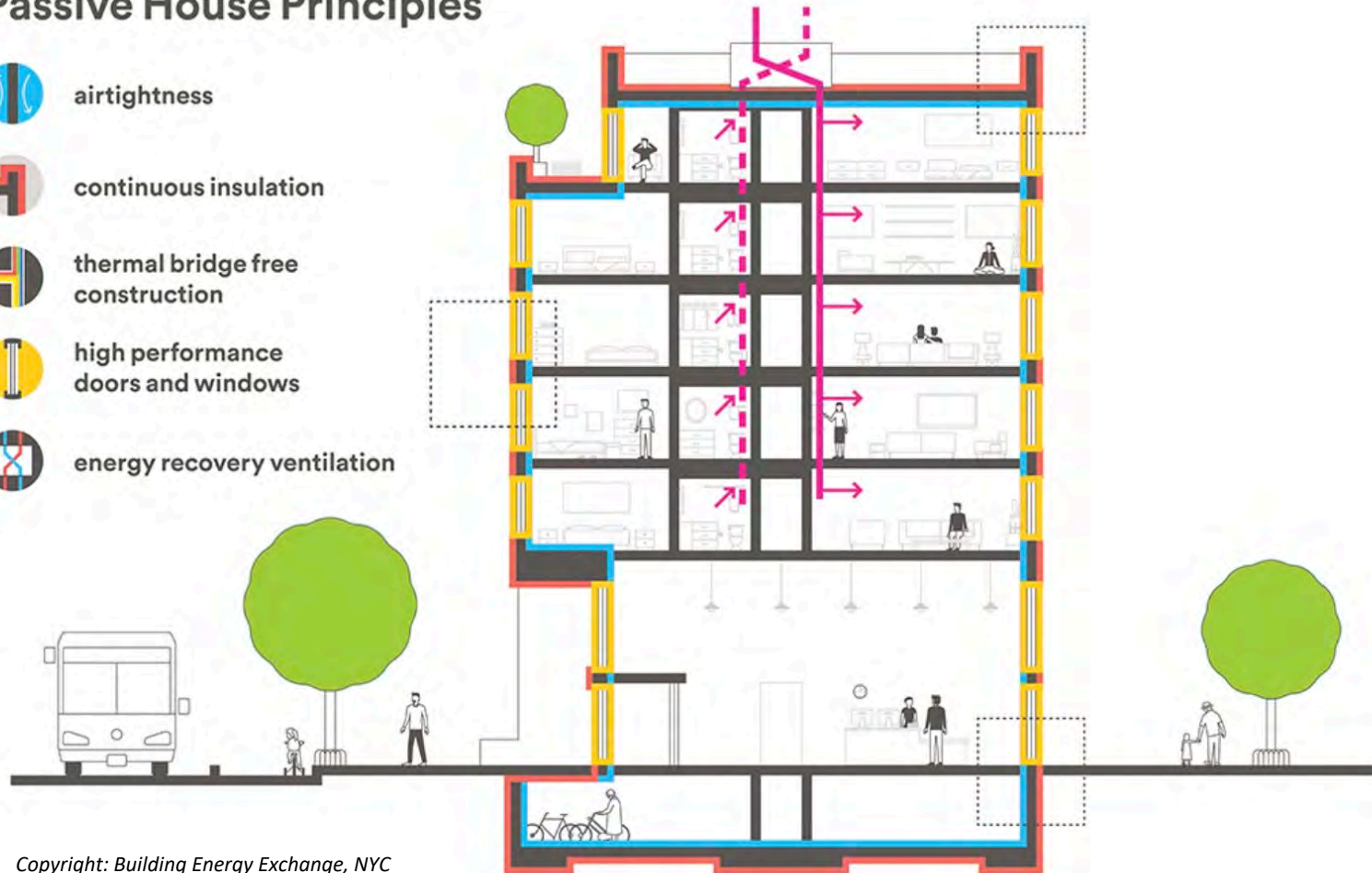
thermal bridge free construction



high performance doors and windows



energy recovery ventilation



Copyright: Building Energy Exchange, NYC





1-39 Hano St

**Boston, MA.....in process**

20 units, Passive House, NZE

RMI: REALIZE Retrofit Program



FAIRWEATHER DANVERS



FAIRWEATHER SALEM



FAIRWEATHER PEABODY



FAIRWEATHER BEVERLY

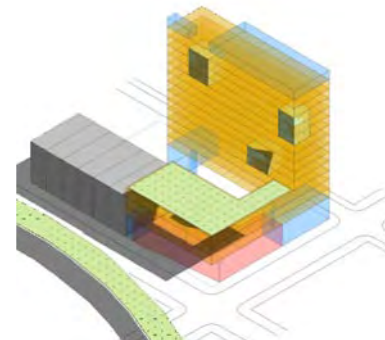


Fairweathers

**North Shore Boston, MA.....in process**

600+ units RMI Deep Energy Retrofit, Passive House, NZE

**CURRENT + RECENT PROJECTS**



Noble Flats (16 stories)

**Phila, PA.....in process**

175 units, Mass Timber, Passive House, NZE



Copper Flats

**Phila, Pa.....under construction**

88 units, Passive House, NZE



Morris Steel

**Phila, PA.....Schematic Design**

692 units, Passive House, NZE



Mercill Flats

**Jackson Hole, WY.....Schematic Design**

30 units, Passive House, NZE



Mermaid Lane

**Phila, PA.....Schematic Design**

280 units, Passive House, NZE





**1600 North St**  
**Baltimore, MD.....under construction**  
 17 units, Passive House, NZE



**Snow King**  
**Jackson Hole, WY.....Schematic Design**  
 24 units, Passive House, NZE



**Fairmount Commons**  
**Newark, NJ.....Schematic Design**  
 24 units, Passive House, NZE



**Rhodia**  
**Louisville, KY.....Schematic Design**  
 600 units, Passive House, NZE



**Parade St. Commons**  
**Erie, PA.....Completed**  
 40 units, Passive House, NZE



**Vine St NZE**  
**Philadelphia, PA.....Schematic Design**  
 220 units, Passive House, NZE



**Radwyn Housing**  
**Radwyn, PA.....in process**  
 48 units, Passive House, NZE



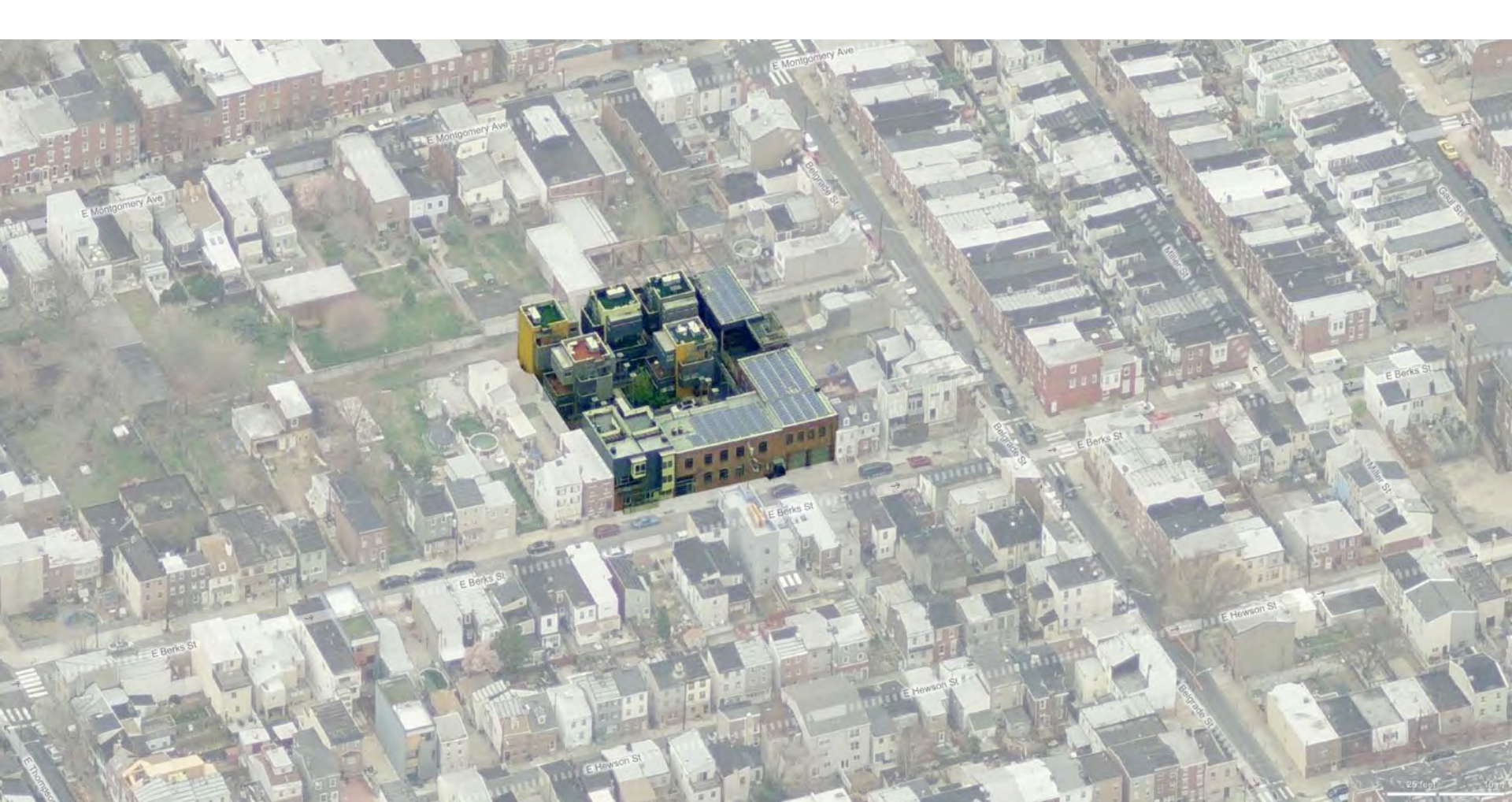


*RAG FLATS 2006: 11 Units*





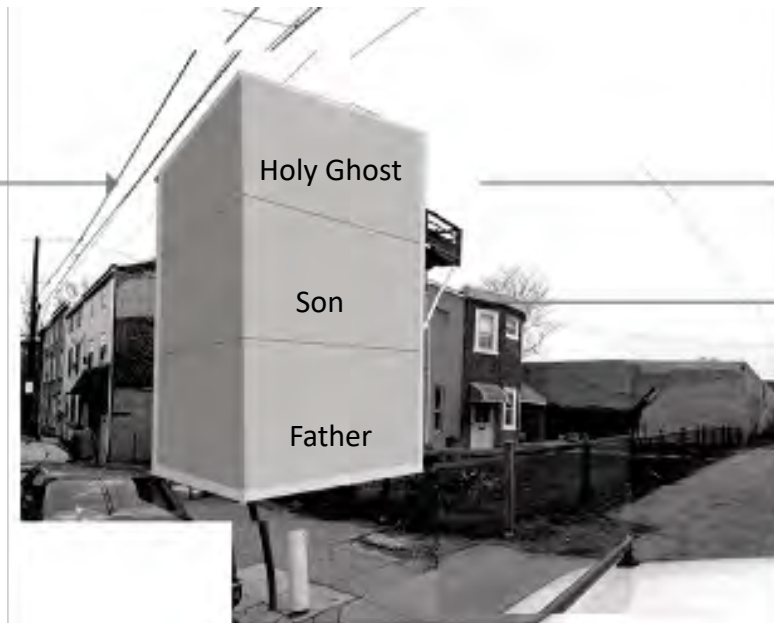








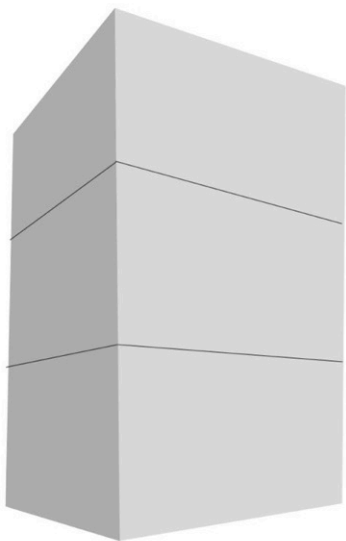
THE GIVEN



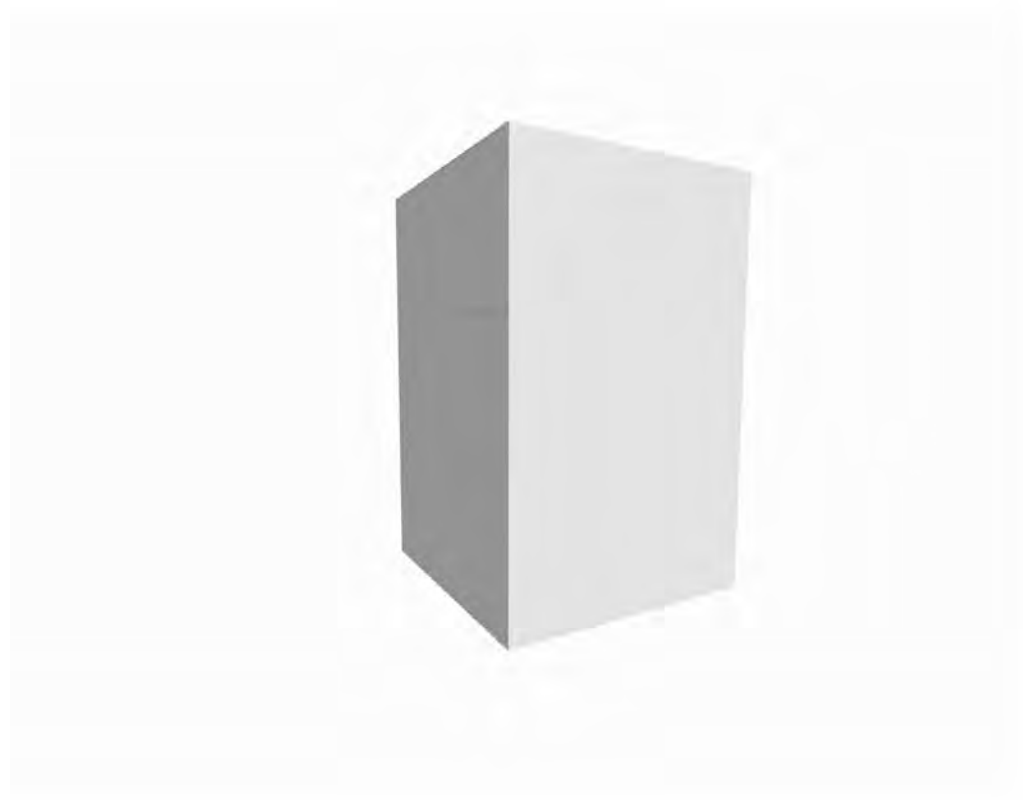
ISOLATED

The Philadelphia "Trinity"

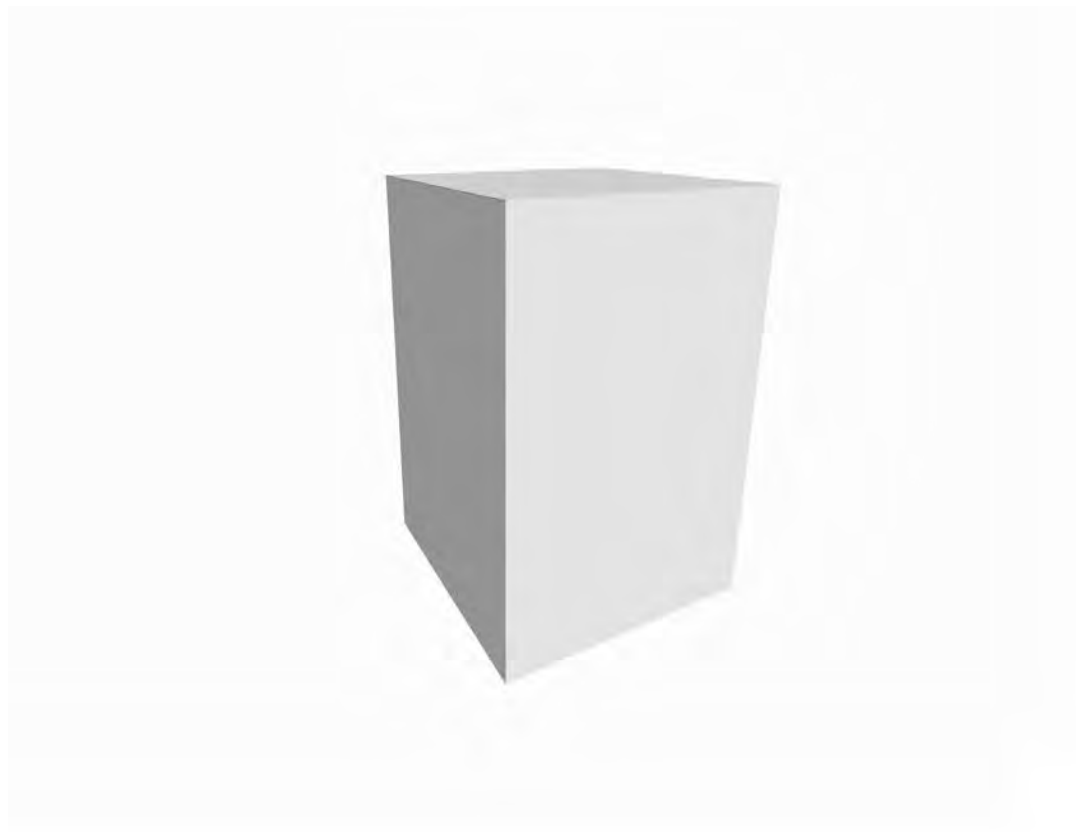




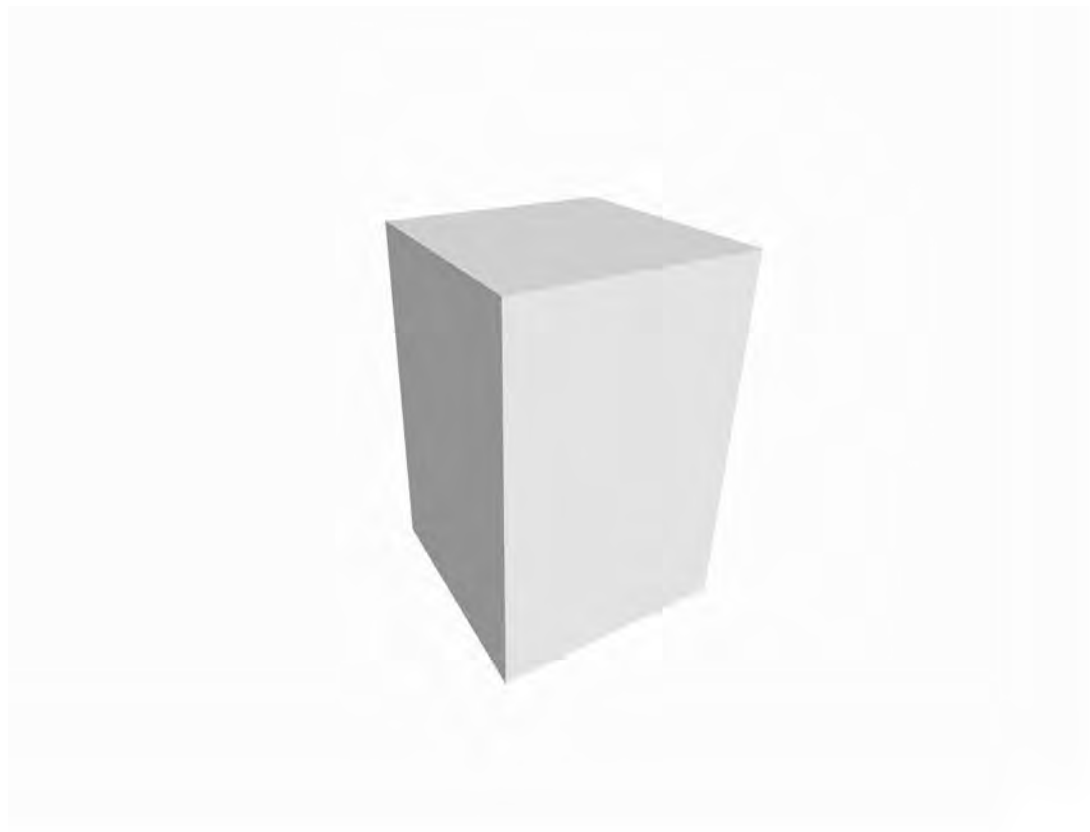




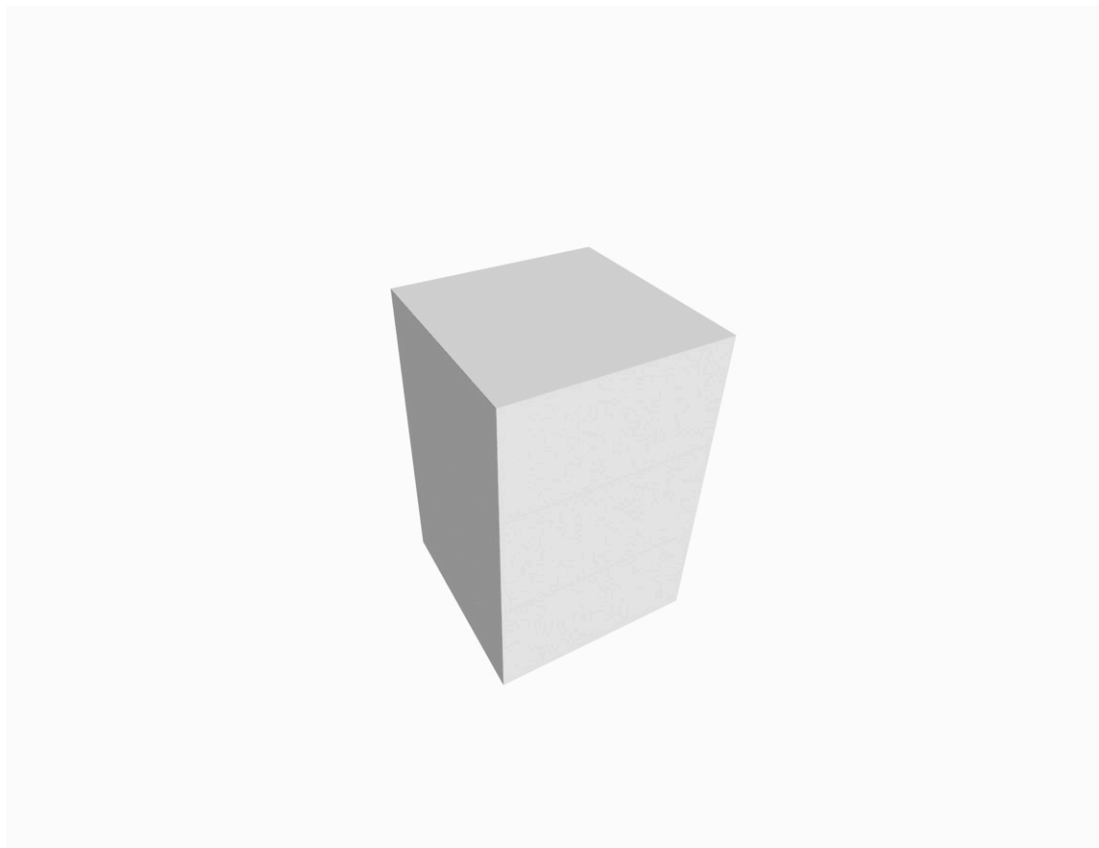




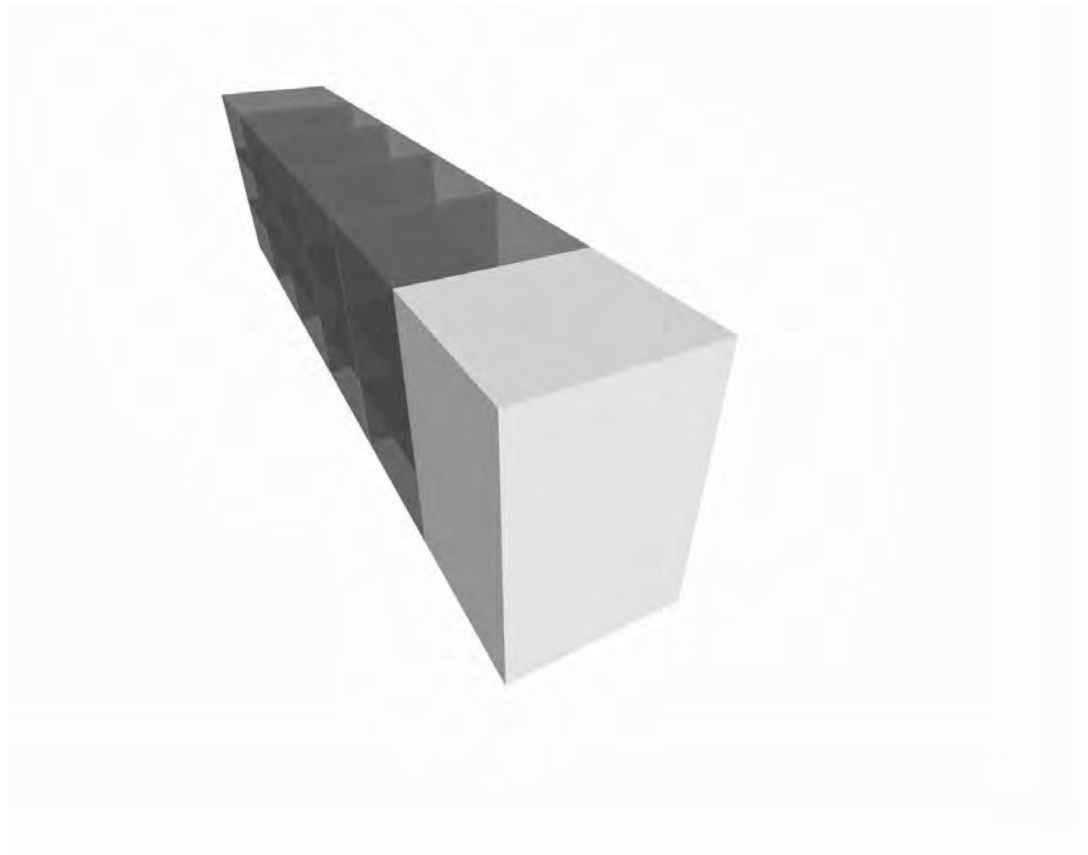




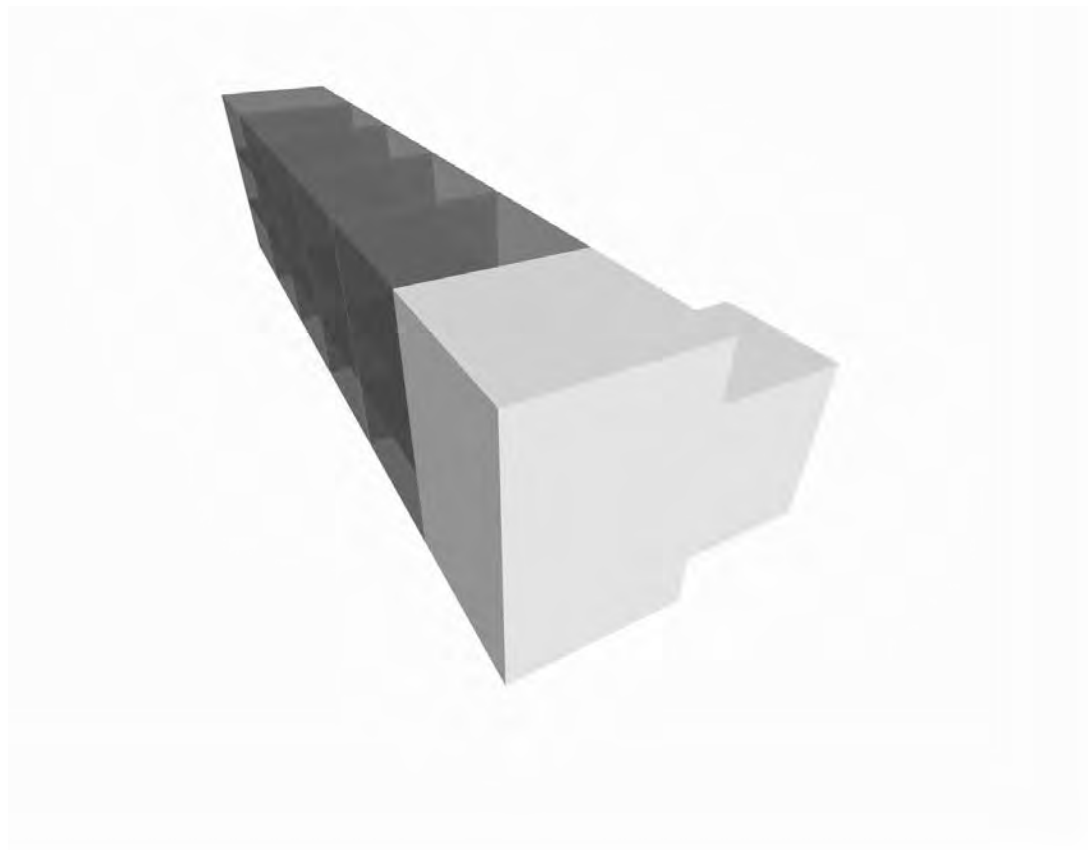




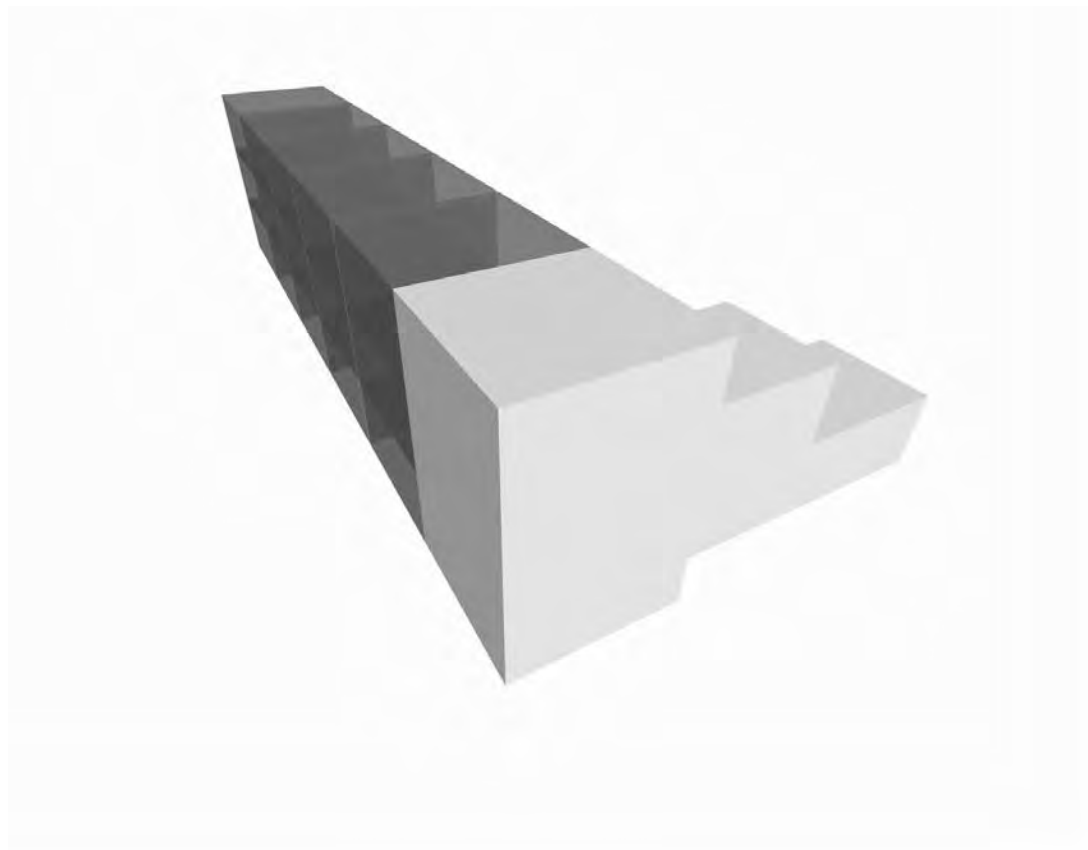




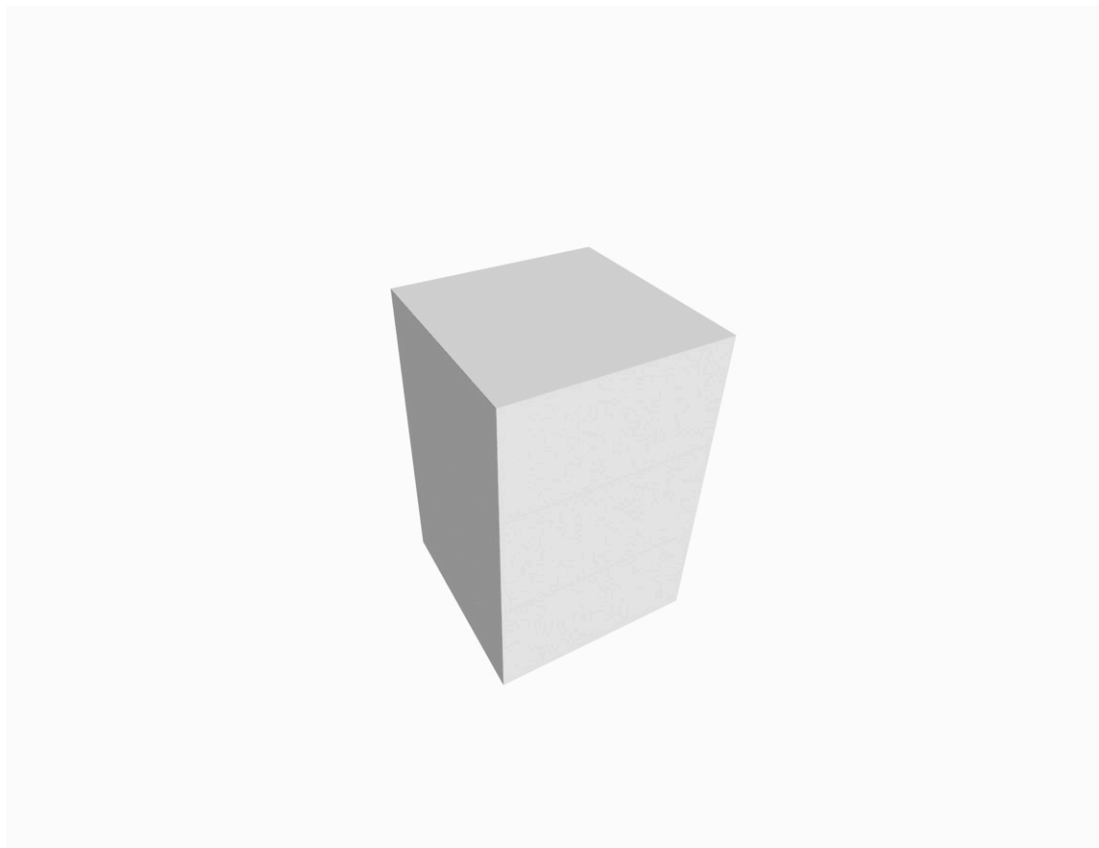




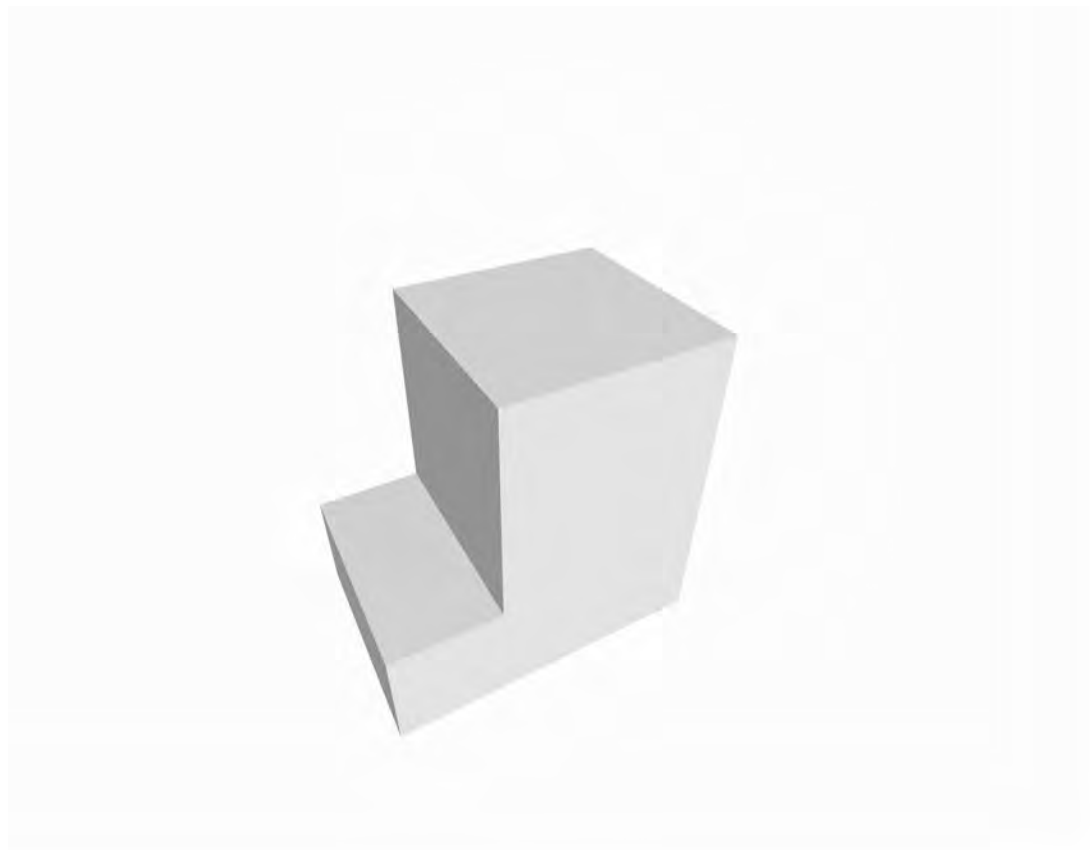




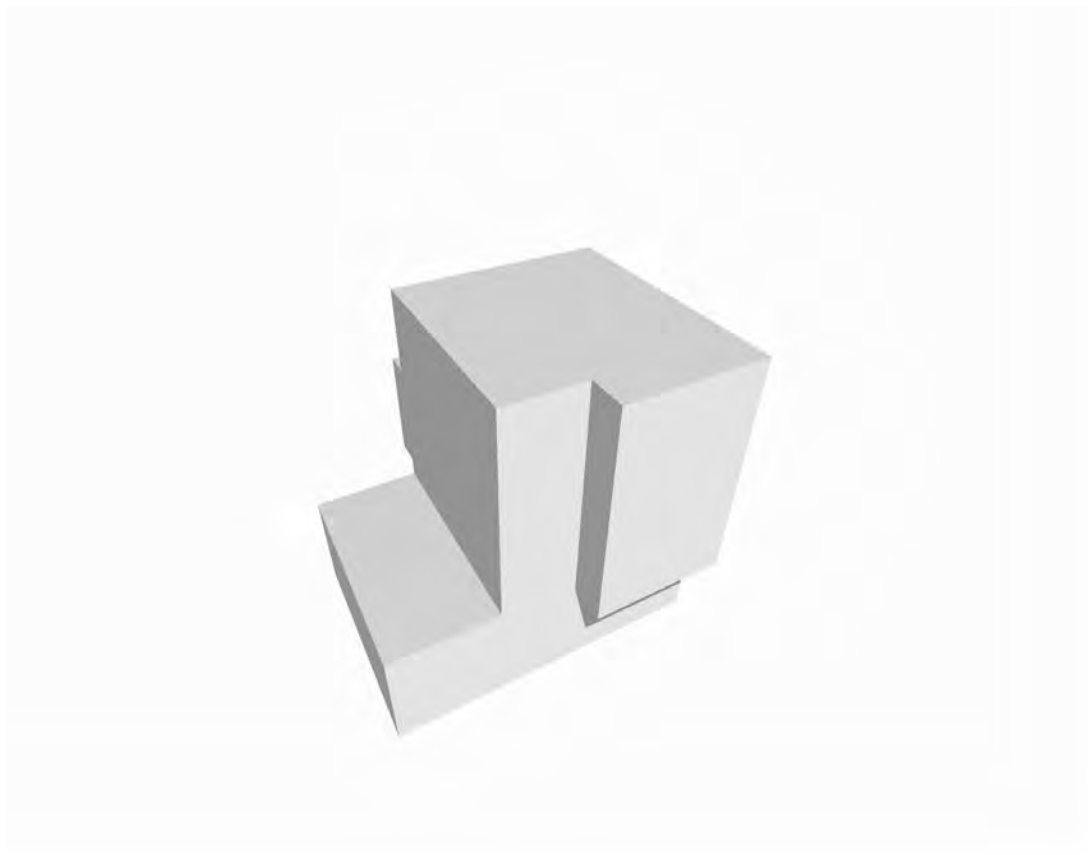








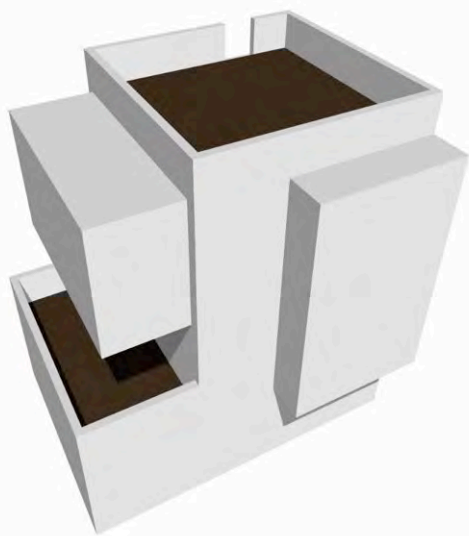




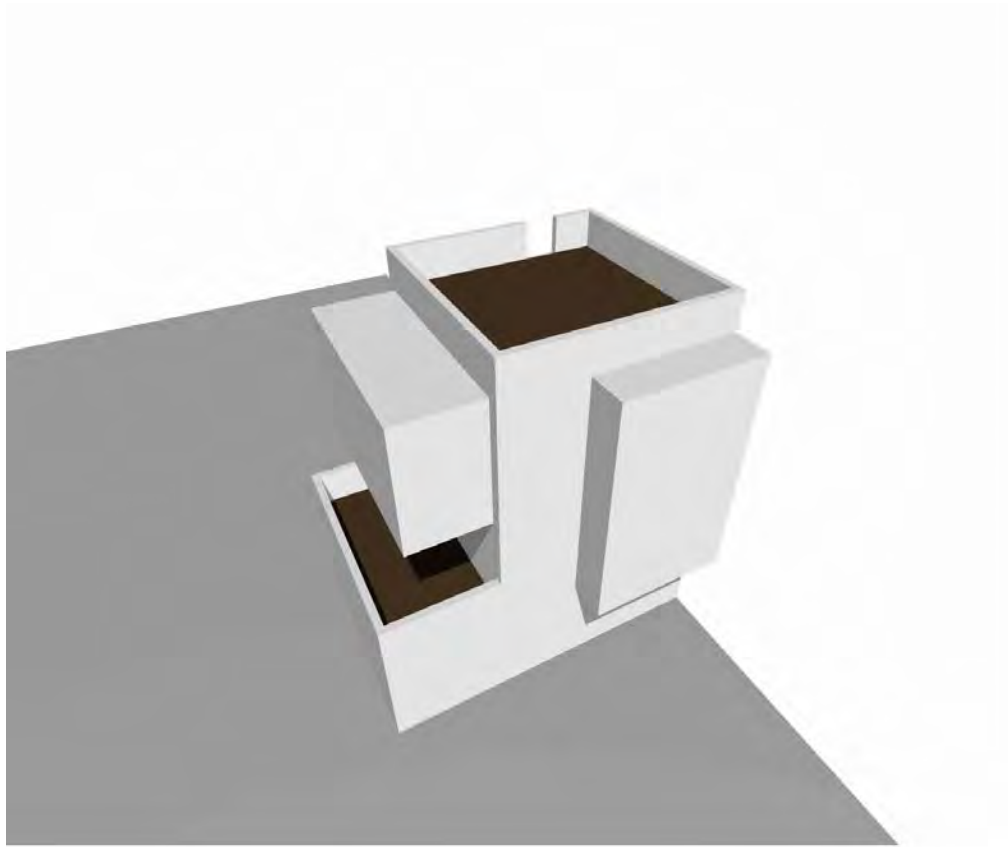




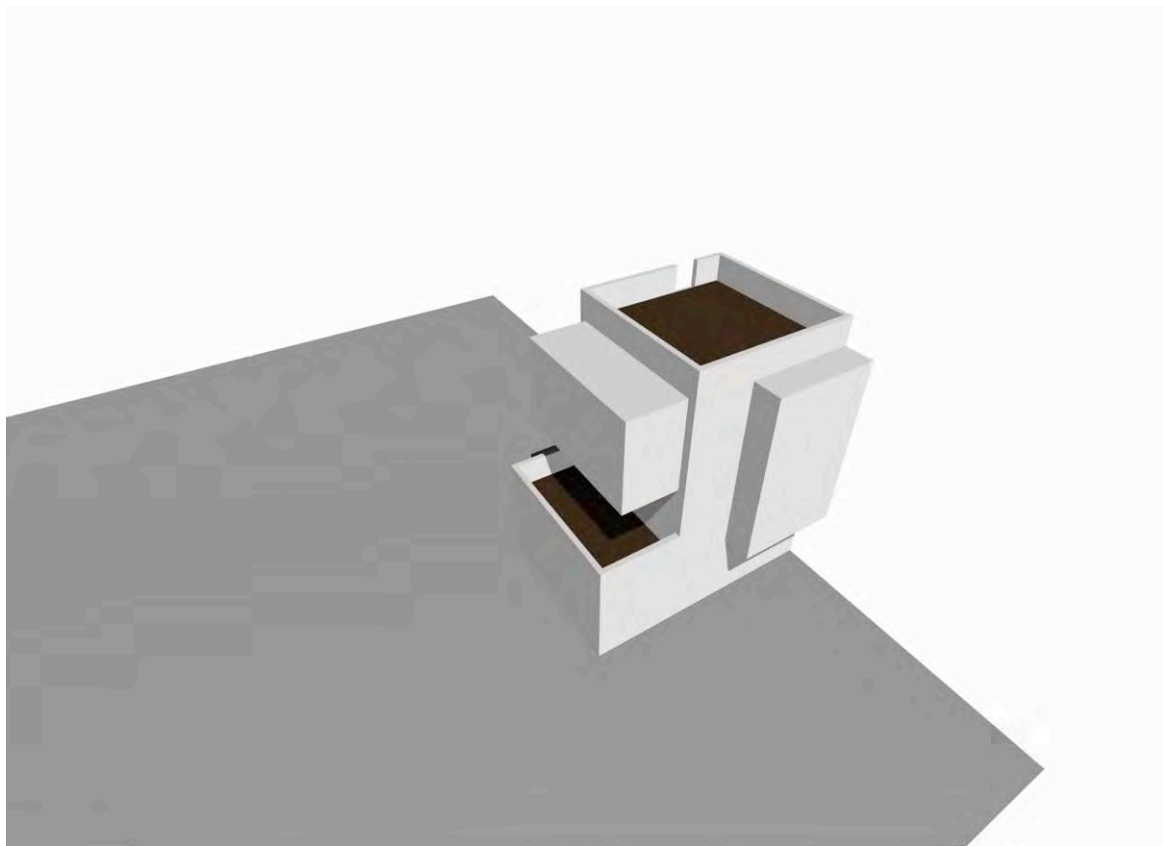




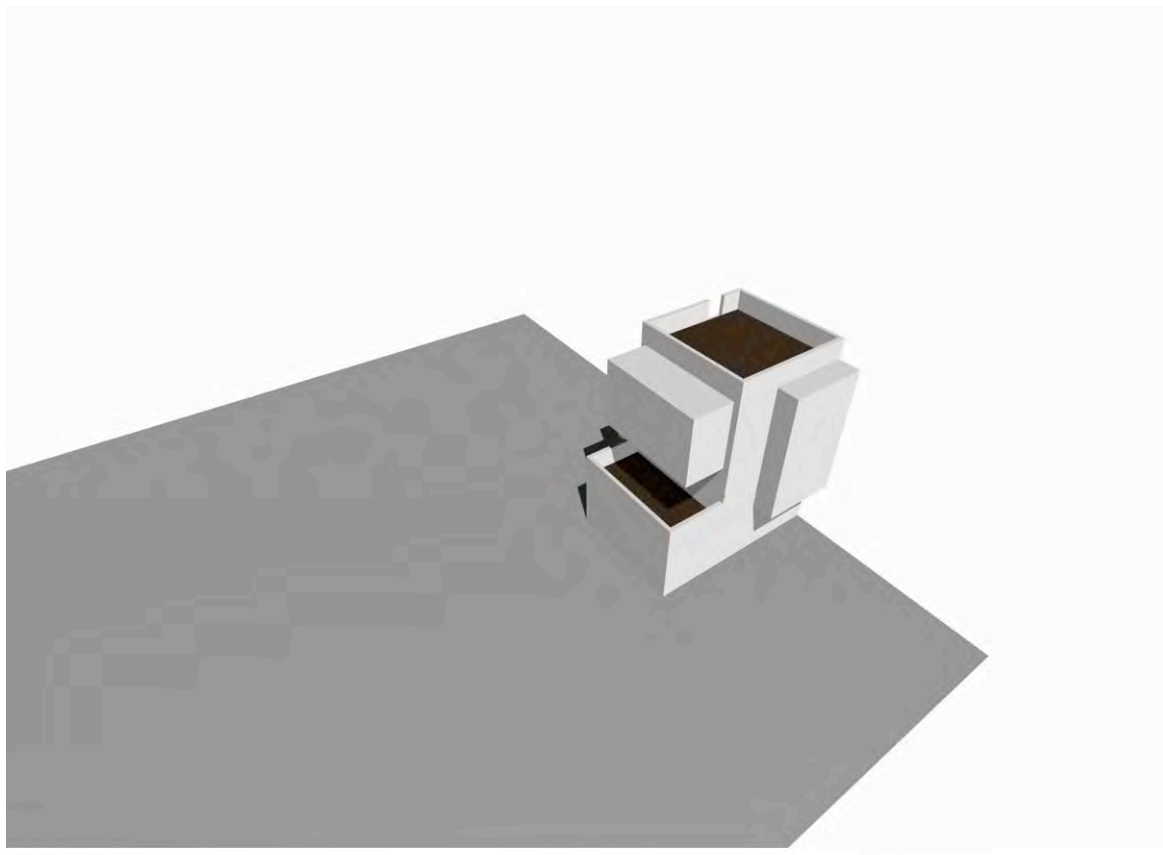




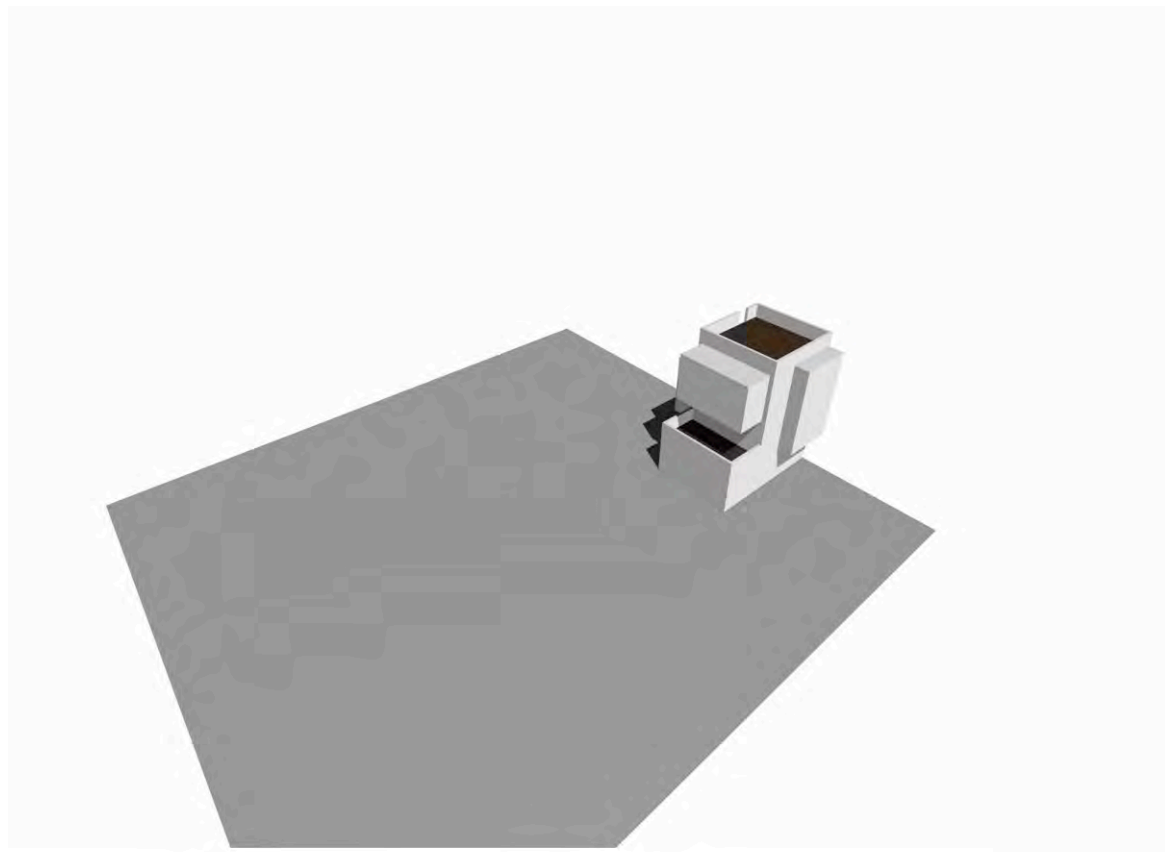






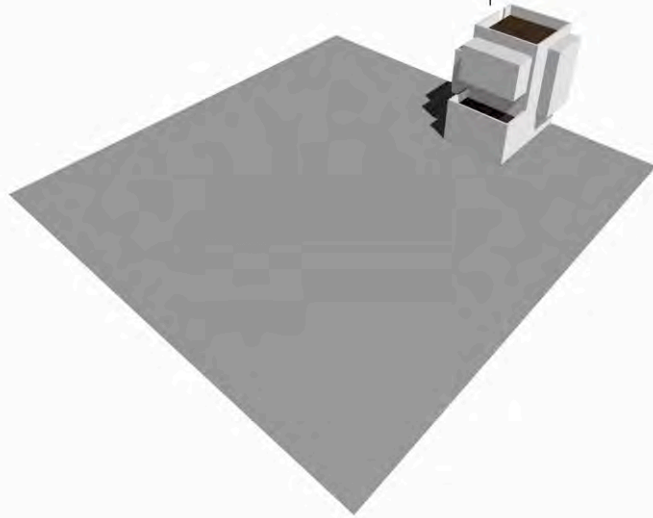






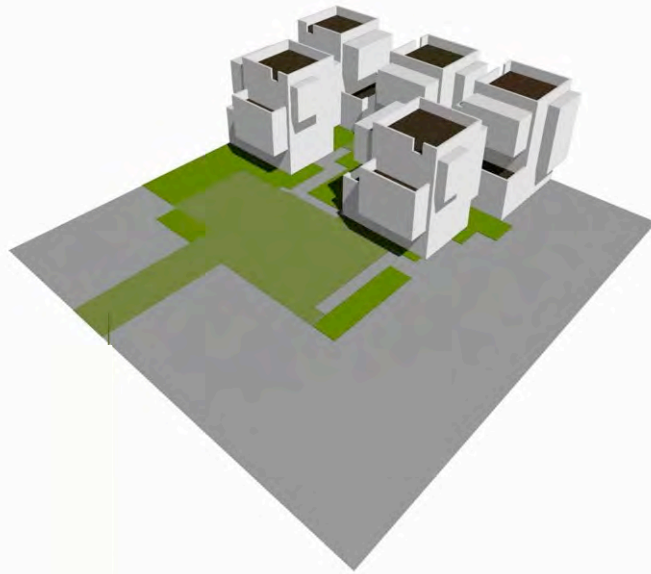


TRINITY





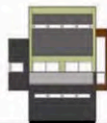
# TRINITY





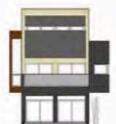
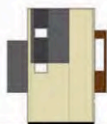




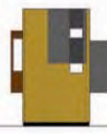
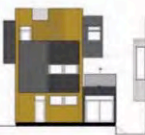


Elevations for Trinity "A"

Elevations for Trinity "B"



Elevations for Trinity "B"



Elevations for Trinity "C"

Elevations for Trinity "D"



ROW HOUSE

TRINITY

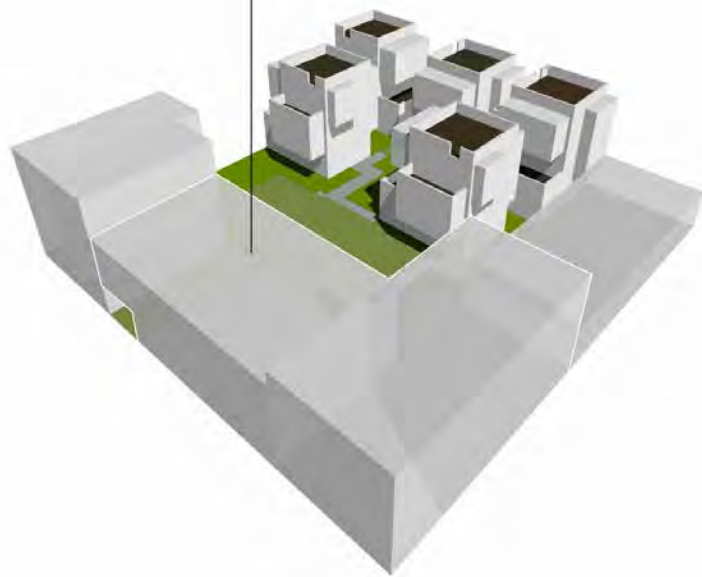




ROW HOUSE

INDUSTRIAL LOFT

TRINITY





ROW HOUSE

INDUSTRIAL LOFT

TRINITY

PAVILLION



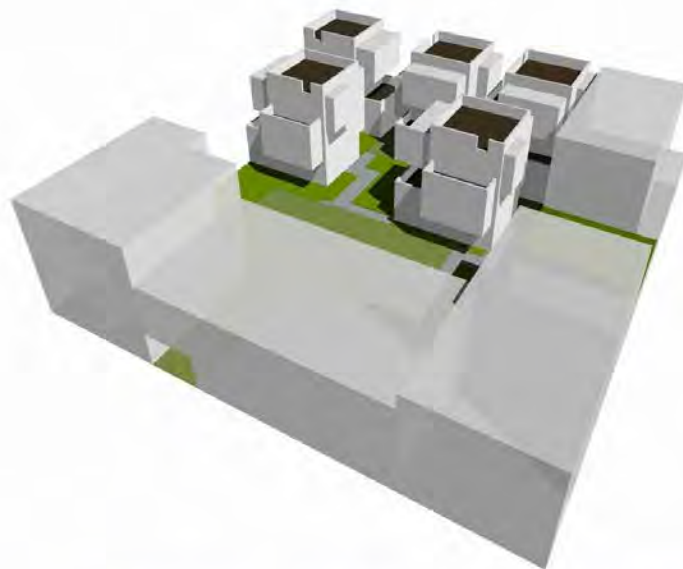


ROW HOUSE

INDUSTRIAL LOFT

TRINITY

PAVILLION



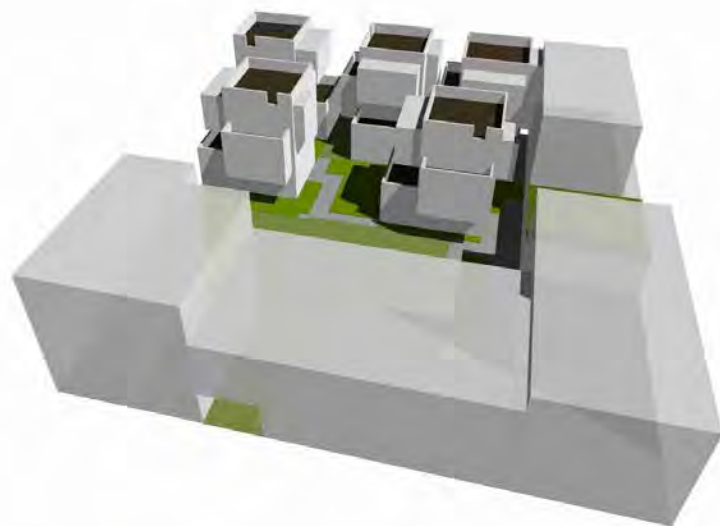


ROW HOUSE

INDUSTRIAL LOFT

TRINITY

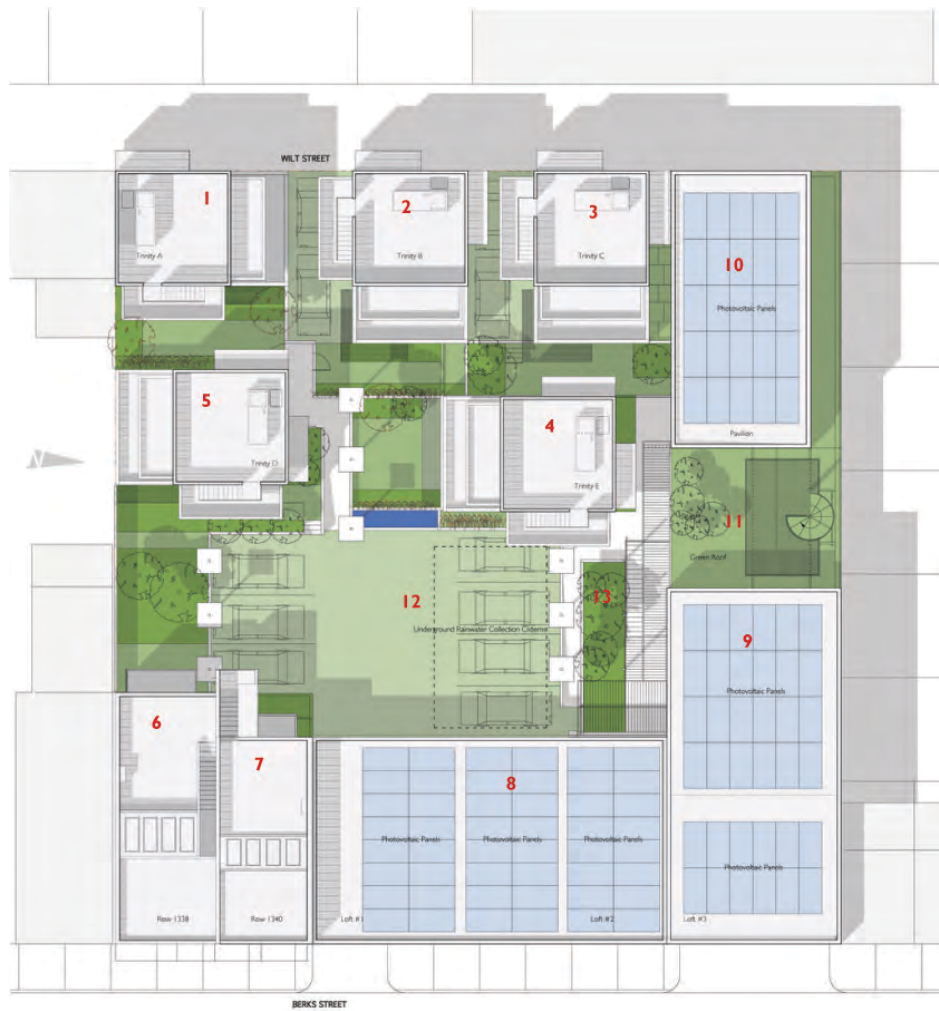
PAVILLION

















































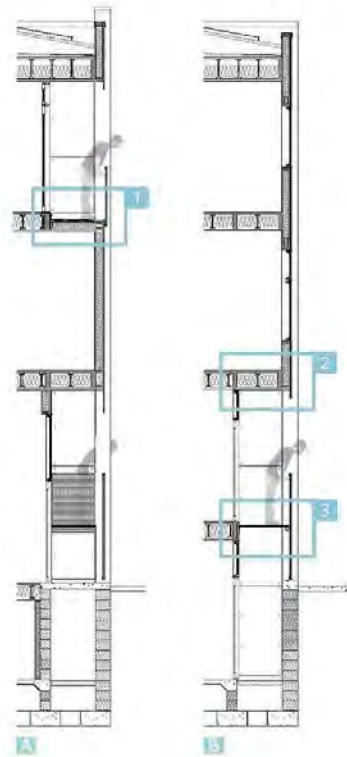
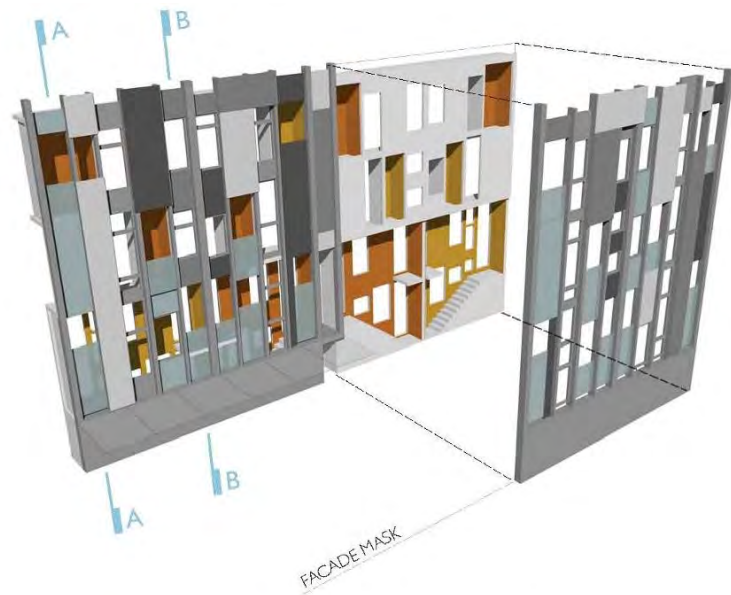


*THIN FLATS, 2008: 9 units 1ST LEED PLATINUM DUPLEXES IN THE USA*

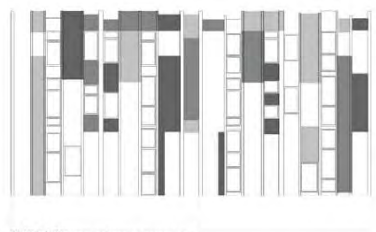




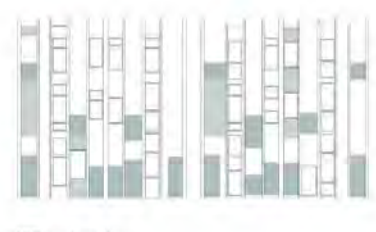




VOID: polychrome trespa panel



SURFACE: monochrome trespa panel



VEIL: translucent glass









*Opening Day, September 14, 2008*





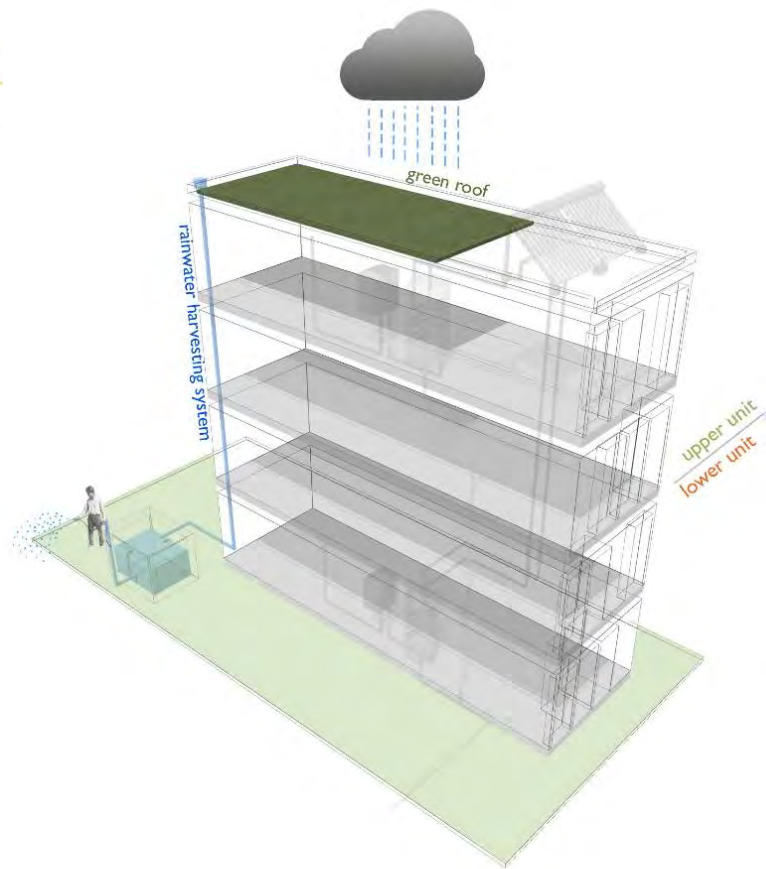
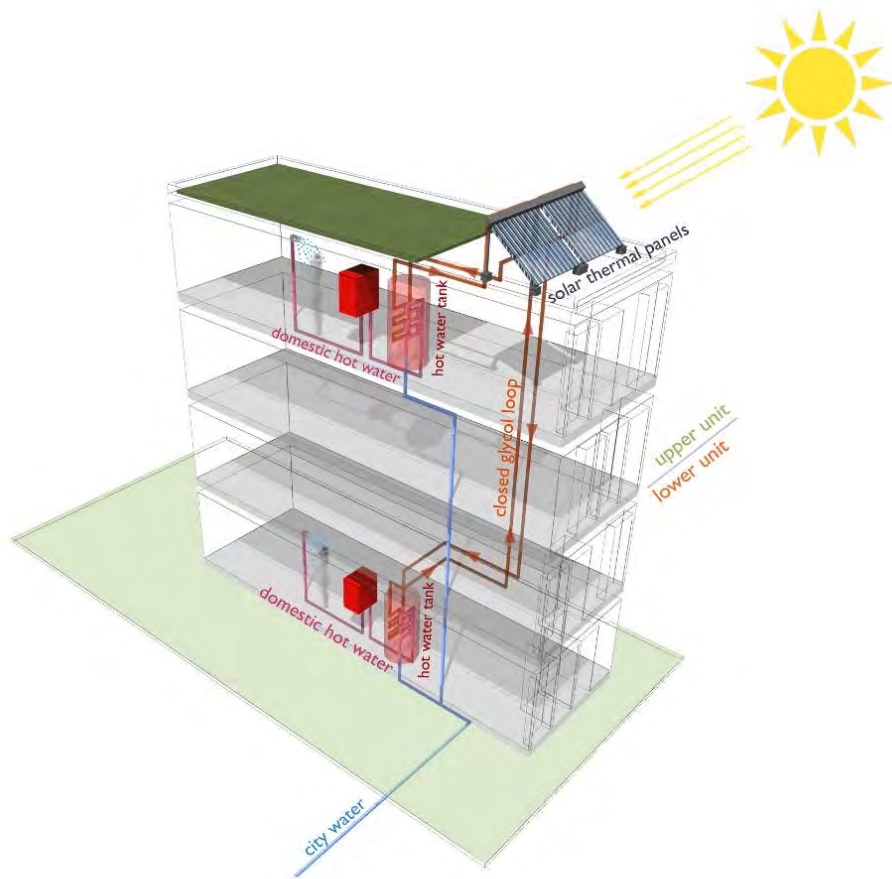


UPPER UNIT

LOWER UNIT















GARDEN LEVEL



1ST LEVEL



2ND LEVEL



3RD LEVEL



ROOF LEVEL

## UPPER UNIT

## LOWER UNIT

















Sustainable Sites



Water Efficiency



Energy & Atmosphere



Materials & Resources



Indoor Environmental Quality



Locations & Linkages



Awareness & Education



Innovation in Design



Regional Priority







Sustainable Sites



Water Efficiency



Energy & Atmosphere



Materials & Resources



Indoor Environmental Quality



Locations & Linkages



Awareness & Education



Innovation in Design



Regional Priority





# FIRST

**CERTIFIED  
PASSIVE HOUSE  
IN  
PENNSYLVANIA**

**START: APRIL 20, 2012**

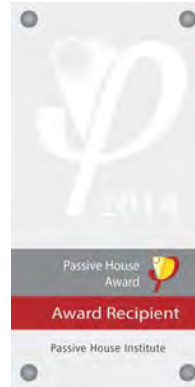
**CERTIFICATE OF OCCUPANCY: JULY 20, 2012**



**RECIPIENT OF THE  
2014 INTERNATIONAL  
PASSIVE HOUSE AWARD**



**SECOND PLACE WINNER  
2015 PHIUS AWARD  
"AFFORDABLE HOUSING"**





# BELFIELD HOMES

PHILADELPHIA, PENNSYLVANIA 19141



NON-PROFIT  
COMMUNITY  
ORGANIZATION

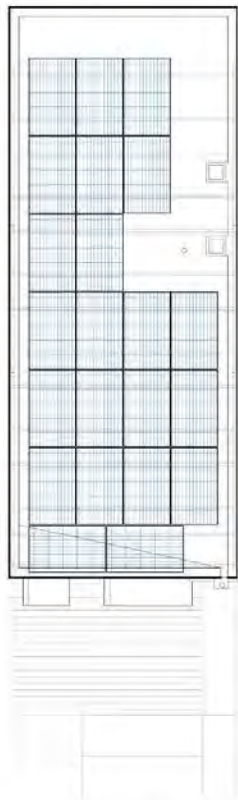


PHILADELPHIA  
REDEVELOPMENT  
AUTHORITY

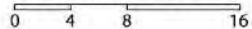


*BELFIELD TOWNHOMES, 2010: 3 subsidized housing units*

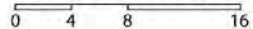




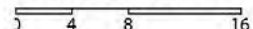
UNIT ROOF LVL



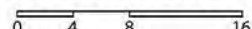
UNIT PLAN LVL 3



UNIT PLAN LVL 2



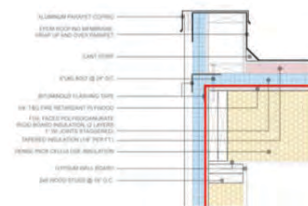
UNIT PLAN LVL 1



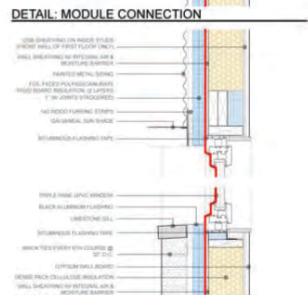
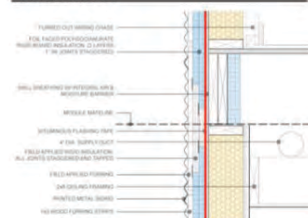




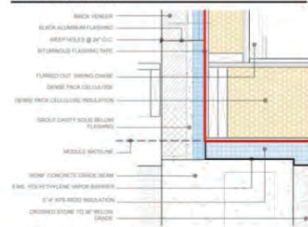
## SITE ASSEMBLE



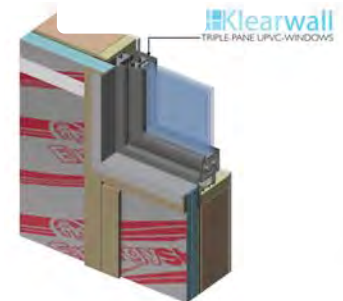
### DETAIL: MODULE CONNECTION



### DETAIL: WINDOW



**DETAIL: FOUNDATION**



**Roof: R52.3**  
**Wall: R33.6**  
**Floor: 58.4**  
**Window: .11**  
**SHGC: .63**



### BUILDING LEAKAGE TEST COMPARISON

Test #1		Test #2	
Test File:	Depressurization File	Test File:	Pressurization File
Date of Test:	7/5/2012	Date of Test:	7/5/2012
Customer:	Onion Flats, LLC 111 West Norris Street Philadelphia, Pennsylvania 19122	Customer:	Onion Flats
Phone:	215-783-5591		

#### Test Results

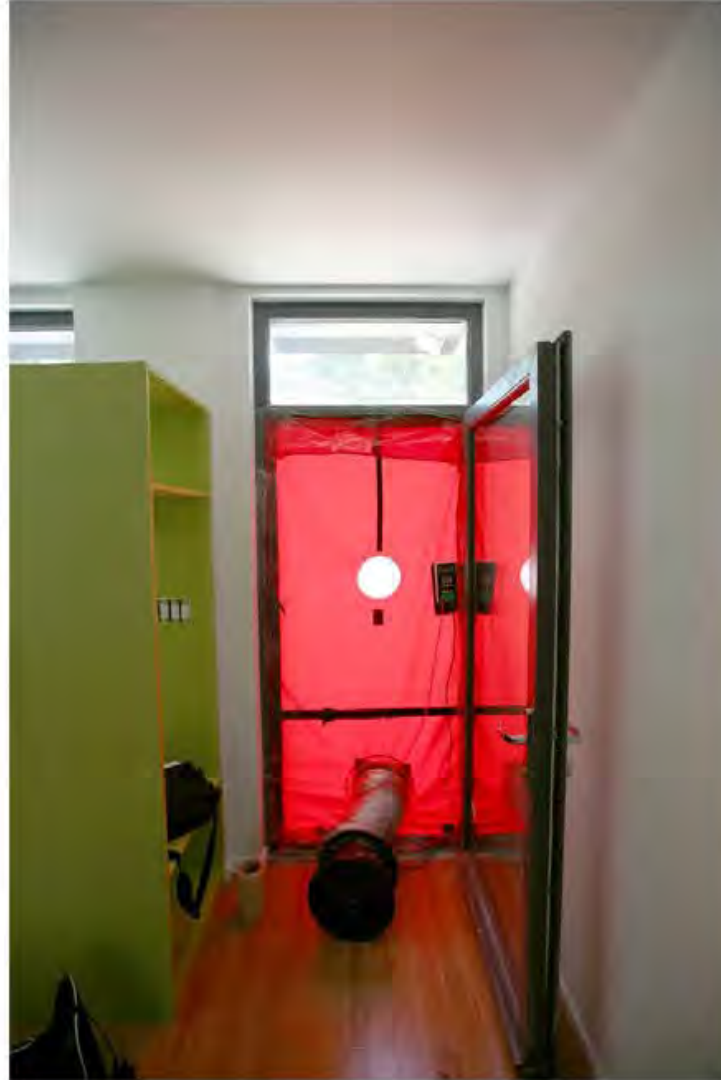
	Test #1	Test #2	Change	Percent
1. Airflow at 50 Pascals:	293 CFM	201 CFM	-92 CFM	-31.4 %
	<b>0.48 ACH</b>	<b>0.33 ACH</b>	-0.15 ACH	-31.4 %

FINAL AIRFLOW:

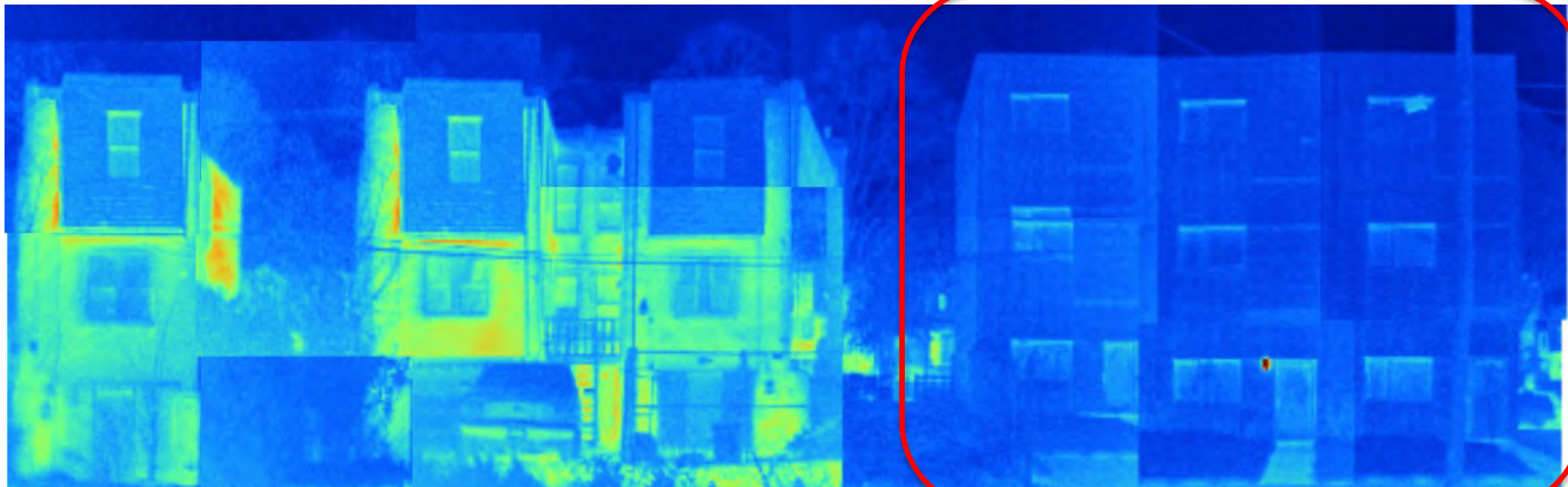
**0.405 ACH 50**

PASSIVE HOUSE MAX

**0.6 ACH 50**















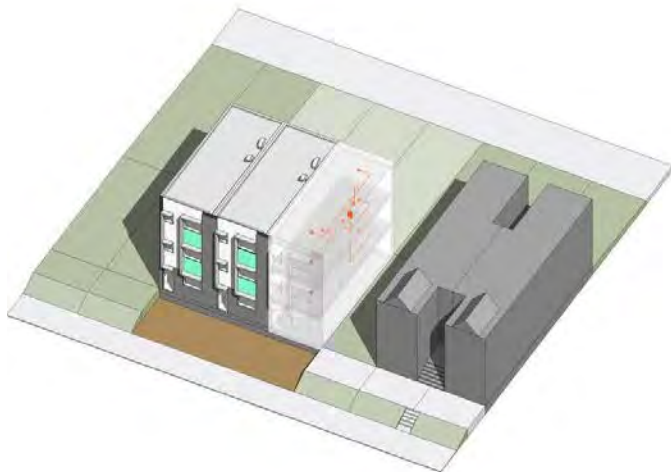










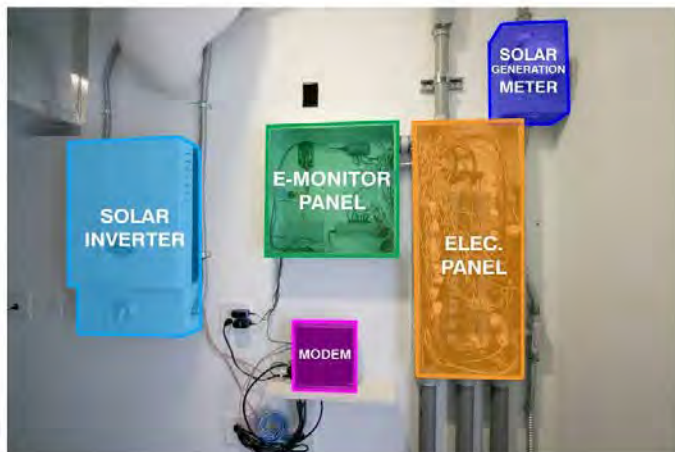


**power wise**

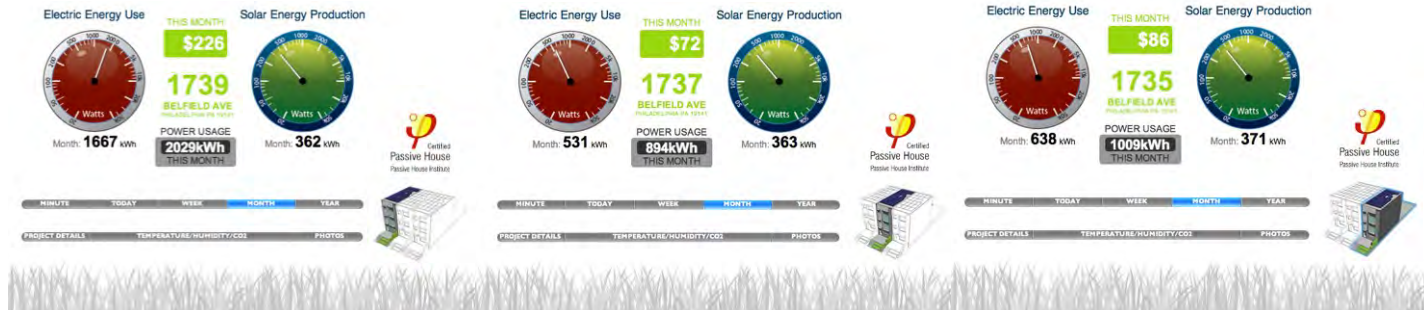
Monitor Status: ●

[Your Information](#)
[Channels](#)
[Smart Controls](#)
[Sensors](#)

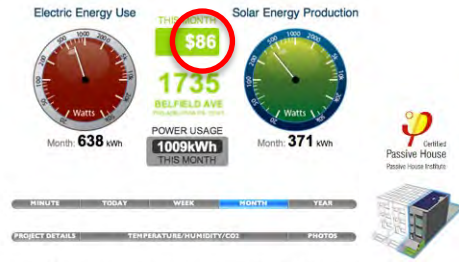
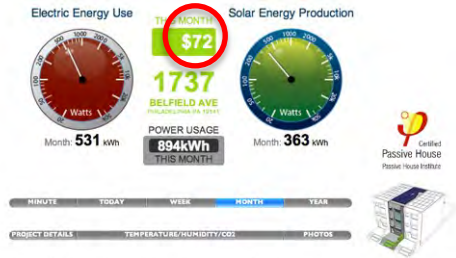
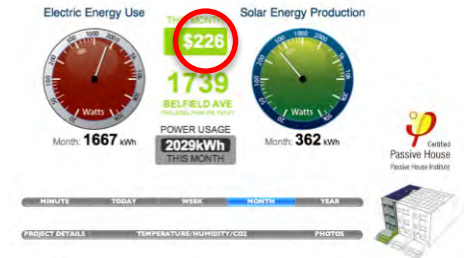
Sensors		
Name	Last Reading	Type
● Unit 1; LVL1-LivingRm	73°F	Temperature
● Unit 1; LVL1-Hall	75°F	Temperature
● Unit 1; LVL1-BedRm (Back)	73°F	Temperature
● Unit 2; LVL2-BedRm (Back)	75°F	Temperature
● Unit 2; LVL2-Hall	73°F	Temperature
● Unit 1; LVL2-WashRm	75°F	Temperature
● Unit 2; LVL2-BedRm (Fnt)	73°F	Temperature
● Unit 2; LVL3-Mech Rm	75°F	Temperature
● Unit 2; LVL3-BedRm (Fnt)	73°F	Temperature
● Unit 2; LVL3-Office (Back)	75°F	Temperature
● Unit 2; LVL 3 - Mech Rm; Inside Retrun Air Duct	77°F	Temperature
● Unit 2; LVL 3 - Mech Rm; Inside Retrun Air Duct	450 ppm	VOC
● Unit 2; LVL 3 - Mech Rm; Inside Retrun Air Duct	%	Humidity
● Unit 1; LVL1-Hall	453 ppm	VOC
● Unit 1; LVL1-Hall	45%	Humidity
● Unit 1; LVL2-WashRm	450 ppm	VOC
● Unit 1; LVL2-WashRm	44%	Humidity





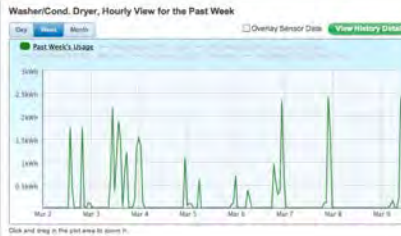






Energy Consumption Per Load

	Number of Loads	Avg Cost per Load	Avg Energy per Load (kWh)	Avg Duration per Load (min)
Yesterday	2	0.02	1.88	79
Last 7 Days	25	0.16	1.36	65
Last 30 Days	104	0.18	1.42	68



Energy Consumption Per Load

	Number of Loads	Avg Cost per Load	Avg Energy per Load (kWh)	Avg Duration per Load (min)
Yesterday	2	0.43	2.75	114
Last 7 Days	8	0.25	1.78	89
Last 30 Days	43	0.22	1.75	86

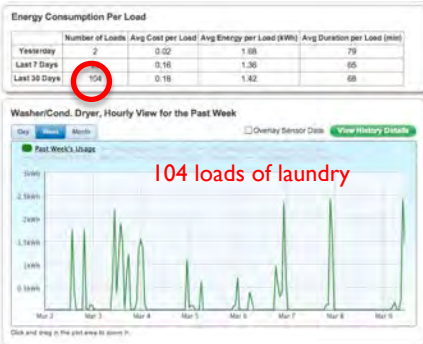
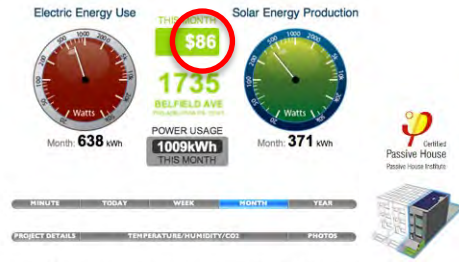
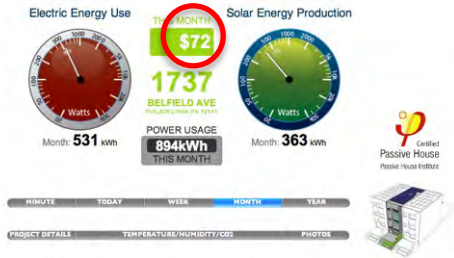
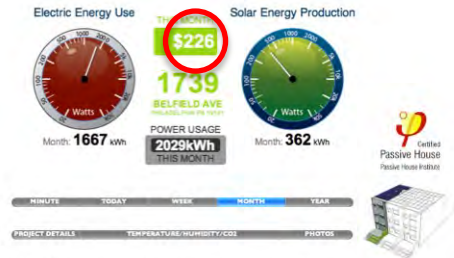


Energy Consumption Per Load

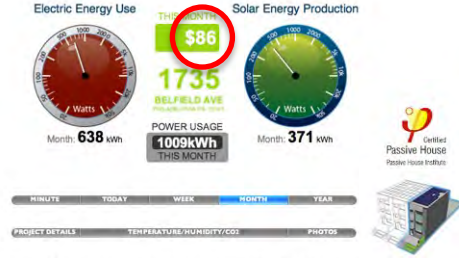
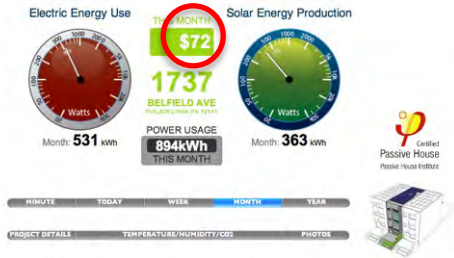
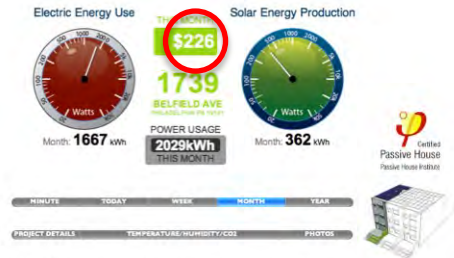
	Number of Loads	Avg Cost per Load	Avg Energy per Load (kWh)	Avg Duration per Load (min)
Yesterday	1	0	0.06	19
Last 7 Days	13	0.08	0.54	40
Last 30 Days	59	0.11	0.88	84





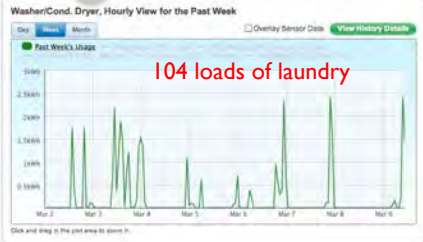






Energy Consumption Per Load

	Number of Loads	Avg Cost per Load	Avg Energy per Load (kWh)	Avg Duration per Load (min)
Yesterday	2	0.02	1.88	79
Last 7 Days	0.16	1.36	65	
Last 30 Days	704	0.18	1.82	68



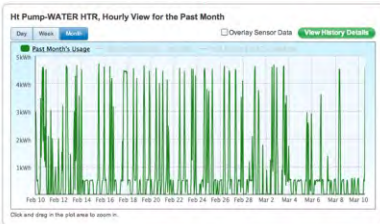
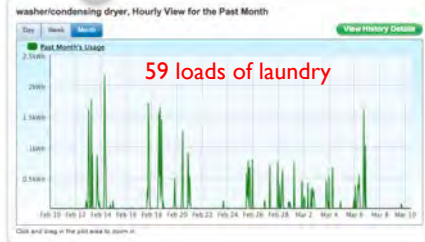
Energy Consumption Per Load

	Number of Loads	Avg Cost per Load	Avg Energy per Load (kWh)	Avg Duration per Load (min)
Yesterday	2	0.43	2.75	114
Last 7 Days	0.25	1.78	89	
Last 30 Days	43	0.22	1.75	80



Energy Consumption Per Load







	Number of Loads	Avg Cost per Load	Avg Energy per Load (kWh)	Avg Duration per Load (min)
Yesterday	1	0	0.06	19
Last 7 Days	0.08	0.54	40	
Last 30 Days	59	0.11	0.88	84







\* 12 Months of Measured Data

	Address	TFA sf	12 Months kWh Total	PV Production kWh	\$/Yr	SITE (kBTU/TFA) kBTU/sf/yr	
	1739	1480.6	17,466	5710 	\$1120 Passive House	40 15	13 4.5 (66%)
					\$93.00/MONTH		
	1737	1480.6	10,809	5631 	\$497 Passive House	25 15	7 4.5 (36%)
					\$41.00/MONTH		
	1735	1480.6	9568	5577 	\$383 Passive House	22 15	6 4.5 (25%)
					\$32.00/MONTH		



## CONSTRUCTION COSTS

	PER UNIT	PROJECT TOTAL
GENERAL CONDITIONS	\$1,500	\$4,500
EXCAVATION & GRADING	\$3,000	\$9,000
FOUNDATIONS	\$7,000	\$21,000
HELICAL PIERS	\$6,500	\$19,500
SITE UTILITIES (WATER / SEWER / ELECTRIC)	\$10,000	\$30,000
SOLAR PV (5 KW PER HOUSE - 15KW TOTAL)	\$15,000	\$45,000
<b>TOTAL SITE WORK</b>	<b>\$43,000</b>	<b>\$129,000</b>
FRAMING / INSULATION / SHEETROCK / PAINT	\$50,250	\$150,750
EXT.WINDOWS & DOORS	\$9,850	\$29,550
MECHANICAL SYSTEM	\$8,500	\$25,500
PLUMBING & SPRINKLERS	\$9,500	\$28,500
ELECTRICAL	\$5,500	\$16,500
CABINETRY / COUNTERTOPS	\$5,500	\$16,500
APPLIANCES	\$6,200	\$18,600
HARDWARE & FINISHES	\$9,300	\$27,900
EXTERIOR CLADDING	\$4,500	\$13,500
E-MONITORING	\$1,900	\$5,700
LABOR / INSPECTIONS / OH-P / DELIVERY / INSTALL	\$95,000	\$285,000
<b>TOTAL MODULAR</b>	<b>\$206,000</b>	<b>\$618,000.00</b>
<b>TOTAL HARD COSTS</b>	<b>\$249,000</b>	<b>\$747,000.00</b>
<b>COST PER SQFT (1920 SQFT x 3 HOMES = 5760 SQFT)</b>		<b>\$129.69</b>



An aerial photograph of a cityscape. In the foreground, a modern, multi-story building with a flat roof covered in solar panels is visible. The building has several large, teal-colored windows. Surrounding this building are other residential structures, including older houses and apartment buildings. The background shows a hilly area with more houses and a church steeple under a blue sky with scattered white clouds.

**Why isn't ALL**  
**AFFORDABLE HOUSING**  
**Built to the PH standard?**





# PHFA

PENNSYLVANIA HOUSING FINANCE AGENCY





An aerial photograph of a city neighborhood. In the foreground, a modern, multi-story building with a flat roof is covered with solar panels. The building has large windows and a grey facade. Behind it, a dense residential area with various houses and buildings is visible. In the background, a church steeple rises above the trees. The sky is blue with scattered white clouds.

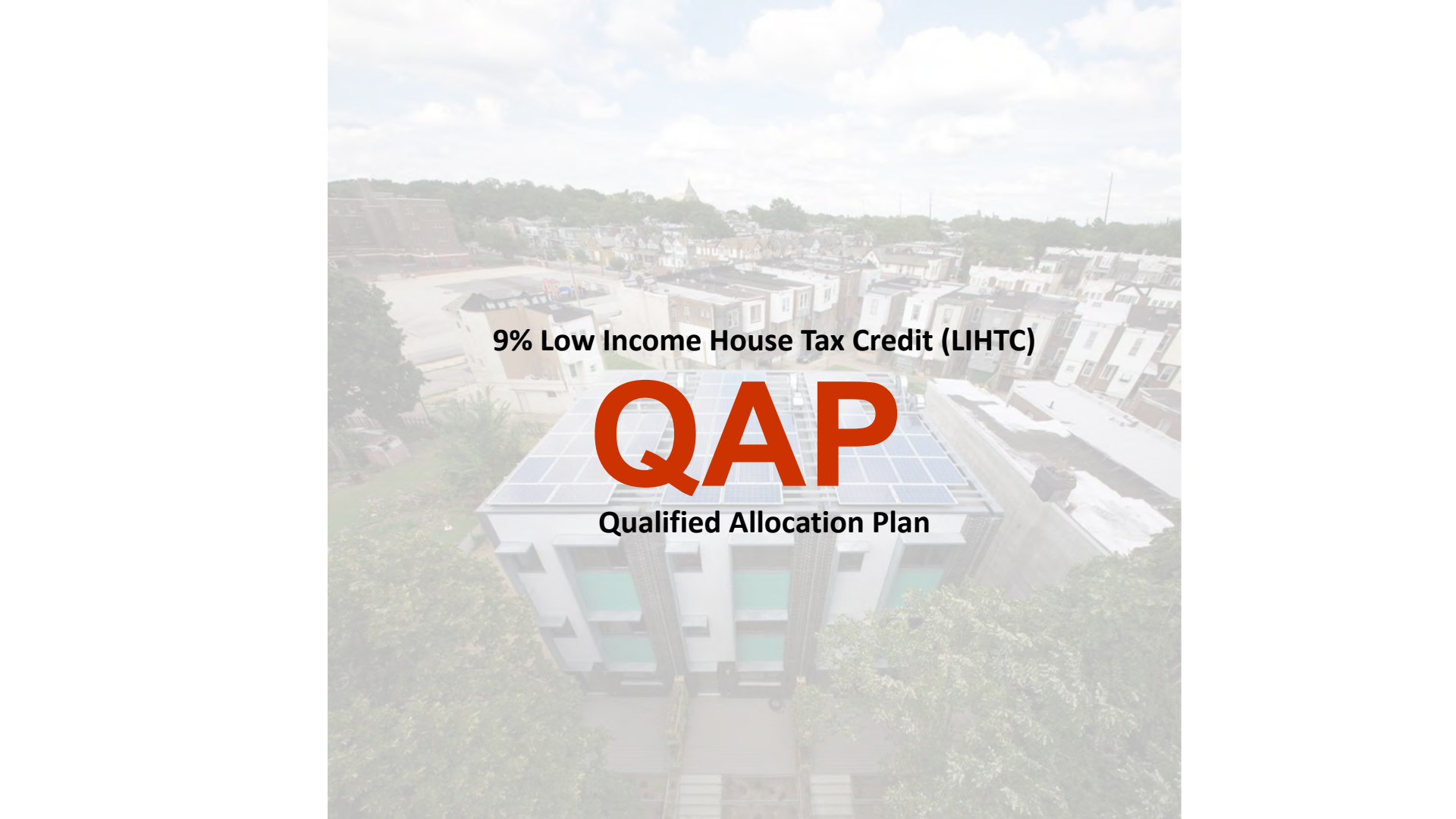
**MAKE ALL AFFORDABLE HOUSING  
NET-ZERO-ENERGY-CAPABLE BY 2030**



An aerial photograph of a modern, multi-story building with a flat roof covered in solar panels. The building has a light-colored facade and large windows. It is situated in a dense urban neighborhood with many other buildings and trees. The sky is blue with some clouds. The text "USE PASSIVE HOUSE AS THE TOOL" is overlaid in the center of the image.

**USE PASSIVE HOUSE AS THE TOOL**



An aerial photograph of a cityscape. In the foreground, a modern, multi-story building with a flat roof is covered in solar panels. The building has several large windows and a central entrance. Behind it, a dense residential area with various houses and buildings is visible. In the background, a church steeple rises above the trees. The sky is blue with scattered white clouds.

**9% Low Income House Tax Credit (LIHTC)**

**QAP**

**Qualified Allocation Plan**



## POINTS-BASED SYSTEM

**Total points**

**120**

**Community and Economic Impact**

**30**

- Underserved Areas
- Senior Occupancy Developments
- Preservation

**Development Characteristics**

**25**

- Smart Site Selection
- Enterprise Green Communities

**Resident Population and Services**

**50**

- Income and Rent Targeting
- Designated Populations and Supportive Services
- Accessible Units
- Large Families

**Development Process**

**15**

- Noncompliance
- Ability to Proceed

**Development Cost Savings**

**10**



## POINTS-BASED SYSTEM



<b>Total points</b>	<b>120</b>
<b>Community and Economic Impact</b>	<b>30</b>
- Underserved Areas	
- Senior Occupancy Developments	
- Preservation	
<b>Development Characteristics</b>	<b>25</b>
- Smart Site Selection	
- Enterprise Green Communities	
- <b>PASSIVE HOUSE</b>	<b>10</b>
<b>Resident Population and Services</b>	<b>50</b>
- Income and Rent Targeting	
- Designated Populations and Supportive Services	
- Accessible Units	
- Large Families	
<b>Development Process</b>	<b>15</b>
- Noncompliance	
- Ability to Proceed	
<b>Development Cost Savings</b>	<b>10</b>



OCT 2014

**“PASSIVE HOUSE points” introduced to PHFA 2015 QAP**

FEB 2015

**85** Multi-family project applications were received

JUNE 2015

**39** projects awarded funding

**38%** applied as Passive House projects

**8** Passive House Projects awarded funding

**422** new Passive House/Net-Zero-Energy-Capable units in PA

**\$COST\$** “Negligibly different” from NON-PH projects

**YEAR 1** A NATIONAL Net-Zero-Energy Initiative by **2030**  
**2015**



## Construction Cost Summary from PHFA Applications

### 2015 Costs

Proj. No.	County	Climate Zone	Units (by BR Qty)					Total Units	Bldg. Area	Constr. \$	\$ /Unit	\$/SF
			0	1	2	3	4+					
SF-1	Franklin	5A			33	21		54	70,218	7,051,522	130,584	100
SF-2	Schuykill	5A		3	9	5		17	21,151	2,238,725	131,690	106
SF-3	Philadelphia	4A		5	19	31	5	60	79,795	9,363,626	156,060	117
SF-4	Allegheny	5A			26	19		45	63,548	8,863,631	196,970	117
SF-5	Lycoming	5A		16	34			50	66,147	8,141,437	162,829	123
SF-6	Bradford	5A		10	24	16		50	62,956	7,964,823	159,296	127
SF-7	Centre	5A			20	20		40	53,652	7,523,233	188,081	140
SF-8	Lebanon	5A			46	16		62	84,168	11,742,459	189,395	140
SF-9	Bradford	5A		2	26	12		40	59,954	8,369,296	209,232	140
SF-10	Butler	5A		3	39	18		60	67,904	9,827,275	163,788	145
SF-11	Erie	5A			9	34		43	53,454	7,870,669	183,039	147
SF-12	Dauphin	5A		3	3	25	4	35	61,504	9,192,750	262,650	149
SF-13	Berks	5A		22	20	16		58	62,097	9,305,340	160,437	150
SF-14	Franklin	5A		7	25	24		56	77,469	11,791,991	210,571	152
SF-15	Luzerne	5A		26	15	15		56	56,250	8,968,491	160,152	159
SF-16	Union	5A		5	12	8	6	31	43,868	7,071,066	228,099	161
SF-17	Chester	4A		48	12			60	58,349	9,809,238	163,487	168
SF-18	Allegheny	5A		4	30	18		52	77,351	12,979,386	249,604	168
SF-19	Berks	5A		10	21	11		42	57,722	9,785,000	232,976	170
SF-20	Montgomery	4A		16	24	15		55	61,480	11,113,700	202,067	181
SF-21	Delaware	4A		8	34	14		56	65,790	12,184,074	217,573	185
SF-22	Philadelphia	4A			17	16	2	35	45,476	8,905,240	254,435	196
SF-23	Allegheny	5A		14	9			23	28,205	5,552,583	241,471	197
SF-24	Westmoreland	5A		28	8			36	43,872	8,331,567	231,432	245
SF-25	Philadelphia	4A		10	19	11		40	46,757	11,453,809	286,345	245

### Single Family / Townhouse

### Adaptive Reuse

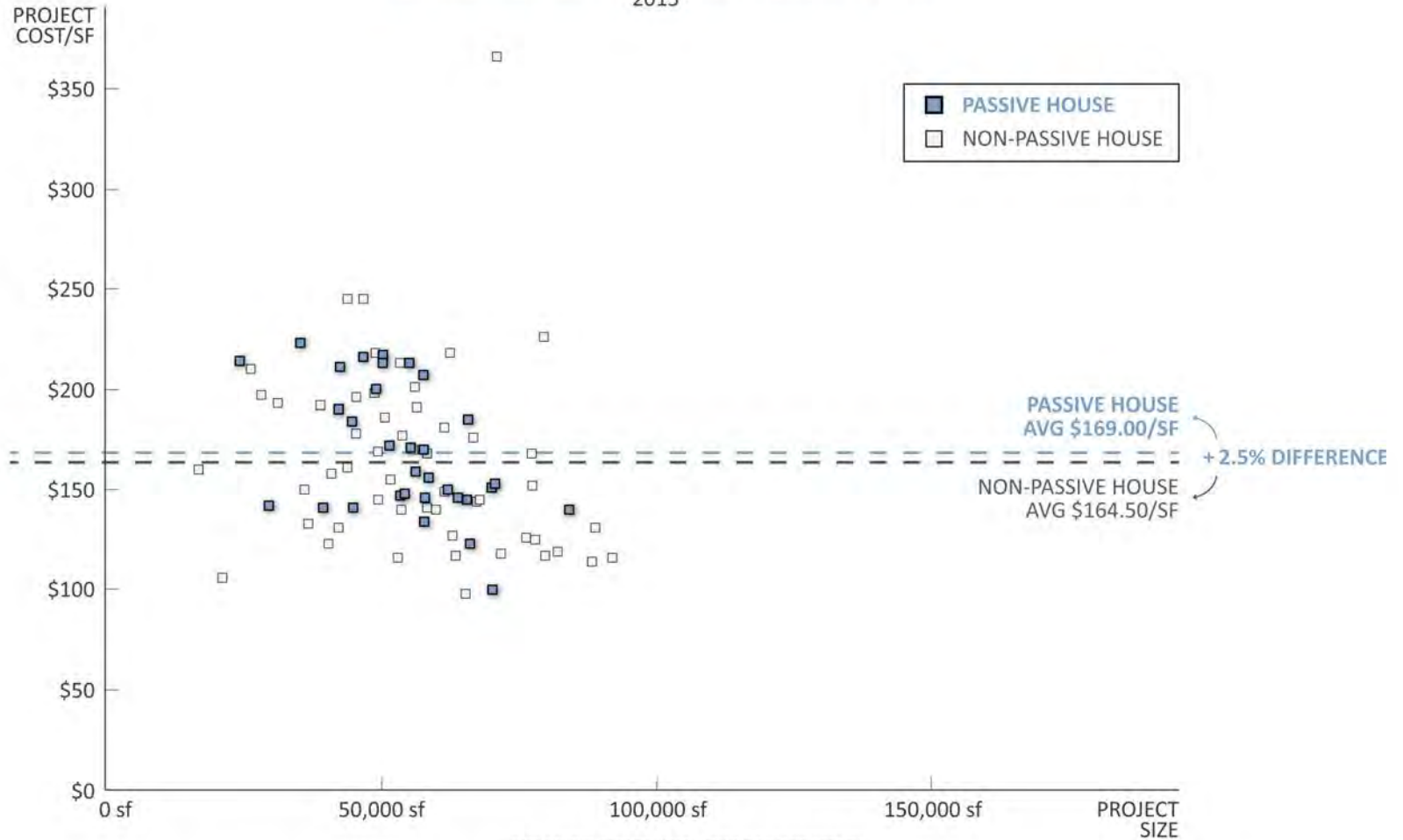
AR-1	Lehigh	5A		34	4	11		49	65,339	6,392,809	130,465	98
AR-2	Erie	5A		29	16			45	53,021	6,152,972	136,733	116
AR-3	Philadelphia	4A	12	54				66	77,975	9,751,707	147,753	125
AR-4	Allegheny	5A	2	49	4			55	65,577	9,514,764	172,996	145
AR-5	Delaware	4A		53				53	51,690	8,030,480	151,518	155
AR-6	Philadelphia	4A		44				44	49,406	8,361,579	190,036	169
AR-7	Montgomery	4A		33	3	7		43	55,832	9,468,816	220,205	170
AR-8	Philadelphia	4A				28	10	38	53,840	9,515,893	250,418	177
AR-9	Dauphin	5A	5	17	6			28	45,434	8,075,064	288,395	178
AR-10	Allegheny	5A		33	3			36	50,664	9,436,523	262,126	186
AR-11	Philadelphia	4A		46				46	56,478	10,795,027	234,675	191
AR-12	Philadelphia	4A		27	10			37	48,768	9,658,098	261,030	198
AR-13	Philadelphia	4A		30	21			51	62,509	13,609,683	266,857	218
AR-14	Washington	4A		17	7			24	35,299	7,856,113	327,338	223
AR-15	Philadelphia	4A		62				62	70,991	25,995,741	419,286	366

Multi-Story / Elevator	MS-1	Northumberland	5A		35				35	40,397	4,276,084	122,174	106
	MS-2	Dauphin	5A		22	14	14		50	88,314	10,055,562	201,111	114
	MS-3	Dauphin	5A		18	59			77	92,000	10,668,511	138,552	116
	MS-4	Lancaster	5A		46	6			52	71,758	8,456,719	162,629	118
	MS-5	Blair	5A		33	20			53	82,070	9,727,007	183,528	119
	MS-6	Chester	4A		46	15			61	76,340	9,638,964	158,016	126
	MS-7	Lancaster	5A		13	39	26		78	88,910	11,681,226	149,759	131
	MS-8	Clearfield	6A		24	6			30	42,254	5,551,584	185,053	131
	MS-9	Indiana	5A		40				40	36,743	4,898,995	122,475	133
	MS-10	Bradford	5A		50	6			56	57,817	7,738,172	138,182	134
	MS-11	Cambria	5A		32	11			43	44,887	6,341,616	147,479	141
	MS-12	Dauphin	5A		38	16			54	58,335	8,201,250	151,875	141
	MS-13	Mifflin	5A		30	4		34	39,447	5,559,187	163,506	141	
	MS-14	Fayette	5A		12	12		24	29,586	4,192,325	174,680	142	
	MS-15	Allegheny	5A		24	12	13		49	67,340	9,698,634	197,931	144
	MS-16	Lackawanna	5A		44	4			48	49,460	7,159,738	149,161	145
	MS-17	Lehigh	5A		54	7			61	63,949	9,318,159	152,757	146
	MS-18	Centre	5A		37	11			48	57,959	8,490,644	176,888	146
	MS-19	Chester	4A		41	3	5		49	54,287	8,007,477	163,418	148
	MS-20	Fayette	5A		21	3		24	36,064	5,407,359	225,307	150	
	MS-21	Chester	4A		61	3		64	70,083	10,557,500	164,961	151	
	MS-22	Allegheny	5A		54	12		66	70,689	10,787,052	163,440	153	
	MS-23	Allegheny	5A		40	6		46	58,617	9,134,790	198,582	156	
	MS-24	Wayne	6A		36	4		40	40,959	6,460,530	161,513	158	
	MS-25	Centre	5A			12		12	16,796	2,683,900	223,658	160	
	MS-26	Beaver	5A		40	12		52	55,361	9,468,440	182,085	171	
	MS-27	Lancaster	5A		51			51	51,500	8,871,635	173,954	172	
	MS-28	Allegheny	5A		52	8		60	66,733	11,716,729	195,279	176	
	MS-29	Montgomery	4A		40	4		44	44,687	8,202,314	186,416	184	
	MS-30	Montgomery	4A		50			50	42,265	8,029,015	160,580	190	
	MS-31	Crawford	5A		36	4		40	38,953	7,490,675	187,267	192	
	MS-32	Philadelphia	4A		9	8	7	24	31,220	6,031,050	251,294	193	
	MS-33	Westmoreland	5A		47			47	49,080	9,825,224	209,047	200	
	MS-34	Philadelphia	4A		58	4		62	56,120	11,262,762	181,657	201	
	MS-35	Philadelphia	4A	60				60	57,672	11,915,227	198,587	207	
	MS-36	Philadelphia	4A		20	4		24	26,284	5,523,620	230,151	210	
	MS-37	Philadelphia	4A		34	11		45	42,523	8,964,723	199,216	211	
	MS-38	Philadelphia	4A		52			52	50,275	10,703,403	205,835	213	
	MS-39	Philadelphia	4A		39	11		50	53,416	11,371,112	227,422	213	
	MS-40	Philadelphia	4A		45	5		50	55,099	11,747,269	234,945	213	
	MS-41	Philadelphia	4A		24			24	24,284	5,194,462	216,436	214	
	MS-42	Philadelphia	4A		45			45	46,754	10,118,014	224,845	216	
	MS-43	Philadelphia	4A		53			53	50,312	10,900,733	205,674	217	
	MS-44	Philadelphia	4A		54			54	48,965	10,664,381	197,489	218	
	MS-45	Philadelphia	4A		88			88	79,650	18,005,791	204,611	226	

### Multi-Story / Elevator



# CONSTRUCTION COST OF PROPOSED PROJECTS TO PHFA 2015







St. John Nueman  
Phila, PA  
52 Units



Wynne  
Phila, PA  
51 Units



Sacred Heart  
Allentown, PA  
61 Units



WhiteHall  
Spring City, PA  
49 Units



Hillcrest  
Pittsburgh, PA  
65 Units



Washington Square  
Townhomes  
Chambersburg, Pa  
54 Units



Mann Edge  
Lewistown, Pa  
34 Units



**7** Passive House Projects **COMPLETED**



## Construction Cost Change from Application to Construction Completion

Proj. No.	Total Units	Resid'tl Bldg. Area	\$/SF @ Applic	\$/SF @ Cost Cert	% Change
2015-443	51	62,509	\$ 218	\$ 186	-15%
2015-431	52	43,868	\$ 296	\$ 287	-3%
2015-436	23	28,205	\$ 197	\$ 193	-2%
2015-608	40	40,959	\$ 158	\$ 157	-1%
2015-810	35	61,504	\$ 149	\$ 149	-1%
2015-419	28	45,434	\$ 178	\$ 178	0%
2015-809	37	48,768	\$ 198	\$ 199	1%
2015-612	31	43,868	\$ 161	\$ 162	1%
2015-804	88	79,650	\$ 226	\$ 228	1%
2015-416	66	70,689	\$ 153	\$ 155	2%
2015-466	40	53,652	\$ 140	\$ 144	3%
2015-619	34	39,447	\$ 141	\$ 145	3%
2015-806	49	54,287	\$ 148	\$ 151	3%
2015-445	50	55,099	\$ 220	\$ 226	3%
2015-439	53	51,690	\$ 155	\$ 163	5%
2015-448	44	49,406	\$ 169	\$ 177	5%
2015-449	61	63,949	\$ 149	\$ 157	5%
2015-616	24	36,064	\$ 150	\$ 160	7%
2015-620	53	82,070	\$ 119	\$ 129	8%
2015-807	43	55,832	\$ 170	\$ 185	9%
2015-614	45	53,021	\$ 116	\$ 128	10%
2015-440	52	50,275	\$ 213	\$ 233	10%
2015-415	56	56,250	\$ 159	\$ 176	10%
2015-610	54	70,218	\$ 100	\$ 111	11%
2015-467	45	63,548	\$ 139	\$ 154	11%
2015-459	12	16,796	\$ 160	\$ 181	13%

### NON-PASSIVE HOUSE

Application  
\$171 SF

Completion  
\$176 SF  
*3% Higher*

### PASSIVE HOUSE

Application  
\$161 SF

Completion  
\$168 SF  
*4% Higher*

*\*NOTE 3-5% Contingency added to budgets after application*



# Pennsylvania

**94** Projects applied, **27** as Passive House projects

**10 PH** projects awarded

**33 NON-PH** projects awarded



Construction Cost Summary for PHFA 2016 Applications													
Proj. No.	County	Climate Zone	Units by BR Qty					Total Units	Resid. Bldg. Area	Resid. Constr. \$	\$ / Unit	\$ / SF	
			0	1	2	3	4+						
Single Family / Townhouse	SF-01	Dauphin	5A		14	16	15	15	60	99,625	10,419,031	173,65	105
	SF-02	Lebanon	5A		9	32	14		55	78,627	8,446,000	153,56	107
	SF-03	Lycoming	5A		20	40			60	82,730	9,436,382	157,22	114
	SF-04	Columbia	5A			7	17		24	48,499	5,669,777	236,24	117
	SF-05	Philadelphia	4A		5	19	31	5	60	79,795	9,739,093	162,33	122
	SF-06	Wyoming	5A			30	12		42	72,100	9,168,380	218,29	127
	SF-07	Erie	5A		8	20	18		46	85,819	10,964,900	238,30	128
	SF-08	Lancaster	5A		6	33	21		60	78,825	10,259,118	170,98	130
	SF-09	Cumberland	5A			18	34		52	75,275	9,921,606	190,80	132
	SF-10	Centre	5A		6	24	18		48	75,737	10,193,457	212,36	135
	SF-11	Lehigh	5A		19	27	16		62	71,254	9,631,860	155,39	135
	SF-12	Lancaster	5A		41	79	18		138	154,370	21,137,388	153,10	137
	SF-13	Erie	5A			9	31		40	53,454	7,870,669	196,70	147
	SF-14	Montgomery	4A			19	29		48	59,976	8,858,000	184,54	148
	SF-15	Lebanon	5A			49	13		62	82,974	12,349,192	199,18	149
	SF-16	Cumberland	5A			10	30	10	50	72,707	10,865,524	217,33	149
	SF-17	Schuylkill	5A		1	11	5		17	21,544	3,225,548	189,73	150
	SF-18	Berks	5A		10	21	11		42	57,722	8,755,000	208,43	152
	SF-19	Berks	5A		22	20	16		58	62,097	9,440,383	162,76	152
	SF-20	Franklin	5A		6	21	21		48	66,583	10,404,256	216,79	156
	SF-21	Lehigh	5A		9	15	20	4	48	53,333	8,377,963	174,54	157
	SF-22	Chester	4A		19	18	11		48	58,541	9,248,927	192,68	158
	SF-23	Cumberland	5A		5	22	8		35	44,186	7,656,200	218,74	173
	SF-24	Montgomery	4A		8	21	15	6	50	65,907	11,589,411	231,78	176
	SF-25	Allegheny	5A		35	16	14		65	87,255	15,376,648	236,50	176
	SF-26	Delaware	4A		8	34	14		56	65,212	11,914,849	212,70	183
	SF-27	Philadelphia	4A			17	16	2	35	45,476	9,441,620	269,70	208
	SF-28	Armstrong	5A			24			24	28,812	6,017,450	250,72	209
	SF-29	Philadelphia	4A			28	14		42	47,964	10,022,268	238,62	209
	SF-30	Philadelphia	4A		11	10	11		32	31,619	6,732,433	210,39	213
	SF-31	Philadelphia	4A		8	19	24	4	55	66,383	19,011,723	345,60	286
	SF-32	Philadelphia	4A	45					45	23,302	7,408,602	164,63	318

Adaptive Reuse Bldgs.	AR-01	Monroe	5A		36	4			40	54,215	5,753,672	143,82	106
	AR-02	Luzerne	5A		6	54	2		62	88,489	9,900,711	159,69	112
	AR-03	Philadelphia	4A	12	54				66	77,978	10,123,117	153,31	130
	AR-04	Allegheny	5A		33	8			41	70,409	9,181,888	223,93	130
	AR-05	Butler	5A		44	18			62	73,114	10,046,992	162,08	137
	AR-06	Washington	5A		24				24	41,046	6,169,663	257,09	150
	AR-07	Allegheny	5A	2	49	4			55	65,190	10,592,039	192,53	162
	AR-08	Delaware	4A		50				50	50,548	8,727,828	174,57	173
	AR-09	Philadelphia	4A		60				60	65,041	11,803,992	196,79	181
	AR-10	Philadelphia	4A		74				74	93,285	20,223,060	273,25	217
	AR-11	Philadelphia	4A	20	37				57	63,960	14,005,881	245,77	219
	AR-12	Perry	5A		28	3			31	36,152	8,548,665	275,73	236

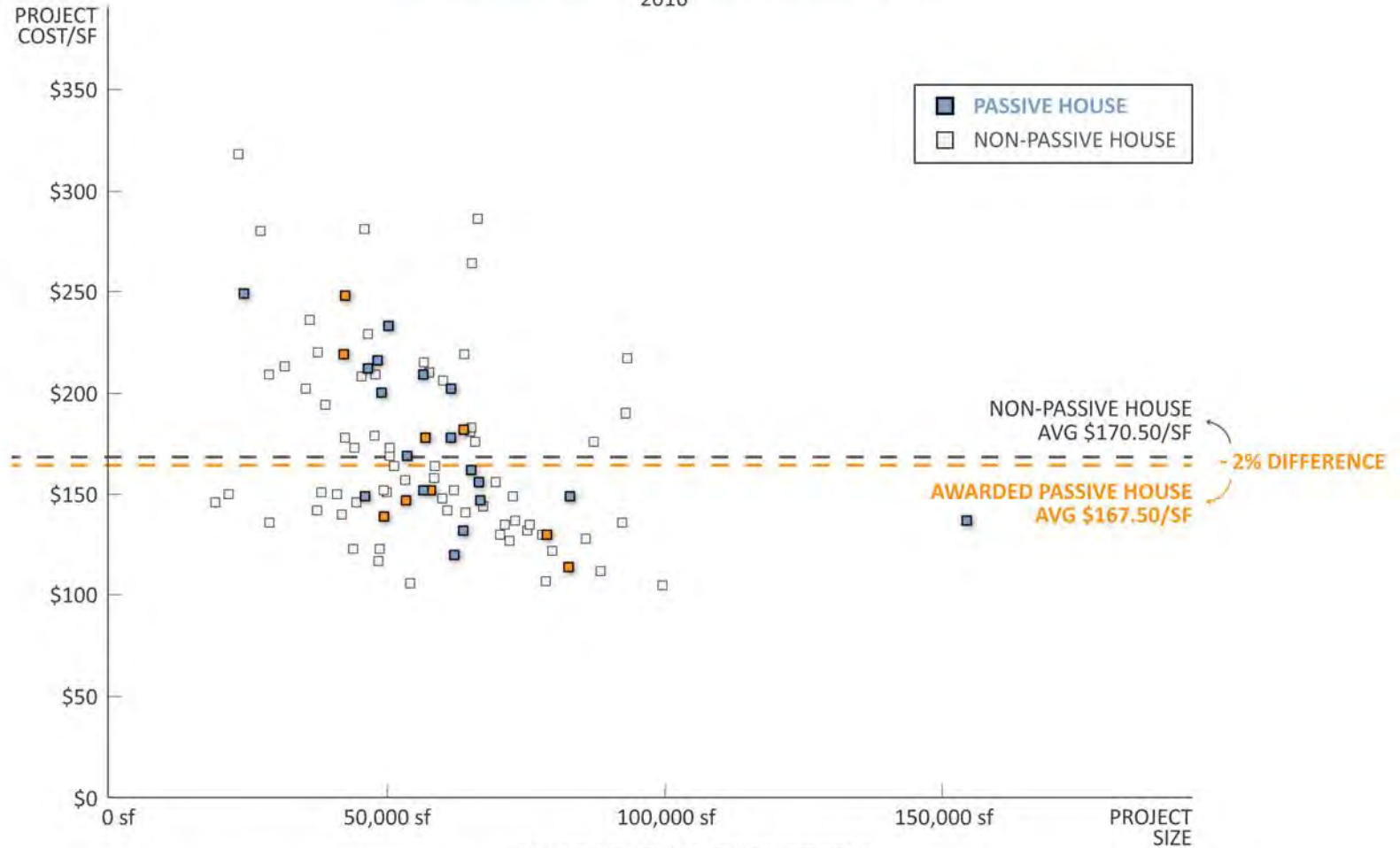
Multi-Story / Elevator Buildings

Multi-Story / Elevator Buildings	MS-01	Berks	5A		40	20			60	62,149	7,432,636	123,87	120
	MS-02	Tioga	6A		34	6			40	48,735	5,999,734	149,99	123
	MS-03	Dauphin	5A		35	2			37	43,964	5,421,065	146,55	123
	MS-04	Bradford	5A		38	12	6		56	63,768	8,446,000	150,83	132
	MS-05	Lancaster	5A		46	6			52	92,370	12,565,629	241,67	136
	MS-06	Fayette	5A		12	12			24	28,904	3,942,323	164,28	136
	MS-07	Cambria	5A		32	11			43	49,491	6,879,001	159,97	139
	MS-08	Clearfield	6A		24	6			30	41,915	5,855,263	195,15	140
	MS-09	Chester	4A		56	3			59	64,180	9,033,100	153,13	141
	MS-10	Centre	5A		16	34			50	60,912	8,666,068	173,33	142
	MS-11	Clinton	5A		28	4			32	37,454	5,333,806	166,66	142
	MS-12	Allegheny	5A		24	12	13		49	67,340	9,698,634	197,99	144
	MS-13	Luzerne	5A		32	3			35	44,543	6,503,636	185,89	146
	MS-14	Dauphin	5A		20				20	19,157	2,803,860	140,13	146
	MS-15	Butler	5A		68				68	66,845	9,821,302	144,43	147
	MS-16	Westmoreland	5A		15	13	8		36	46,095	6,855,424	190,43	149
	MS-17	Lackawanna	5A		12	12	8	4	36	50,019	7,560,000	210,00	151
	MS-18	Northumberland	5A		32				32	38,240	5,789,694	180,99	151
	MS-19	Centre	5A		37	11			48	57,959	8,781,136	182,90	152
	MS-20	Lackawanna	5A		44	4			48	49,460	7,493,999	156,15	152
	MS-21	Allegheny	5A		30	34			64	69,605	10,837,117	169,33	156
	MS-22	Dauphin	5A		43	11			54	51,319	8,411,465	155,78	164
	MS-23	Montgomery	4A		60				60	58,681	9,643,959	160,73	164
	MS-24	Adams	5A		39	4			43	50,532	8,515,443	198,03	169
	MS-25	Clarion	5A		48				48	53,668	9,090,720	189,30	169
	MS-26	Allegheny	5A		40	6			46	56,969	10,124,143	220,00	178
	MS-27	Allegheny	5A		28	8			36	42,500	7,582,274	210,67	178
	MS-28	Chester	4A		47	13			60	61,551	10,982,435	183,00	178
	MS-29	Delaware	5A		38	3			41	47,797	8,539,207	208,29	179
	MS-30	Allegheny	4A		52	8			60	63,861	11,647,354	194,13	182
	MS-31	Philadelphia	4A		37	44			81	93,000	17,635,125	217,73	190
	MS-32	Crawford	5A		36	4			40	38,953	7,552,475	188,88	194
	MS-33	Westmoreland	5A		47				47	49,080	9,801,657	208,56	200
	MS-34	Bucks	4A		56	10			66	61,576	12,448,922	188,60	202
	MS-35	Lycoming	5A		23	11			34	35,437	7,169,151	210,87	202
	MS-36	Philadelphia	4A		61				61	60,137	12,416,322	203,56	206
	MS-37	Bradford	5A		40	10			50	56,580	11,852,026	237,04	209
	MS-38	Philadelphia	4A		58	4			62	57,653	12,079,768	194,86	210
	MS-39	Philadelphia	4A		52				52	46,619	9,903,739	190,47	212
	MS-40	Philadelphia	4A	60					60	56,672	12,174,301	202,96	215
	MS-41	Philadelphia	4A		45				45	48,351	10,464,750	232,50	216
	MS-42	Montgomery	4A		50				50	42,265	9,236,729	184,73	219
	MS-43	Allegheny	5A		29	4			33	37,592	8,284,054	251,08	220
	MS-44	Philadelphia	4A		46	4			50	46,640	10,701,164	214,03	229
	MS-45	Philadelphia	4A		53				53	50,312	11,711,200	220,96	233
	MS-46	Philadelphia	4A		34	11			45	42,520	10,560,747	234,63	248
	MS-47	Philadelphia	4A		24	24			24	24,284	6,040,593	251,66	249
	MS-48	Philadelphia	4A		60				60	65,340	17,249,402	287,40	264
	MS-49	Luzerne	5A		36				36	27,296	7,653,000	212,58	280
	MS-50	Philadelphia	4A		48				48	46,000	12,915,822	269,00	281

**YEAR 2 A NATIONAL Net-Zero-Energy Initiative by 2030**  
2016



# CONSTRUCTION COST OF PROPOSED PROJECTS TO PHFA 2016







Morningside Crossing  
Pittsburgh, PA  
46 Units



Glassport  
Glassport, PA  
55 Units



Mt. Lebanon Sr. Housing  
Pittsburgh, PA  
60 Units



Roxbury Place  
Johnstown, PA  
43 Units



Westminster @ Windy  
Phillipsburg, PA  
48 Units



Parade St. Commons  
Erie, PA  
40 Units



The Willows  
Landisville, PA  
60 Units



Muncy Green  
Muncy, PA  
60 Units



Montgomery Park  
Norristown, PA  
50 Units



Anthony Wayne Senior  
Phila, PA  
45 Units



# 10 Passive House Projects *COMPLETE*



# Pennsylvania

**40** Projects Awarded funding

**8 PH** projects awarded

**32 NON-PH** projects awarded



Construction Cost Summary of 2018 PHFA Applications													
	Ref. No.	County	Climate Zone	Units by BR Qty					Total Units	Resid. Bldg Area	Resid Constr \$	\$ / Unit	\$ / SF
				0	1	2	3	4+					
Single Family / Townhouses	SF-01	York	5A			10	13		23	44,064	4,475,121	194,570	102
	SF-02	Dauphin	5A				22	22	44	66,603	8,409,248	191,119	126
	SF-03	York	5A		6	23	24	3	56	72,013	9,258,025	165,322	129
	SF-04	Berks	5A			24	22		46	66,030	8,557,500	186,033	130
	SF-05	Lebanon	5A		18	26	16		60	76,101	10,333,056	172,218	136
	SF-06	Franklin	5A			7	25		32	54,375	8,150,464	254,702	150
	SF-07	Philadelphia	4A		2	5	11	2	20	29,503	4,490,975	224,549	152
	SF-08	Lackawanna	5A		12	12	8	4	36	50,019	7,805,595	216,822	156
	SF-09	Franklin	5A		6	21	21		48	66,583	10,727,005	223,479	161
	SF-10	Multiple Co's	5A	52					52	52,330	8,909,580	171,338	170
	SF-11	York	5A		18	9	7		34	35,636	6,396,969	188,146	180
	SF-12	Allegheny	5A		47	10			57	48,150	9,106,659	159,766	189
	SF-13	Westmoreland	5A		3	6	9		18	20,489	4,108,548	228,253	201
	SF-14	Allegheny	5A		4	7	9		20	26,198	5,407,155	270,358	206
	SF-15	Armstrong	5A			24			24	29,147	6,230,195	259,591	214
	SF-16	Susquehanna	6A		34	2			36	31,103	7,031,404	195,317	226
	SF-17	Philadelphia	4A			17	16	2	35	45,476	10,281,980	293,771	226
	SF-18	Philadelphia	4A		11	10	12		33	34,388	8,875,449	268,953	258
	SF-19	Philadelphia	4A		28	12			40	46,232	12,214,948	305,374	264
	SF-20	Philadelphia	4A		12	18	11	9	50	71,903	21,367,901	427,358	297

	Construction Cost Summary of 2018 PHFA Applications													
	Ref. No.	County	Climate Zone	Units by BR Qty					Total Units	Resid. Bldg Area	Resid Constr \$	\$ / Unit		\$ / S
				0	1	2	3	4+						
	MS-01	Erie	5A			45			45	100,201	8,587,936	190,843	86	
	MS-02	Lancaster	5A		44	18			62	76,045	8,306,538	133,976	109	
	MS-03	Lancaster	5A		45	15			60	68,993	8,544,047	142,401	124	
	MS-04	Cumberland	5A		14	12	16		42	49,581	6,440,993	153,357	130	
	MS-05	Berks	5A		45	12			57	59,916	7,892,757	138,469	132	
	MS-06	Westmoreland	5A		15	13	8		36	46,095	6,087,669	169,102	132	
	MS-07	Fayette	5A		18	18			36	42,820	5,679,247	157,757	133	
	MS-08	Dauphin	5A		35	2			37	43,928	5,896,750	159,372	134	
	MS-09	Bradford	5A		38	12			56	63,759	8,603,563	153,635	135	
	MS-10	Allegheny	5A		30	10			40	54,495	7,335,750	183,394	135	
	MS-11	Lancaster	5A		46	6			52	94,440	12,791,060	245,982	135	
	MS-12	Centre	5A		16	34			50	60,599	8,371,068	167,421	138	
	MS-13	Montgomery	4A		42	14			56	60,166	8,477,023	151,375	141	
	MS-14	Luzerne	5A		32	3			35	44,543	6,416,086	183,317	144	

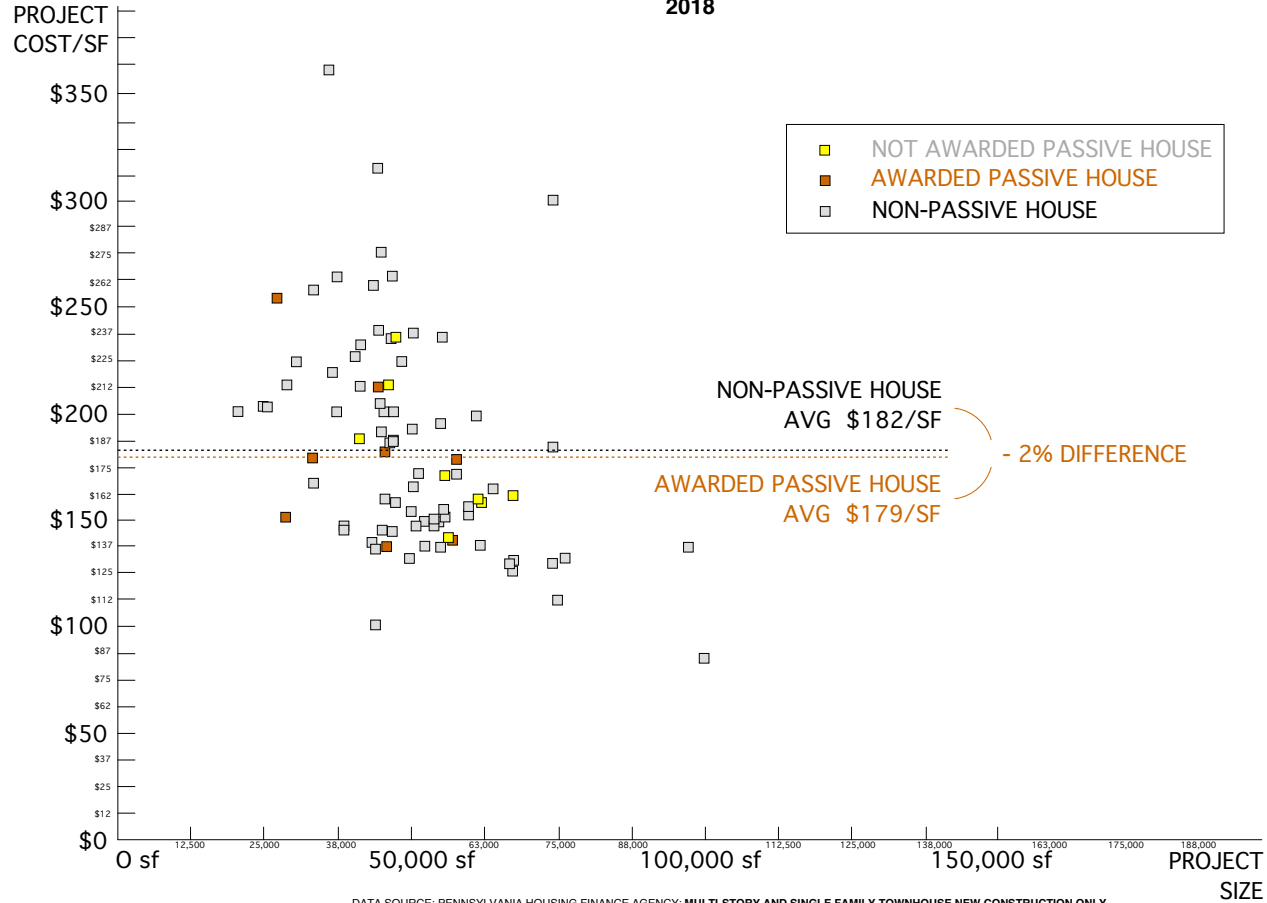
Multi-Story / Elevator Buildings	MS-14	Luzerne	5A		32	3			35	44,543	6,416,086	183,317	144
	MS-15	Clinton	5A		28	4			32	37,454	5,470,901	170,966	146
	MS-16	Dauphin	5A		20	29			49	53,976	8,066,609	164,625	149
	MS-17	Washington	5A		21	25			46	53,310	8,000,885	173,932	150
	MS-18	Franklin	5A		36	4			40	54,596	8,326,929	208,173	153
	MS-19	Chester	4A		57	3			60	60,931	9,310,170	155,170	153
	MS-20	Northumberland	5A		32	4			36	43,826	6,998,140	194,393	160
	MS-21	York	5A		16	26	8		50	63,425	10,125,538	202,511	160
	MS-22	Allegheny	5A		27	18	9		54	64,875	10,797,000	199,944	166
	MS-23	Westmoreland	5A		43	4			47	50,680	8,439,569	179,565	167
	MS-24	Clearfield	5A		24	6			30	35,984	6,065,728	202,191	169
	MS-25	Beaver	5A		44	8			52	57,297	9,797,660	188,417	171
	MS-26	Northampton	5A		12	33	15		60	60,212	10,329,351	172,156	172
	MS-27	Montgomery	4A		60				60	61,110	10,869,266	181,154	178
	MS-28	Dauphin	5A		38	11			49	48,638	8,730,738	178,178	180
	MS-29	Montgomery	4A		66	8			74	74,468	13,541,230	182,990	182
	MS-30	Clarion	5A		39	3			42	48,847	8,988,545	214,013	184
	MS-31	Philadelphia	4A		28	13			41	49,625	9,204,879	224,509	185
	MS-32	Lehigh	5A		27	13			40	40,937	7,663,199	191,580	187
	MS-33	Allegheny	5A		31	3	1		35	46,015	8,714,276	248,979	189
	MS-34	Butler	5A		30	13	1		44	50,825	9,697,495	220,398	191
	MS-35	Delaware	4A		58				58	57,365	11,293,126	194,709	197
	MS-36	Bucks	4A		68	1			69	62,844	12,503,344	181,208	199
	MS-37	Delaware	4A		38	3			41	43,515	8,746,409	213,327	201
	MS-38	Blair	5A		43	2			45	47,642	9,595,216	213,227	201
	MS-39	Tioga	5A		34	6			40	32,800	6,591,082	164,777	201
	MS-40	Lycoming	5A		18	6			24	26,749	5,419,721	225,822	203
	MS-41	Philadelphia	4A		44				44	46,306	9,443,528	214,626	204
	MS-42	Philadelphia	4A		52				52	46,619	9,893,465	190,259	212
	MS-43	Crawford	5A		37	2			39	40,256	8,580,594	220,015	213
	MS-44	Allegheny	5A		46				46	48,600	10,405,629	226,209	214
	MS-45	Luzerne	5A		36				36	36,784	8,000,600	225,000	220
	MS-46	Philadelphia	4A		11	11	8		30	39,650	8,957,527	298,584	226
	MS-47	Allegheny	5A		19	13	11		43	41,797	9,558,272	222,285	229
	MS-48	Philadelphia	4A		46	4			50	48,315	11,197,257	223,945	232
	MS-49	Philadelphia	4A		60				60	57,672	13,556,215	225,937	235
	MS-50	Philadelphia	4A		45				45	48,351	11,428,626	253,969	236
	MS-51	Philadelphia	4A		37	10			47	50,527	12,095,152	257,344	239
	MS-52	Philadelphia	4A		32	6	6		44	44,889	10,869,638	247,037	242
	MS-53	Philadelphia	4A		24				24	24,284	6,253,770	260,574	258
	MS-54	Allegheny	5A		30	20			50	37,290	9,905,483	198,110	266
	MS-55	Philadelphia	4A		20	30			50	46,110	12,718,548	254,371	276
	MS-56	Philadelphia	4A		48				48	45,000	14,294,705	297,806	318
	MS-57	Philadelphia	4A		46				46	31,878	11,701,929	254,390	367

**YEAR 3-4 A NATIONAL Net-Zero-Energy Initiative by 2030**  
**2017-18**



# CONSTRUCTION COST OF PROPOSED PROJECTS TO PHFA

2018



**YEAR 3-4** **A NATIONAL Net-Zero-Energy Initiative by 2030**  
**2017-18**





**THE WHITEHALL:** [missionfirsthousing.org](http://missionfirsthousing.org)

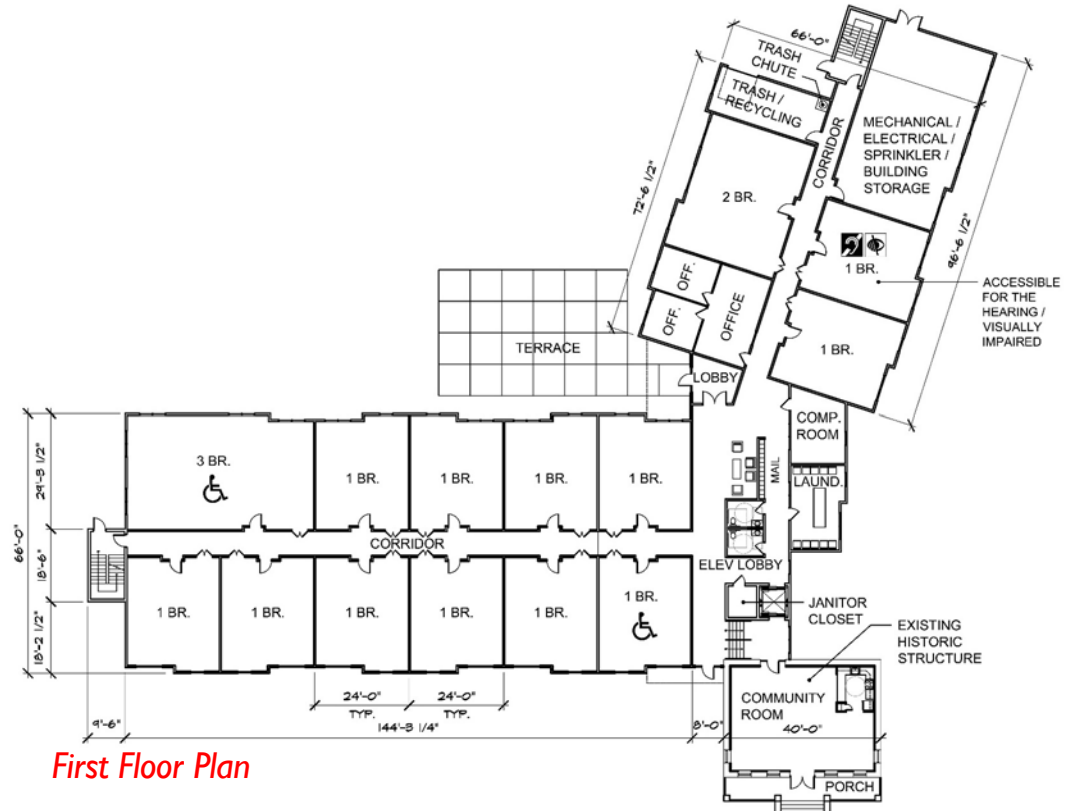
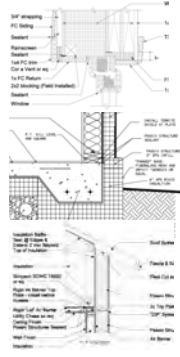
2017

49units of Veteran housing



# 2015 Final Design – 49 Units

- I. Wall:
  - Adam Cohen's BuildSmart panelized wall system
  - 2x6 stud with Dense-Pack Cellulose (R3.8/inch) in cavity, OSB, 3.5" EPS, Zip Panel
  - **TOTAL R33**
  - Windows: Come pre-installed in wall system: Klearwall Future Proof, glass has Uvalue of .11 BTU/hr/ft2, with SHGC of .61 (window muntins reduce SHGC to .57)
2. Slab:
  - Adam Cohen BuildSmart preformed EPS slab/foundation system, thermal bridge free.
  - **TOTAL R26.3**
3. Roof:
  - Roof truss with 18" of Cellulose
  - ZIP panel as Air Barrier underside of truss to be fully taped at joints and to Zip panel at wall.
  - A service cavity below the Air barrier with Chicago grid will allow for lighting, wiring sprinklers, etc without puncturing the Air Barrier
  - **TOTAL: R50**
4. Domestic Hot water:
  - State 50 gallon Heat Pump Water Heater (HPWH) with a COP of 2.75, one per unit
5. Ventilation:
  - Three Ultimate Aire 2000DX ERV centralized and ducted system for all of the 49 apartments and corridors, ancillary areas and Community Room. The ERV should be located in attic space.
  - Addressed discrepancy between PH and Energy Star with respect to Sach requirement by ducting the kitchen hood directly to outside with magnetic damper. Flow rates for units:
    - 1 bdrm units: 47 cfm
    - 2 bdrm units: 71 cfm
    - 3 bdrm units: 83 cfm
6. Heating/Cooling:
  - Fujitsu ducted mini-splits within each apartment with ganged condensers at grade. They have an HSPF between 12.2-11.5 BTU/h/W and a SEER of 19.7-21.5 depending on size of units.
7. Laundry
  - 5 commercial washers and dryers in common laundry room
  - Gas dryers vented to outside with magnetic dampers and gas DHW dedicated in room.
8. Construction costs: Not sure right now but originally at \$148sf
9. CHALLENGES
  - shifting from decentralized Zehnder units, one per unit, to centralized US manufacturer. Took hit in performance.
  - Shift to BuildSmart wall/foundation system but I think good move for overall coordination. Taking risk, however, because this has not been tested.

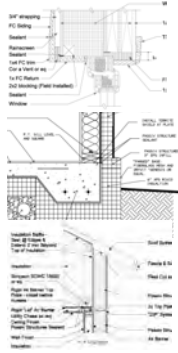


First Floor Plan

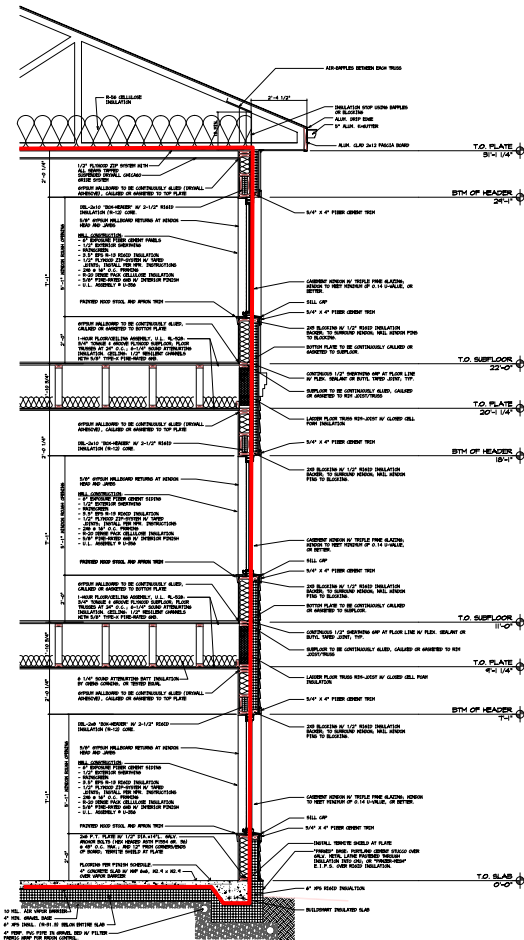


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Typ Wall Section







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2017

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2017

49units of Veteran housing



*PRE-DRYWALL BLOWER DOOR TEST*  
*September 26, 2016*

**.5 ACH50**





FINAL DRYWALL BLOWER DOOR TEST  
April 17, 2017

**.42 ACH50**





# The Whitehall Utility Cost Comparison

	1 BR	2 BR	3 BR
Housing Authority Allowances	\$103.00	\$138.00	\$169.00
Calculated Passive House	\$42.37	\$60.45	\$80.97





# Impact of Utility Costs on Operating Budget

	Housing Authority Allowances	Calculated Passive House
TTP For All Units	\$545,748	\$545,748
Less Utilities	\$64,548	\$27,372
Rent	\$481,200	\$518,376
Operating Costs	\$382,084	\$382,084 *
Net Income	\$99,116	\$136,292



**CHIP: “\*Understates the case: operating costs include common area utilities, which are lower in Passive House construction than in traditional construction. So the operating costs in the Housing Authority scenario would be higher, meaning that the actual difference in Net Income is higher than shown”**



# Impact of Utility Costs on Operating Budget

	Housing Authority Allowances	Calculated Passive House
Net Operating Income	\$99,116	\$136,292
Debt Coverage Ratio*	1.8	1.8
Payment (NOI/DCR)	\$55,064	\$75,718
Max Mortgage (30 yrs @ 5.5%)	\$800,000	\$1,100,000
*1.07 in Year 15		



**CHIP: "Passive House lets you borrow/leverage more money to build more housing."**



# Impact of Utility Costs on Operating Budget

	Housing Authority Allowances	Calculated Passive House
Total Development Cost	\$12,750,000	\$12,750,000
LIHTC Equity	\$11,000,000	\$11,000,000
Soft Debt/Grants	\$450,000	\$450,000
<b>Mortgage</b>	<b>\$800,000</b>	<b>\$1,100,000</b>
Total	\$12,250,000	\$12,550,000
Deferred Fee Required	\$500,000	\$200,000
Gross Fee	\$1,500,000	\$1,500,000
<b>Net Fee</b>	<b>\$1,000,000</b>	<b>\$1,300,000</b>



**CHIP: “We’re a nonprofit, which means we don’t put the net fee in our pockets. We put that money into new developments. Higher net fees mean we can house more people.”**





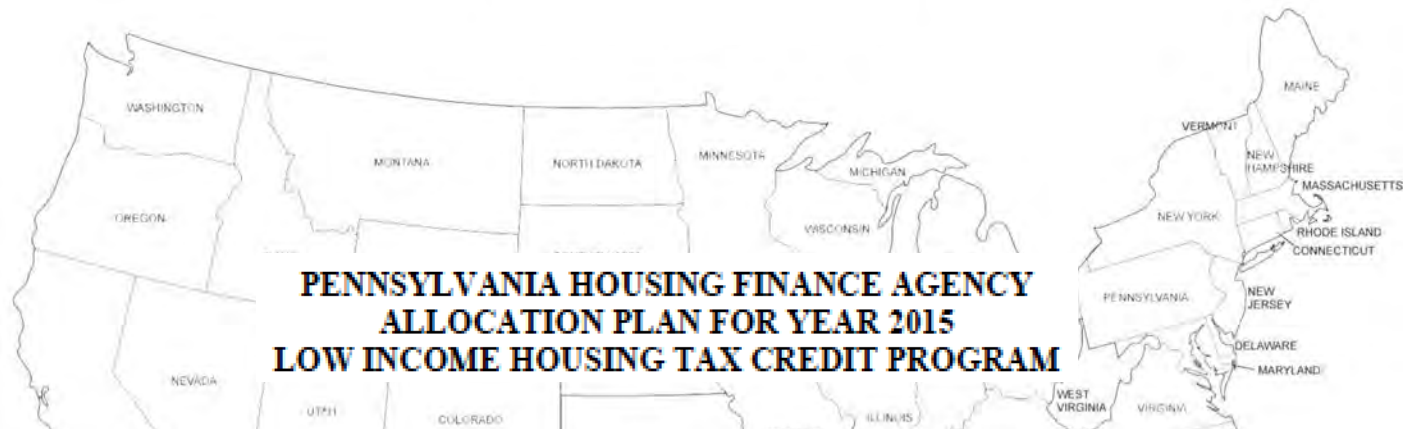
*Opening Day  
June 14, 2017*

**THE WHITEHALL:** [missionfirsthousing.org](http://missionfirsthousing.org)

2017

49 units of Veteran housing

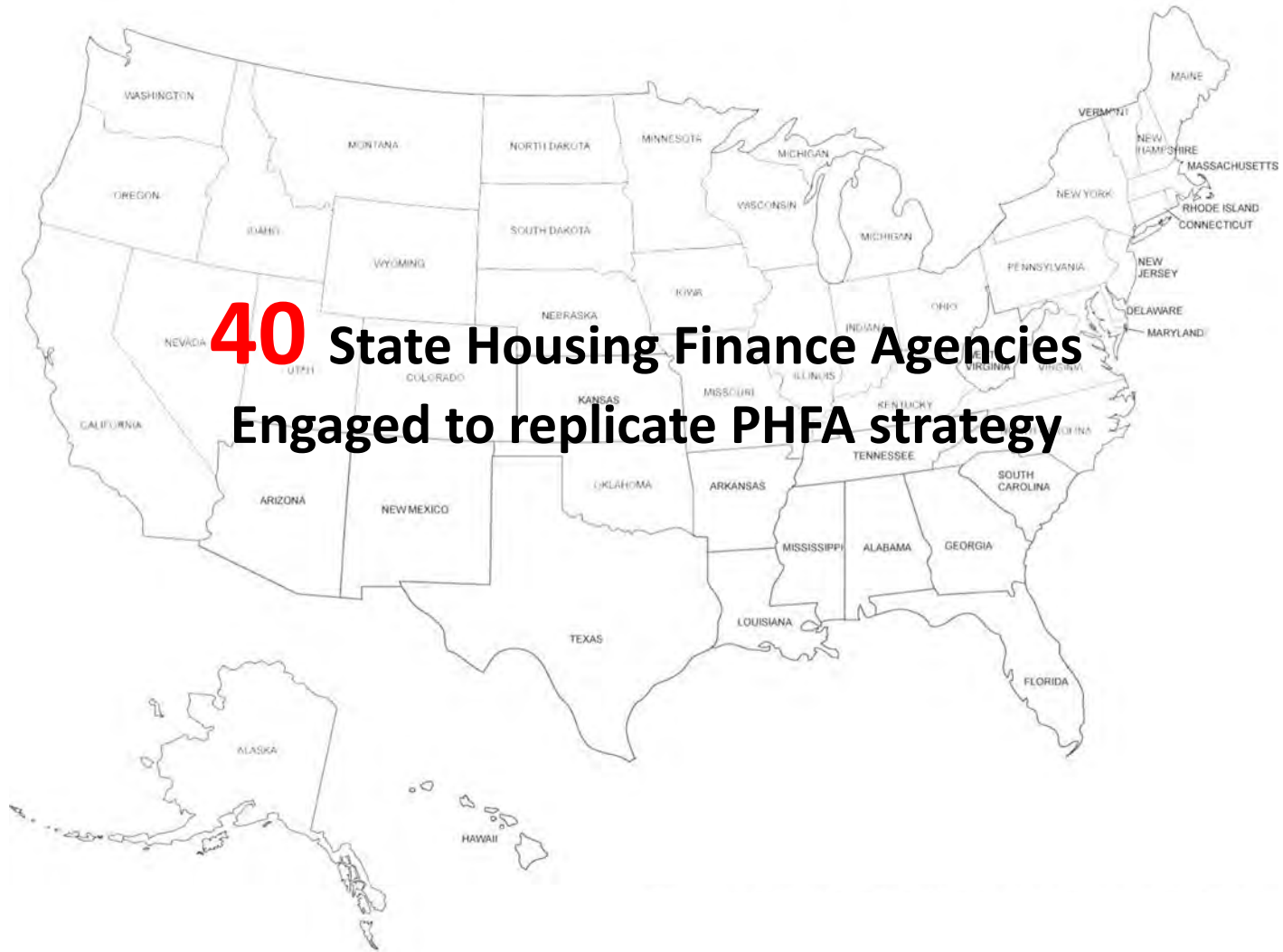




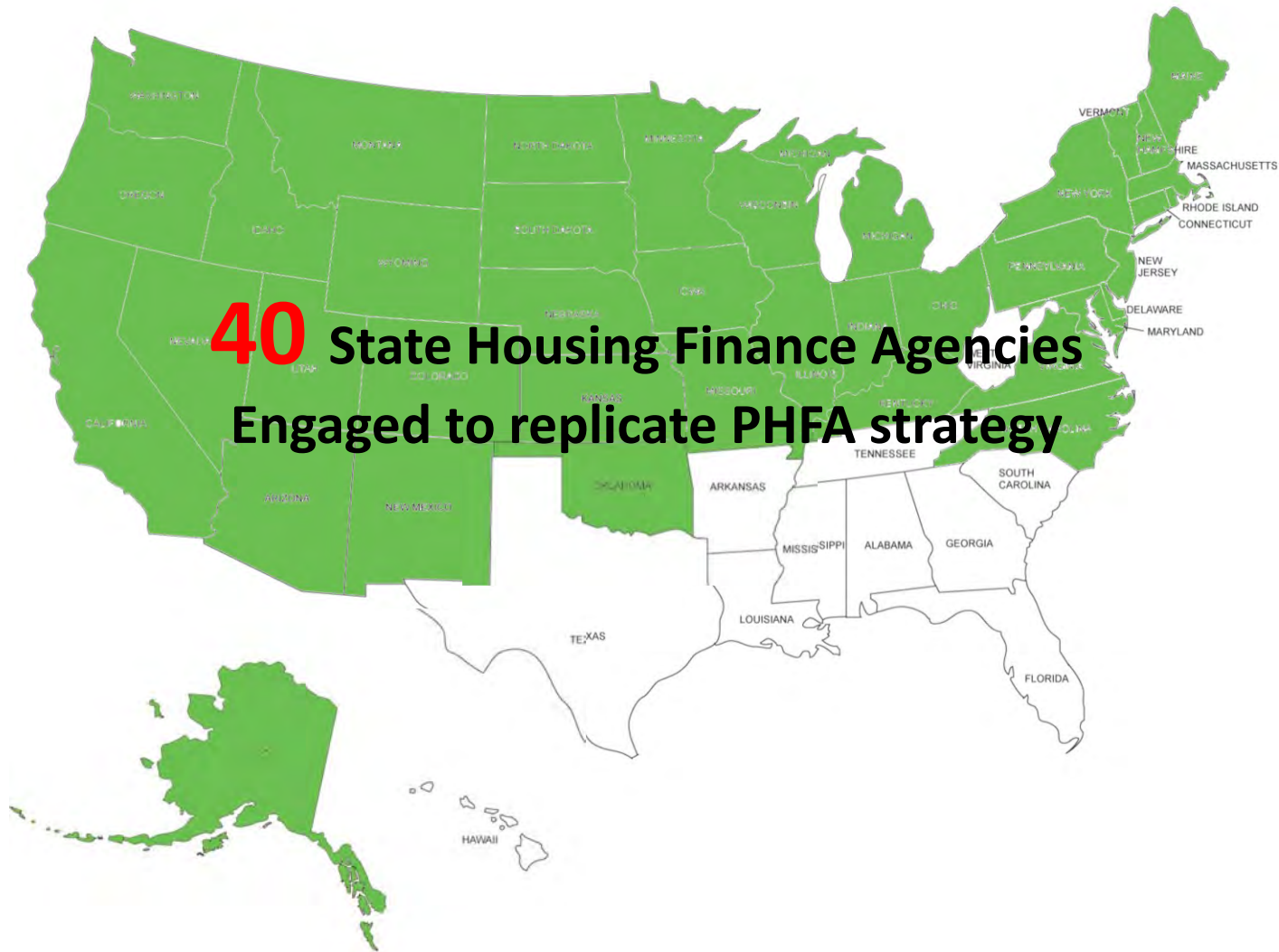
- **Energy Efficiency Goals – 10 points may be awarded to those developments which meet Passive House Certification (nationally or internationally) for energy efficiency. (See Multifamily Housing Application and Guidelines and [www.passivehouse.us](http://www.passivehouse.us) or <http://passiv.de/en/> for additional guidance.)**

















PENNSYLVANIA

NEW YORK



# 18 COMMITTED



**NEW HAMPSHIRE:** *Gilford Village Knolls*



**SOUTH DAKOTA:** *Student Passive House Project and Copper Pass Apartments*



**OHIO:** *Fairwood Commons*



**NYC:** *The House at Cornell Tech, Knickerbocker Commons, Sendero Verde*



11 Crown St.

Residential - Single Family



Columbus Commons

Family - Multi, Portfolio, Residential - Single Family, Retail



## Sustainability Design Measures: New Construction

*Benchmarking with EPA's Energy Star Portfolio Manager is a prerequisite for all Sustainability points*

### Energy Conservation

Prerequisites:

- DOE Zero Energy Ready Home Certification
- Balanced ventilation

Criteria	Points
<b>Tier 1</b> Average HERS Index $\leq 50$ ; OR Average % below ENERGY STAR Target Index $\geq 15\%$	2
<b>Tier 2</b> Average HERS Index $\leq 46$ ; OR Average % below ENERGY STAR Target Index $\geq 25\%$	3
<b>Tier 3</b> Average HERS Index $\leq 42$ ; OR Average % below ENERGY STAR Target Index $\geq 35\%$ ; OR Passive House; OR International Living Future Institute (ILFI) Zero Energy Ready	4



**WASHINGTON**

**OREGON**

**NEVADA**

**UTAH**

**MINNESOTA**

**IOWA**

**MISSOURI**

**OKLAHOMA**

**WISCONSIN**

**MICHIGAN**

**INDIANA**

**KENTUCKY**

**MAINE**

**ALASKA**

**....14 ON THEIR WAY!!**





WASHINGTON

OREGON

NEVADA

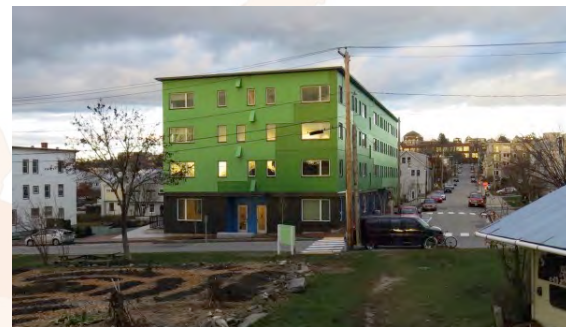
....14 ON THEIR WAY!!



**Vermont: Elm Place**



**Oregon: The Orchards at Orenco**



**Maine: Bayside Anchor Passive House  
Village Centre Passive House**



**Minnesota: West Side Flats**



**Missouri: Second and Delaware, Kansas City**





GREEN  
BUILDING  
UNITED



★ Worth 5 Phius & 6 AIA CEUs

# New Gravity Housing Conference 2022



# **AFFORDABLE HOUSING**



# AFFORDABLE HOUSING



*Architects, Engineers, Builders*



**AFFORDABLE HOUSING**



*Architects, Engineers, Builders*



**MARKET-RATE HOUSING**



*Catalyst for radical and significant transformation of the  
HOUSING INDUSTRY.....*

**AFFORDABLE HOUSING**



*Architects, Engineers, Builders*



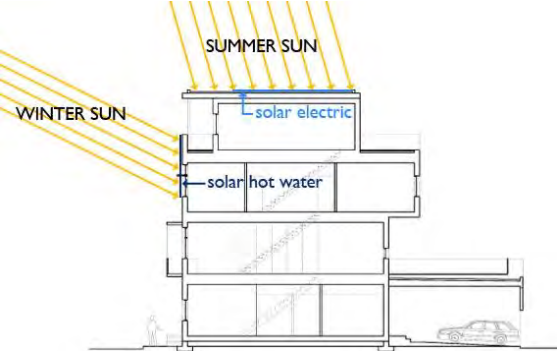
**MARKET-RATE HOUSING**





*STABLE FLATS 2015: 26 townhomes*

































FINAL AIRFLOW

**.49 ACH 50**



ENERGY/BUILDING CONSULTANTS & ENGINEERS

One Crescent Drive • Philadelphia, PA 19112 • 1-888-MAGRANN • www.magrann.com

New Jersey • Pennsylvania • Kentucky • Ohio

#### BUILDING LEAKAGE TEST COMPARISON

Test #1		Test #2	
Test File:	Depressurization File	Test File:	Pressurization File
Date of Test:	7/5/2012	Date of Test:	7/5/2012
Customer:	Onion Flats, LLC 111 West Norris Street Philadelphia, Pennsylvania 19122	Customer:	Onion Flats
Phone:	215-783-5591		

#### Test Results

	Test #1	Test #2	Change	Percent
1. Airflow at 50 Pascals:	293 CFM	201 CFM	-92 CFM	-31.4 %
	<b>0.48 ACH</b>	<b>0.33 ACH</b>	-0.15 ACH	-31.4 %







**\$150.00 sf**

*\* 12 Months of Measured Data*

Address	TFA sf	12 Months kWh Total	PV kWh	NET	COST \$/Yr
235 George	1908	13,088	4172	8916	\$1079 \$90/m
Typical Code Building		40,068	68% BETTER		\$4407 \$367/m





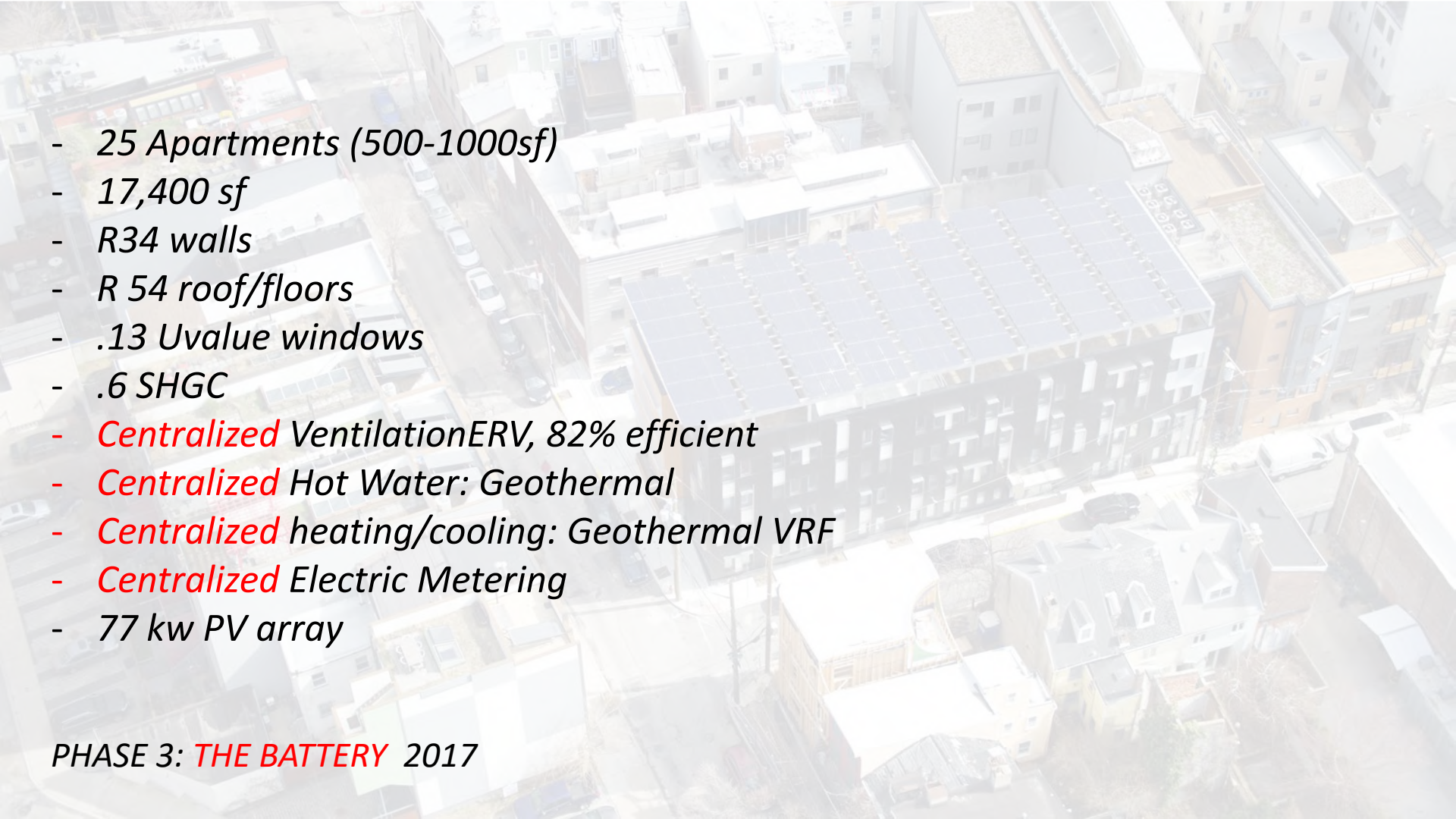
PHASE 1  
**THE FACTORY**  
1999

PHASE 2  
**THIN FLATS**  
2008

PHASE 3  
**THE BATTERY**  
2017

PHASE 3: **THE BATTERY** 2017

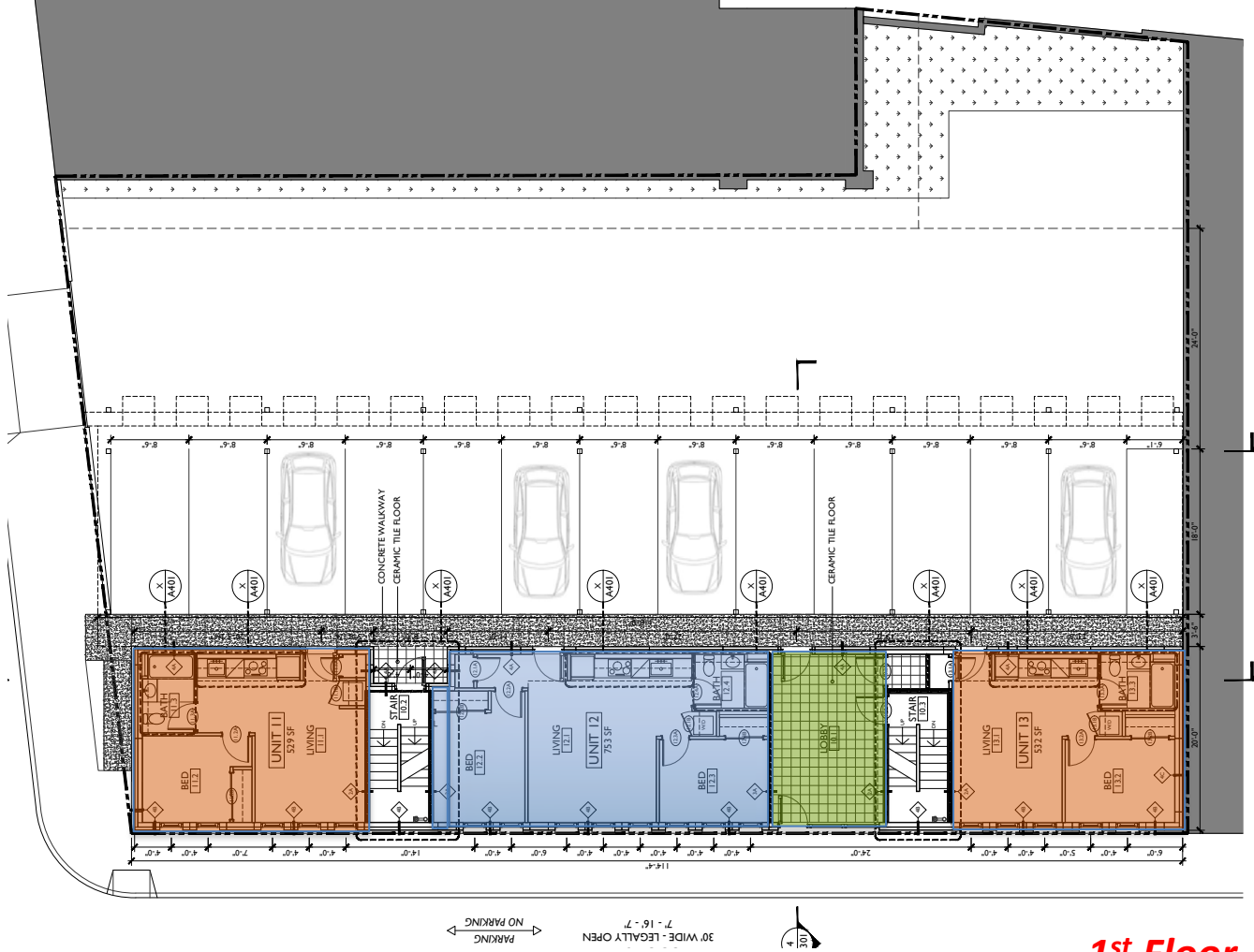


- 
- 25 Apartments (500-1000sf)
  - 17,400 sf
  - R34 walls
  - R 54 roof/floors
  - .13 Uvalue windows
  - .6 SHGC
  - **Centralized** VentilationERV, 82% efficient
  - **Centralized** Hot Water: Geothermal
  - **Centralized** heating/cooling: Geothermal VRF
  - **Centralized** Electric Metering
  - 77 kw PV array

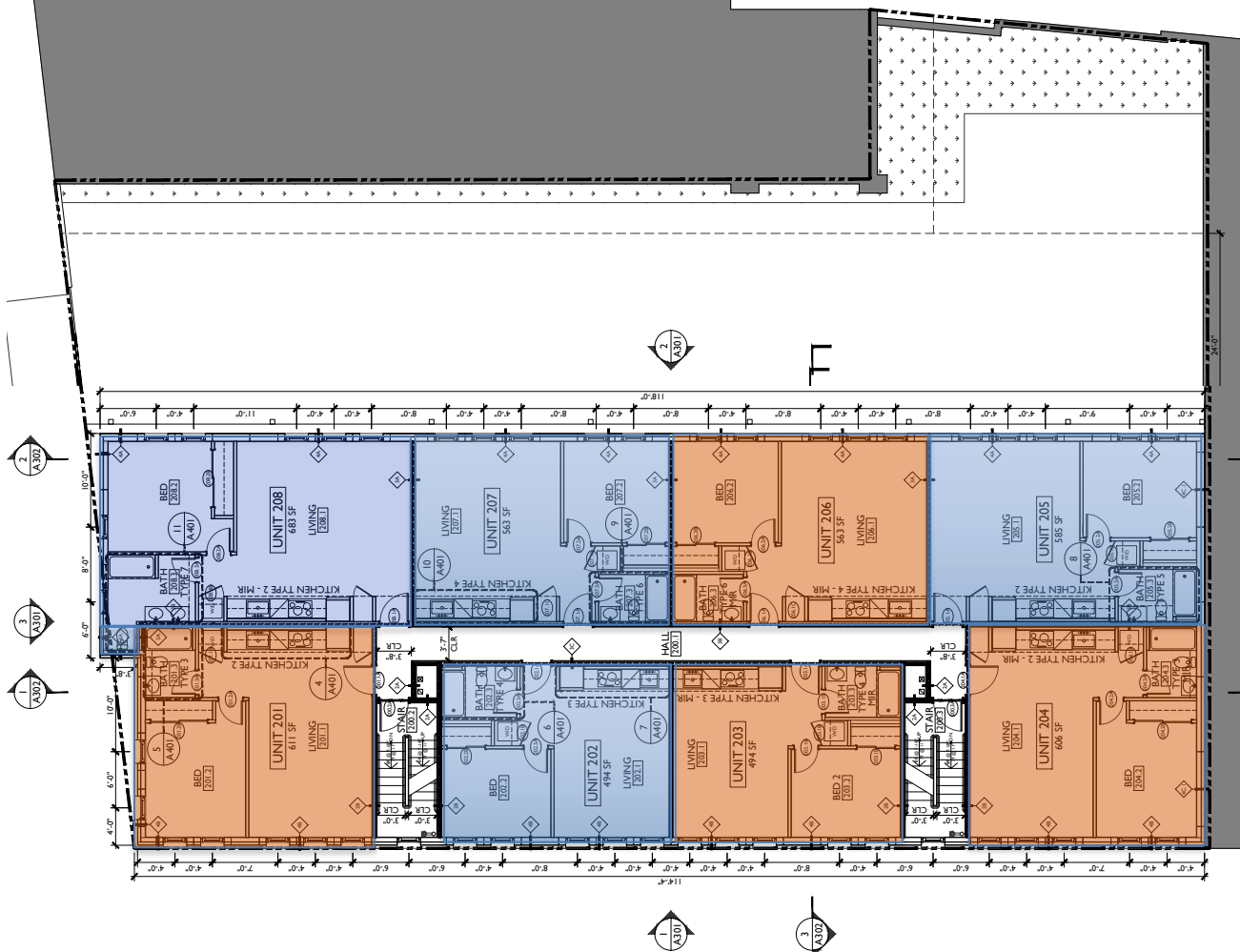
PHASE 3: **THE BATTERY** 2017



# 1<sup>st</sup> Floor







**2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> Floors**

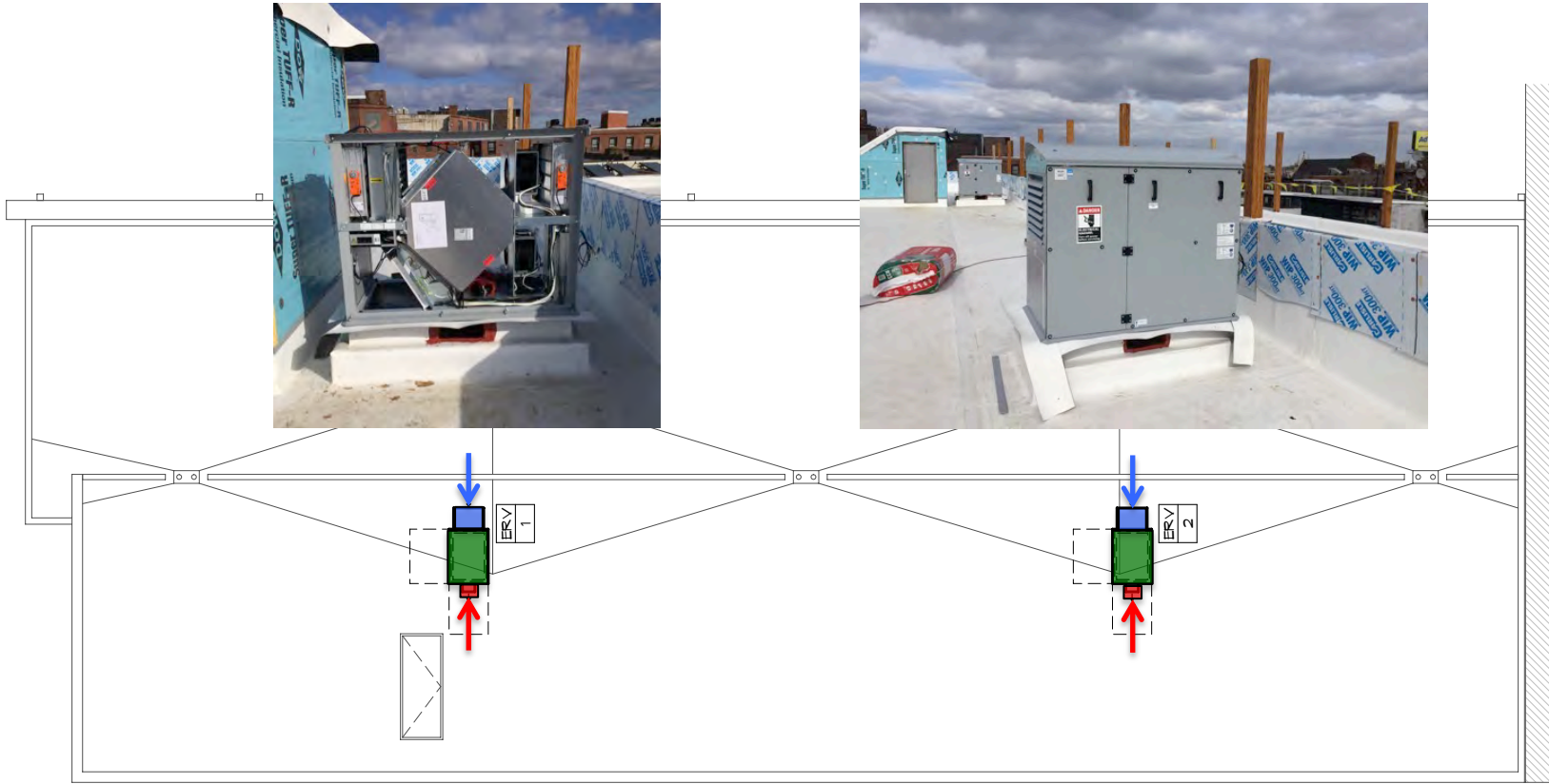






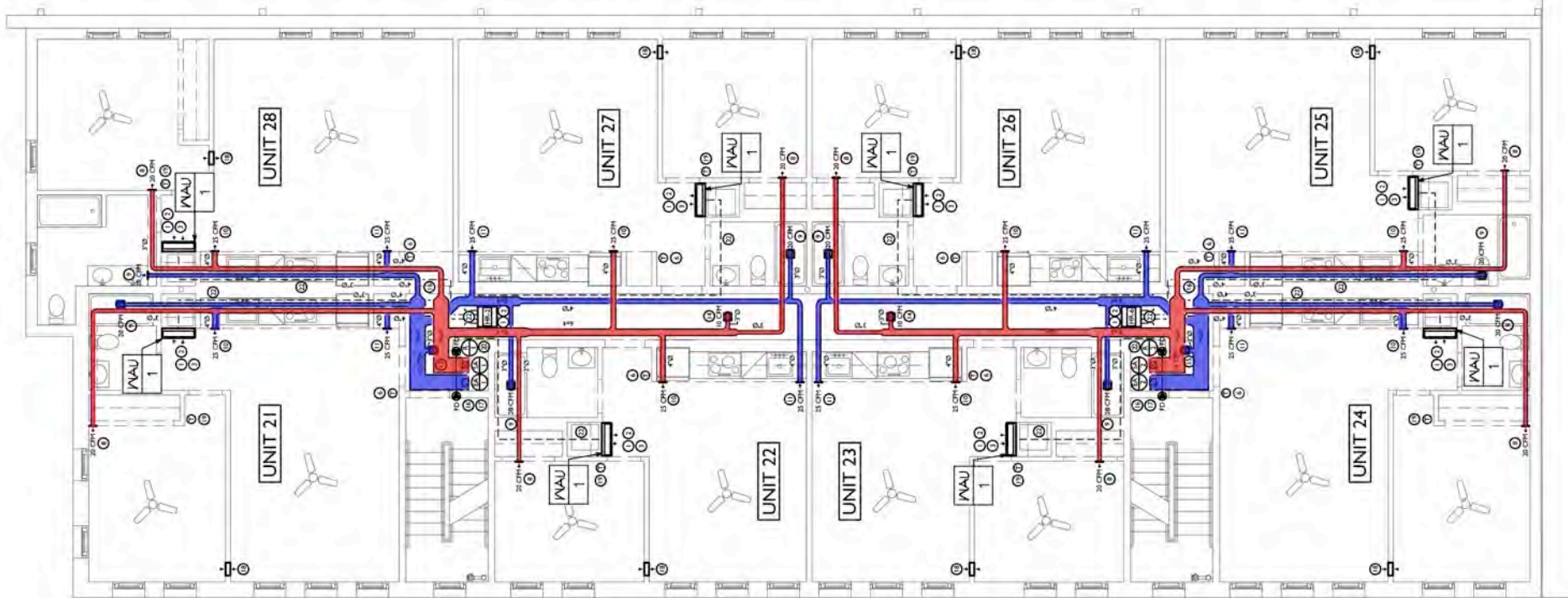






*Balanced/Centralized Ventilation, 2 Ventacuity 2000cfm ERVs*

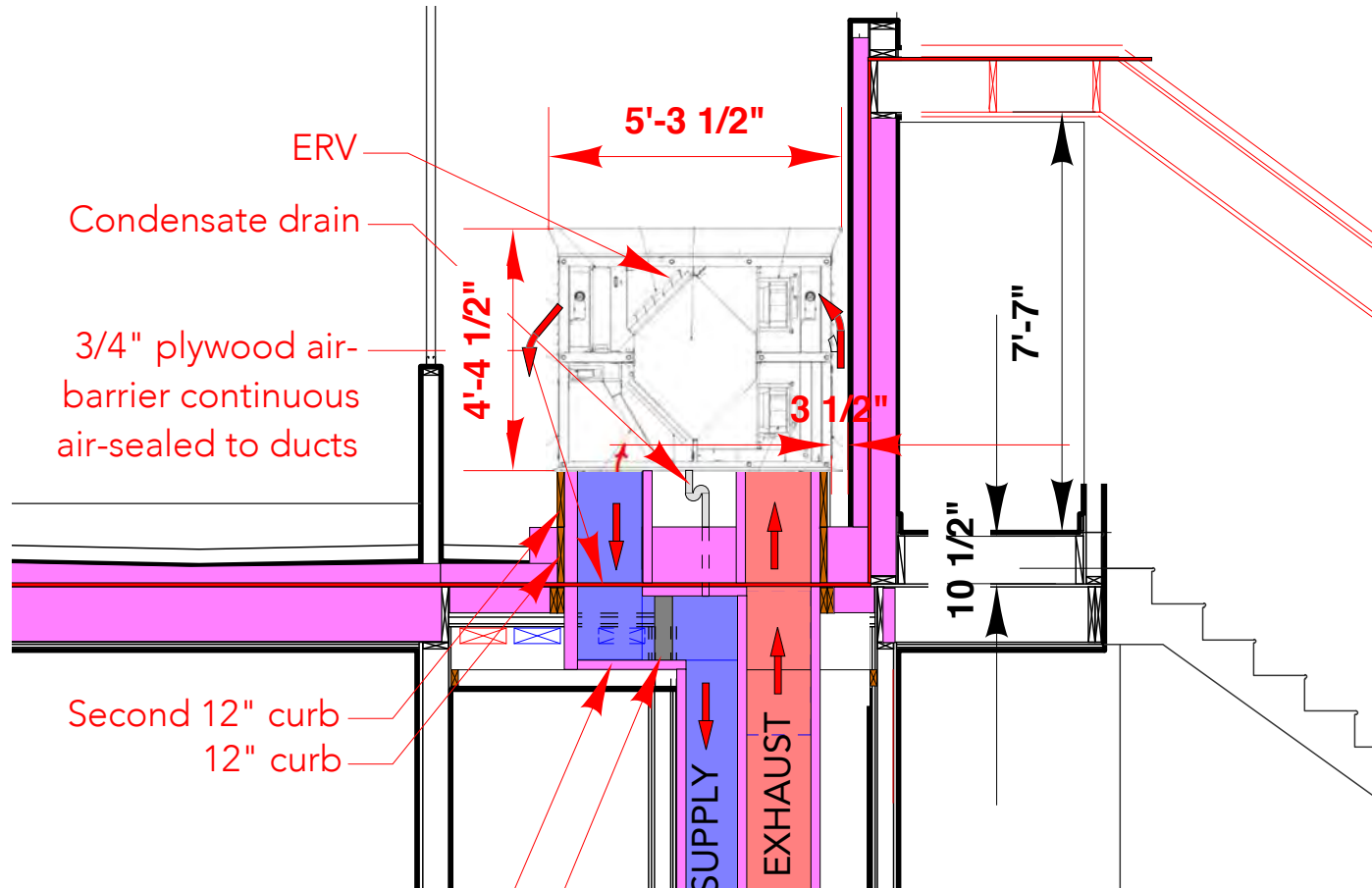




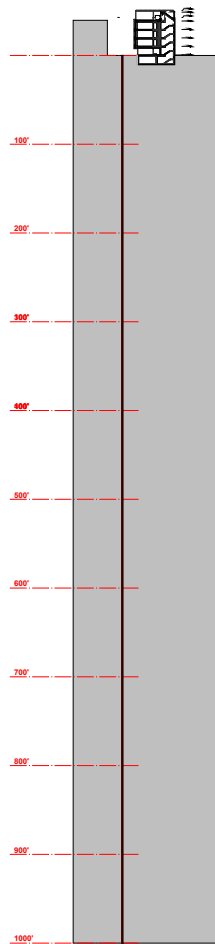
2<sup>nd</sup>-4<sup>th</sup> Floors

Balanced/Centralized Ventilation, 2 Ventacity 2000cfm ERVs

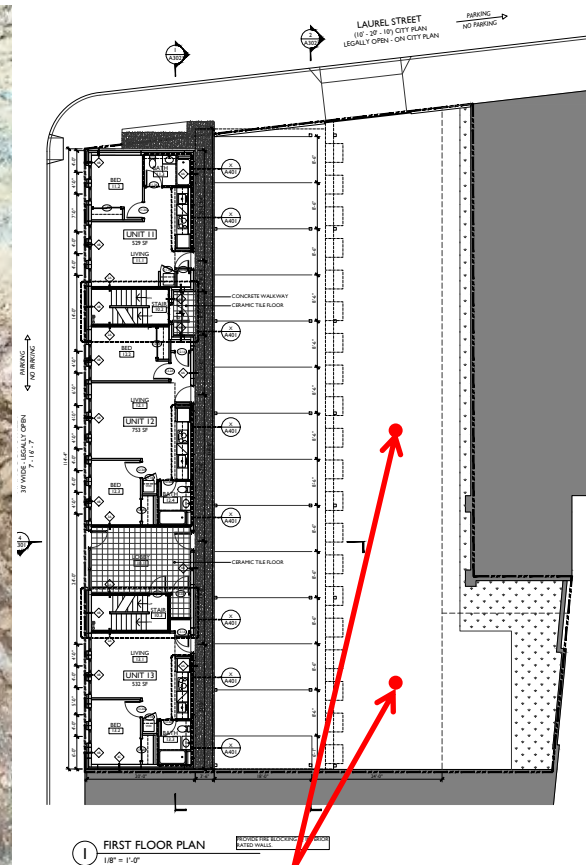








**GEO THERMAL SECTION**

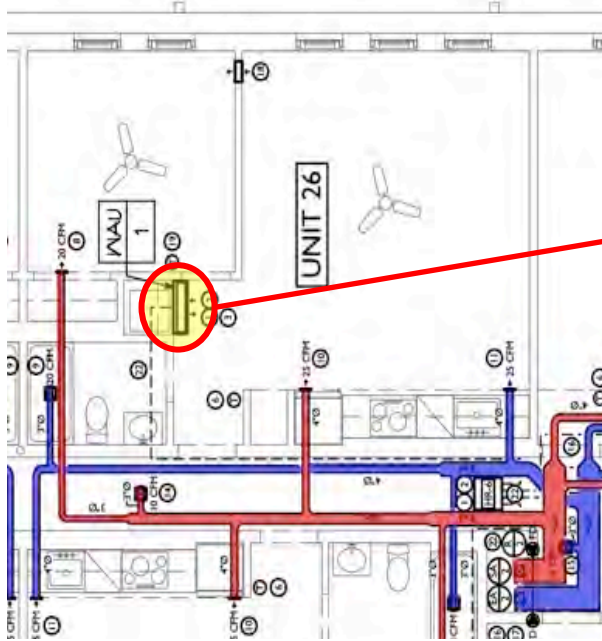


**FIRST FLOOR PLAN**  
1/8" = 1'-0"

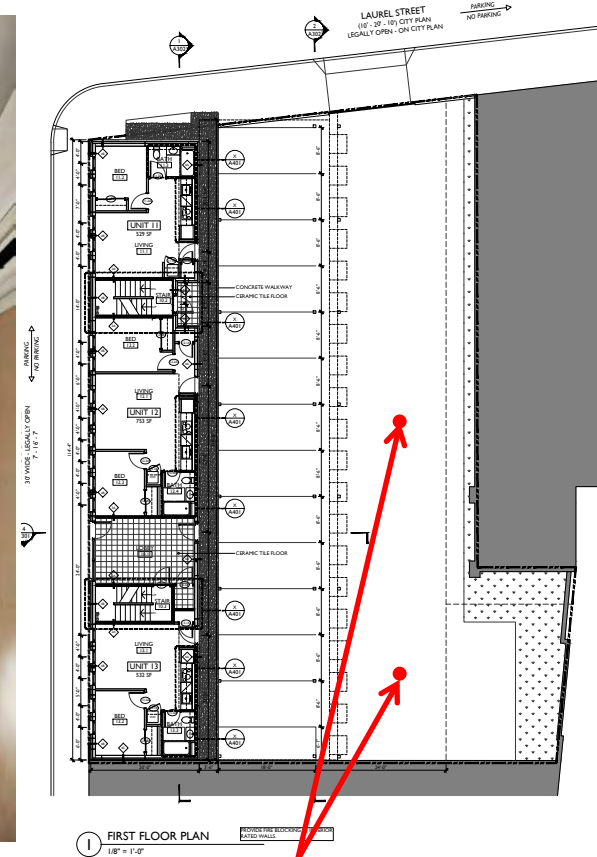
**2 – 1000' deep Standing Column  
Geothermal Wells**  
ALL heating/cooling and domestic hot water for  
ALL 25 apartments



**OPEN TRANSOM TO BEDROOM**



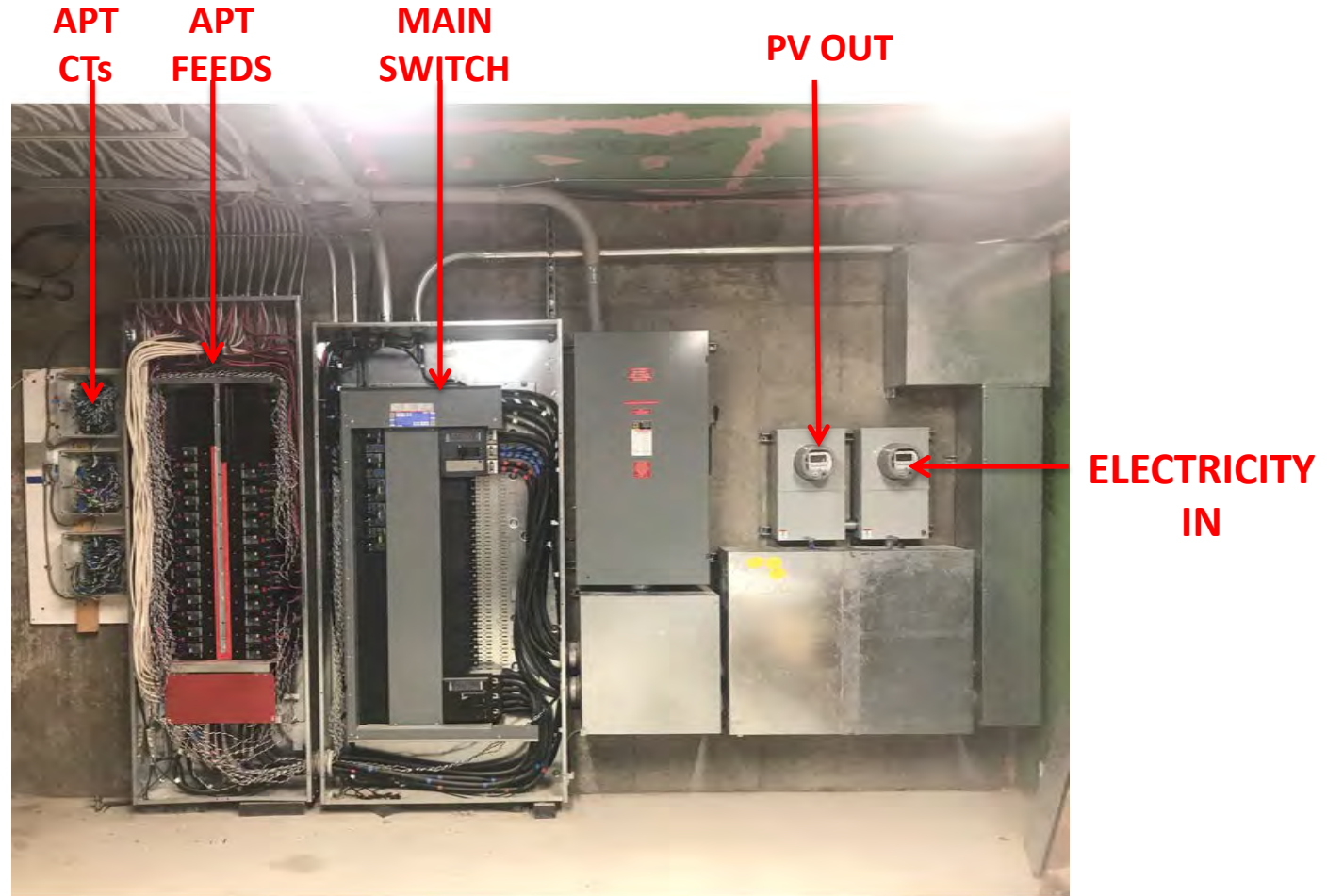
**Ductless Evaporator located next to open transom and intentionally located above laundry for easy connection of condensate drain**



**2 – 1000' deep Standing Column Geothermal Wells**  
**ALL heating/cooling and domestic hot water for ALL 25 apartments**

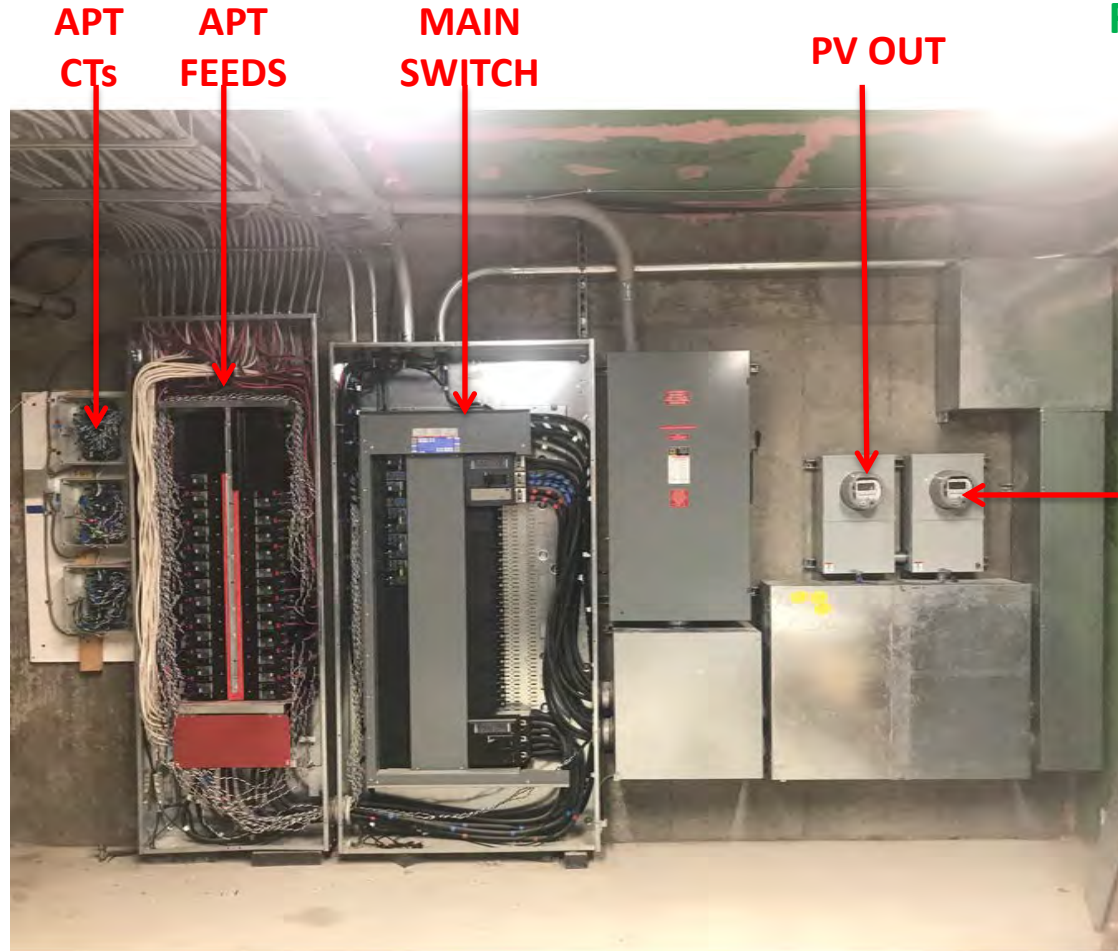


## ***ONE METER: Metering vs Monitoring***





## ONE METER: Metering vs Monitoring



TENANTS CHARGED  
FLAT UTILITY FEE OF  
\$100/month

ELECTRICITY  
IN





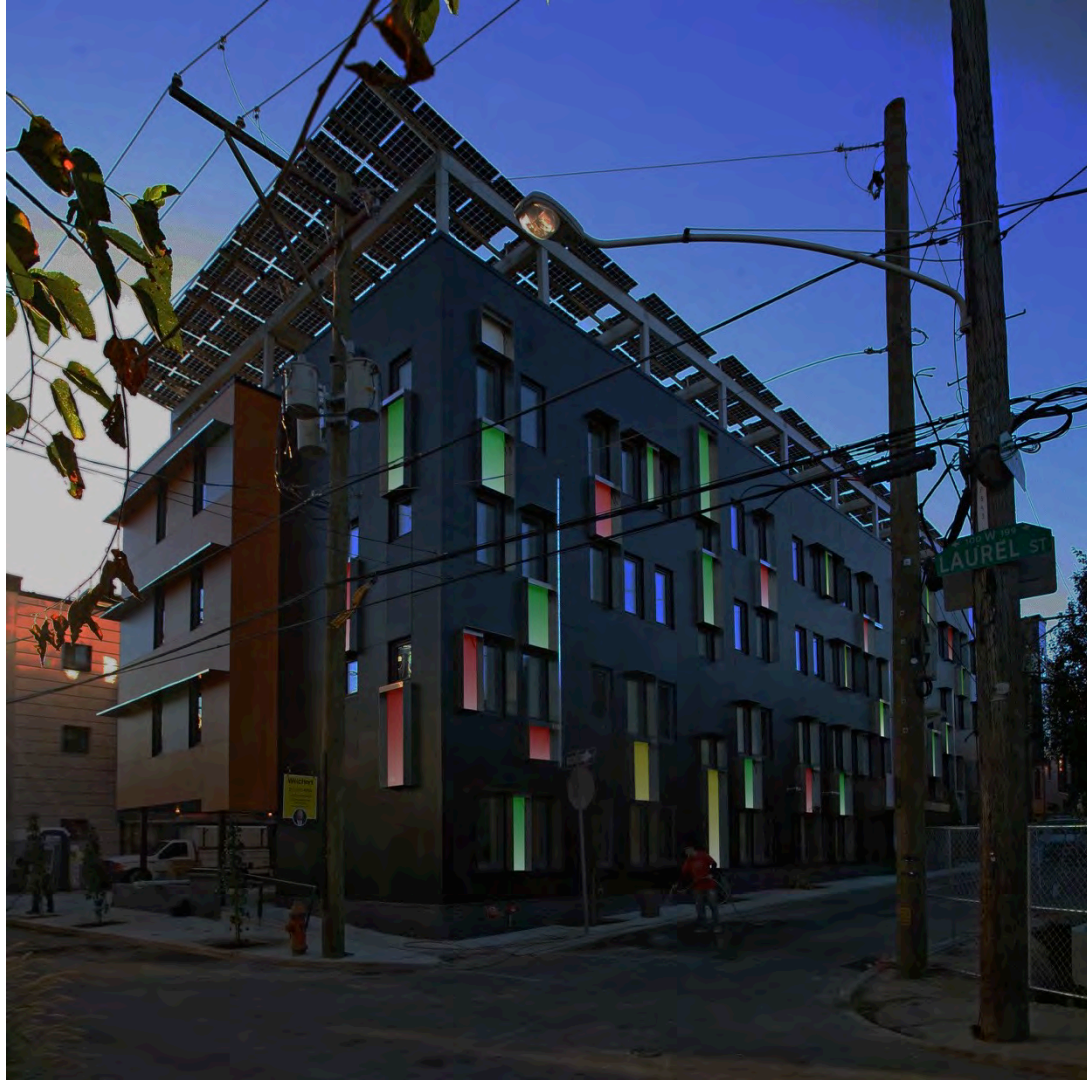
**FINAL BLOWER DOOR TEST**  
**Sept 29, 2017**  
**.53 ACH50**











WHO'S WHO???





#### Onion Flats

PROJECT OWNER

April 10, 2018

DATE

Tim McDonald | Kara Haggerty Wilson

CPHC®

Onion Flats Architecture

ARCHITECT

Onion Flats Construction

CONSTRUCTION

Neil Goldman

ON-SITE VERIFICATION

## The Passive House Institute US Awards

The Designation of

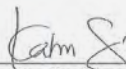
### PHIUS+ 2015 CERTIFIED PROJECT

No. 1414

## Capital Flats II

152-158 W. Laurel Street  
Philadelphia, PA 19123

• INTERIOR CONDITIONED FLOOR AREA	16,782	ft <sup>2</sup>
• ANNUAL HEATING DEMAND	3.0	kBTU/ft <sup>2</sup> ·yr
• ANNUAL COOLING DEMAND	6.2	kBTU/ft <sup>2</sup> ·yr
• PEAK HEATING LOAD	3.3	BTU/ft <sup>2</sup> ·hr
• PEAK COOLING LOAD	2.8	BTU/ft <sup>2</sup> ·hr
• AIR-TIGHTNESS TEST RESULTS	0.05	CFM50/ft <sup>2</sup>
• SOURCE ENERGY	4,768	kWh/person·yr
• SITE ENERGY USE INDEX (EUI)	17.0	kBTU/ft <sup>2</sup> ·yr

  
Executive Director



Passive House Institute US





**\$169/sf**













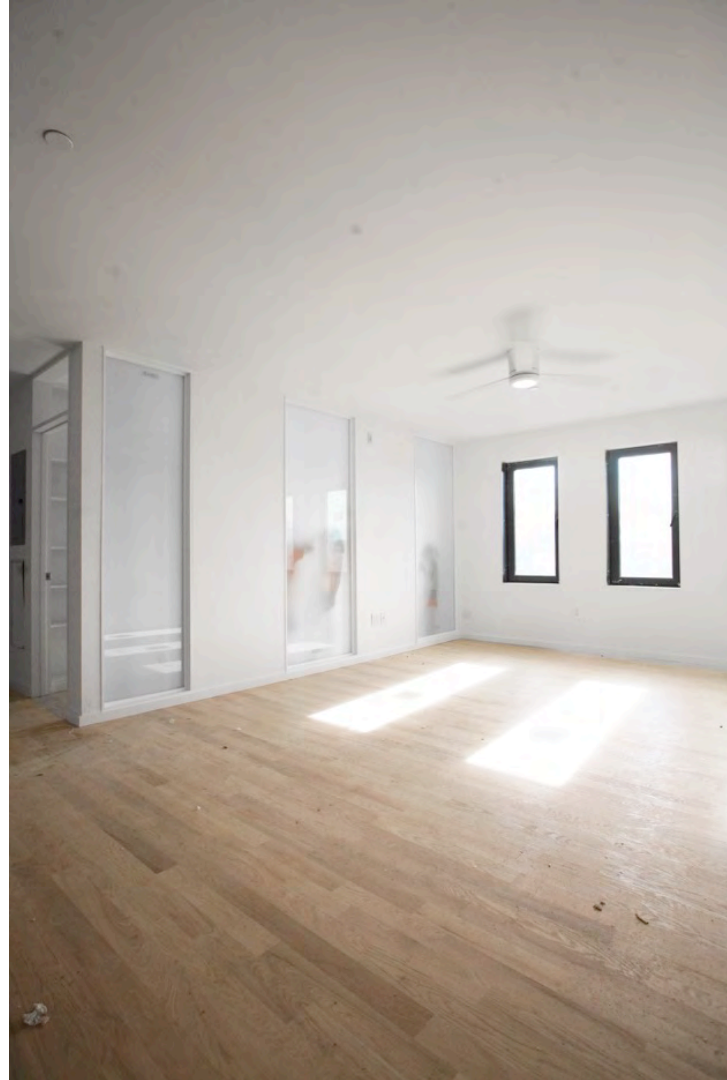
















Home



Building Electricity



Apartment Energy

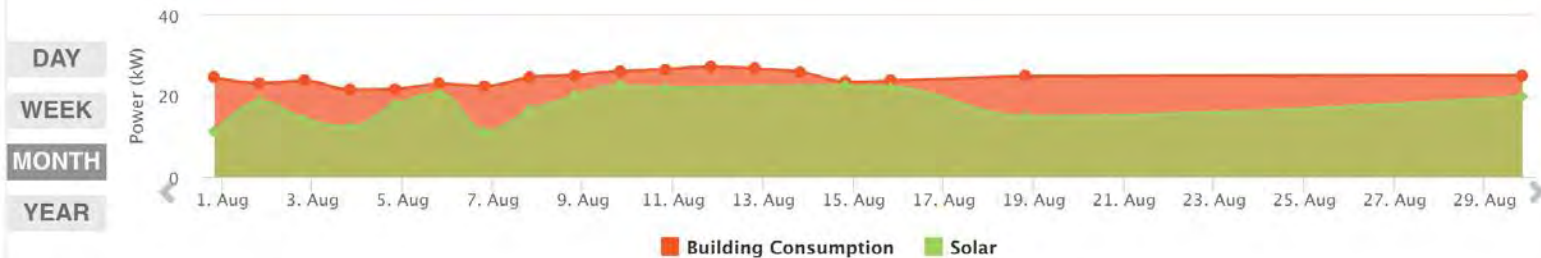
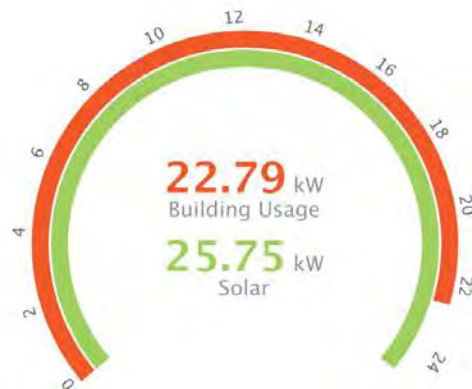


DHW



Data

## Summary

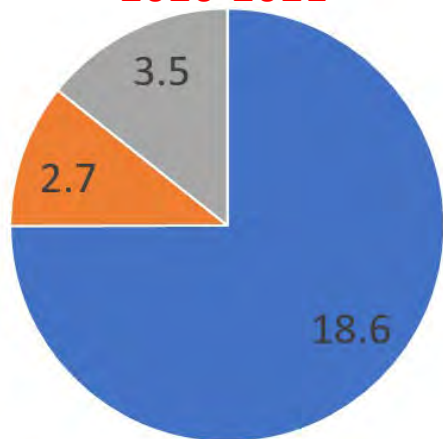






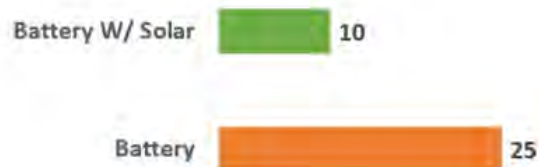
### Battery End Use

2020-2021



- Total Baseload Site Energy
- Total Heating Site Energy
- Total Cooling Site Energy

### EUI: Site Energy Use Intensity Comparison (kBtu/SF)

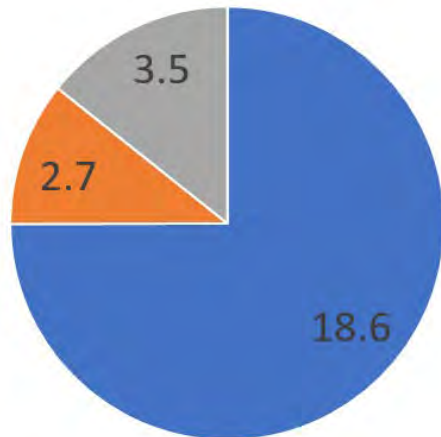






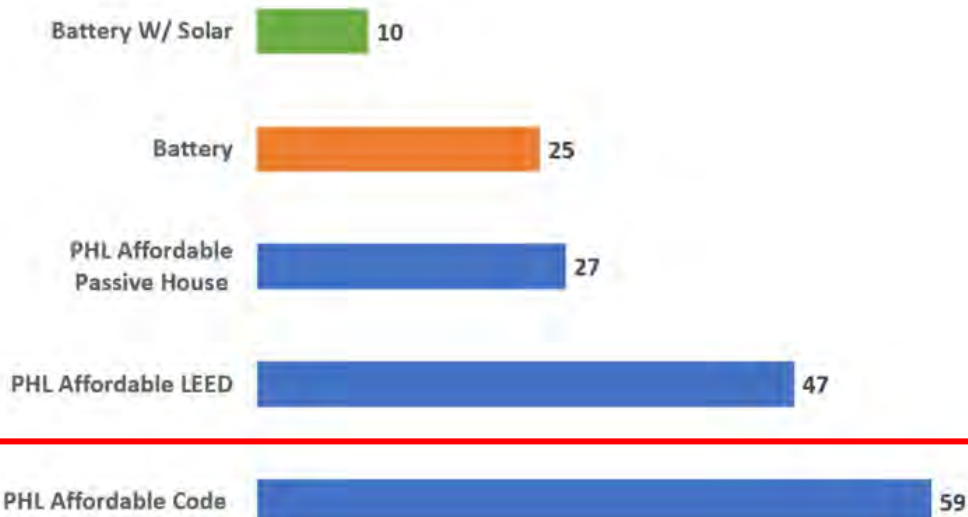
### Battery End Use

2020-2021



- Total Baseload Site Energy
- Total Heating Site Energy
- Total Cooling Site Energy

### EUI: Site Energy Use Intensity Comparison (kBtu/SF)



83% BETTER THAN CODE BLDG



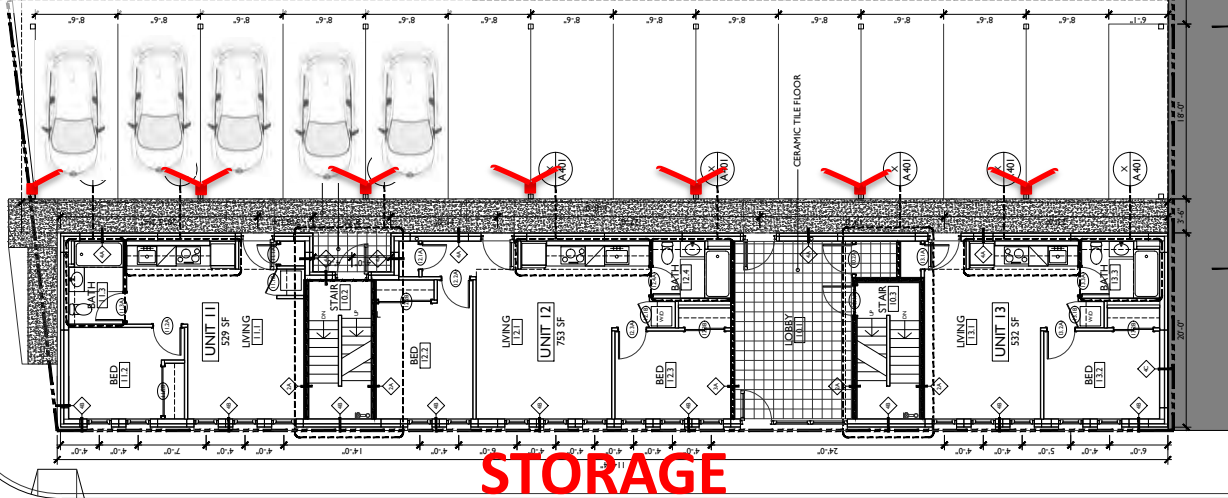
40 kWh batteries  
13 Cars  
520 kWh TOTAL STORAGE

**REDUCED DEMAND CHARGE AND OFF-GRID**

1. No need to own a car (car as appliance)
2. Building charges car
3. Car charges building
4. Car sharing income stream



BI-DIRECTIONAL  
CHARGER



**STORAGE**

NO PARKING  
PARKING

30' WIDE - LEGALLY OPEN  
7' - 16' - 7'





FRONT FLATS



FRONT FLATS 2020: 28 units and Office



- 28 Apartments (300-500sf)
- 24,141 sf
- R34 walls, panelized system
- R 54 roof/floors
- *DE-Centralized* VentilationERV
- *DE-Centralized* heating/cooling
- *SEMI-Centralized* Hot Water
- *Centralized* Electric Metering
- 174 kw PV array

*FRONT FLATS 2020: 28 units and Office*





- 28 Apartments (300-500sf)
- 24,141 sf
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*FRONT FLATS 2020: 28 units and Office*



















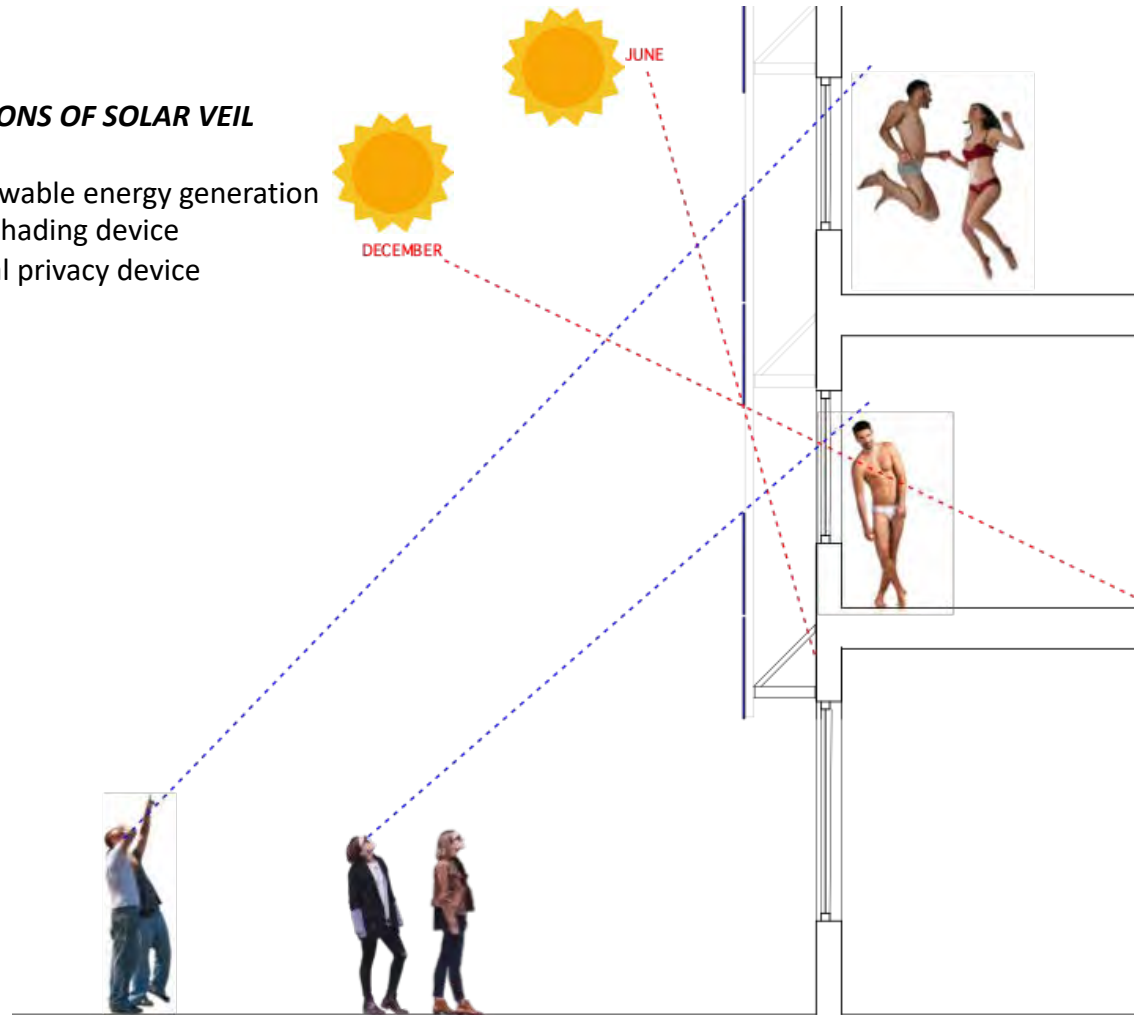






## ***FUNCTIONS OF SOLAR VEIL***

- Renewable energy generation
- Sun shading device
- Visual privacy device







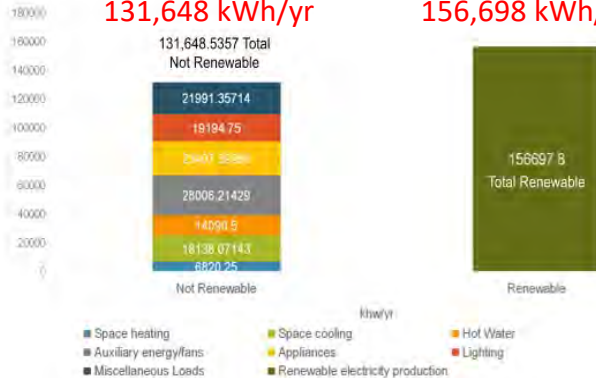


Project name	Front Flats - Residential Only
Climate	Philadelphia International AP
Type	Residential
Interior conditioned floor area	15,588.9 ft <sup>2</sup>
Number of units	28
Occupants	50
Source energy use	723,022.7 kBtu/yr
Specific source energy use	46.4 kBtu/ft <sup>2</sup> ·yr
Source energy use	211,917.9 kWh/yr
Source energy use per person	4,238 kWh/Person yr
Net source energy use (with 100% renewables)	-824,970.6 kBtu/yr
Specific net source energy use (with 100% renewables)	-52.9 kBtu/ft <sup>2</sup> ·yr
Net source energy use (with 100% renewables)	-241,798.9 kWh/yr
Specific source energy use per person (with 100% renewables)	-4,836 kWh/Person yr

PHIUS+ Source Zero **YES**

**CONSUMPTION**  
131,648 kWh/yr

**PRODUCTION**  
156,698 kWh/yr



**PROJECTED 20% MORE THAN NEEDED**





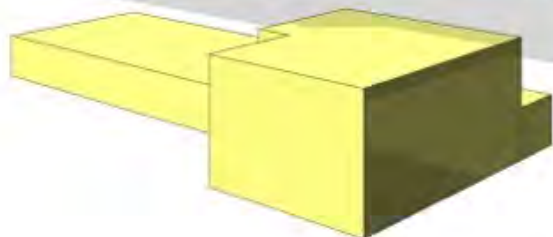
SOLAR  
PRODUCTION  
**165,260kWh/yr**

PROJECTED  
156,698 kWh/yr



RESIDENTIAL  
CONSUMPTION  
**138,501 kWh/yr**

PROJECTED  
131,648 kWh/yr



OFFICE/STORAGE  
CONSUMPTION  
**30,402 kWh/yr**

TOTAL BUILDING  
CONSUMPTION  
**168,904 kWh/yr**

NET *POSITIVE*  
RESIDENTIAL  
ENERGY PRODUCTION  
**26, 758 kWh/yr**

PROJECTED  
25,050 kWh/yr

## MONITORED ACTUAL 2020 CONSUMPTION/PRODUCTION

2020 Month	Solar Generation kWh	Total Building Usage kWh
Jan	12,207	9,819
Feb	11,346	9,106
Mar	15,290	9,412
Apr	14,797	9,124
May	15,290	10,065
Jun	18,708	17,237
Jul	16,156	21,471
Aug	13,866	21,706
Sep	15,411	17,411
Oct	12,262	15,399
Nov	11,749	14,593
Dec	8,177	13,562
Total	165,260	168,904





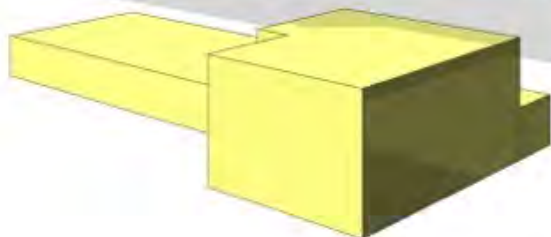
SOLAR  
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**138,501 kWh/yr**

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**168,904 kWh/yr**

NET *POSITIVE*  
RESIDENTIAL  
ENERGY PRODUCTION  
**26, 758 kWh/yr**

PROJECTED  
25,050 kWh/yr

## UTILITIES AS REVENUE

\$100/month x 28 x 12 =

**\$33,600.00**

26,758 kWh x \$.17=

**\$4548.00**

**\$38,148.00**

**ADDITIONAL REVENUE**





PANELIZATION



**\*NOTE:**

*Tenants are charged  
a flat fee of \$100/month  
for all utilities*



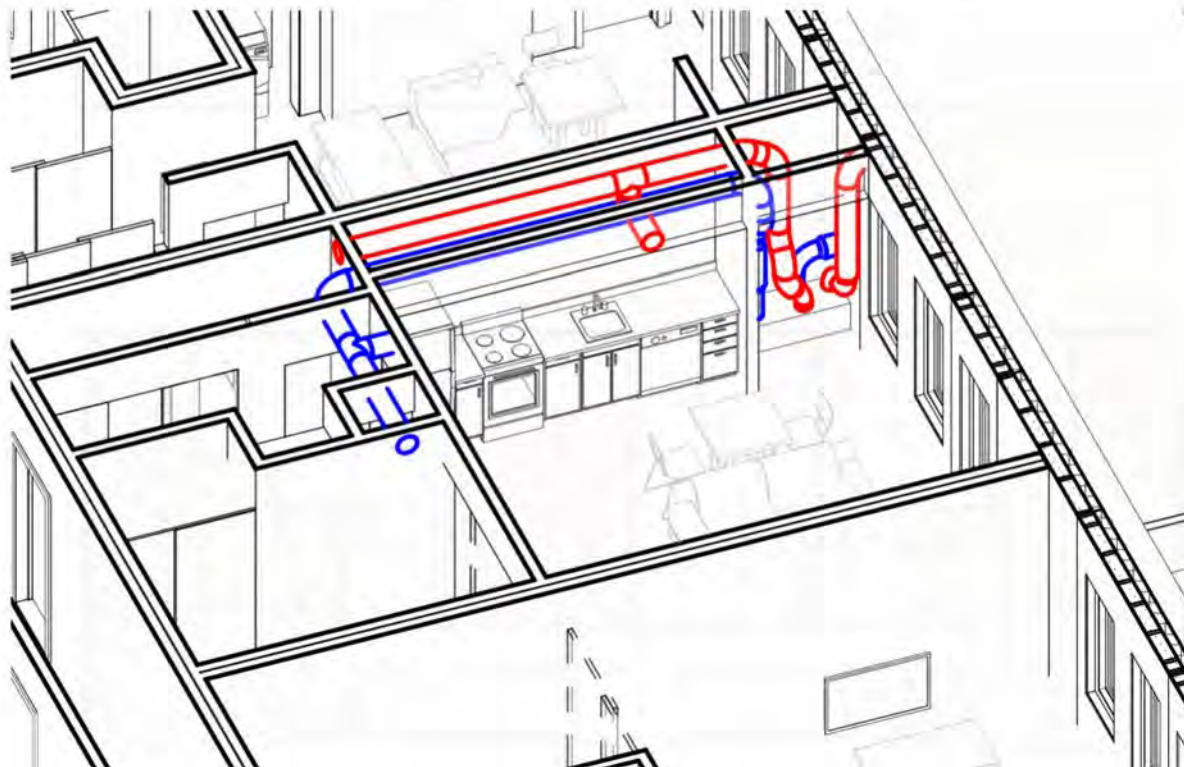
ONE METER: Metering vs Monitoring





## HEATING, COOLING, VENTILATION, DEHUMIDIFICATION MINOTAIR

- Decentralized
- Combination ERV, heating, cooling
- Condenser self-contained
- No separate HVAC needed for hallways



HVAC strategy



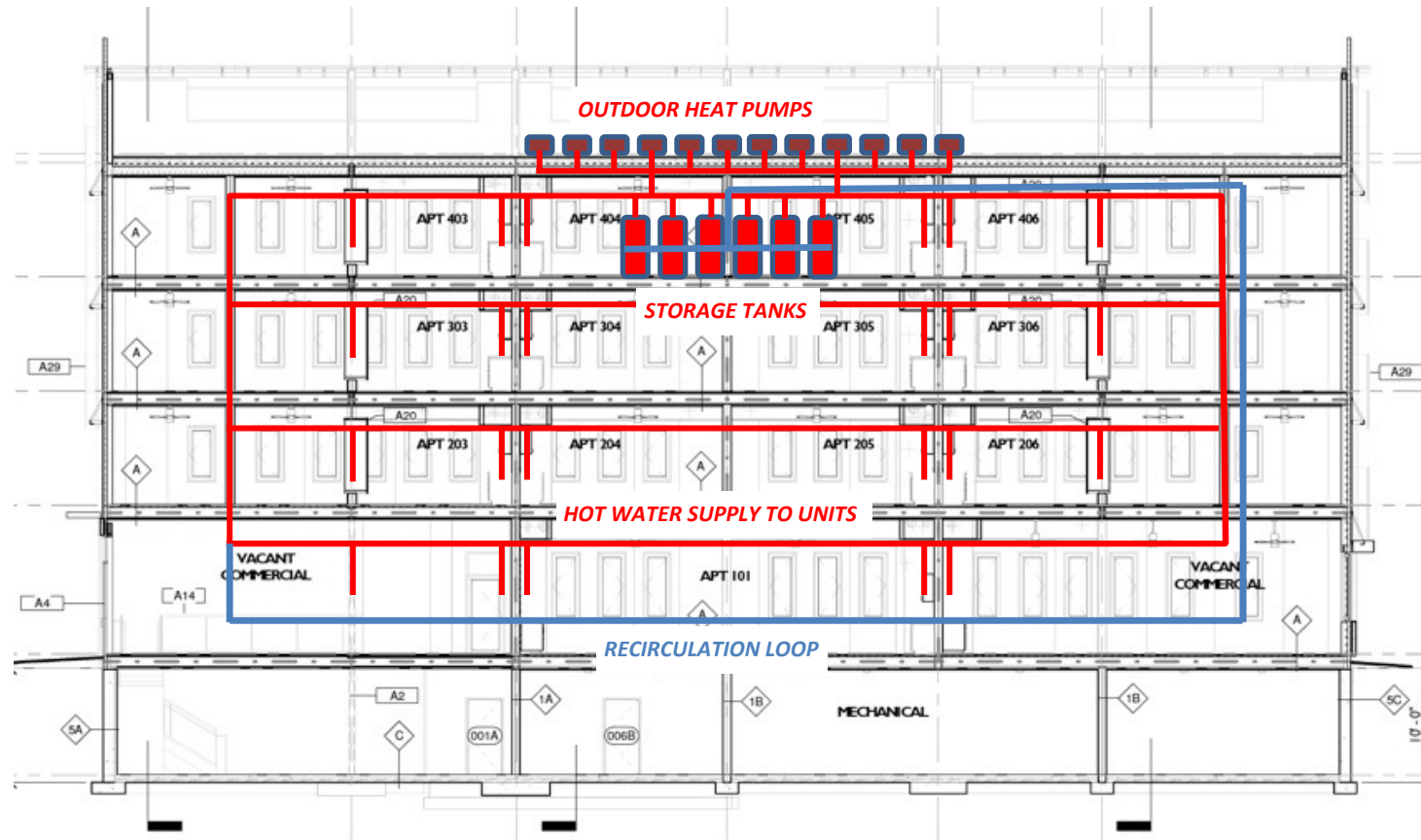


*HVAC Closet merged with Kitchen cabinetry*







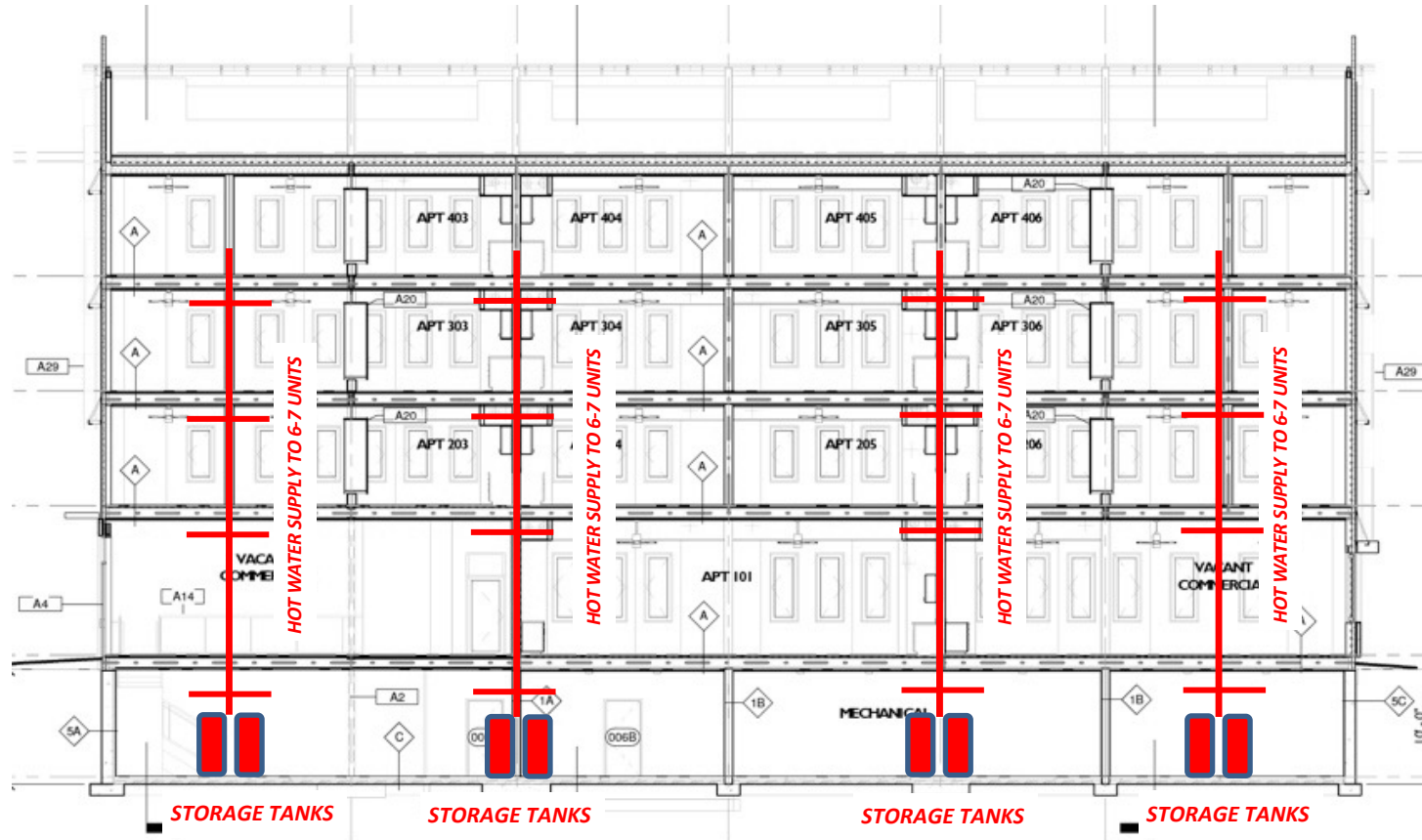


*Domestic Hot Water Strategy: CENTRALIZED*



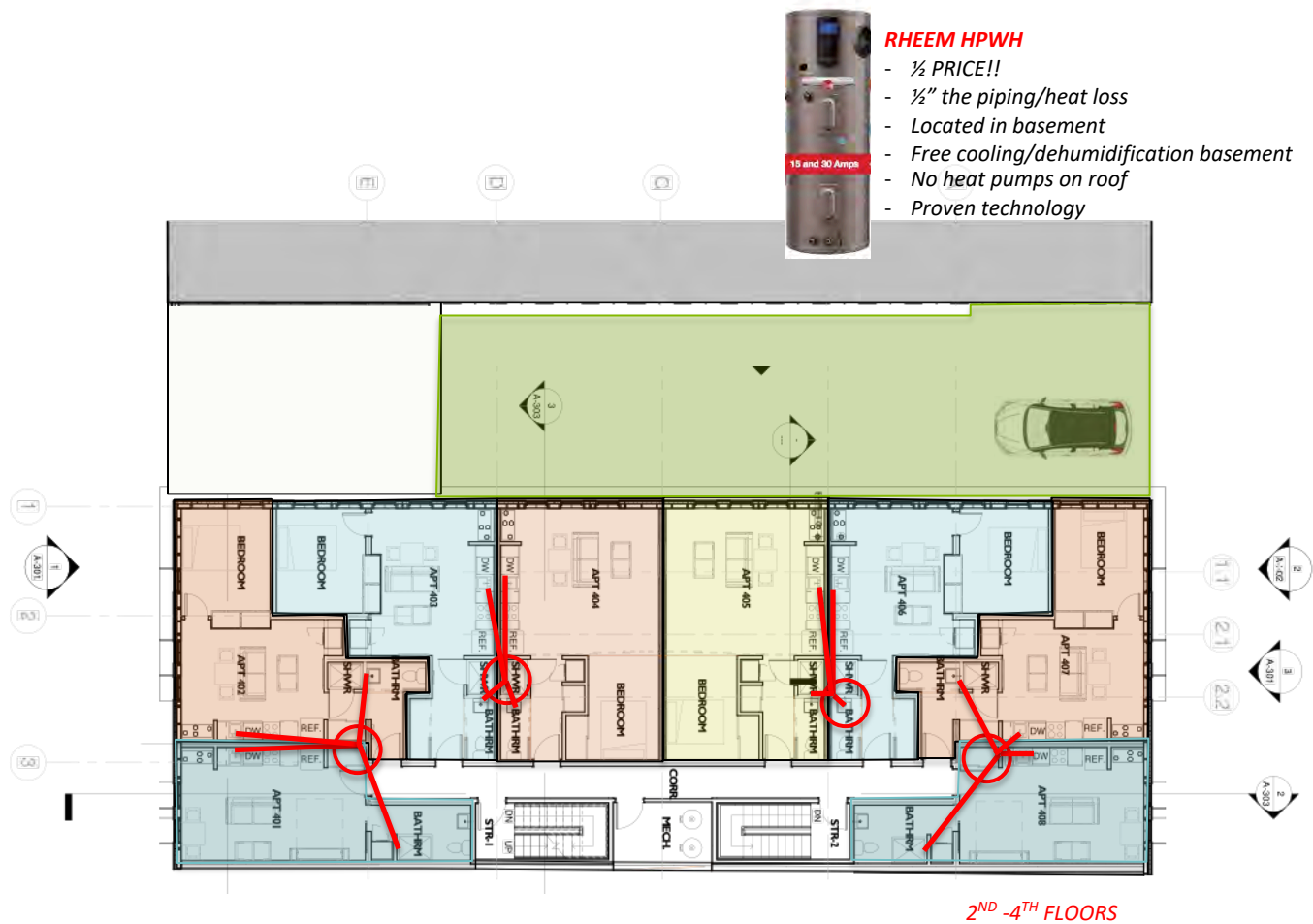






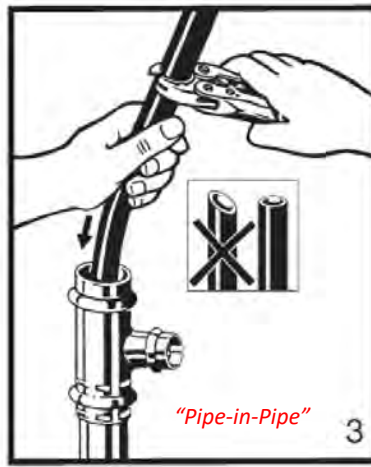
*Domestic Hot Water Strategy: FOLLOW THE VENT STACK!!*



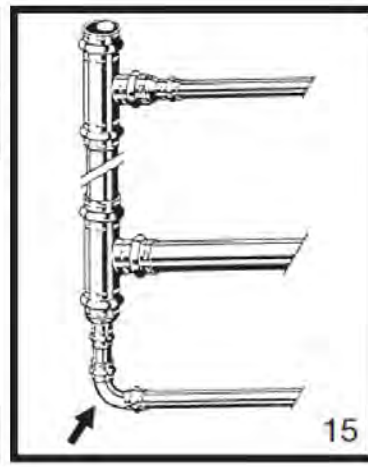


Domestic Hot Water Strategy: SEMI-CENTRALIZED





"Pipe-in-Pipe"



### RHEEM HPWH

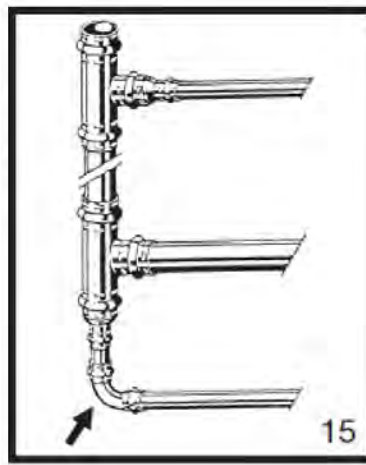
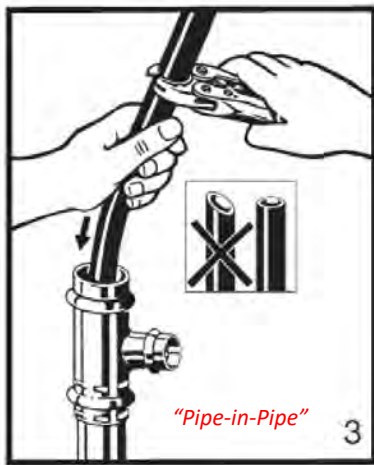
- ½ PRICE!!
- ½" the piping/heat loss
- Located in basement
- Free cooling/dehumidification basement
- No heat pumps on roof
- Proven technology



2<sup>ND</sup> -4<sup>TH</sup> FLOORS

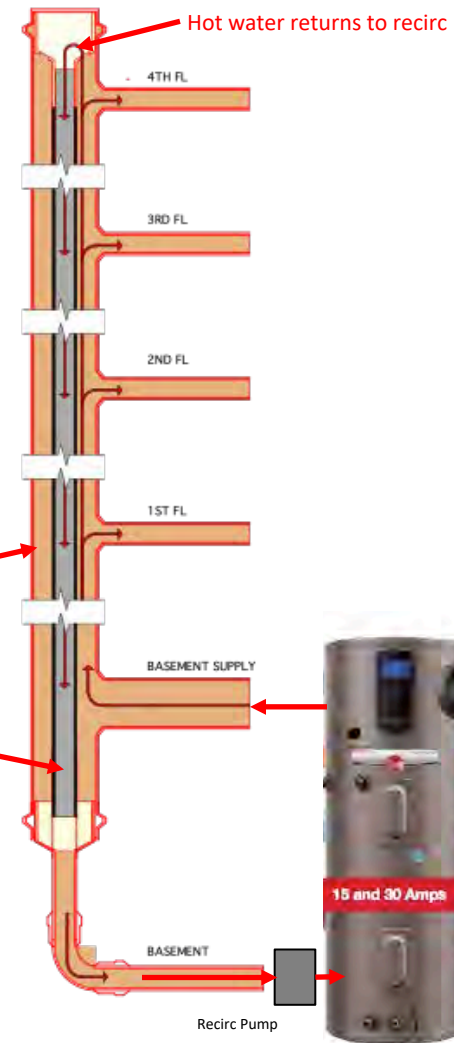
## PIPE-IN-PIPE Recirculation Loop Strategy





Copper Hot water  
supply line to apartments

PVC Recirc line



*PIPE-IN-PIPE Recirculation Loop Strategy*

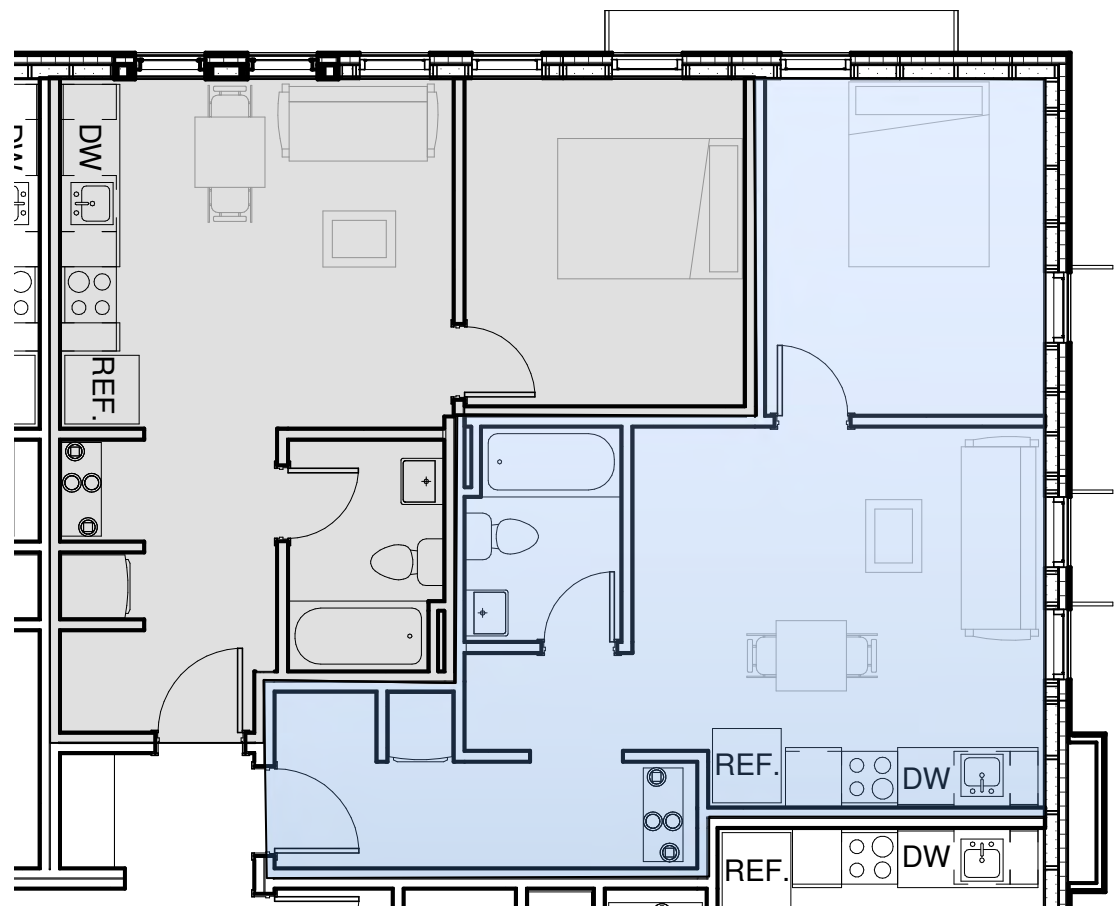


*2 – 80 gallon HPWH for 6-7 Apartments*



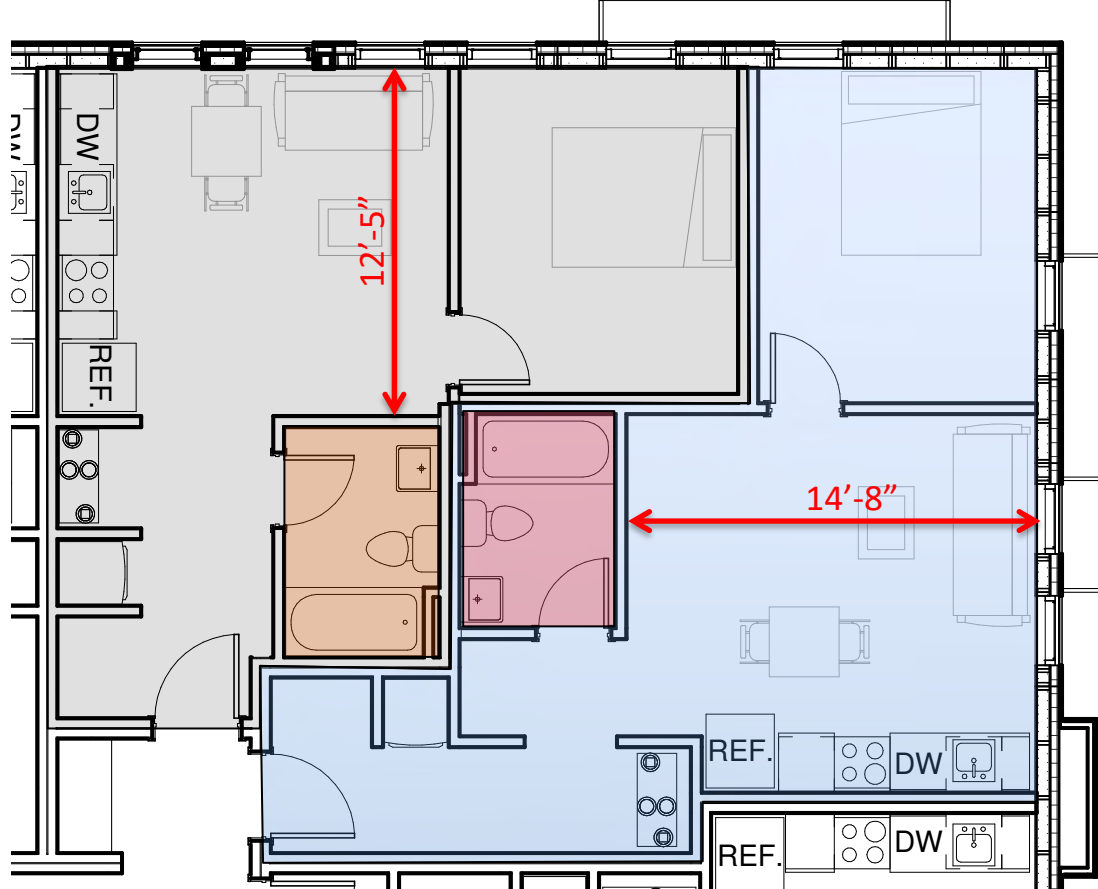


Original 450sf, 1-bed unit



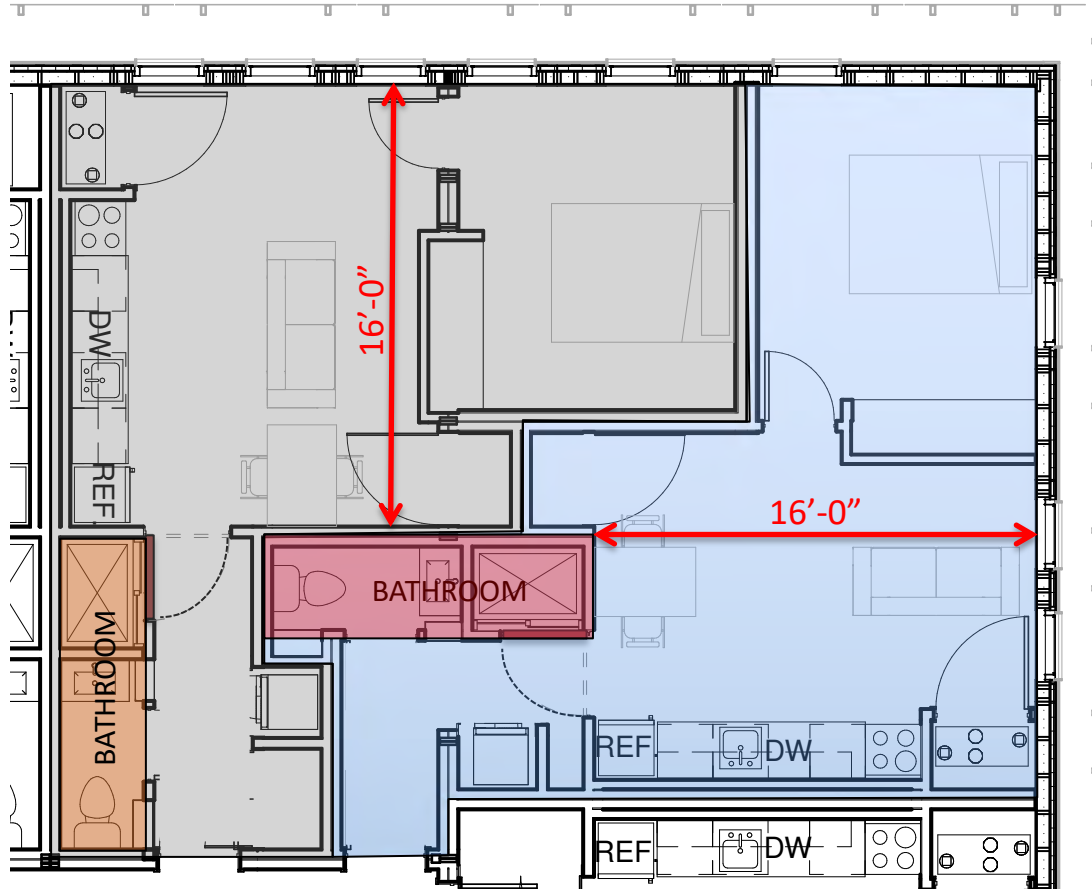


# Original 450sf, 1-bed unit





## NEW 450sf, 1-bed unit

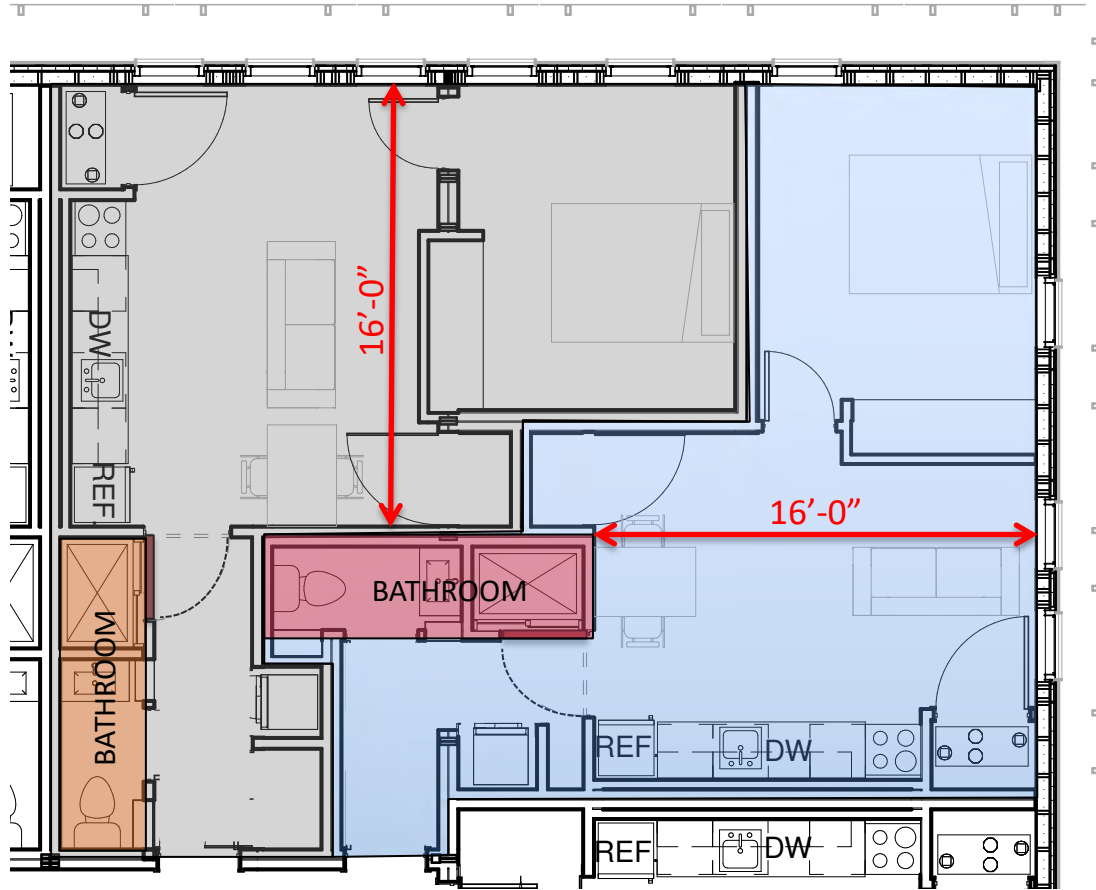


*Marcel Duchamp's door at Rue Larrey  
that is both open and closed  
1927*



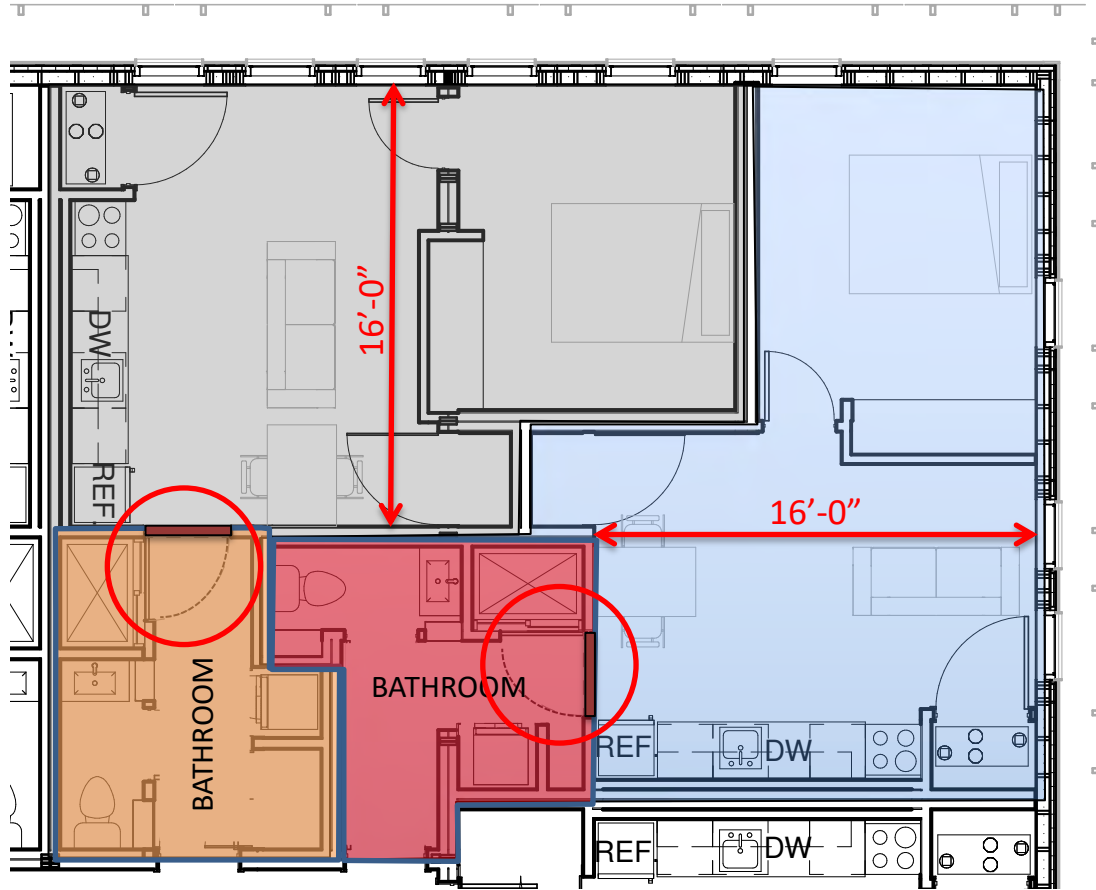


## NEW 450sf, 1-bed unit





# NEW 450sf, 1-bed unit













# ENERGIESPRONG

Net Zero Energy





## ENERGIESPRONG

Net Zero Energy















**BUILDING EVOLUTION  
CORPORATION**

*Achieve Performance & Durability Through a Holistic Approach™*





**BUILDING EVOLUTION  
CORPORATION**

*Achieve Performance & Durability Through a Holistic Approach™*



**SOLUTION PROVIDER**

**FACILITATOR**



**HVAC / ELECT/ENVELOPE ENGINEER**

**ARCHITECT  
ENERGY MODELING  
R+D PANELIZATION**



**GENERAL  
CONTRACTOR**



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SOLUTION PROVIDER

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HVAC / ELECT/ENVELOPE ENGINEER

ARCHITECT  
ENERGY MODELING  
R+D PANELIZATION



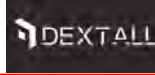
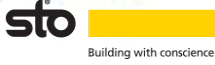
GENERAL  
CONTRACTOR



HAYCON

BUILDING EVOLUTION  
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PANELIZERS



## OWNERS



Honeywell



## FACILITATOR



## HVAC / ELECT/ENVELOPE ENGINEER

## ARCHITECT ENERGY MODELING R+D PANELIZATION



## GENERAL CONTRACTOR



## BUILDING EVOLUTION CORPORATION

Achieve Performance & Durability Through a Holistic Approach™



## PANELIZERS





## Bldg Info

1-39 Hano Street,  
Allston Brighton, MA

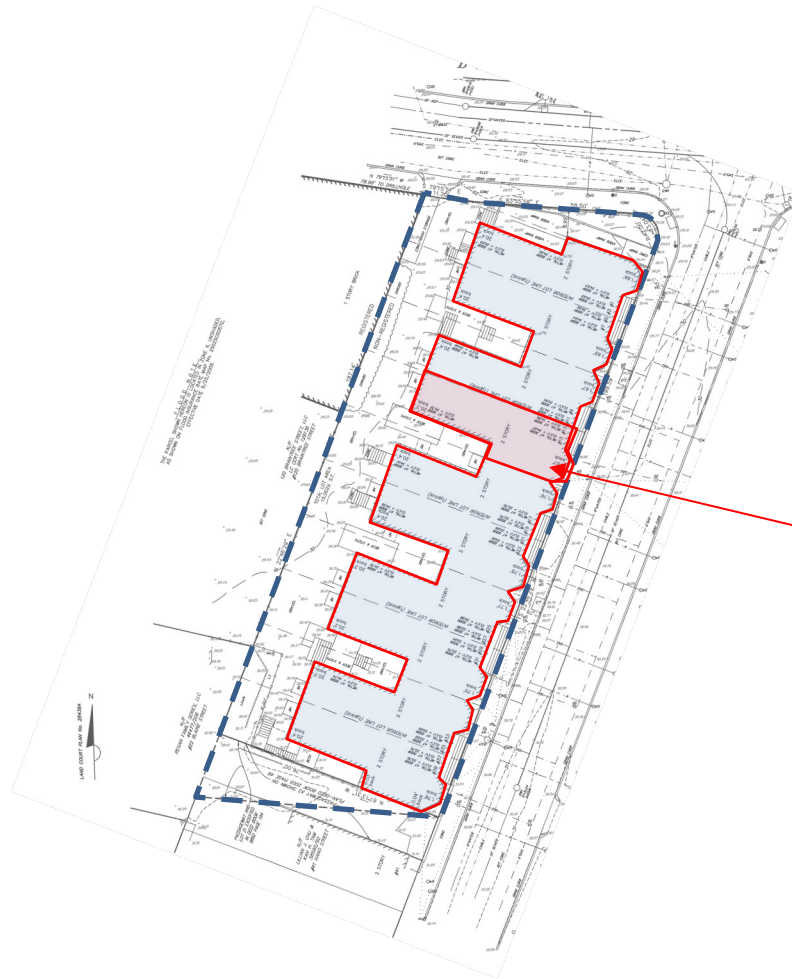
- Year Built – 1888
- Size – 24,083 GSF
- Zoning: R-3
- 10 Duplexes, 20 Units
- Materials – Wood framed, masonry fire walls





- Challenging building form
- Very tight access at street
- Overhead wires make front panelization difficult
- Model as one building or Ten?





## RECENT SURVEY PLAN

- Challenging building form
- Very tight access at street
- Overhead wires make front panelization difficult
- Model as one building or Ten?
- Chose to model one duplex at a time.



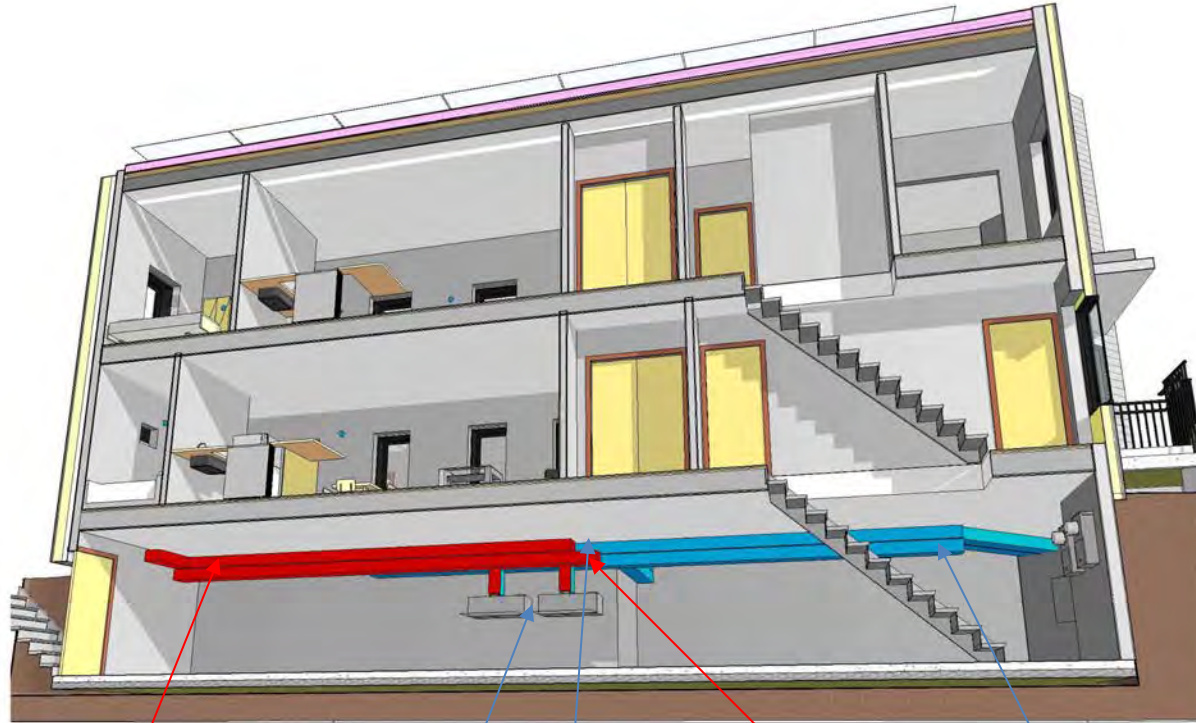


## HVAC STRATEGY

### EXISTING CONDITIONS

- Eliminate gas and centralized boiler for heating
- Eliminate gas and DHW tanks
- No cooling





Minotair units

1<sup>st</sup> floor supply/exhaust ducts  
Flush to ceiling and feed 1<sup>st</sup> floor  
Through floor registers

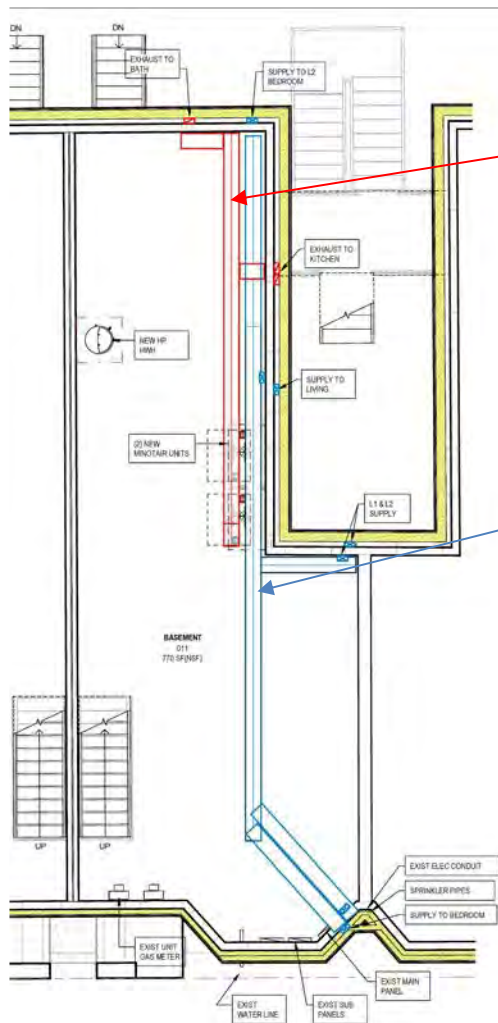
2<sup>nd</sup> floor supply/exhaust ducts  
Sandwiched below 1<sup>st</sup> floor ducts  
feed 2<sup>nd</sup> floor on outside

## HVAC STRATEGY

- Decentralized ventilation, heating, and cooling strategy
- Replace gas water heaters with Heat Pump Water Heaters (HPWH)
- Use Minotair Unit







**EXHAUST** Ducts to  
1<sup>st</sup> + 2<sup>nd</sup> floor bathrooms  
And kitchens.

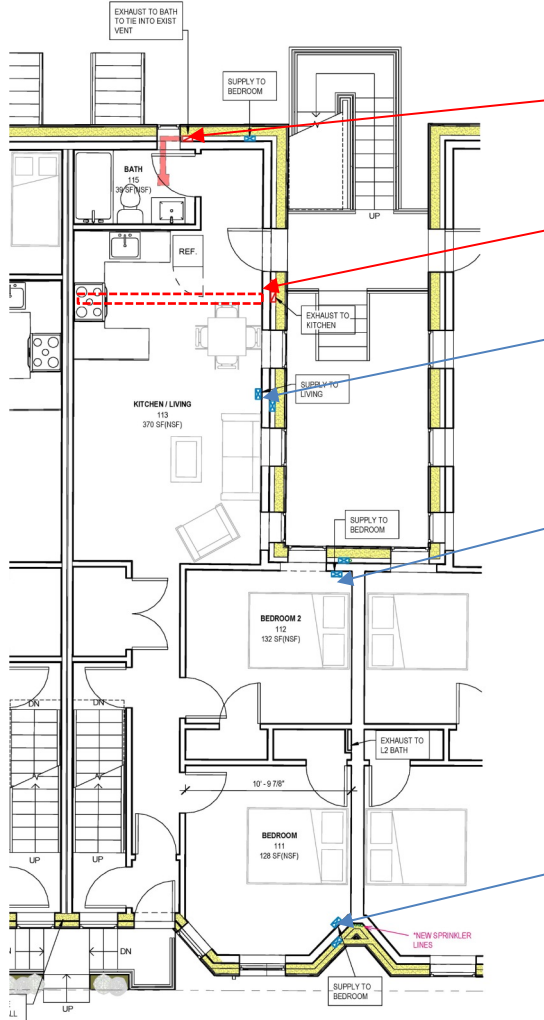
**SUPPLY** Ducts to  
Bedrooms and living  
areas

## HVAC STRATEGY

- Decentralized ventilation, heating, and cooling strategy
- Replace gas water heaters with Heat Pump Water Heaters (HPWH)
- Use Minotair Unit
- Use KOOL DUCT

**BASEMENT PLAN**





Exhaust connected to existing  
Bath exhaust to exterior

Exhaust connected to existing  
Kitchen exhaust to exterior

Supply Floor register

Supply Floor register

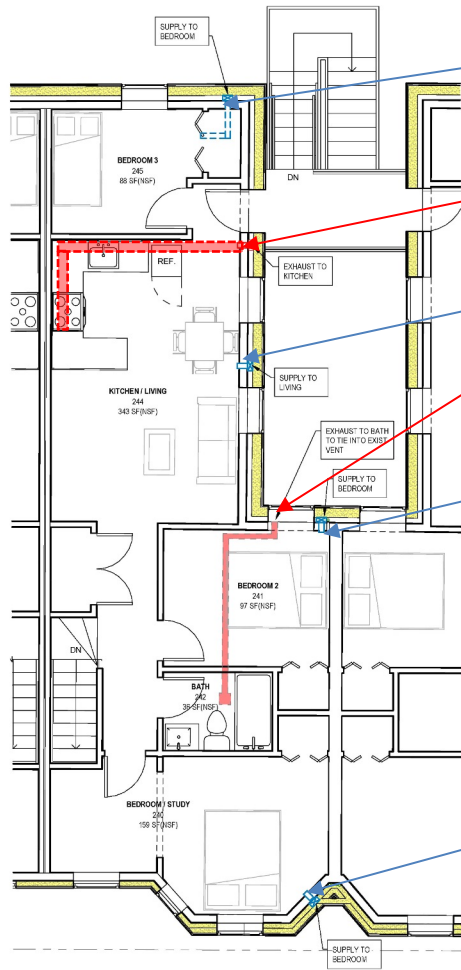
Supply Floor register

## HVAC STRATEGY

- Decentralized ventilation, heating, and cooling strategy
- Replace gas water heaters with Heat Pump Water Heaters (HPWH)
- Use Minotaur Unit
- Use KOOL DUCT
- Service 1<sup>st</sup> floor unit through floor registers

**1<sup>st</sup> FLOOR PLAN**





Supply Wall register

Exhaust connected to existing  
Kitchen exhaust to exterior

Supply Wall register

Exhaust connected to existing  
Bath exhaust to exterior

Supply Wall register

Supply Wall register

## HVAC STRATEGY

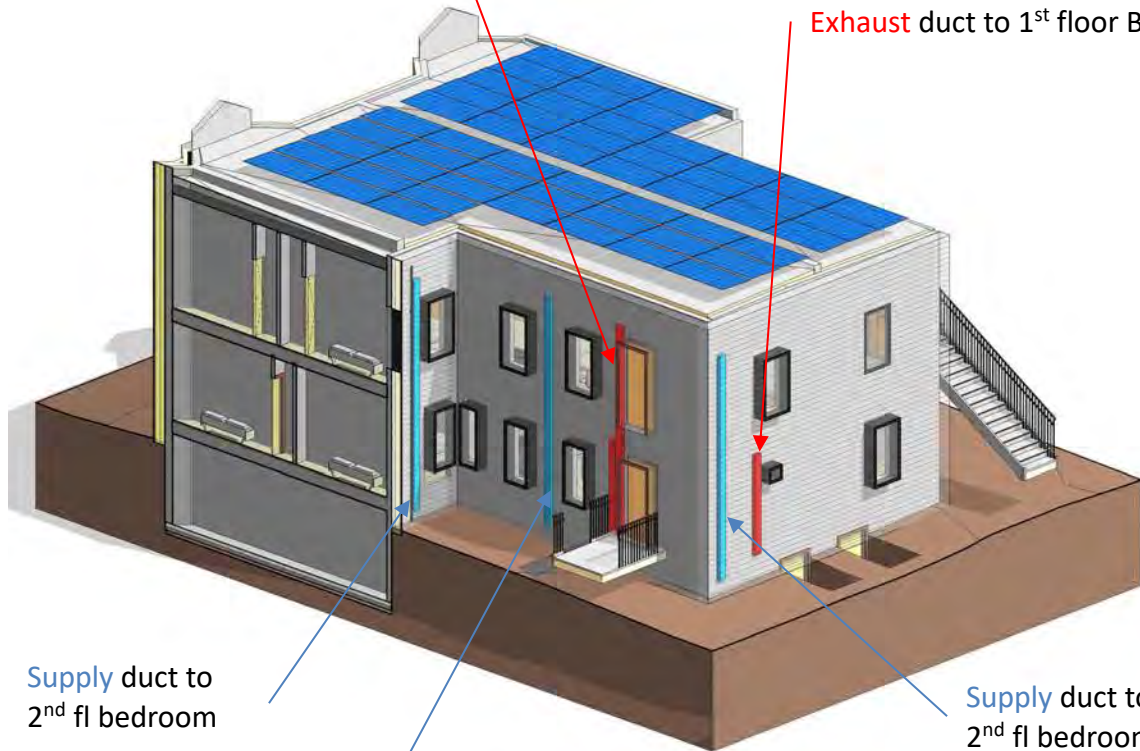
- Decentralized ventilation, heating, and cooling strategy
- Replace gas water heaters with Heat Pump Water Heaters (HPWH)
- Use Minotaur Unit
- Use KOOL DUCT
- Service 1<sup>st</sup> floor unit through floor registers
- Service 2<sup>nd</sup> floor from outside between new and existing envelop

**2<sup>nd</sup> FLOOR PLAN**



Exhaust duct to 2<sup>nd</sup> floor  
Bath and Kitchen

Exhaust duct to 1<sup>st</sup> floor Bath



Supply duct to  
2<sup>nd</sup> fl bedroom

Supply duct to  
2<sup>nd</sup> fl Living Room

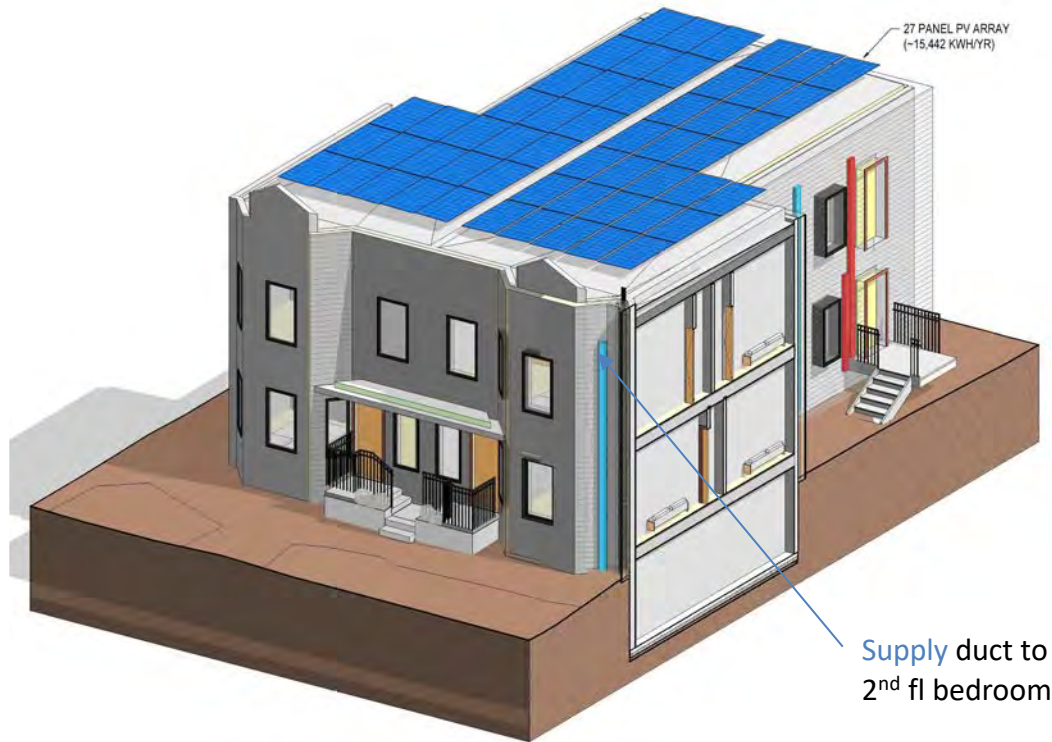
Supply duct to  
2<sup>nd</sup> fl bedroom

## HVAC STRATEGY

- Decentralized ventilation, heating, and cooling strategy
- Replace gas water heaters with Heat Pump Water Heaters (HPWH)
- Use Minotaur Unit
- Use KOOL DUCT
- Service 1<sup>st</sup> floor unit through floor registers
- Service 2<sup>nd</sup> floor from outside between new and existing envelop

**AXONOMETRIC**





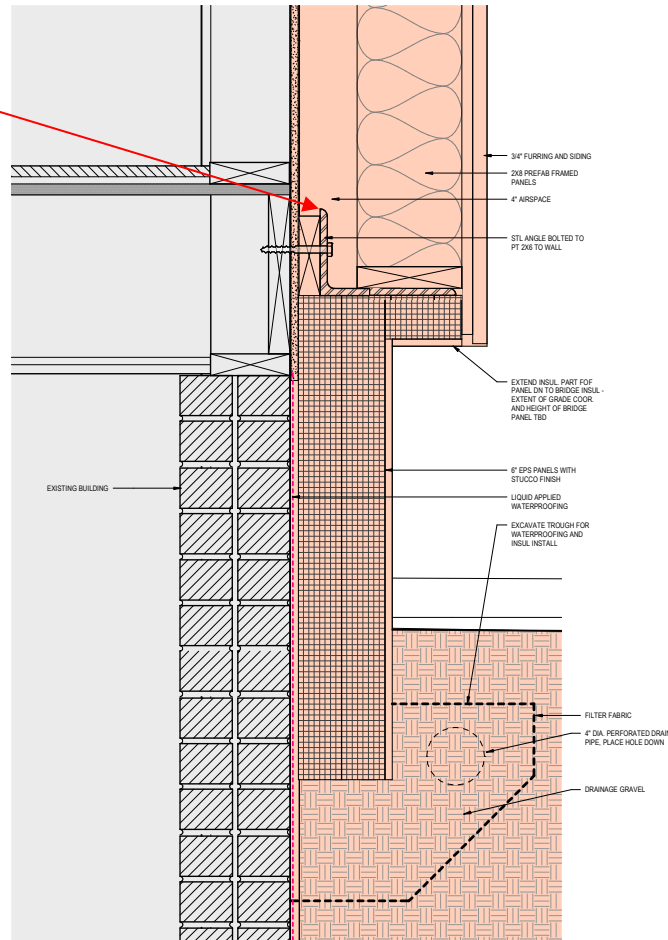
**AXONOMETRIC**

## HVAC STRATEGY

- Decentralized ventilation, heating, and cooling strategy
- Replace gas water heaters with Heat Pump Water Heaters (HPWH)
- Use Minotaur Unit
- Use KOOL DUCT
- Service 1<sup>st</sup> floor unit through floor registers
- Service 2<sup>nd</sup> floor from outside between new and existing envelop



Anchor shelf angle  
to existing basement  
leaving 4' space for  
Ductwork



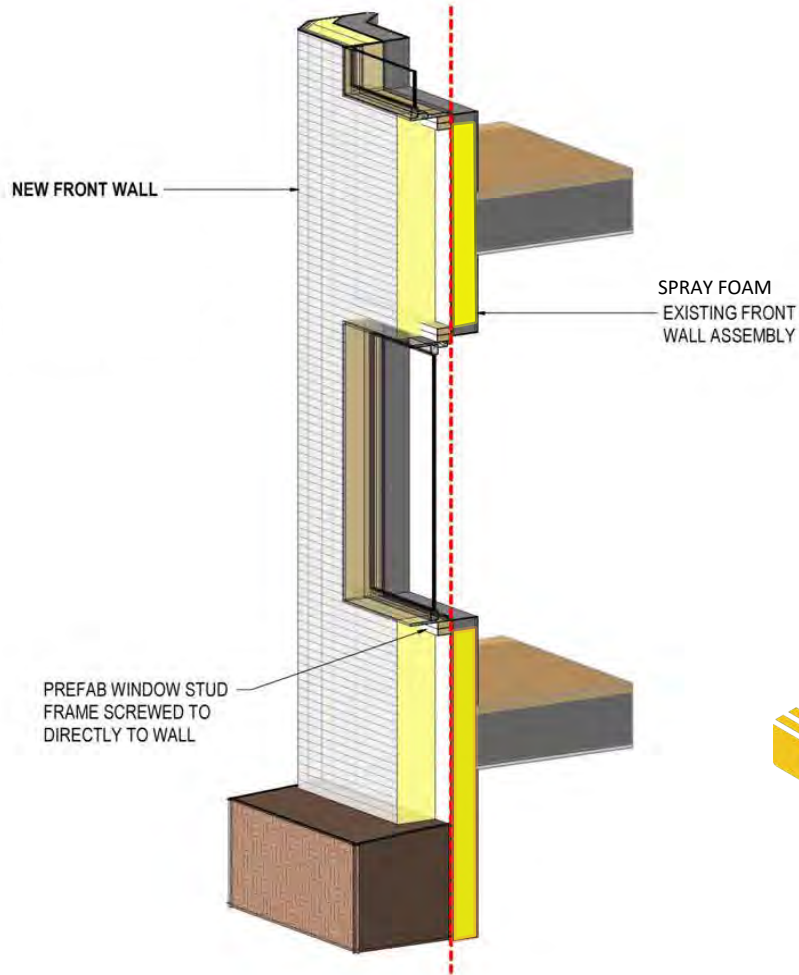
Foundation Detail

## ENVELOP STRATEGY

### ALL OTHER WALLS

- Strip existing skin from building down to studs
- Install new 1/2" Zip layer as primary **AIR BARRIER**
- Install PRE-FRAMED window screwed directly to existing wall
- Install 1 layer of 4" TimberHP wood fibre Insulation
- Furring strips and new siding
- Wrap parapet and roof
- Stop insulation of basement at grade





## ENVELOP STRATEGY

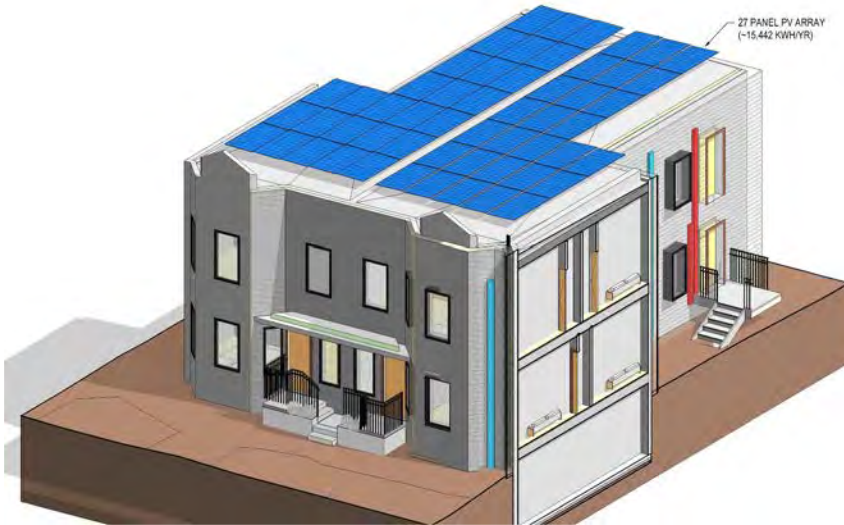
### FRONT WALL

- Strip existing skin from building down to studs
- Install new ½" Zip layer as primary AIR BARRIER
- Install PRE-FRAMED window screwed directly to existing wall
- Install 1 layer of 4" TimberHP wood fibre Insulation
- Furring strips and new siding



**TIMBERHP**  
BY GO LAB

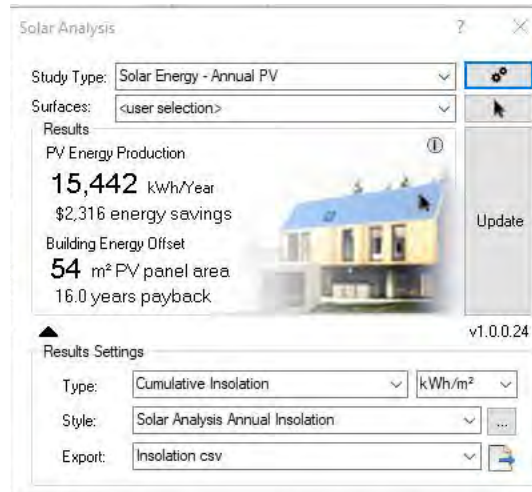




## SOLAR

### PER DUPLEX:

- (27) 300W solar panels on 10 deg east west roof racks for maximum efficiency
- Total Array Size – 8.1kw per duplex
- **@ \$2/watt = \$16,200 per duplex or \$8100 per unit or \$162,000.00**





## HISTORIC AND PROJECTED ENERGY CONSUMPTION

- Historical data below from the Capital Needs Worksheet shows an average EUI of 75.2 kBTU/sf/yr.

Table 5. Normalized Historical Utility Consumption

Utility	Consumption	Cost (\$)	% Total Cost	Your Building	Index	Unit
Water	1,268,030 Gal.	\$21,907	33.5%	67.8	61.1	Gal./bedroom/day
Electricity	104,423 kWh	\$24,257	37.1%	13.2	10.2	kBTU/ft <sup>2</sup>
Gas	13,656 therms	\$19,307	29.5%	12.0	49.3	kBTU/ft <sup>2</sup>
<b>TOTAL</b>	<b>1,722 MMBtu</b>	<b>\$65,471</b>	<b>100.0%</b>	<b>75.2</b>	<b>59.5</b>	<b>kBTU/ft<sup>2</sup></b>

Existing EUI of 75 kBTU/sf/yr

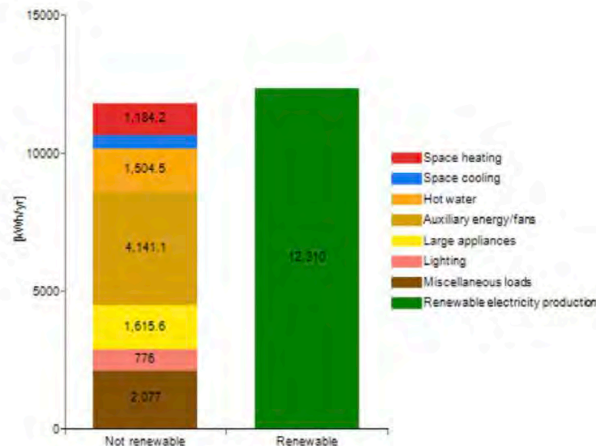
\$43,566.00 Annual Cost of Utilities

New EUI after DER: 23 kBTU/sf/yr

The chart below summarizes the results of the WUFI Passive model and projected energy consumption, as well as energy generation based on a 11.2 kW PV array **per building** (28,400 watt LG panels). Without the solar, the EUI is projected to be **23 kBTU/sf/yr**, 70% better than historical data. With the projected energy generation from the solar, the projected EUI is **0 kBTU/sf/yr**, or Net Zero Energy:

NET ZERO ENERGY

\$43,566.00 SAVINGS PER YEAR



### WUFI Passive EUI Calculator

Project: Hano Homes

1/10 Units

Gross sf	
L1	890.00
L2	890.00
<b>Total Gross Sf</b>	<b>1,780.00</b>

Total ICFA 1431.00

**Total Site Energy Use kBTU/yr 41,213.89**

kWh/yr 12079.10

kWh/yr to kBTU/yr 41213.89

Specific Source Energy Use kBTU/sf/yr 19.80

**EUI kBTU/sf/yr: 23.15**

EUI is expressed as energy per square foot per year.

It is calculated by dividing the total energy consumed by the building in one year by the total gross floor area of the building.



A	B	C	D	E	F	G	H	I
ITEM	DESCRIPTION OF WORK	Direct Cost	Markup	Material Cost	Material Markup	Sub Contractor	Sub Con. Markup	Total
<b>Division 02 Membrane Roofing Sub</b>								
07 30 00.02 Membrane Roofing Sub		\$4,000	\$400	\$0	\$0	\$180,000	\$27,000	\$211,400
07 35 00.02 Green Roof Systems Sub		\$0	\$0	\$0	\$0	\$37,500	\$5,625	\$43,125
07 71 00.02 Roofing Spectacles/Gutter Sub (Included in 07 30 00.02)		\$0	\$0	\$0	\$0	\$0	\$0	\$0
						\$22		
<b>Division 8 Doors, Window &amp; Interiors</b>								
08 14 10.01 Exterior Doors Mtl (Included in 08 50 00.01)		\$0	\$0	\$0	\$0	\$0	\$0	\$0
08 14 10.09 Exterior Doors Sub		\$0	\$0	\$0	\$0	\$61,000	\$9,450	\$70,450
08 50 00.01 Windows Mtl		\$0	\$0	\$200,035	\$27,203	\$0	\$0	\$227,238
08 50 00.02 Window Sub (Included in 07 42 63.01)		\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Division 9 Finishes</b>								
09 21 00.09 Plaster Sub		\$2,000	\$200	\$0	\$0	\$82,450	\$12,368	\$87,248
09 91 13.01 Exterior Painting Mtl		\$300	\$30	\$2,500	\$340	\$0	\$0	\$3,390
09 91 13.09 Exterior Painting Sub		\$2,000	\$200	\$0	\$0	\$47,500	\$7,125	\$54,825
09 91 23.01 Interior Paint Mtl		\$0	\$0	\$400	\$54	\$0	\$0	\$454
09 91 23.09 Interior Paint Sub (Included in 09 21 00.02)		\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>Division 11 Equipment</b>								
11 30 13.01 Kitchen Appliances Mtl		\$1,000	\$100	\$17,000	\$2,312	\$0	\$0	\$20,412
11 30 13.02 Kitchen Appliances Sub		\$0	\$0	\$0	\$0	\$5,634	\$845	\$6,479
<b>Division 12 Furnishings</b>								
<b>Division 21 Fire Suppression</b>								
21 00 00.02 Fire Suppression Sub		\$6,000	\$600	\$0	\$0	\$132,447	\$19,867	\$158,914
<b>Division 22 Plumbing</b>								
22 00 00.00 Plumbing Demolition		\$0	\$0	\$0	\$0	\$0	\$0	\$0
22 00 00.00 Plumbing Sub		\$1,000	\$100	\$0	\$0	\$0	\$0	\$1,100
22 33 00.01 Plumbing Water Heaters Mtl		\$1,000	\$100	\$37,570	\$7,850	\$0	\$0	\$46,520
<b>Division 23 HVAC</b>								
23 72 00.01 HVAC ERV Mtl		\$6,000	\$600	\$128,200	\$17,453	\$0	\$0	\$152,253
23 72 00.09 HVAC ERV Sub		\$0	\$0	\$0	\$0	\$124,000	\$18,600	\$142,600
<b>Division 26 Electrical</b>								
26 50 00.00 Electrical Demolition (Included in 26 00 00.02)		\$0	\$0	\$0	\$0	\$0	\$0	\$0
26 00 00.02 Electrical Sub		\$2,000	\$200	\$0	\$0	\$113,000	\$17,250	\$132,450
26 50 00.01 Lighting Fixtures Mtl		\$1,000	\$100	\$5,952	\$748	\$0	\$0	\$7,700
26 51 00.01 Photovoltaic Sub		\$1,000	\$100	\$0	\$0	\$235,417	\$35,343	\$272,760
<b>Division 28 Electronic Safety and Security</b>								
28 00 00.02 Electronic Safety Sub		\$0	\$0	\$0	\$0	\$89,470	\$13,461	\$103,121
<b>Division 31 Earthwork</b>								
A	B	C	D	E	F	G	H	I
ITEM	DESCRIPTION OF WORK	Direct Cost	Markup	Material Cost	Material Markup	Sub Contractor	Sub Con. Markup	Total
<b>Division 32 Exterior Improvements</b>								
32 10 00.02 Paving Sub		\$0	\$0	\$0	\$0	\$3,000	\$450	\$3,450
32 14 23 02 Sidewalks Sub		\$0	\$0	\$0	\$0	\$1,950	\$293	\$2,243
32 90 00.02 Landscape Sub		\$1,000	\$100	\$0	\$0	\$6,000	\$1,200	\$8,200
<b>Division 33 Utilities</b>								
33 11 39 09 Fire Suppression Utility Water Sub		\$1,000	\$100	\$0	\$0	\$25,000	\$3,750	\$29,850
33 40 00 09 Stormwater Utilities Sub		\$1,000	\$100	\$0	\$0	\$25,000	\$3,750	\$29,850
33 40 00 09 Stormwater Utilities Sub - Avoid All Curbcut		\$10,000	\$1,000	\$0	\$0	\$271,500	\$31,750	\$323,250
						\$7,299.61	\$1,103.91	\$8,403.52
								Total \$ 3,724,000.00
								Cost by Unit \$ 184,300.00
								SQFT cost by GSF \$ 149.00
								SQFT cost by GSF of Envelope \$ 207.85
<b>Add Alternate - Field Installed Insulation in lieu of panels</b>								
06 11 00.01 Wood Framing Mtl (1x3 wood strapping) - Add		\$0	\$0	\$12,000	\$1,402	\$0	\$0	\$13,402
07 21 13.01 Insulation Mtl - Add		\$0	\$0	\$14,779	\$1,602	\$0	\$0	\$16,381
07 21 13.03 Insulation Sub - Add		\$2,000	\$200	\$0	\$0	\$ 45,780.80	\$6,867	\$54,848
07 21 13.03 Insulation Sub - Deduct		(\$2,000)	(\$200)	\$0	\$0	(\$35,214)	(\$5,282)	(\$42,706)
07 27 00.01 Air Barrier Mtl - Deduct		(\$2,000)	(\$200)	(\$25,000)	(\$3,402)	\$0	\$0	(\$30,602)
07 42 63.01 Fabricated Wall Panel Assemblies Mtl - Deduct		\$0	\$0	(\$580,417)	(\$78,944)	\$0	\$0	(\$659,361)
07 42 63.02 Wall Assemblies Sub - Deduct		(\$10,000)	(\$1,000)	\$0	\$0	(\$21,500)	(\$3,225)	(\$24,725)
08 50 00.02 Window Sub - Add		\$0	\$0	\$0	\$0	\$7,299.61	\$1,103.91	\$8,403.52
								Add Total \$485.41
								Adjusted Total \$3,040.38
								Cost by Unit \$ 152,019.90
								SQFT cost by GSF \$ 121.45
								SQFT cost by GSF of Envelope \$ 169.57



**FAIRWEATHER SALEM**



**FAIRWEATHER BEVERLY**



**FAIRWEATHER DANVERS**



**FAIRWEATHER PEABODY**





**FAIRWEATHER SALEM**



**SALEM HEIGHTS**



**Salem Heights, 281 Units Family, Salem, MA**  
**Built: 1974**



## FAIRWEATHER SALEM



## SALEM HEIGHTS

### History and Facts:

POAH Purchased the Property in 2003  
Family Community  
Proceeds in 2003 were used to purchase site so  
minimal upgrades were made at that time  
90% Units leased at 60% AMI or Lower  
(until June 2057)  
Project and Tenant Based Vouchers  
POAH Pays all Utilities  
New Boiler and DHW Paid for by Utility Incentive

### How did we pay for this:

Construction Loan  
Seller Note  
Federal LIHTC  
CIPF  
Deferred Developer Fee  
Construction Period Income from Operations  
Energy Incentives  
=\$45,000,000 construction cost



**\$45,000,000**  
**\$160,000/UNIT**  
**\$1,000,000 in relocation costs**





## FAIRWEATHER SALEM



## SALEM HEIGHTS



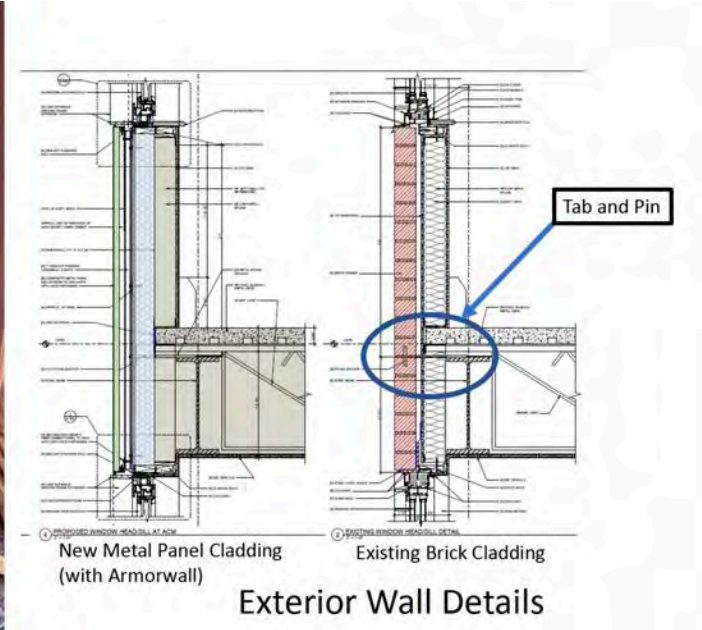
**\$45,000,000**  
**\$160,000/UNIT**  
**\$1,000,000 in relocation costs**



## FAIRWEATHER SALEM



## SALEM HEIGHTS



**\$45,000,000**  
**\$160,000/UNIT**  
**\$1,000,000 in relocation costs**



**FAIRWEATHER SALEM**



**SALEM HEIGHTS**



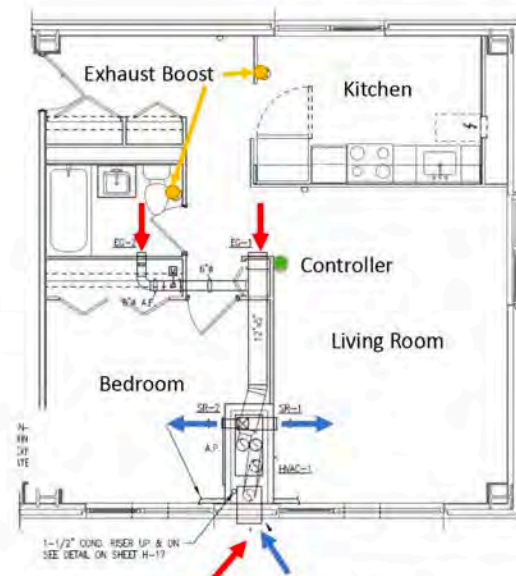
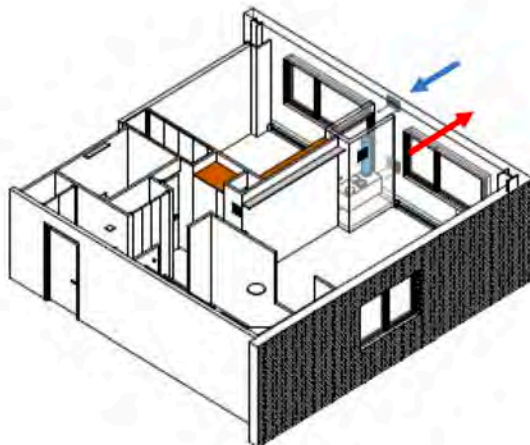
**\$45,000,000**  
**\$160,000/UNIT**  
**\$1,000,000 in relocation costs**



## FAIRWEATHER SALEM



## SALEM HEIGHTS



18 x 12" Exhaust Louver Below  
Alternating each floor

18 x 12" Intake Louver Above  
Alternating each floor

**BUILDING EVOLUTION  
CORPORATION**

Address Performance & Quality Through a Holistic Approach™



**\$45,000,000**

**\$160,000/UNIT**

**\$1,000,000 in relocation costs**



## **FAIRWEATHER SALEM**



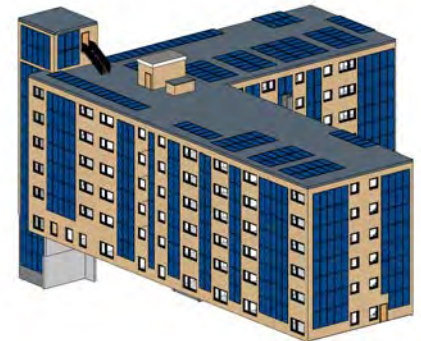
**127 unit, 73,920 sf, 6 stories**

**Feasibility Study**

**Deep Energy Retrofit**

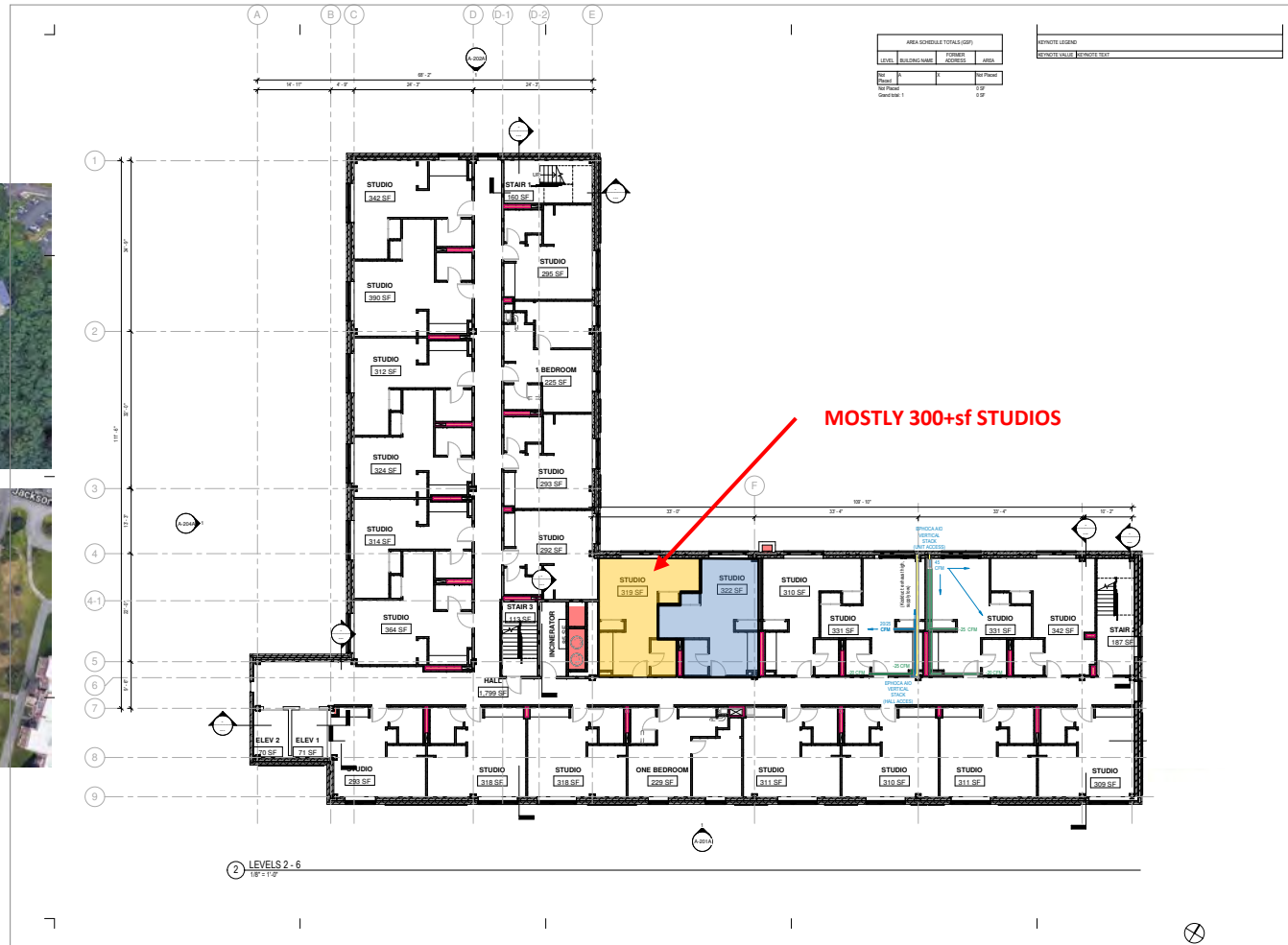
**Goals:**

- 1. Research 7 Panelized manufacturers for most cost-effective, factory-built, high performance envelop, including new roof**
- 2. Research 3-4 HVAC strategies for most cost-effective approach to bringing heating, cooling and ventilation to every apartment and communal space**
- 3. Research all-electric centralized Domestic Hot Water Systems to replace gas boiler**
- 4. Eliminate all gas equipment and appliances from building for all-electric building**
- 5. Create WUFI model of proposed design to meet the Passive House standard.**
- 6. Incorporate as much PV renewable energy as possible with goal of Net Zero Energy.**
- 7. Create preliminary budget for DER**

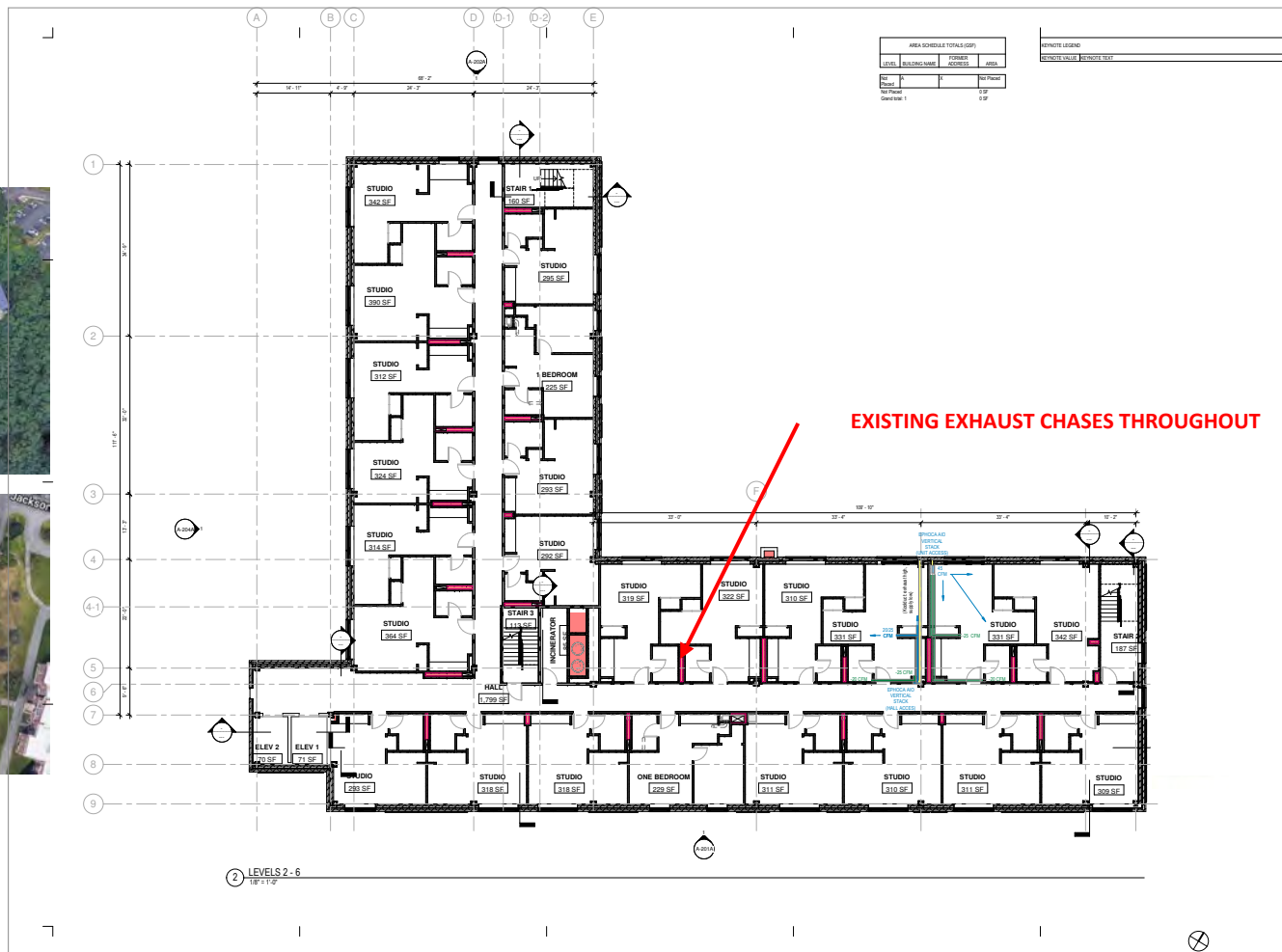




## FAIRWEATHER SALEM





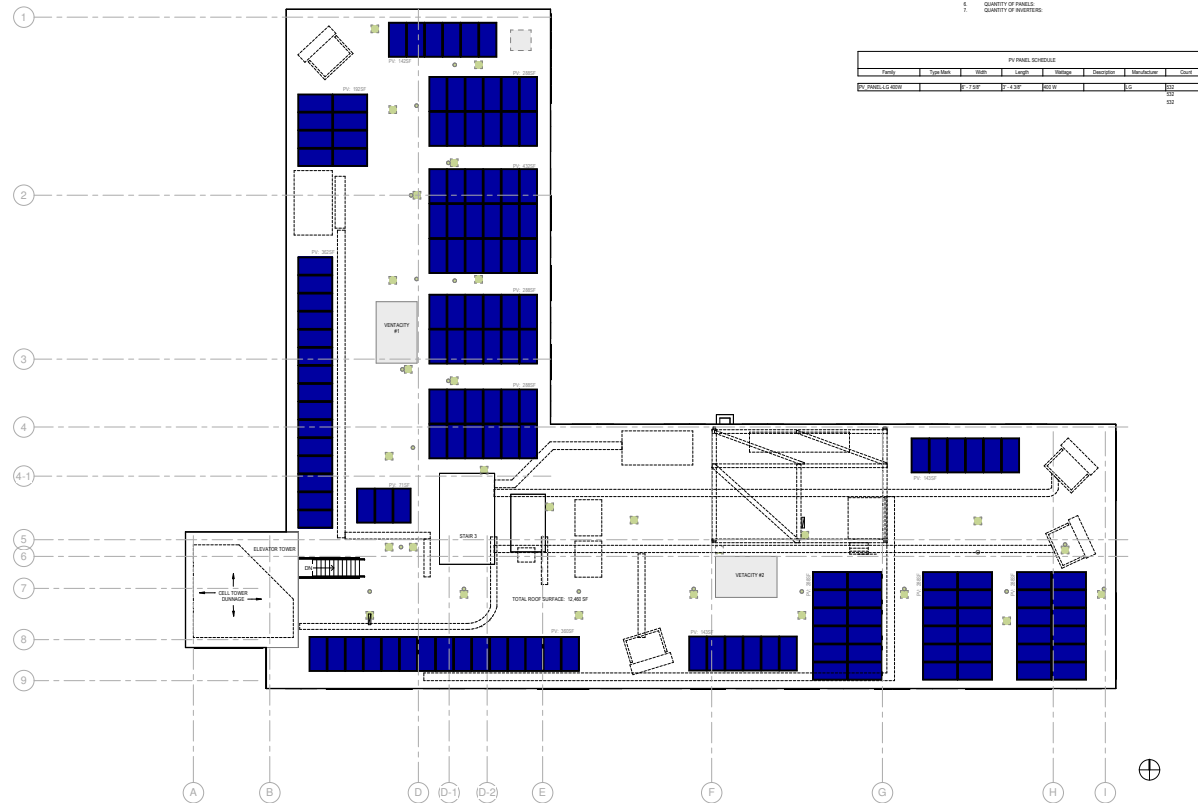






1. TYPE OF SOLAR PV SYSTEM:
2. SYSTEM LOCATION:
3. SYSTEM MOUNTING STRATEGY:
4. PV PANEL SIZE(S):
5. SYSTEM EXPECTED YIELD:
6. QUANTITY OF PANELS:
7. QUANTITY OF INVERTERS:

PV PANEL SCHEDULE						
Family	Type Mark	Width	Length	Weight	Description	Manufacturer
PV_PANEL.LG 400W		6'-7 5/8"	4'-4 3/8"	400 W		LG



1 ROOF PLAN  
1/8" = 1'-0"



## FAIRWEATHER SALEM

**23 KW array**  
**28,000 kWh/yr**



### Renewable Energy Generation

Only after the enclosure and mechanical systems have been analyzed for optimization can the Project Team begin to understand the renewable energy requirements for reaching NZE. POAH directly engaged Sunbug Solar to review the existing site/building conditions and prepare recommendations for solar coverage. Due to extensive tree coverage adjacent to the building as well as the cellular service infrastructure on the roof to remain, it was determined there are likely two options for rooftop solar implementation:



(1) Ballasted array yielding 23.9 kW, or approximately 28,000 kwh/yr



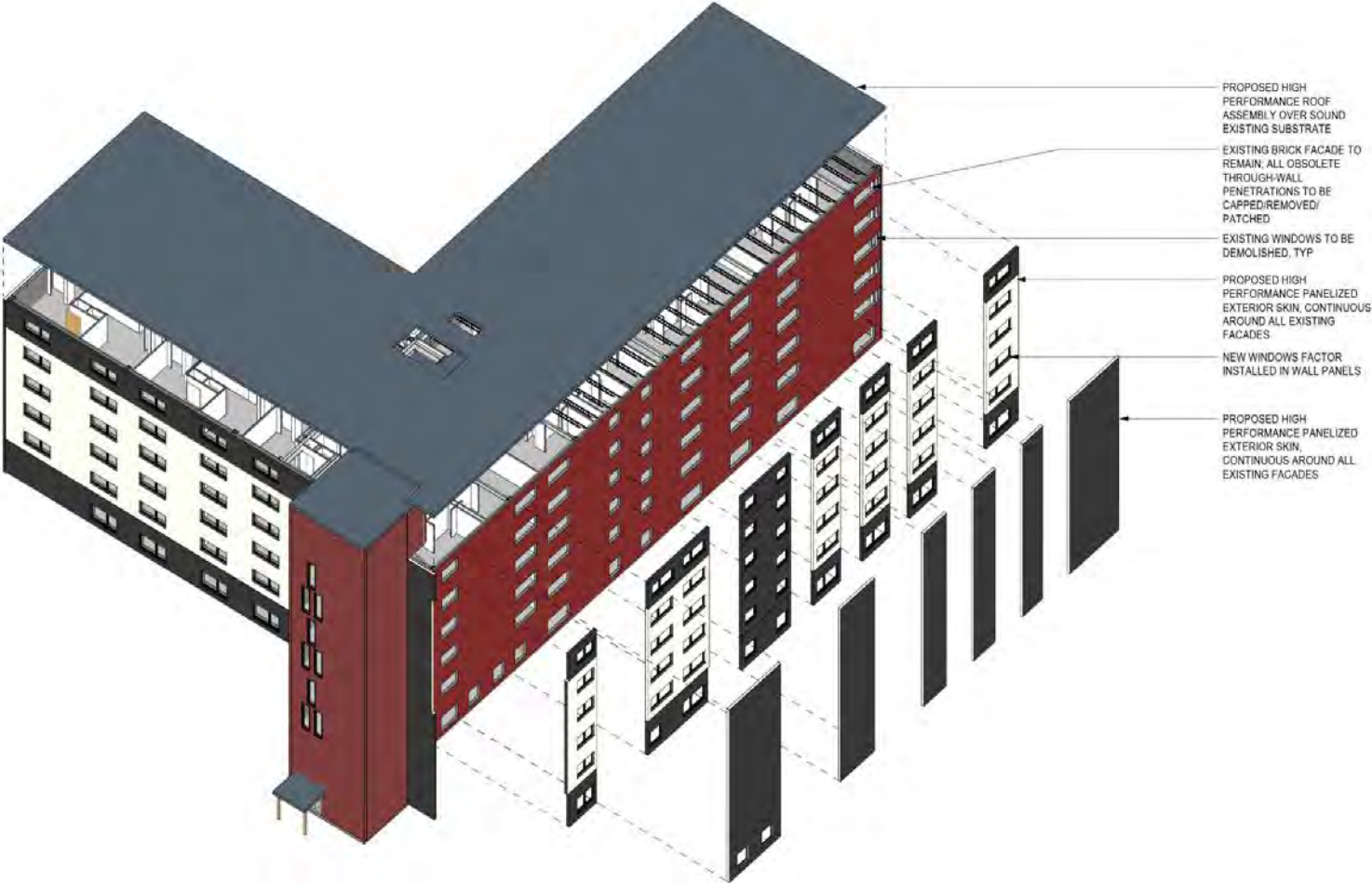
Above: 23.9 kW array



Above: 63.5 kW array



PANELIZATION





## PANELIZATION



**EXOSHELL**  
A COMPOSITE EXTERIOR WALL PANEL



**CERACLAD®** Color Coating  
Triple Coated Ceramic Coating  
Plasticscreen Siding  
Plasticscreen Siding

CERACLAD® custom color program is available in this texture. Custom color samples can be requested at:  
<https://veracul.com/ceracul-custom-color>



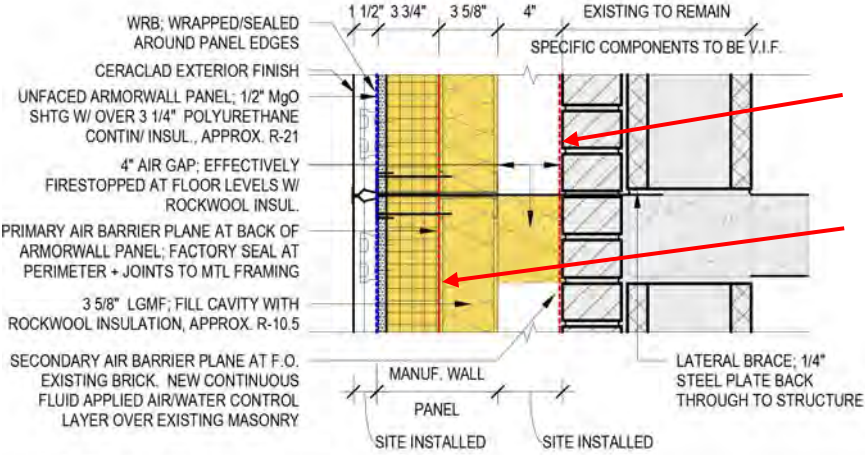
Daisy Orange (HWR912110)

1. The provided color chart is for informational purposes only. Actual color may vary due to lighting conditions and material variations.  
2. Color and texture are subject to change.  
3. Please contact your local distributor for more information and to request a sample.  
4. Product performance and approval documents are available upon request.





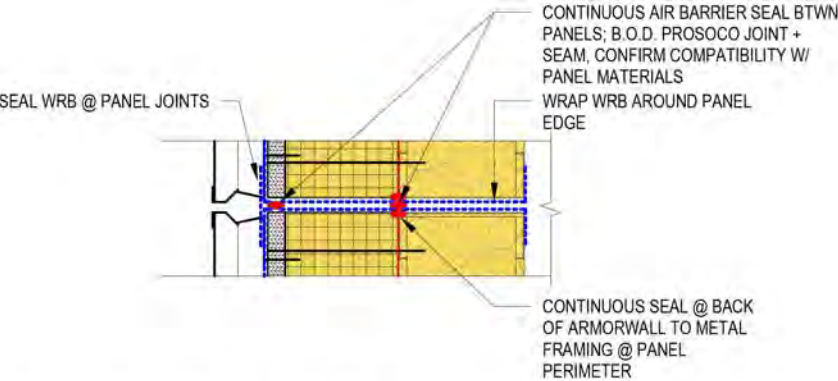
**PANELIZATION**



Liquid applied air barrier on Existing brick facade

Primary air barrier at back of panel

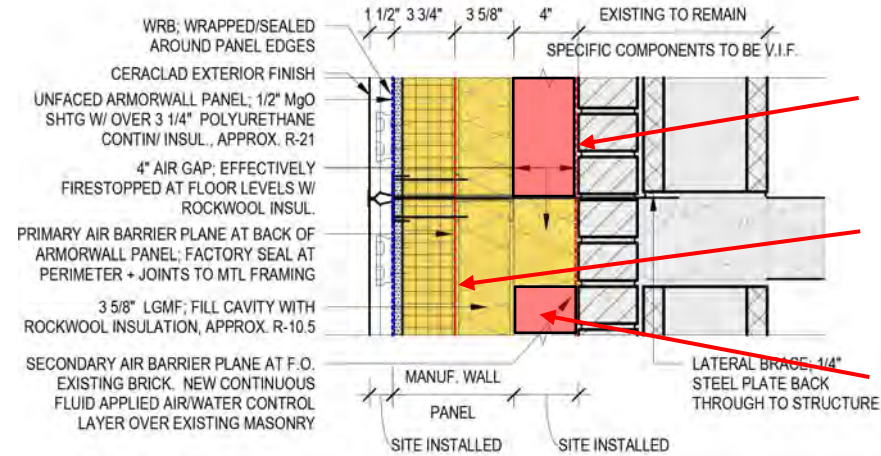
**PROPOSED METALLEVE WALL PANEL**  
1 1/2" = 1'-0"



**PROPOSED METALLEVE WALL PANEL JOINT DETAIL**  
3" = 1'-0"



## PANELIZATION



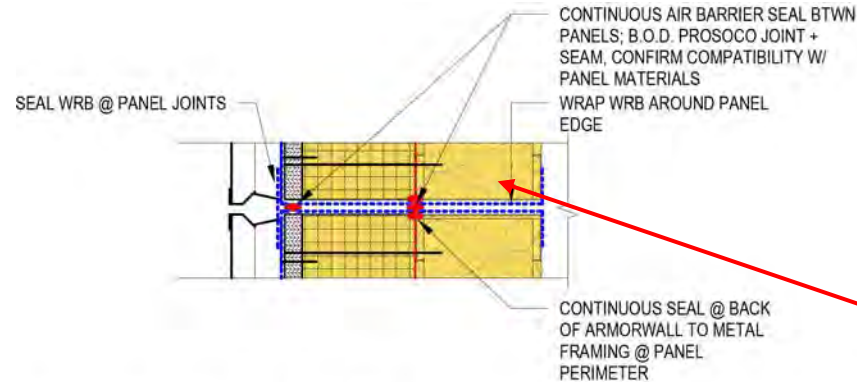
Liquid applied air barrier on Existing brick facade

Primary air barrier at back of panel

4" Air space for running supply Ducts to apts, line sets, and electrical

### PROPOSED METALLEVE WALL PANEL

1 1/2" = 1'-0"



- 2x4 metal stud frame
- Filled with Rockwool
- R21 Armorwall
- Gasket at perimeter of panel
- Finished rainscreen skin

### PROPOSED METALLEVE WALL PANEL JOINT DETAIL

3" = 1'-0"





**HVAC Options:**

1. Unitary Ephoca vertical stack with ERV: **\$3,076,246 [ \$42/sf]; \$24,222/unit**
2. Ephoca thru-wall with centralized ERV:
  - a. ERV ductwork through internal shaft/core: **\$4,311,600 [\$58/sf ]; \$33,949/unit**
  - b. ERV ductwork at exterior: **\$3,759,900 [\$51/sf]; \$29,605/unit**
3. VRF with heat recovery with centralized ERV:
  - a. ERV ductwork through internal shaft/core: **\$3,163,900 [\$43/sf ]; \$29,605/unit**
  - b. ERV ductwork at exterior: **\$3,575,200 [\$48/sf]; \$28,151/unit**
4. HEX refrigerant-water heat exchangers, VRF, condenser loop and water source heat pumps, with centralized ERV:
  - a. ERV ductwork through internal shaft/core: **\$3,514,700 [\$47/sf ]; \$27,647/unit**
  - b. ERV ductwork at exterior: **\$3,926,000 [\$53/sf]; \$30,913/unit**



## VRF w/Heat Recovery and wall hung FCUs + De-coupled ventilation

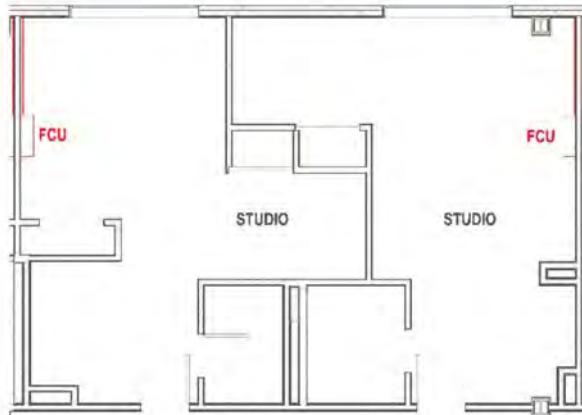
### PROS

- Lowest overall operating cost with heat recovery benefit
- Wall-mounting FCUs does not take away real estate in apartments
- Improved comfort with independent control of heating and cooling
- System can scale to heating/cooling load requirements
- Central maintenance (condensers, controls)

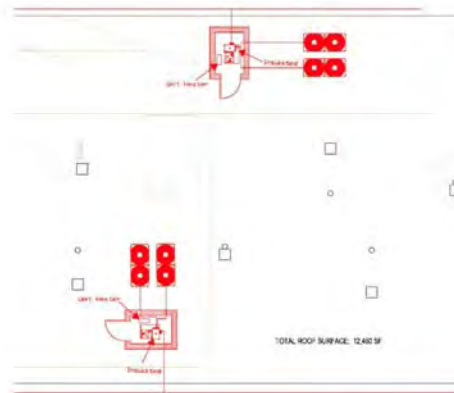
### CONS

- Reduces roof space availability for solar array
- Limited space within building to mount branch controllers, may have to be installed on roof in purpose built semi-conditioned space
- Vertical chases for refrigerant lines may still require fire-stopping
- Externally run refrigerant lines will still require maintenance access

### Heating/Cooling



+



+

### Ventilation

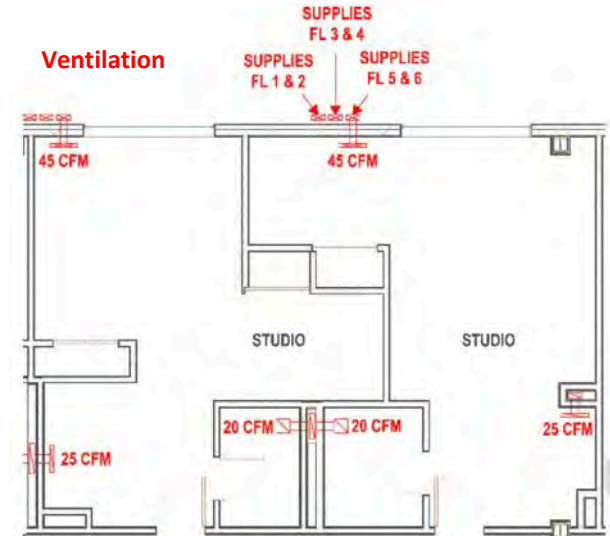


Figure 10: External ductwork staggered



## EMBODIED CARBON

Wall assembly: 6.17 kgCO<sub>2</sub>eq/SF:

METAL/LEVE R-30 WALL PANEL				
COMPONENT / FUNCTION	MATERIAL	NOTES	MATERIAL EPD FACTOR / 100 SF	
LIQUID APPLIED VP AB	HENRY AIRBLOC 17MR		49.7	KG CO <sub>2</sub> e / 100 SF
4" AIR GAP	MINERAL WOOL BOARD / ROCKWOOL / COMFORTBOARD 80 / R 4.2/INCH	FIRESTOPPING ONLY	28	KG CO <sub>2</sub> e / 100 SF
STRUCTURAL FRAME	3 5/8" STEEL STUDS - NON-LOADBEARING / STEEL RECYCLING INSTITUTE / 20EQ GAUGE [INDUSTRY AVG]	3 5/8"	61.2	KG CO <sub>2</sub> e / 100 SF
CAVITY INSULATION	MINERAL WOOL BATT / ROCKWOOL / COMFORTBATT R14 (3 1/2") / R4.0/INCH	3" = R-12	24	KG CO <sub>2</sub> e / 100 SF
STRUCTURAL SHEATHING	ARMORWALL FR SIS PANEL	3 1/4" = R-21	212	KG CO <sub>2</sub> e / 100 SF
AIR, VAPOR, WATER BARRIER	3M 3015 PEEL AND STICK		4.62	KG CO <sub>2</sub> e / 100 SF
MISC METAL ANGLES	METAL ANCHORS TO EXISTING AND SIDING		12.2	KG CO <sub>2</sub> e / 100 SF
CLADDING	FIBER CEMENT SIDING / CEMBRIT / SOLID & EXPRESS / 8MM (5/16")		225	KG CO <sub>2</sub> e / 100 SF
			616.72	KG CO <sub>2</sub> e / 100 SF
		EMBODIED CARBON		6.17 SF

Roof Assembly: 4.25 kgCO<sub>2</sub>eq/SF

ROOF				
COMPONENT / FUNCTION	MATERIAL	NOTES	MATERIAL EPD FACTOR / 100 SF	
ROOF COVERBOARD OVER EXISTING	POLYISO HD COVERBOARD	1/2", R 2.5	99.2	KG CO <sub>2</sub> e / 100 SF
AIR BARRIER	FULLY ADHERED AV BARRIER		8.75	KG CO <sub>2</sub> e / 100 SF
INSULATION	POLYISOCYANURATE / ROOF BOARDS / HIGH DENSITY / R 4.5/INCH / PIMA / INDUSTRY AVG	R-60	237	KG CO <sub>2</sub> e / 100 SF
RECOVERY BOARD	3/4" PLYWOOD / AWC + CWC INDUSTRY AVG		39	KG CO <sub>2</sub> e / 100 SF
ROOF MEMBRANE	TPO ROOFING MEMBRANE, CARLISLE 60 MIL		41	KG CO <sub>2</sub> e / 100 SF
			424.95	KG CO <sub>2</sub> e / 100 SF
		EMBODIED CARBON		4.25 SF

Window assembly: 9.18 kgCO<sub>2</sub>eq/SF

WINDOWS				
COMPONENT / FUNCTION	MATERIAL	NOTES	MATERIAL EPD FACTOR / 100 SF	
VINYL FRAME, TRIPLE PANE	TPO ROOFING MEMBRANE / CARLISLE / 60 MILS	BICA Study [US & CA]	920	KG CO <sub>2</sub> e / 100 SF
			920	KG CO <sub>2</sub> e / 100 SF
		EMBODIED CARBON		9.2 SF

Total Embodied carbon of retrofit: 311.16 MT CO<sub>2</sub>e

**Embodied v. Operational Carbon payback:**

Assuming 60% energy savings: 3.40 yrs.

Assuming 80% energy savings: 1.23 yrs.

**Total Embodied carbon of retrofit: 311.16 MT CO<sub>2</sub>eq**

***Embodied v. Operational Carbon payback:***

Assuming 60% energy savings: 3.40 yrs.

Assuming 80% energy savings: 1.23 yrs.



COMPARING EXISTING SALEM FAIRWEATHER ENERGY CONSUMPTION AND COST OF UTILITIES WITH POST-DEER FAIRWEATHER								
	Baseload					Baseload: With AHU		
		Rate	Usage	Spending	EUI	Usage (kWh)	Spending	EUI (kBtu/sf/yr)
EXISTING SALEM FAIRWEATHER	Electricity	\$ 0.21	316,027	\$ 66,468		556,224	\$ 116,973	
	Gas	\$ 0.97	68,712	\$ 66,791		92,307	\$ 89,731	
	Solar		28,257			28,257		
	<b>Total</b>			<b>\$ 133,259</b>	<b>106</b>		<b>\$ 206,704</b>	<b>165</b>
DEER SALEM FAIRWEATHER	Electricity	\$ 0.21				469,203	\$98,673	21.44
	Solar	\$ 0.21				97,000	\$20,399	
	<b>Total</b>					<b>372,203</b>	<b>\$78,274</b>	<b>18</b>
EUI COMPARISON %								87%
UTILITY COST SAVINGS PER YEAR						\$ 128,430		62%



# PLACETAÏLOR



## Basis Of Design:

- VRF with Centralized ventilation
- Panelized System: \$65/sf installed
- \$10,971,000.00 Hard Cost Budget
- \$148/sf (GFA)
- \$86,386.00 per unit  
(Salem Heights \$160,000/unit)
- Saves \$1million in relocation costs
- \$128,430.00 Utility savings per year

[illegible][illegible]





### GOALS:

- Retrofit 1960's building to NZE standard
- Panelized Envelope strategy to reduce down-time of facility
- 20,000 sf expansion of child care/swimming
- \$24million budget





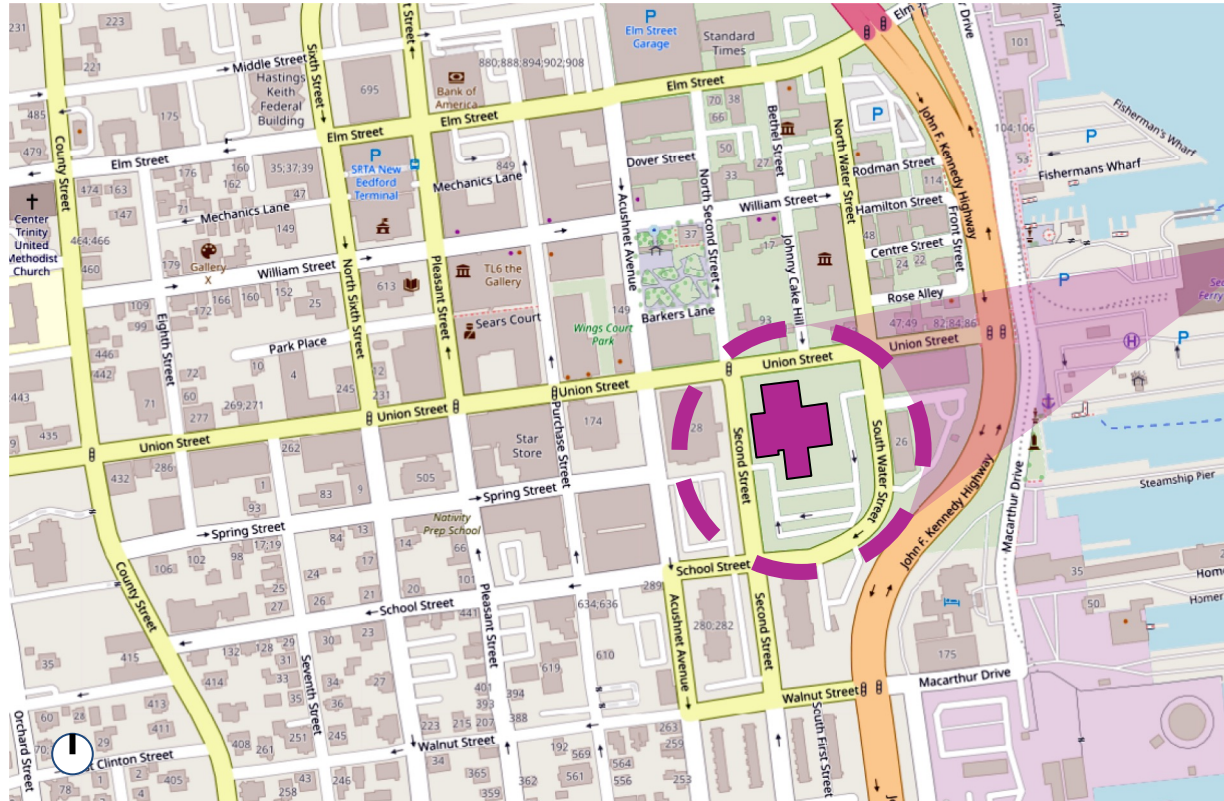
Previous Design: 30,000 sf, \$40million, NO SUSTAINABLE AGENDA

### GOALS:

- Retrofit 1960's building to NZE standard
- Panelized Envelope strategy to reduce down-time of facility
- 20,000 sf expansion of child care/swimming
- \$24million budget



# THE PROJECT SITE



## 25 S WATER STREET

- BOUND BY UNION STREET TO THE NORTH, SECOND STREET TO THE WEST AND SOUTH WATER STREET TO THE EAST AND SOUTH
- JFK HIGHWAY RUNS NORTH/SOUTH AND IS DUE EAST OF THE SITE
- THE HISTORIC BEDFORD WHALING MUSEUM IS JUST NORTH OF THE SITE ALONG THE FAMOUS JOHNNY CAKE HILL
- IMMEDIATELY EAST ON UNION STREET IS THE MAJOR CONNECTION TO THE STATE PIER AND FERRY TERMINALS
- THE SITE IS IN CLOSE PROXIMITY TO MULTIPLE NEW HOUSING DEVELOPMENTS THAT WILL INCREASE FOOT TRAFFIC AND STREET PRESENCE IN THIS AREA.



# THE EXISTING BUILDING



## SITE CONSIDERATIONS & TRAFFIC FLOW

- BUILDING CURRENTLY LACKS A PRESENCE ALONG UNION STREET & LANDSCAPING CREATES CONFUSION AROUND BUILDING ENTRY
- ENTRY SEQUENCE NEEDS TO SERVE MANY POPULATIONS: SCHOOL AGE CHILDREN DROP-OFF, GYM MEMBERS ARRIVING BY VEHICLE, & COMMUNITY MEMBERS ARRIVING ON FOOT OR BICYCLE
- CONSIDER BUILDING SERVICES, TRASH COLLECTION & VEHICULAR TRAFFIC THROUGH & AROUND THE SITE



# THE EXISTING BUILDING

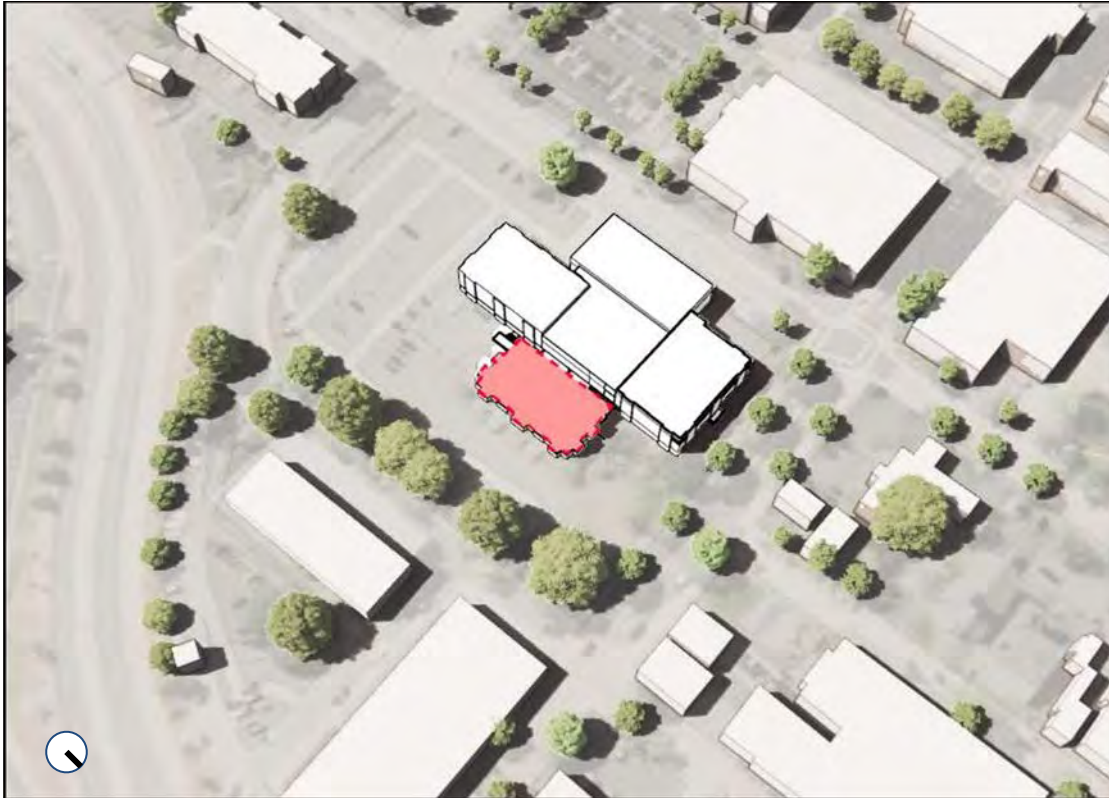


## BUILDING COMPOSITION / STRUCTURE

- 5 MAIN VOLUMES
- FIRST FLOOR OFFSET & ACCESSIBILITY CHALLENGES
- STRUCTURAL VARIATIONS



# PROPOSED IMPROVEMENTS

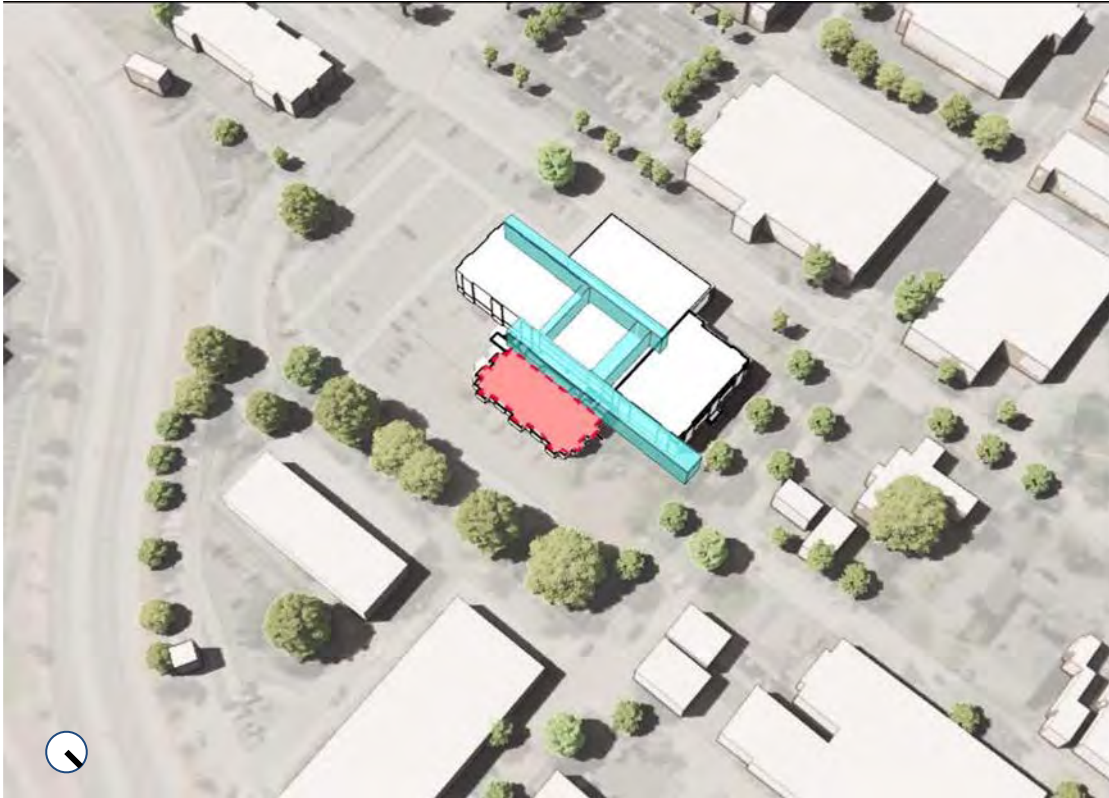


## SELECTIVE DEMOLITION

- REMOVE ONE-STORY ENTRY & CHILDCARE
- CORRECT INTERIOR FLOOR MISALIGNMENT
- MAKE ROOM FOR LARGER CHILDCARE PROGRAMMING



# PROPOSED IMPROVEMENTS

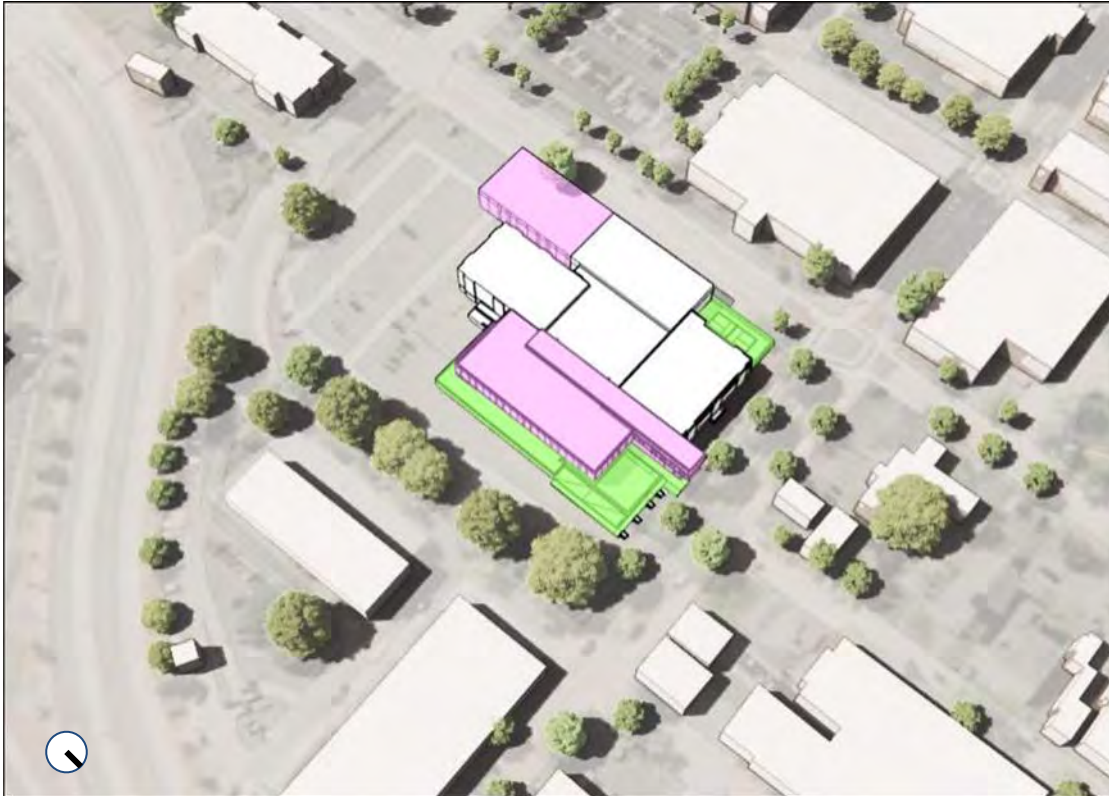


## NEW CLEAR CIRCULATION

- ENTRY SPINE CONNECTING UNION ST. TO PARKING LOT
- CLEAR DELINEATION BETWEEN PROGRAM AREAS
- WORK WITHIN EXISTING STRUCTURAL GRID



# PROPOSED IMPROVEMENTS

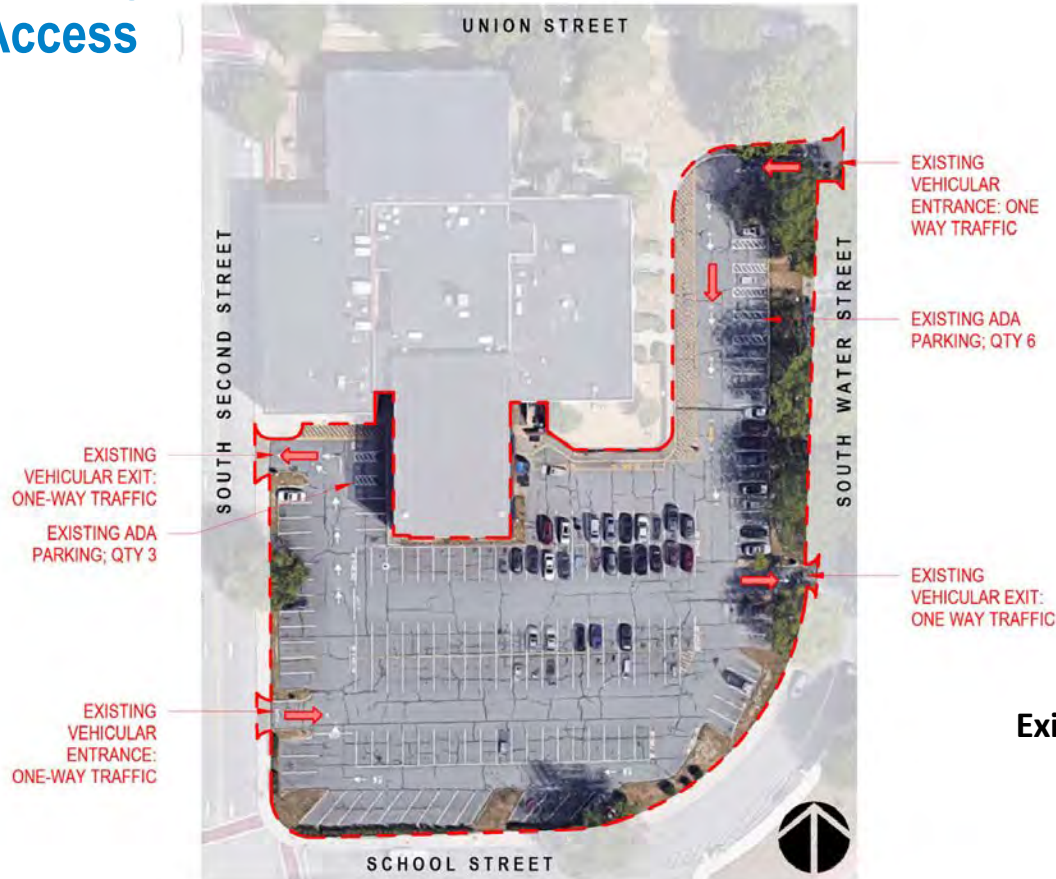


## ADDITIONS & OUTDOOR SPACES

- 2 STORY CHILDCARE ADDITION WITH DEDICATED OUTDOOR PLAY SPACE
- FAMILY POOL
- OUTDOOR MULTI-USE COURT ADJACENT TO MAIN GYM



# Parking Access



## PLAN AROUND FUTURE NEEDS

- INTERNAL VEHICULAR CIRCULATION AND PARKING TO SERVICE THE IMMEDIATE NEEDS OF THE "Y" ARE DESIGNED IN A WAY THAT ACCOMMODATES A FUTURE PARKING STRUCTURE
- INCREASES EFFICIENCY OF CHILDCARE DROP OFF
- INCREASES NUMBER OF REGISTERED PARKING STALLS
- INCREASES PLANNED GREEN SPACE

**Existing Parking Scheme: 123 Parking Spaces**



# Parking Access



**New Parking Scheme: 143 Parking Spaces**  
**Existing Parking Scheme: 123 Parking Spaces**



# Parking Access Green space

OUTDOOR  
COURTYARD

SOUTH SECOND STREET

SOUTH WATER STREET

SCHOOL STREET

NEW OUTDOOR SEATING  
EXTERIOR PLAY SPACE

NEW CHILD CARE  
EXTERIOR PLAY SPACE





## EXTERIOR SPACE: Entry, Existing conditions





## EXTERIOR SPACE: Entry gathering space





## EXTERIOR SPACE: Entry, Proposed





## EXTERIOR SPACE: Precedent image



Miller Park in downtown Chattanooga, TN





## EXTERIOR SPACE: Entry at night

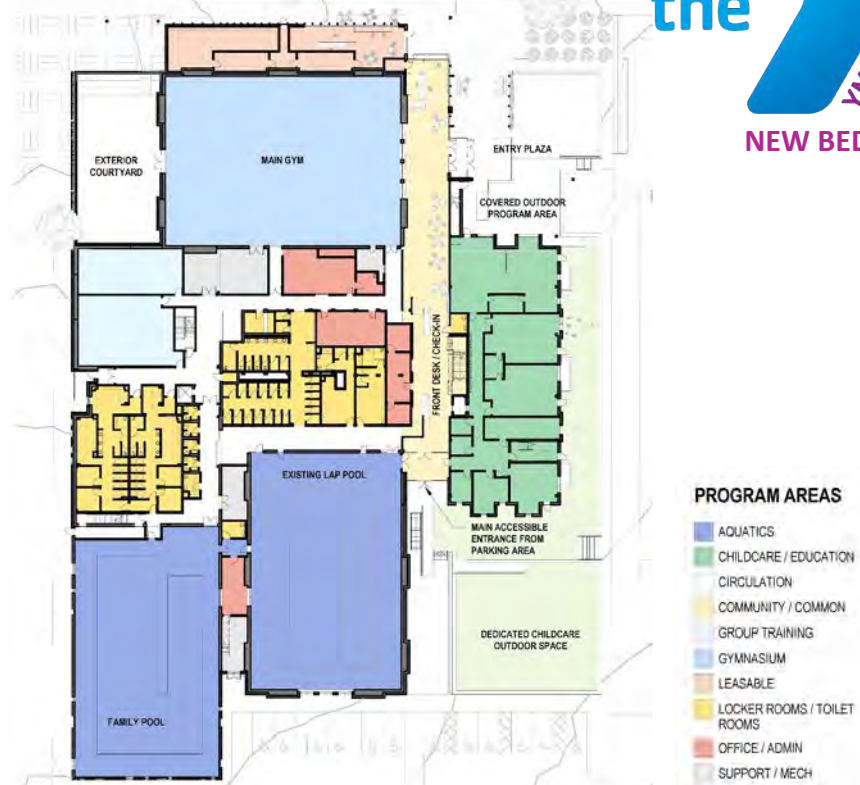




# PROGRAM ANALYSIS – COMMUNITY, MULTI-PUROSE



BASEMENT



GROUND FLOOR PLAN

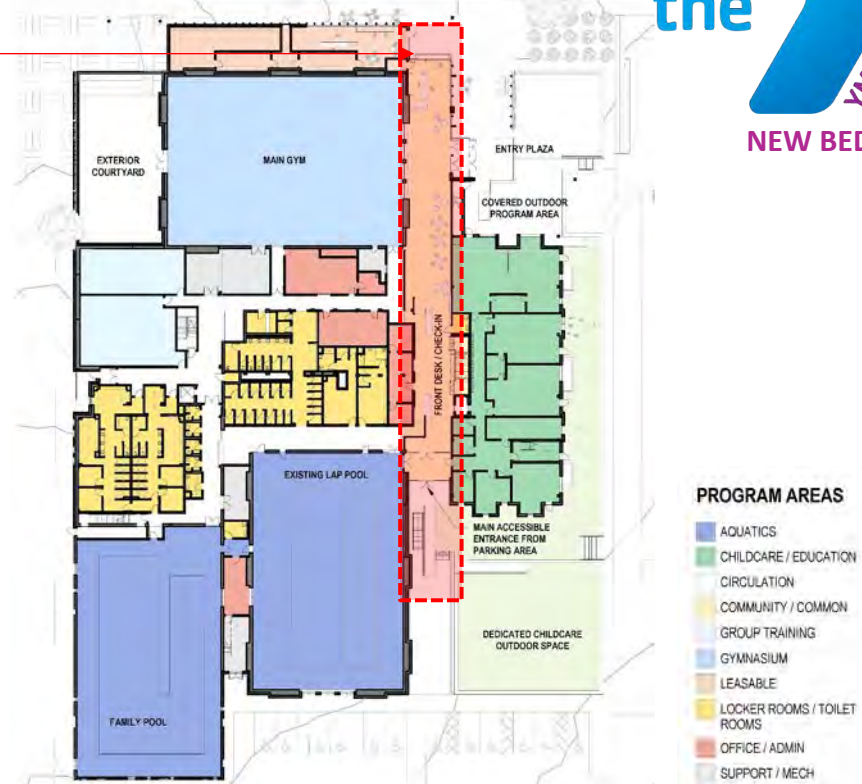


# PROGRAM ANALYSIS – COMMUNITY, MULTI-PUROSE



BASEMENT

"Y STREET"



GROUND FLOOR PLAN



# PROGRAM ANALYSIS – COMMUNITY, MULTI-PUROSE



Above: Rendering of double-height entrance to "Y Street" looking South; new windows into the gym



Above: New Bedford street festival



# PROGRAM ANALYSIS - ADMINISTRATION



## Offices

	EXISTING ADMIN	NEW ADMIN
Executive Director	125	155
Admin. & Break Room	0	378
Aquatics Director	225	205
Meeting/Multipurpose	0	425
Childwatch	721	721
<b>TOTAL AREA (sf):</b>	<b>1,071</b>	<b>1,884</b>

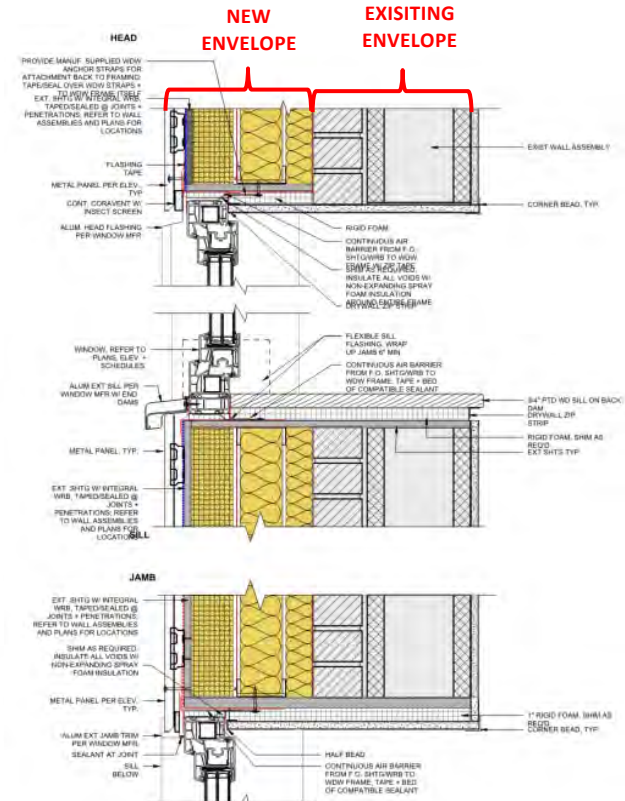
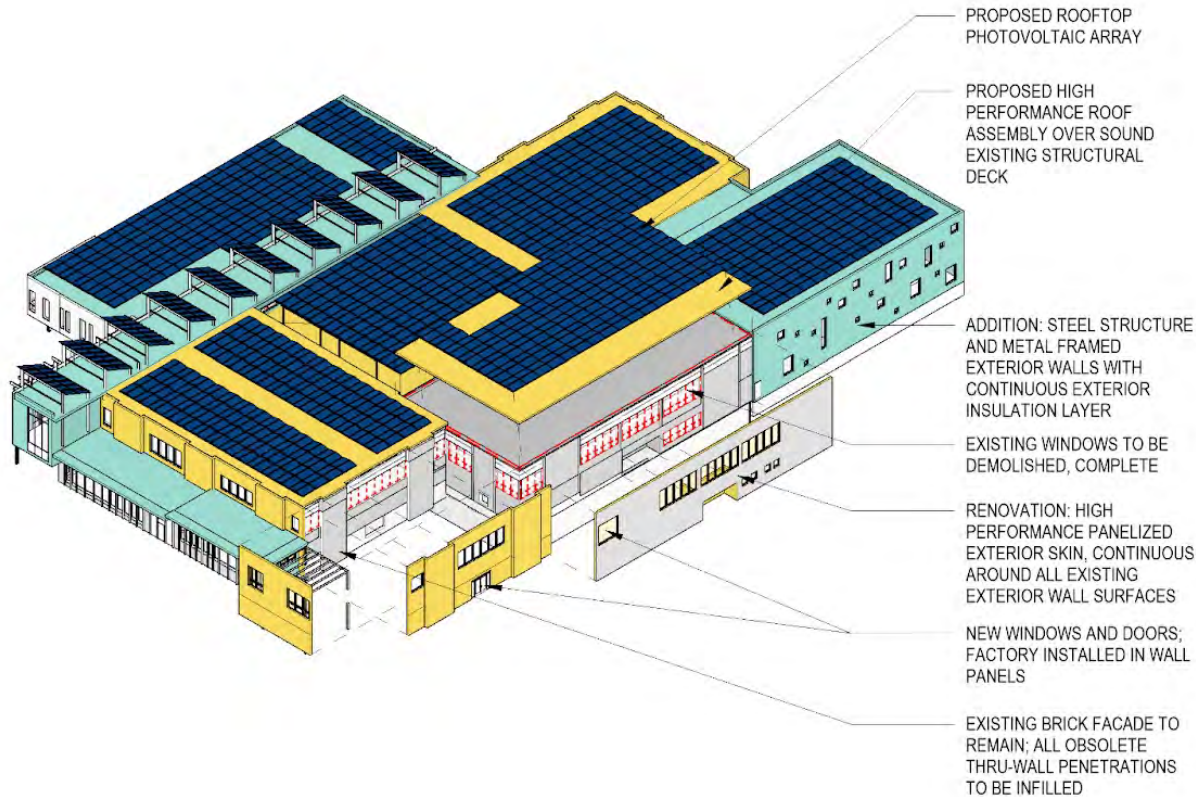








# PANELIZED ENVELOPE

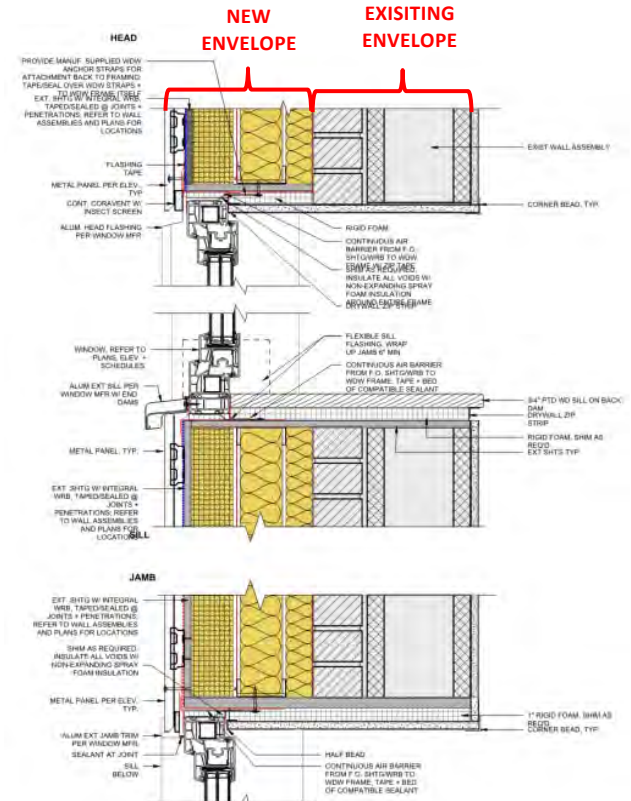




# PANELIZED ENVELOPE



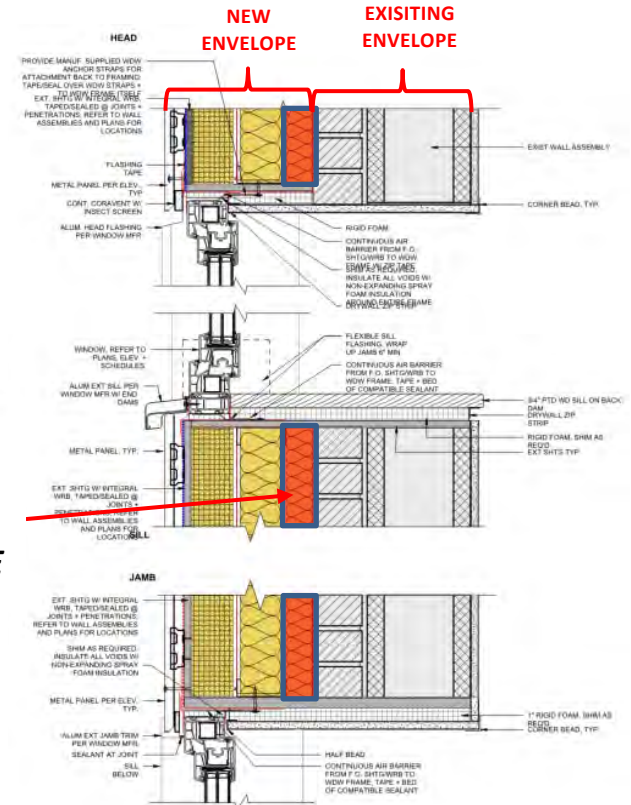
Above: FacadesX factory and site installation, Boston, MA





A 3D cutaway diagram of a wall assembly. The wall consists of several layers: an exterior cladding (light grey), an insulation layer (white), and an interior masonry layer (brown). A vertical red dashed line indicates a thermal bridge location. A red arrow points to the junction where the wall meets a horizontal structural element (a window sill or lintel). The diagram shows how heat can bypass the insulation through this junction.

**DUCTING, ELECTRICAL,  
REFRIGERATION LINES  
RUN THROUGH 4" SPACE**





# PANELIZED ENVELOP



1 | EAST ELEVATION  
Scale: 3/32" = 1'-0"



# PANELIZED ENVELOP



1 | SOUTH ELEVATION  
Scale: 3/32" = 1'-0"



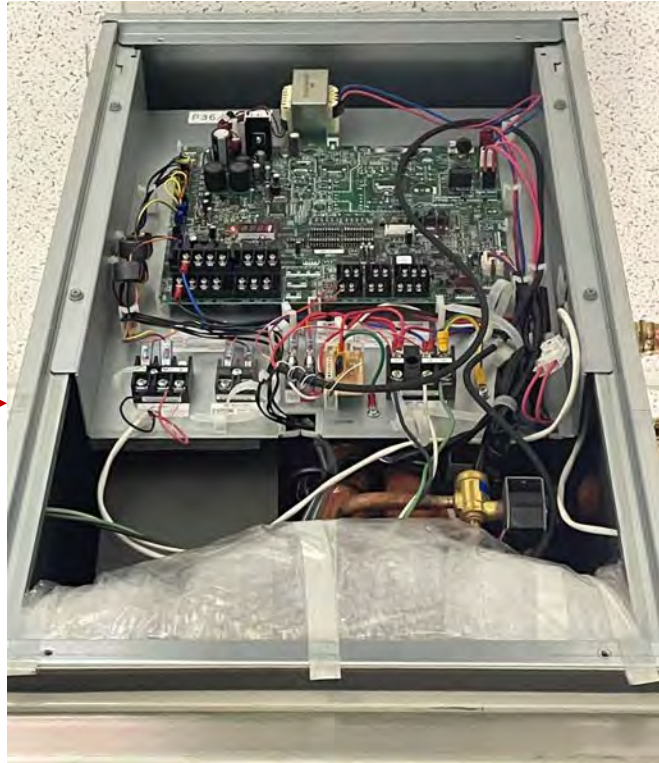
2 | WEST ELEVATION  
Scale: 3/32" = 1'-0"



# HEATING, VENTILATION, AIR CONDITIONING (HVAC)

HEATING/ COOLING

HEX System



Refrigerant

Hydronic

Hot or Cold

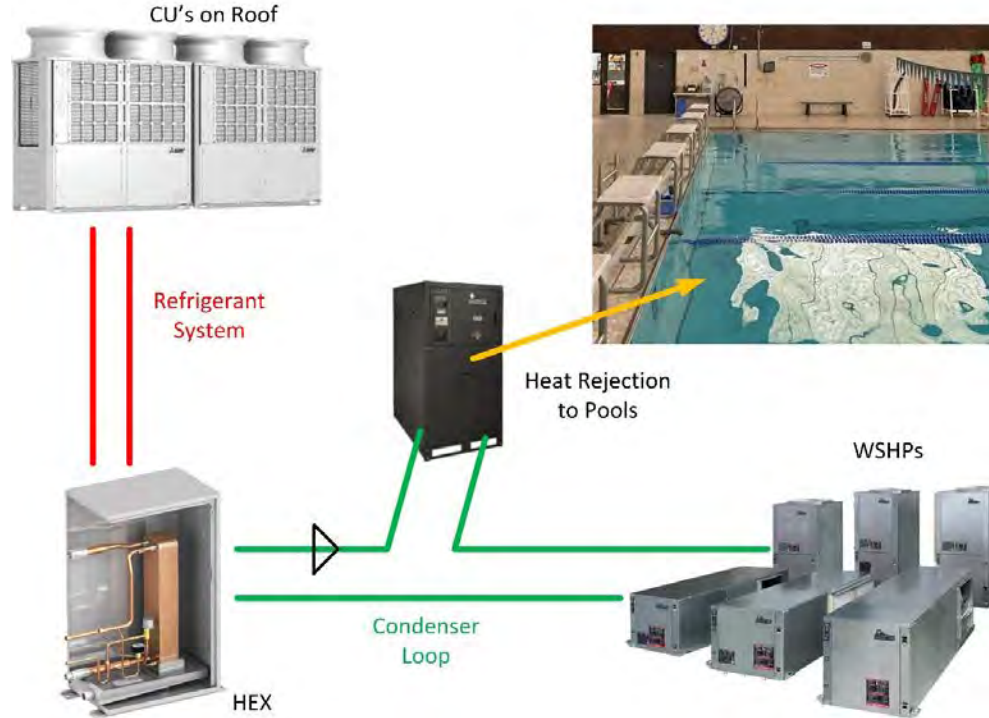
Water

**BUILDING EVOLUTION CORPORATION**  
*Achieve Performance & Durability Through A Holistic Approach™*



# HEATING, VENTILATION, AIR CONDITIONING (HEX VRF)

## HEATING/ COOLING



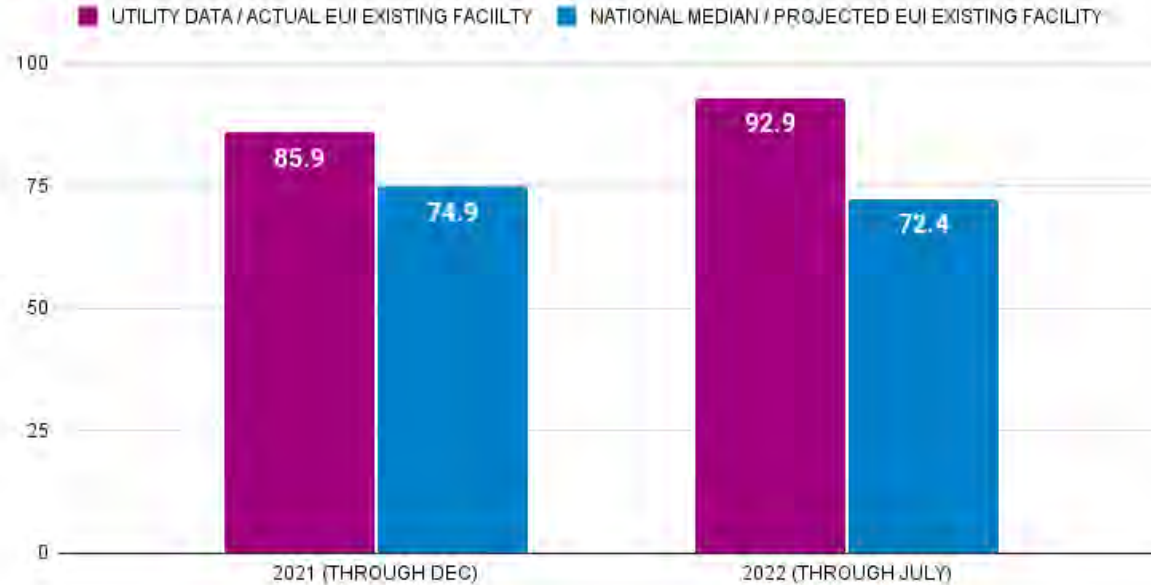


# ENERGY ANALYSIS

## EXISTING CONSUMPTION



### EXISTING ENERGY USAGE INTENSITY (EUI) - NEW BEDFORD YMCA FACILITY



## EXISTING EUI

### Electric and Gas Cost for the NBY in 2021

- Natural Gas (Eversource)	\$39,989.23
- Electric (Eversource & Constellation)	\$74,282.62

### TOTAL

**\$122,412.00**    **2022**  
**\$114, 271.00**



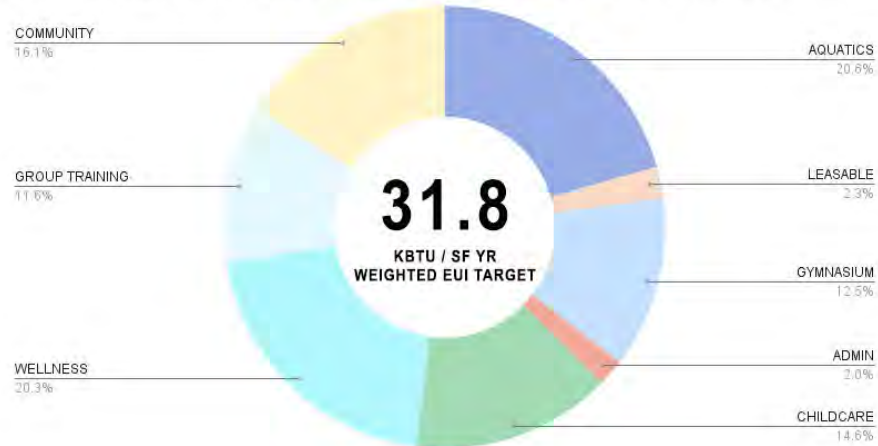
# ENERGY ANALYSIS

## PROPOSED CONSUMPTION



### AREA BREAKDOWN BY %

\*MECHANICAL/CIRCULATION/SERVICE AREAS INCLUDED IN AREA TOTALS, AS THEY RELATE TO EACH PROGRAM AREA

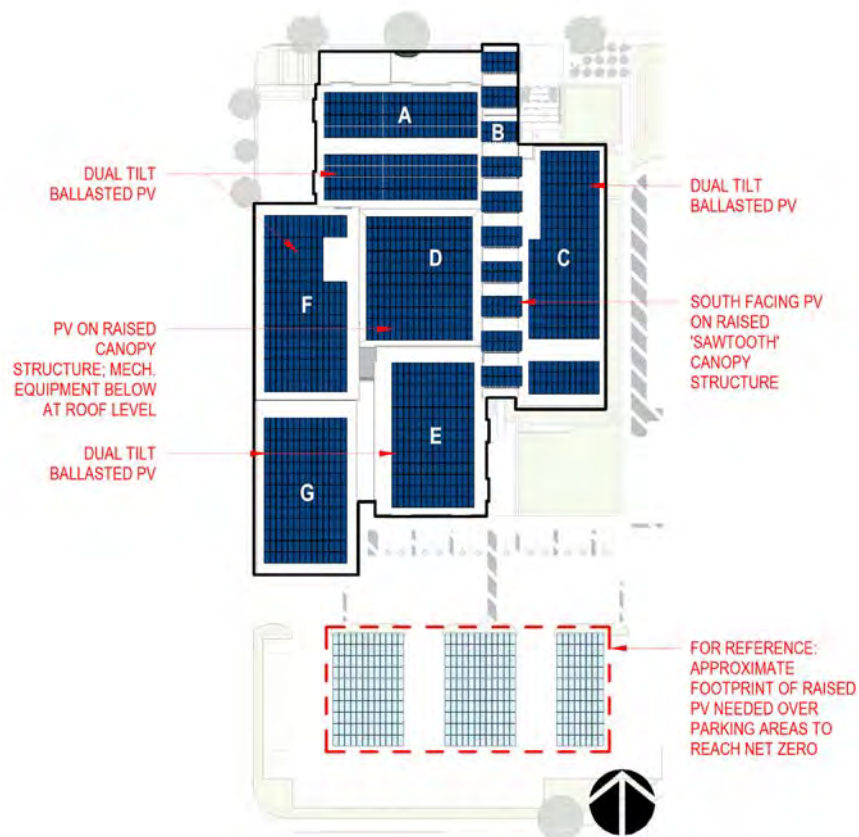


**PROPOSED EUI**



# ENERGY ANALYSIS

## SOLAR PV



PV SCHEDULE			
ROOF LOCATION	DESCRIPTION	TOTAL PANELS	kWh/yr
ROOF A	E/W DUAL TILT, BALLASTED	208	105765
ROOF B	SOUTH FACING, RAISED SUPPORT CANOPY	140	85515
ROOF C	E/W DUAL TILT, BALLASTED	224	114798
ROOF D	E/W DUAL TILT, RAISED SUPPORT CANOPY	198	101474
ROOF E	E/W DUAL TILT, BALLASTED	182	93274
ROOF F	E/W DUAL TILT, BALLASTED	208	106599
ROOF G	E/W DUAL TILT, BALLASTED	182	93274
		1342	700699



# ENERGY ANALYSIS



## ENERGY USAGE INTENSITY (EUI) COMPARISON



**93% REDUCTION IN ENERGY**



# ENERGY ANALYSIS



## ENERGY USAGE INTENSITY (EUI) COMPARISON



**\$122,412 PER YEAR**

**78% REDUCTION IN UTILITY COST**  
**\$27,519 PER YEAR**



# ENERGY ANALYSIS



## ENERGY USAGE INTENSITY (EUI) COMPARISON



**\$94,893.00**

**UTILITY  
SAVINGS  
PER YEAR....  
.....EVERY  
YEAR**

**\$122,412 PER YEAR**

**78% REDUCTION IN UTILITY COST  
\$27,519 PER YEAR**



# BUDGET

# INCENTIVES

NEW Deep Energy Retrofit BASE BUILDING BUDGET

(with landscaping, parking, solar, all site work, retail space)

**\$24,193,449.00 (\$275/sf)**



November 28, 2022				
SECTION	ITEM	AMOUNT	COST/SF	REMARKS
01 00 00	PROJECT REQUIREMENTS	88,263	\$1.00	
02 40 00	DEMOLITION	808,600	\$9.20	
03 00 00	CONCRETE WORK	2,136,976	\$24.31	
04 00 00	MASONRY	0	\$0.00	confirm scope / exist. Bldg. retains
05 10 00	STRUCTURAL FRAME	1,475,545	\$16.78	
05 41 00	LGM FRAMING & DRYWALL	374,745	\$4.26	
05 50 00	MISCELLANEOUS IRON	335,000	\$3.47	
06 10 53	ROUGH CARPENTRY	152,200	\$1.73	
06 22 00	MILLWORK & TRIM	150,000	\$1.71	allowance - scope TBD
07 10 00	WATERPROOFING	233,395	\$2.65	
07 42 00	METAL SIDING/SOFFITS	2,468,685	\$28.08	pricing provided by FacadesX
07 50 00	ROOFING	729,000	\$8.29	
08 11 00	DOORS/FRAMES/HARDWARE	217,700	\$2.48	
08 50 00	WINDOWS & GLAZING	389,670	\$4.43	
09 30 13	CERAMIC TILE	383,630	\$4.36	exist. pool tile to remain
09 50 00	ACOUSTIC CEILINGS	269,364	\$3.06	
09 65 00	RESILIENT FLOORING	344,866	\$3.92	
09 91 00	PAINTING	338,484	\$3.85	
10 00 00	SPECIALTIES	152,675	\$1.74	
13 11 13	POOL	485,000	\$5.52	based on 3'-0" deep pool
14 20 00	ELEVATOR	157,500	\$1.79	
21 00 00	SPRINKLER	541,508	\$6.16	
22 00 00	PLUMBING	151,300	\$1.72	
23 00 00	HVAC	5,247,825	\$59.69	
26 00 00	ELECTRICAL & FIRE ALARM	2,415,987	\$27.48	
	<b>SUBTOTAL</b>	<b>20,017,918</b>		
00 72 00	GENERAL CONDITIONS	806,120	\$15.71	based on a 12 month project
-	BUILDERS RISK INSURANCE	0	\$0.00	None by Owner
-	UMBRELLA INSURANCE	116,208	\$1.40	
-	LIABILITY INSURANCE	166,919	\$2.02	
-	SUBCONTRACT BONDS	0	\$1.91	on major trades only
-	CONTRACTOR'S FEE	733,883	\$9.13	
-	BUILDING PERMITS & FEES	35,000	\$0.51	lump sum - new \$.45/sf reno = \$.30/sf
	CONTINGENCY	1,100,000		
	<b>SUBTOTAL</b>	<b>2,958,139</b>		
<b>INCENTIVES</b>	Mass Save, MassCEC, Fed	-1,000,000		
	<b>NET BASE BUILDING</b>	<b>\$21,976,049</b>	<b>\$249.96</b>	<b>bldg. area = 87,918sf</b>

SITework				
NO.	ITEM	AMOUNT	COST/SF	REMARKS
31 00 00	SITework PAVING & CURBS	825,000	\$9.38	allowance - scope TBD allowance - scope TBD allowance - scope TBD allowance -
32 00 00	LANDSCAPING & IRRIGATION	260,000	\$3.68	scope TBD allowance - scope TBD
32 90 00	SITE IMPROVEMENTS	75,000	\$0.85	allowance - building shell only
32 30 00	Soccer / Playfield Lease / Rental Space	39,300	\$0.45	
A B		100,000		
	<b>SITework</b>	<b>\$1,828,800</b>		

ADD ALTS				
C	Photovoltaics	1,388,000		
<b>INCENTIVES</b>	Mass Save, Fed	-1,000,000		
	<b>TOTAL</b>	<b>\$388,000</b>		

<b>NEW BASE BUILDING with PV AND SITE</b>	<b>\$24,193,449</b>	<b>\$275.18</b>	<b>Versus all New Construction at \$455/sf or \$40,002,690.00</b>
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<b>FURTHER REDUCTIONS</b>	1800 sf reduction 1st/2nd fl "Main Street"	810,000
	850 sf reduction of new pool area	292,500
	Smaller raised play area	-260,000
	<b>SUBTOTAL</b>	<b>1,352,500</b>

<b>REDUCED</b>	<b>NEW BASE BUILDING with PV AND SITE</b>	<b>\$22,840,949</b>	<b>\$259.80</b>	<b>Versus all New Construction at \$455/sf or \$40,002,690.00</b>
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# BUDGET

# INCENTIVES

## NEW Deep Energy Retrofit BASE BUILDING BUDGET

(with landscaping, parking, solar, all site work, retail space...)

**\$24,193,449.00 (\$275/sf)**

\*NOTE: Still verifying incentives from Mass Save, Mass CEC, Federal Govt., New Bedford, etc.....currently showing **\$2million** in total incentives.....

...More incentives will be available for **Design Fees** in 2023...

## DEMOLISH....NEW CONSTRUCTION

(with landscaping, parking, solar, all site work, retail space...)

**\$40,002,690.00 (\$455/sf)**

November 28, 2022				
SECTION	ITEM	AMOUNT	COST/SF	REMARKS
01 00 00	PROJECT REQUIREMENTS	88,263	\$1.00	
02 40 00	DEMOLITION	808,600	\$9.20	
03 00 00	CONCRETE WORK	2,136,976	\$24.31	
04 00 00	MASONRY	0	\$0.00	confirm scope / exist. Bldg. retains
05 10 00	STRUCTURAL FRAME	1,475,545	\$16.78	
05 41 00	LGM FRAMING & DRYWALL	374,745	\$4.26	
05 50 00	MISCELLANEOUS IRON	305,000	\$3.47	
06 10 53	ROUGH CARPENTRY	152,200	\$1.73	
06 22 00	MILLWORK & TRIM	150,000	\$1.71	allowance - scope TBD
07 10 00	WATERPROOFING	233,395	\$2.65	
07 42 00	METAL SIDING/SOFFITS	2,468,685	\$28.08	pricing provided by FacadesX
07 50 00	ROOFING	729,000	\$8.29	
08 11 00	DOORS/FRAMES/HARDWARE	217,700	\$2.48	
08 50 00	WINDOWS & GLAZING	389,670	\$4.43	
09 30 13	CERAMIC TILE	383,630	\$4.36	exist. pool tile to remain
09 50 00	ACOUSTIC CEILINGS	269,364	\$3.06	
09 65 00	RESILIENT FLOORING	344,866	\$3.92	
09 91 00	PAINTING	338,484	\$3.85	
10 00 00	SPECIALTIES	152,675	\$1.74	
13 11 13	POOL	485,000	\$5.52	based on 3'-0" deep pool
14 20 00	ELEVATOR	157,500	\$1.79	
21 00 00	SPRINKLER	541,508	\$6.16	
22 00 00	PLUMBING	151,300	\$1.72	
23 00 00	HVAC	5,247,825	\$59.69	
26 00 00	ELECTRICAL & FIRE ALARM	2,415,987	\$27.48	
	<b>SUBTOTAL</b>	<b>20,017,918</b>		
00 72 00	GENERAL CONDITIONS	806,120	\$15.71	based on a 12 month project
-	BUILDERS RISK INSURANCE	0	\$0.00	None by Owner
-	UMBRELLA INSURANCE	116,208	\$1.40	
-	LIABILITY INSURANCE	166,919	\$2.02	
-	SUBCONTRACT BONDS	0	\$1.91	on major trades only
-	CONTRACTOR'S FEE	733,883	\$9.13	
-	BUILDING PERMITS & FEES	35,000	\$0.51	lump sum - new \$.45/sf reno = \$.30/sf
-	CONTINGENCY	1,100,000		
	<b>SUBTOTAL</b>	<b>2,958,139</b>		
	<b>INCENTIVES</b> Mass Save, MassCEC, Fed	<b>-1,000,000</b>		
	<b>NET BASE BUILDING</b>	<b>\$21,976,049</b>	<b>\$249.96</b>	<b>bldg. area = 87,918sf</b>

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NO.	ITEM	AMOUNT	COST/SF	REMARKS
31 00 00	SITEWORK PAVING & CURBS	825,000	\$9.38	allowance - scope TBD allowance - scope TBD allowance - scope TBD allowance -
32 00 00	LANDSCAPING & IRRIGATION	260,000	\$3.98	scope TBD allowance - scope TBD
32 90 00	SITE IMPROVEMENTS	75,000	\$0.85	allowance - building shell only
32 30 00	Soccer / Playfield Lease / Rental Space	39,300	\$0.45	
A B		100,000		
	<b>SITEWORK</b>	<b>\$1,828,800</b>		
	<b>ADD ALTS</b>			
C	Photovoltaics	1,388,000		
	<b>INCENTIVES</b> Mass Save, Fed	<b>-1,000,000</b>		
	<b>TOTAL</b>	<b>\$388,600</b>		

<b>NEW BASE BUILDING with PV AND SITE</b>		<b>\$24,193,449</b>	<b>\$275.18</b>	<b>Versus all New Construction at \$455/sf or \$40,002,690.00</b>
<b>FURTHER REDUCTIONS</b>	1800 sf reduction 1st/2nd fl "Main Street"	810,000		
	850 sf reduction of new pool area	292,500		
	Smaller raised play area	-260,000		
	<b>SUBTOTAL</b>	<b>1,352,500</b>		
<b>REDUCED</b>	<b>NEW BASE BUILDING with PV AND SITE</b>	<b>\$22,840,949</b>	<b>\$259.80</b>	<b>Versus all New Construction at \$455/sf or \$40,002,690.00</b>









**THANK  
YOU**

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