

# RetrofitNY Cost-Compression Study Phase One: Evaluation of Deliverables and Main Cost Drivers

Final Report | Report Number 20-09 | March 2020

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# **RetrofitNY**

## **Cost-Compression Study Phase One: Evaluation of Deliverables and Main Cost Drivers**

*Final Report*

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## Notice

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## **Abstract**

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New York State Energy Research and Development Authority's (NYSERDA) PON 3750 RetrofitNY High-Performance Retrofit Solutions Design aimed to spark the creation of standardized, scalable solutions and processes to improve the performance of multifamily residential buildings in New York State. Of the six projects in the program, three represented low-rise projects in Upstate New York and three midrise projects in the New York Metropolitan Area.

The biggest cost drivers for the projects were consistent although the order varied slightly depending on whether the projects were upstate or downstate. Major cost-driving categories were HVAC, mechanical, electrical, plumbing (MEP), facades, general conditions, interior finishes, solar PV, lights and appliances, overhead and profit, and soft costs. This analysis highlights commonalities across projects, estimated costs of each of the top five most expensive net zero strategies, a discussion of the major cost drivers for each, and recommendations for further clarifications.

## **Keywords**

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Net zero, construction cost, incremental cost, retrofit cost, RetrofitNY, electrification, air-source heat pumps, energy-recovery ventilation, envelope improvement, cost compression

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# Executive Summary

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New York State Energy Research and Development Authority's (NYSERDA) PON 3750 RetrofitNY High-Performance Retrofit Solutions Design aimed to spark the creation of standardized, scalable solutions and processes to improve the performance of multifamily residential buildings in New York State. Steven Winter Associates, Inc. was engaged to do the following:

- Review the proposed solutions and identify the primary cost drivers for each solution.
- Summarize the full cost of the solutions with the highest costs and identify their biggest cost drivers.
- Identify the intermediary markups for the components identified as the primary cost drivers.

Of the six projects in the program, three represented low-rise projects in Upstate New York and three midrise projects in the New York Metropolitan Area. The analysis conducted reviewed all six projects side by side as well as in the specific geographic areas and corresponding building typology since they face different logistical and economic challenges.

Each team provided a midterm and final evaluation for their projects. The following are challenges faced in evaluating these designs and the associated costs:

- Change in number of buildings or units between the midterm and final reports
- Change in the energy use intensity (EUI) target between the two phases
- Refined business as usual estimates between the two phases
- Lack of enough detail in the estimates to properly assign full costs to each energy improvement
- Changes in pricing with no indication of change in scope
- Changes in product manufacturer on recommendation of consultants
- Lack of response to requests for clarifications

Because of these extensive challenges, the midterm deliverables are treated qualitatively and the analysis of project costs in this report focuses solely on the estimates for business as usual and net zero improvements in the final reports.

The biggest cost drivers for the projects were consistent although the order varied slightly depending on whether the projects were upstate or downstate. First, the following major categories along with their corresponding subcategories (if applicable) were evaluated:



- HVAC—heating and cooling, ventilation, domestic hot water (DHW) and controls, electrical
  - Electrical was assumed to be largely tied to HVAC upgrades
- Façade—walls, windows, roof, doors, storefront, other openings
- General Conditions and Site—general conditions, sitework, concrete, masonry, metals, woods, and plastics, furnishings, elevator, safety and security
- Interior Finishes
- Solar PV
- Lights and Appliances
- Overhead—overhead, profit, insurance
- Soft costs

The major categories were further analyzed as 17 subcategories. This highlighted cost drivers as above grade walls, heating/cooling, and general conditions/overhead/soft costs.

A further look into these analyses is provided in the body of this report and includes commonalities across projects, estimated costs of each of the top five most expensive net zero strategies, a discussion of the major cost drivers for each, and recommendations for further clarifications.

# 1 Introduction

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In spring of 2018, New York State Energy Research and Development Authority (NYSERDA) released PON 3750 RetrofitNY High-Performance Retrofit Solutions Design with the goal of spearheading the creation of standardized, scalable solutions and processes that would dramatically improve the energy performance of multifamily residential buildings, while improving their aesthetics and comfort. RetrofitNY is working aggressively to bring a substantial portion of New York State's affordable housing units to or near net zero energy performance over the next decade, and in so doing develop significant new business opportunities in the State.

NYSERDA qualified Solution Provider Teams to design high-performance retrofit solutions as well as affordable housing multifamily buildings that were appropriate candidates for retrofits with these solutions. Other requirements included the following:

- Buildings needed to be affordable housing multifamily buildings no taller than seven stories, for which a substantial rehabilitation or comparable work was already in the plans for the 12–24 months following the application.
- Solution Provider Teams were required to demonstrate their ability to design, build, and maintain retrofit solutions that could:
  - approach or achieve net zero energy performance
  - exclude the use of fossil fuels onsite
  - be standardized, scalable, and expected to be cost-effective when implemented at scale
  - improve resident health, comfort and quality of life
  - be installed with minimal resident disturbance or displacement
  - covered by a long-term performance guarantee from the Solution Provider Team
  - contribute to building resiliency

Qualified teams and owners of qualified buildings then had the opportunity to pair up and submit a Joint Project Application to NYSERDA. Ultimately, six contracts were awarded to qualified team/building pairs late summer of 2018.

All buildings were expected to achieve a site energy use intensity (EUI) of 20 kilo British thermal units per square foot per year (kBtu/ft<sup>2</sup>/year) or less. The teams were given some basic design parameters to follow. First it was recommended that the combined space heating and cooling site EUI was not to exceed 11 kBtu/ft<sup>2</sup>/year. Additionally, to ensure comfort and service, assumptions for set points and end uses were limited to the following:

- Minimum heating season space temperature: 68° F (daytime: 6 a.m.–10 p.m.), 62° F (nighttime: 10 p.m.–6 a.m.)
- Maximum cooling season space temperature: 77° F
- Domestic hot water service: 21 gallons/person/day delivered at 120°F
- Apartment ventilation as the greater of:
  - 20 cubic feet per minute (cfm) per bathroom + 25 cfm per kitchen
  - 18 cfm per person
- Solutions must account for a reasonable level of apartment-level electrical consumption (lighting, appliances, and plug loads), expected to be at least 5 kBtu/ft<sup>2</sup>/year.

The teams were given six months to provide schematic design documents for each of their proposed solutions. A conceptual or “midterm” design report was due three months into the process and included:

- Conceptual drawings, standard details, critical custom details, specifications, and renderings, and room details
- Projected budget
- Preliminary construction schedule
- Preliminary life-cycle cost analysis for the building over the expected term of financing
- Preliminary building performance summary
- Preliminary on-site distributed energy resource summary
- Regulatory barriers
- Resiliency summary

Due to the high costs of the retrofit solutions in the midterm reports, NYSERDA relaxed the project site EUI target to 27 kBtu/ft<sup>2</sup>/year. This allowed the teams room to reduce efficiencies in areas that were particularly costly.

At the six-month mark, the teams were to supply updates to all deliverables listed above in addition to the following:

- Replicability plan
- Financing plan
- Resident management plan
- High-performance guarantee
- Resident health summary
- Proposal for performing any elements of the building’s rehabilitation scope of work not included in the high-performance retrofit solution.

Table 1 and Table 2 list the resulting midterm and final EUIs for each of the six teams proposing solutions for RetrofitNY.

Table 3 and Table 4 show the breakouts by end use for the final solutions.

**Table 1. RetrofitNY Summary: Whole Building EUI [kBtu/ft<sup>2</sup>/yr] Upstate Projects**

Upstate Projects	ICAST	King & King	SWBR
Climate Zone	5	5 (on border of 6)	6
Midterm	16.3*	20.2	17.7*
Final	21.4	22.7	26.7

\* SWA was not provided with midterm results for these teams. Values are taken from Solutions v.5 provided by NYSERDA.

**Table 2. RetrofitNY Summary: Whole Building EUI [kBtu/ft<sup>2</sup>/yr] NYC Projects**

NYC Projects	Bright Power	Chris Benedict, RA	Levy
Climate Zone	4	4	4
Midterm	26.3	16.0	20.3
Final	29.6	18.1	30.4

**Table 3. RetrofitNY Summary: End Use Analysis [kBtu/ft<sup>2</sup>/yr] Upstate Projects**

Upstate Projects	ICAST	King & King	SWBR
Climate Zone	5	5 (on border of 6)	6
Heating	2.98	5.1	2.2
Cooling	1.82	0.7	1.1
DHW	5.94	5.3	5.4
Lighting and Plugs	10.67	11.6	18

**Table 4. RetrofitNY Summary: End Use Analysis [kBtu/ft<sup>2</sup>/yr] NYC Projects**

NYC Projects	Bright Power	Chris Benedict, RA	Levy
Climate Zones	4	4	4
Heating	5.7	1.1	0.7
Cooling	1.0	0.8	2.2
DHW	4.7	6.2	7.2
Lighting and Plugs	18.3	11.5	19.7

The following sections describe the evaluation and comparison of the solutions provided in the project teams' reports, identification of major cost drivers common across the teams, and research to determine intermediary markups and the potential for cost compression.

## 2 Task 1. Identify Primary Cost-Drivers

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### 2.1 Review Process and Clarifications Received

The first step in this analysis involved a review of the project documentation provided to NYSERDA from the six RetrofitNY project teams listed in Table 5.

**Table 5. RetrofitNY Project Teams**

<b>Team Lead</b>	<b>Project Name</b>	<b>City</b>
<b>Bright Power</b>	300-304 East 162nd St	Bronx
<b>Chris Benedict, RA</b>	104-110 Grove St	Brooklyn
<b>Levy Partnership</b>	439 West 125th Street	New York
<b>ICAST &amp; AOW</b>	Martin Luther King apartments	Troy
<b>King + King</b>	Christopher Court, 22 Maplehurst Drive	Phoenix
<b>SWBR</b>	Portville Square	Portville

Of the documents provided for review, the primary documents referenced in this report include the following:

- Midterm conceptual design narratives
- Report 04. RetrofitNY— Final Budget and Financing Plan
- Report 06. RetrofitNY—Building Performance Summary
- NYSERDA’s solutions summary spreadsheet v.5

These reports provided insights into pricing and energy use intensity breakdown by end use; however, details and the deliverables were not consistently provided in the midterm deliverable packages across the teams. For example, the SWBR and Chris Benedict, RA teams did not provide a midterm 06. Building Performance Summary report. The level of detail in the cost estimates also varied greatly among teams.

After comparing each subcategory scope across projects, Steve Winter Associates (SWA) reached out to the project teams via email and telephone to obtain clarity and further breakdown of costs where needed. Some were able to provide more granular breakdowns than were provided in the summary reports, while others could not separate line items, such as ventilation from heating and cooling.

Challenges faced in evaluating these designs and the associated costs were complex and included the following:

- Change in number of buildings or units between the midterm and final reports
- Change in the EUI target between the two phases
- Refined business as usual estimates between the two phases
- Lack of enough detail in the estimates to assign full costs to each energy improvement (e.g., narratives called out several elements in the upgrade of a single component, but the estimate only listed a lump sum for that component)
- Changes in pricing with no indication of change in scope
- Changes in product or manufacturer selected as the basis of design
- Lack of response to requests for clarifications

A summary of the information gathered along with the specific questions posed to each team and their corresponding answers can be found in appendix A. Because of these extensive challenges, the midterm project scopes were judged to be incomplete and are therefore not included in summary cost analysis findings presented in this report.

The ICAST project reports are incomplete and vary significantly from midterm to final due to the change from one six-unit building to six buildings of a similar size, and unfortunately the final building performance report was not updated to reflect the changes. Due to these reasons, the project is excluded from many of the detailed analyses that follow.

## **2.2 Commonalities Across Teams**

With respect to the proposed pathways to achieve net zero performance, there were several commonalities across teams as well as some notable differences. The similarities include:

- All project teams recommended air source heat pumps for the heating/cooling upgrades (half called for 1:1 systems and half for multi-head VRFs).
- Of the three projects that are upgrading the exterior walls, two are specifying field installed exterior insulation and finish system (EIFS) and one a panelized EIFS.
- Four out of five teams chose to insulate above the roof deck.
- All teams suggested energy recovery systems for mechanical ventilation—four out of five specified central systems.
- The final demolition costs were typically higher in the final scopes of work than when compared to business as usual (BAU) due to the extensive upgrades proposed.

A few interesting differences included:

- Each project selected a unique window manufacturer.
- SWBR specified a panelized wall system (including windows) but did not have the highest combined above-grade wall and window upgrade costs. It should be noted that the panel company has never produced such a panel, so cost estimates may not be accurate. If costs are accurate and would come down with experience and demand, this could result in a viable net zero façade solution for low-rise buildings.

Table 6 and 7 summarize the façade and HVAC system improvements proposed for the final net zero solutions packages by each team.

**Table 6. Summary of Façade Solutions per Project Team**

Project	Wall	Window	Roof
<b>Bright Power</b>	(existing masonry; insulation removed from final scope)	Intus Tilt and Turn double glazed w/ argon U-0.277, SHGC 0.4	Owens Corning blown in R-30 cellulose + Rockwool R-16 ci rigid mineral wool
<b>Chris Benedict, RA</b>	STO StoTherm StoLit ci Front: 4" XPS EIFS Fire escape: 1" XPS EIFS Rear and bulkhead: 6" EPS EIFS Cellar passage: 10mm (0.4") Spaceloft Aerogel R-10.3/in	Schuco Triple Glazed Low-E Insulated Glass	Sto 8" XPS insulation
<b>Levy Partnership</b>	Sto R-20 EIFS (rear and sides only)	Wythe Windows double pane uPVC Ug-0.25, Uf-0.176, SHGC-0.52 (front only)	SiPlast/Paratherm R-37 total (R-25 4" polyiso above deck + R-11 FG batt in dropped ceiling)
<b>King + King</b>	(existing wood frame; insulation removed from final scope)	Zola uPVC Ug-0.09, Uf-0.193, SHGC-0.50	Added 12" cellulose to shed ceiling and 18" cellulose to newly enclosed corridor ceiling (existing wood frame with 18" cellulose; insulation removed from final scope)
<b>SWBR</b>	Funform EIFS R-24 ci panel with Neopor core, installed in factory w/ windows	Manufacturer not selected (Alpen, Klearwall, Wasco priced) Zone 6 Certified PHIUS triple glazed windows	Owens Corning PRMA, R-30 EPS over existing R-10 c.i.

**Table 7. Summary of HVAC Solutions per Project Team**

Project	Plumbing	Heating/Cooling	Ventilation
<b>Bright Power</b> <b>300-304 E 162nd St, Bronx, NY</b>	Colmac CxV 5 tons Central HPWH	Daikin VRF; Outdoor: RXYQ144TTJU RXYQ168TTJU Indoor: FXSQ12TAVJU FXSQ15TAVJU (16) FXSQ18TAVJU (1) FXSQ24TAVJU	Swegon Central ERV GOLD RX, rotary heat exchanger, size 05
<b>Chris Benedict, RA</b> <b>104-110 Grove St, Brooklyn, NY</b>	LAARS Central Boiler	Daikin VRF, ductless Outdoor: 3MXS24NMVJU Indoor: FTXS09, CTXS07, FTXS12	Cellar: Zehnder ComfoAir 350, ERV, ducted Residential: UltimateAir 200DX, (10) roof mounted ERVs, ducted
<b>Levy Partnership</b> <b>439 West 125th Street, New York, NY</b>	Sanden Central HPWH Storage: SAN-119GLBK Heat Pump: GS3-45HPA-US	Daikin to LG Residential: central VRF; ARUM072BTE5/ ARUM096BTE5/ARUM144BTE5 multiV-5 Commercial: LMU360HHV	Residential: Ventacity VS1000 RT; central ERV Commercial: Zehnder to Fantech FIT120E
<b>King + King</b> <b>Christopher Court, 22 Maplehurst Drive, Phoenix, NY</b>	Sanden Central HPWH; SanCO2 Gen 3 (changed from WaterFurnace water to water GSHP 504W11 or similar)	Daikin ASHP in-unit, ductless AURORA Outdoor: 2MXL18QMVJU (1 br) 3MXL24RMVJU (2 br) Indoor: CTXS07LVJU	Renewaire EV450IN central ERV; hot water coil from Sanden to temper supply air
<b>SWBR</b> <b>Portville Square, Portville, NY</b>	AO Smith ENT-40, In-unit electric WH (changed from GSHP supply, no manufacturer noted)	LG ASHP in-unit, Apts: ducted Common: ducted and ductless Indoor: LDN097 or LSN090 Outdoor: LD097 or LMU189	Trane Central DOAS with energy wheel; Horizon ASHP B072

## 2.3 Noteworthy Cost-Reducing Measures Incorporated in Designs

One of the only noteworthy design differences among the solutions provided was the location selected for new refrigerant piping. Installation of refrigerant piping under new exterior insulation eliminates the need for interior chases, which reduces the time and cost to building those chases and any corresponding loss of conditioned square footage. There was no cost breakdown shown for interior versus exterior installation of this piping, but if incorporating a new cladding system, it follows that exterior installation could result in notable installation cost savings.



Another source of project cost savings was in leveraging acceptable existing infrastructure instead of including costly measures that have relatively small incremental benefits above the existing structures. Because the building had been constructed relatively efficiently in 1991, the King + King project team determined that the existing building envelope was good enough for getting to the project target when viewed holistically. Eliminating an envelope overhaul reduced cost and project material consumption.

Cost reductions from the midterm to the final were generally due to value engineering exercises that resulted in cost savings offset by increased energy use. A few of the value engineering measures included:

- Storefront glazing was removed from the Levy project's scope due to high cost and relatively minimal energy impact.
- Levy investigated replacing gas ranges with induction ranges at midterm. The induction range scope was removed due to high cost and relatively minimal energy impact. The range requires a 220V electrical circuit rewired from the apartment panel, which was priced out to about \$3,000 per apartment. This design change is a step away from full electrification but is balanced against a high-cost estimate.
- King + King's domestic hot water (DHW) costs dropped almost in half by changing from a WaterFurnace GSHP to a central Sanden AWHP.
- SWBR elected to replace existing in-unit water heaters on an as-needed basis instead of using a ground-source central system. This approach is only feasible in buildings with unitized equipment and would not be applicable to a future state where pod-based, multi-system equipment is used.

## 3 Task 2. Understand Solution Cost and Breakout

### 3.1 Cost of Solution

The project costs were evaluated to the level of detail allowed by the documentation available. Some project teams provided greater granularity in their cost estimation than others. Table 8 summarizes the project costs for the net zero solutions for each of the teams where comprehensive and complete estimates were available.

**Table 8. Total, Incremental, and Incremental Cost/Unit for Each Team**

Project	# of Units	EUI	Total Cost*	Hard Costs*	Overhead+ Gen. Cond. + Soft Cost*	Incremental Cost	Incremental \$/unit
<b>BRIGHT POWER</b>	42	29.6	\$6,251,802	\$3,297,488	\$2,954,314	\$3,060,221	\$72,862
<b>Chris Benedict, RA</b>	46	18.1	\$9,432,903	\$4,573,930	\$4,858,973	\$2,679,610	\$58,252
<b>LEVY</b>	21	30.2	\$2,409,079	\$1,648,279	\$757,434	\$1,010,955	\$48,141
<b>KING+KING</b>	40	22.7	\$3,523,399	\$2,057,354	\$1,466,045	\$1,682,749	\$42,069
<b>SWBR</b>	24	27	\$3,315,628	\$2,174,285	\$1,141,343	\$1,971,712	\$82,155

\* Contingency not included.

Note that the total project costs do not include contingencies for hard or soft costs as provided in the budgets.

The biggest cost drivers for the projects were consistent, though the order varied slightly depending on whether the projects were upstate or downstate. The following major categories were identified and evaluated:

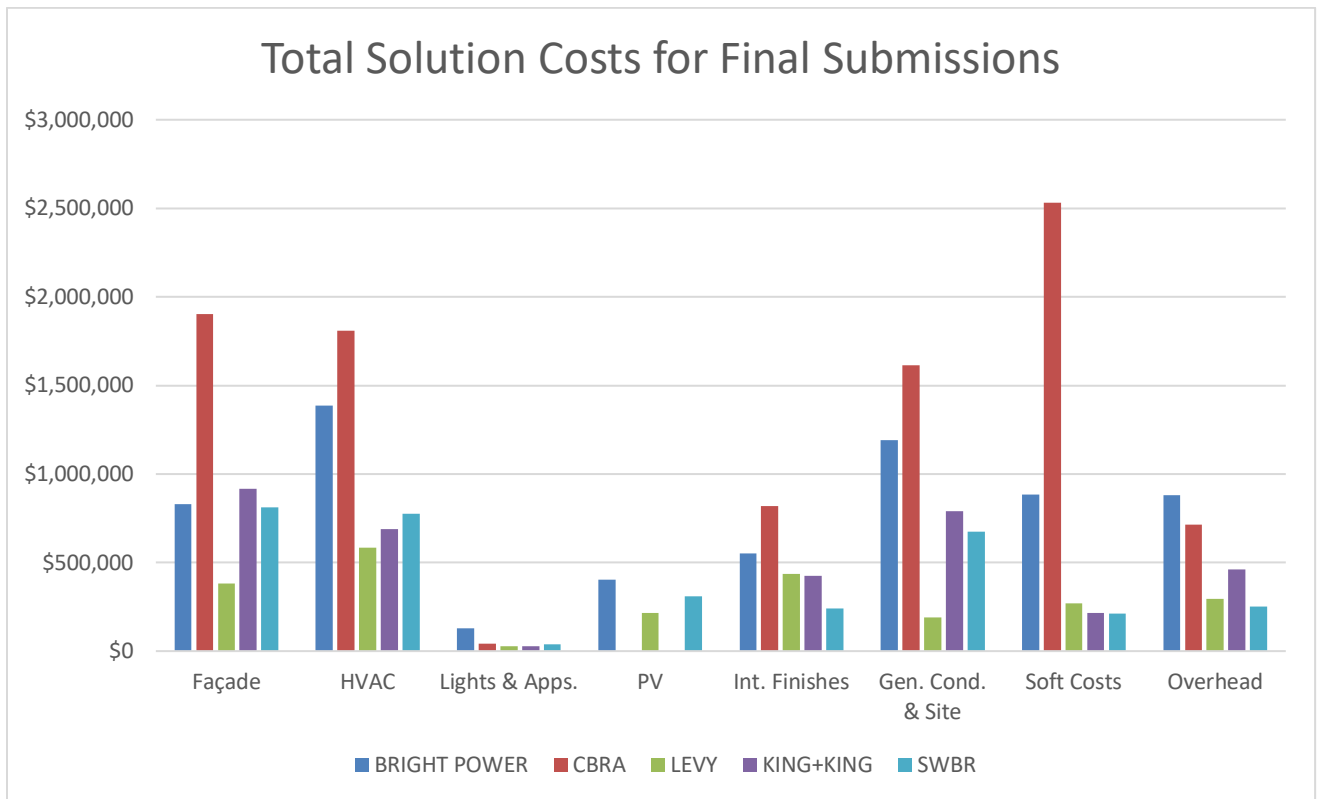
- HVAC—heating and cooling, ventilation, DHW and controls, electrical
  - Electrical was assumed to be largely tied to HVAC upgrades
- Façade—walls, windows, roof, doors, storefront, other openings
- General Conditions and Site—general conditions, sitework, concrete, masonry, metals, woods, plastics, furnishings, elevator, safety and security
- Interior Finishes
- Solar PV
- Lights and Appliances
- Overhead—overhead, profit, insurance
- Soft costs

### 3.1.1 Categorical Costs

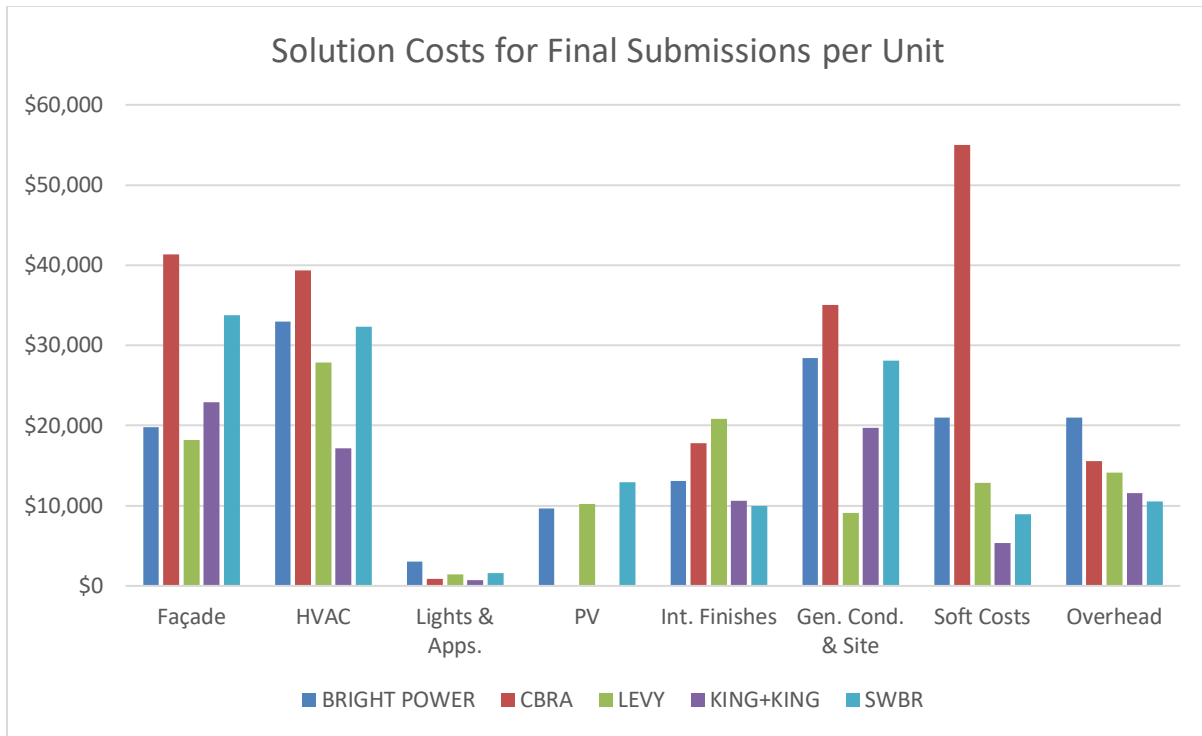
The following charts summarize the final solution cost drivers for project teams that provided complete documentation. Costs are presented as standalone numbers, against business as usual, and normalized per dwelling unit. Figure 1 illustrates the total solution costs for the net zero solution by project team and by each of the major categories listed above. Figure 2 presents those total costs on a per dwelling unit basis. Figure 3 and Figure 4 display the same information for each category based on the incremental cost of the net zero solution above the owners' BAU practices.

**Figure 1. Total Solution Cost by Project Team**

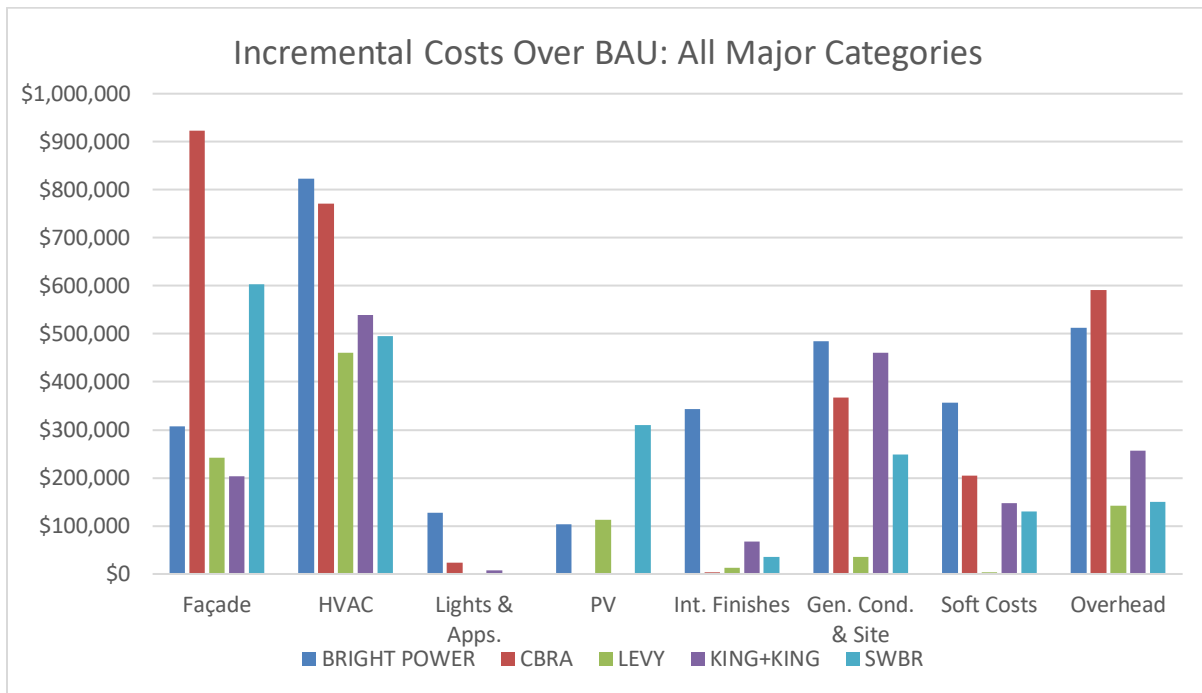
CBRA refers to Chris Benedict, RA



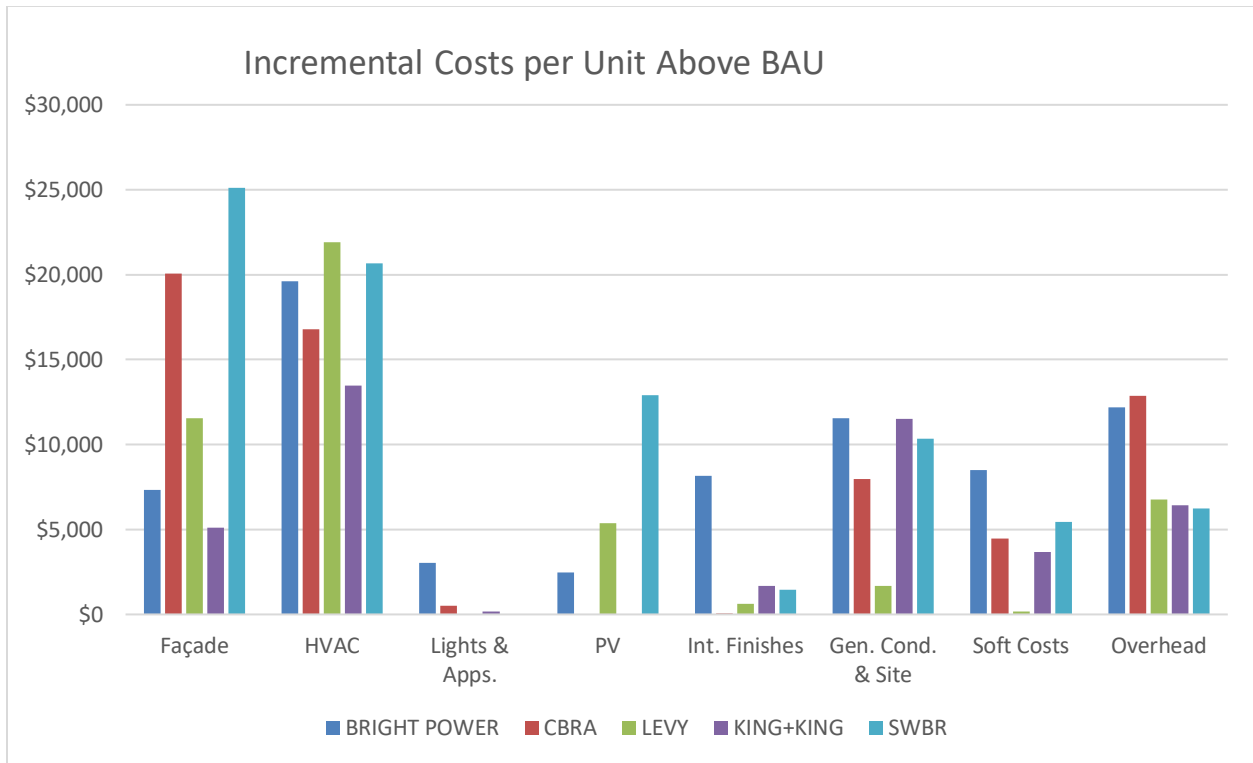
**Figure 2. Solution Cost per Dwelling Unit by Project Team**



**Figure 3. Total Incremental Cost over BAU**



**Figure 4. Incremental Costs over BAU per Dwelling Unit**



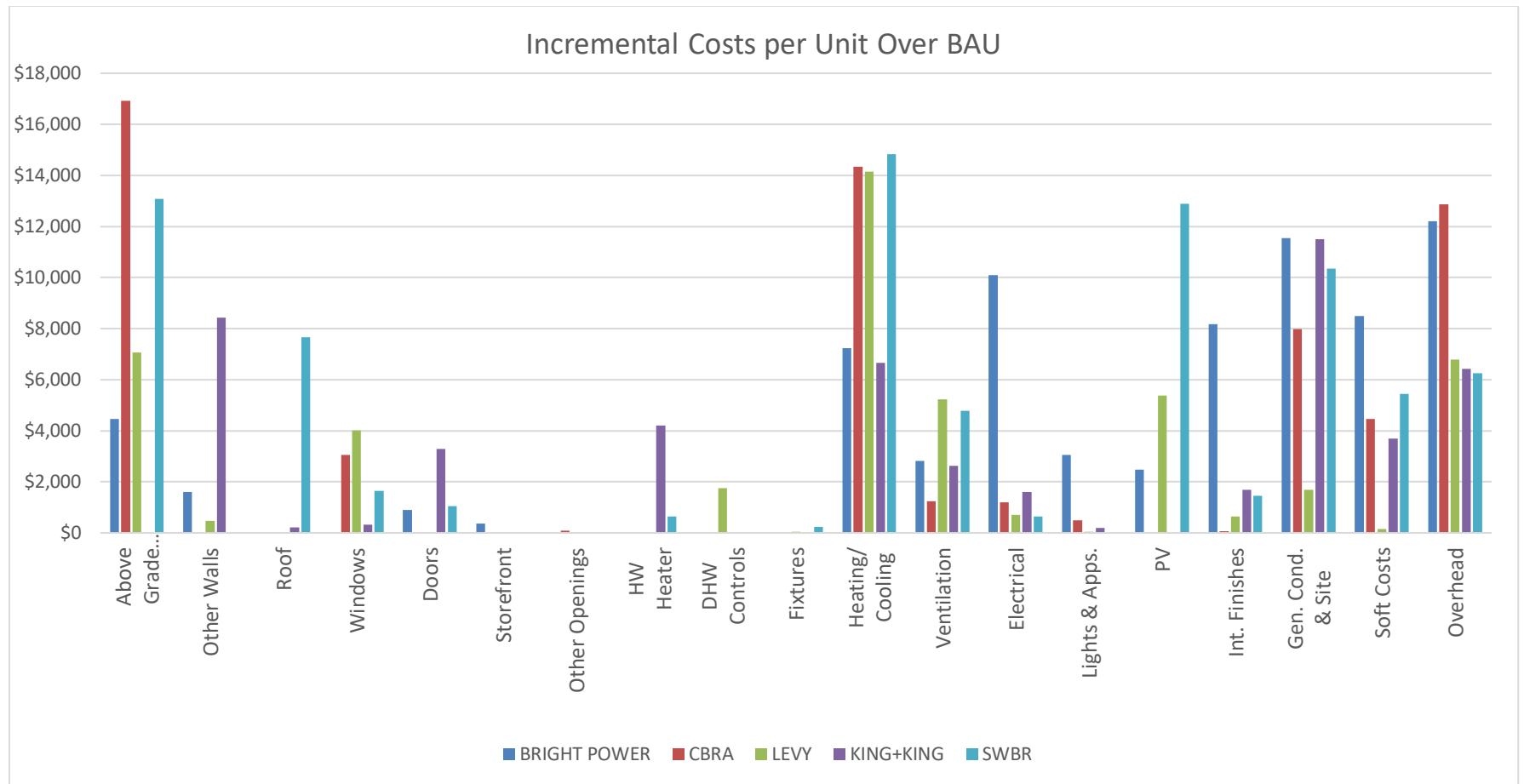
Observations on these cost analyses include the following:

- HVAC (heating, cooling, ventilation, and DHW) and Façade (windows, doors, walls, and roof) were in the top five cost drivers for all projects, generally ranking in the top 1 or 2 highest costs no matter how the data was evaluated—by total solution, by total incremental costs over the BAU or by incremental costs per unit.
- After façade and HVAC, soft costs and general conditions were typically the next highest costs in all cases and according to all evaluation methods—by total solution, by total incremental costs over the BAU or by incremental costs per unit.
- The fifth highest costs were associated with interior finishes and overhead. While these appear to be similar for most of the projects when comparing total project costs, interior finishes were not in the top five when evaluating incremental costs over the BAU cases. Overhead costs were higher when evaluating the solution costs on an incremental basis.
- The additional incremental costs for interior finishes may be associated with window and door replacements or ceiling repair due to HVAC or domestic hot water upgrades.

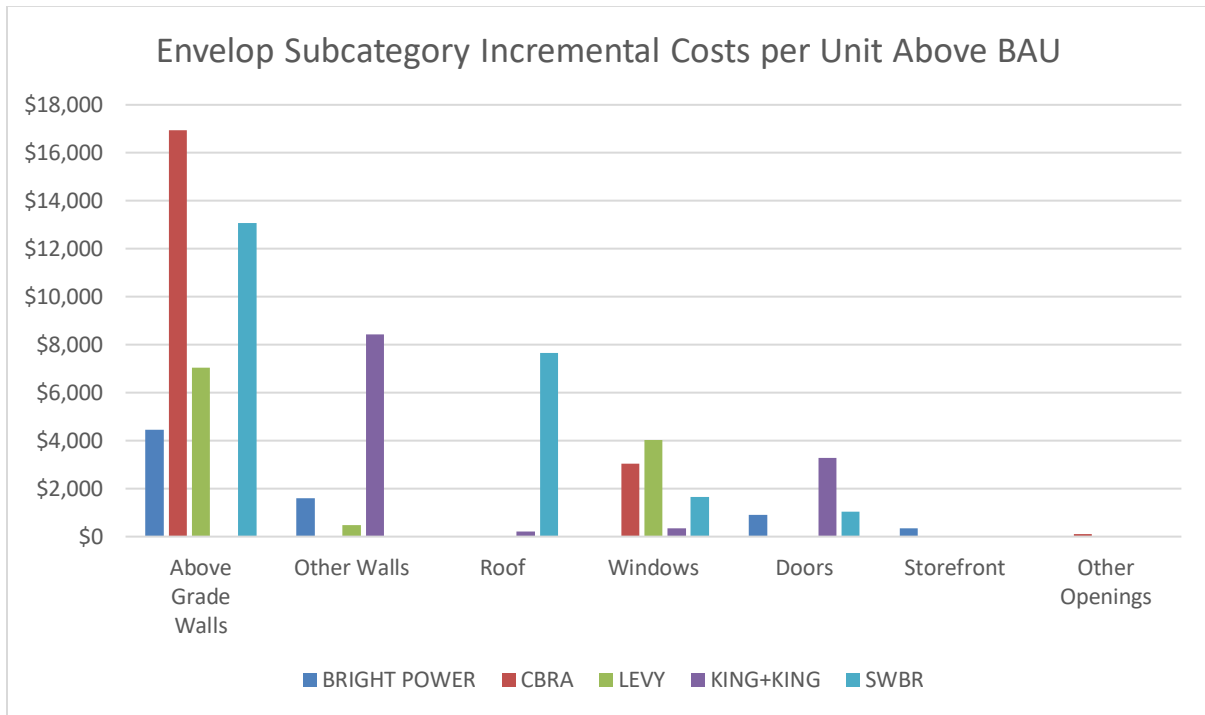
To identify the major cost drivers in each of the net zero strategies, the façade and HVAC categories were broken out into the subcategories listed below and once again compared to the other cost categories in Figure 5.

- General Conditions and Site
- Overhead
- Interior Finishes
- Electrical
- Heating/Cooling
- Solar PV
- Windows
- HW Heater
- Roof
- Above Grade Walls
- Lights and Appliances
- Ventilation
- Other Walls
- Doors
- Storefront
- Other Openings
- DHW Control

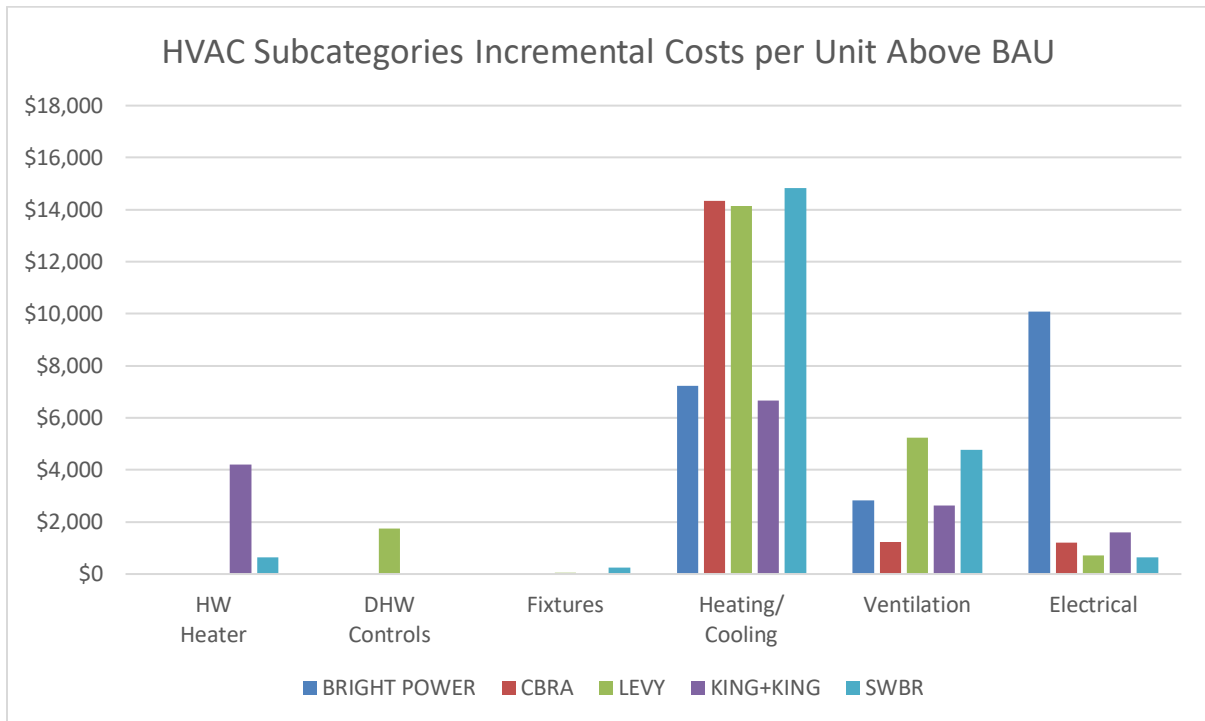
**Figure 5. Normalized Incremental Costs of High Performance over BAU (\$/Dwelling Unit)**



**Figure 6. Incremental Costs above BAU: Net Zero Envelope Measure**



**Figure 7. Incremental Costs above BAU: Net Zero Mechanical, Electrical, and Plumbing Measures**





As can be seen in Figure 5, General Conditions and Site, Soft Costs, and Overhead continue to be three of the top five costs. With respect to soft costs and overhead, the items are often priced as a fixed percentage of project work. Of all the subcategories under Soft Costs provided in the budget worksheets, the highest incremental costs were loan fees and engineer/architect fees. Since these are based on a percentage of the overall budget, it makes sense that the fees would increase as the costs for the net zero solutions increase over the BAU case.

As noted earlier, the category titled General Conditions includes general conditions, sitework, concrete, masonry, metals, woods, plastics, furnishings, elevator, and safety and security provided in the project budgets. The general trend in the net zero solutions was an increase in costs due to the need for scaffolding for exterior façade work and demolition of existing appliances and mechanical systems, which were typically recorded in Divisions 1 and 2 in the budgets.

If simply evaluating measures that result in achieving the targeted EUI, the top five net zero categories with respect to cost are: Above Grade Walls and Heating/Cooling, followed more distantly by Solar PV, Ventilation, and Electrical. There is no breakdown in the budgets for material cost, labor, or warranty costs, so recommendations for decreases in those categories cannot be provided. Possible suggestions for cost reductions are provided under Task 3 of this report and are based on SWA's conversations with several manufacturers.

### **3.1.2 Notable Variations in Pricing Across Projects**

As costs are reduced, as they were from midterm to a more relaxed final requirement, overhead costs are reduced. These are often a percentage of the overall job cost, so overhead has a direct relationship with the overall job costs.

The cost of the full scope of work ranged from approximately \$88,000–\$205,000 per dwelling unit. The lowest end of the range is King + King's project, which greatly reduced above grade wall expenses and heating/cooling system cost. The other project team estimates were more tightly clustered between \$125,000–\$170,000 total per dwelling unit.

Some variation in total cost breakdowns is due to teams allocating certain interconnected needs in one line-item or another, with equipment connection costs going into the electrical versus heating/cooling categories, for example. After estimating the impacts of this accounting, subcategories with the greatest cost estimation fluctuation to note include roofing, doors, water heating, solar PV, and the site and soft cost categories.

Variation also speaks to the vigor with which project teams have approached the base case retrofits versus incremental low EUI goal. Chris Benedict, RA has the highest total solution budget but the incremental cost per unit compared to the BAU case is average compared to the other teams, and they also have the lowest final EUI overall. This indicates that Chris Benedict, RA's base case renovation is of much higher cost and energy performance than any of the other teams.

### **3.1.3 Volume-Dependency in Cost**

Some equipment specified in the project scopes is infrequently used in the New York State market. Volume-driven cost compression opportunities are expected from projects such as these. The factors are investigated further in the following task.

One ancillary volume dependency is the impact of contractor and cost estimator comfort. Cost estimates for new types of work, new scopes and products, tend to include an extra contingency. Products specified by some teams, including Sanden water heaters or energy-recovery ventilation systems, may be the first ones ever installed by the participating contractor. It is common to see costs shift as the installer becomes more familiar with the labor required and has gained the proficiency in efficient and accurate labor costs.

## **3.2 Outstanding Questions**

The reliability of some cost estimates is not clear at this stage. Soft costs and labor can be difficult to accurately estimate without significant contractor time investment. It is not uncommon to get a very different cost estimate from a contractor during early project estimating phases compared to the actual construction bid. Project teams did not report this issue explicitly, but the phenomenon is seen commonly in similar projects in the industry where cost estimation is being done by a third party and is not pricing for contract. SWA's experience with cost estimates prepared for high-performance projects such as these supports these assessments. This is particularly true when the estimator has never worked on such a project. Estimates from experienced developers on their 2nd and 3rd high-performance projects

typically come down significantly. This is partly because they are no longer making conservative estimates out of the fear of losing money and primarily because, through experience, they understand methods and means to reduce costs even further while achieving the same high-performance goals.

Unfortunately, the items proposed and estimated in these projects are all individual components. There is no mechanical pod or retrofit-oriented wall panel solution on the market today. The cost differential between solutions proposed in the six RetrofitNY projects and the costs of early generation modular solutions remains to be seen.

## 4 Task 3: Understand Intermediary Markups

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### 4.1 Information Obtained from RetrofitNY Estimates

The RetrofitNY project teams did not provide pricing breakdowns that are granular enough to identify subcomponents of cost, such as the balance between materials and labor. The pricing provided is more detailed than would typically be expected at this stage in a project, and SWA recommends continuing the investigation of cost drivers with the teams and their cost estimators. NYSERDA can provide line items for contractor bid applications in order to get real bid data on pricing breakdowns. These line items would be added to the bid application, requesting that contractor pricing be broken out by materials, labor, contingency, etc. Note that requesting greater information from contractors can result in higher bid pricing overall as it can be viewed as a sign for extra management labor on the project.

### 4.2 Manufacturer Outreach

SWA directly contacted manufacturers for envelope, heating/cooling, water heating, and ventilation equipment with a focus on companies that produce equipment best suited for high-performance/net zero projects. Firms with high-performance equipment not yet available or not well established in the North American market were not excluded if the solutions they provide were deemed viable options once the hurdles for importing were overcome. Table 9 lists the equipment manufacturers targeted.

**Table 9. Manufacturers Contact List**

Product	Manufacturer/ Company	Contact Name	Contact Email	Contact Phone number
<b>Envelope</b>	EEWS	Ken Loush	<a href="mailto:kloush@eews.com">kloush@eews.com</a>	T: 610-868-5522
	Ecocor	Chris Corson	<a href="mailto:chris@ecocor.us">chris@ecocor.us</a>	C: 207 323 0638
<b>Water Heater</b>	Colmac	Joey Schmitz	<a href="mailto:jschmitz@highmark-ny.com">jschmitz@highmark-ny.com</a>	T: 646-863-0449 C: 917-580-0723
	Sanden	John Miles	<a href="mailto:John.Miles@sanden.com">John.Miles@sanden.com</a>	C: 213 400 7758
	Rheem			
<b>Heating/ Cooling</b>	Carrier	Anthony San Jose	<a href="mailto:anthony.sanjose@carrierenterprise.com">anthony.sanjose@carrierenterprise.com</a>	C: 347.306.8795
	LG			
	Daikin	Jon Hacker	<a href="mailto:jon.hacker@daikin.com">jon.hacker@daikin.com</a>	T: 212-340-7425
	Mitsubishi	Rick Nortz	<a href="mailto:rnortz@hvac.me.com">rnortz@hvac.me.com</a>	C: 617-733-1058
	Fujitsu	Bill Hick	<a href="mailto:bhick@fujitsugeneral.com">bhick@fujitsugeneral.com</a>	C: 413-237-4199

<b>Ventilation</b>	Renewaire			
	Zehnder	John Rockwell	<a href="mailto:John.rockwell@zehnderamerical.com">John.rockwell@zehnderamerical.com</a>	C 508 932 2600
	Panasonic			
	UltimateAir	Jason Morosko	<a href="mailto:jmorosko@ultimateair.com">jmorosko@ultimateair.com</a>	T: 740 594 2277
	Swegon	Mike Woolsey	<a href="mailto:Mike.Woolsey@swegon.com">Mike.Woolsey@swegon.com</a>	T: 612 685 6519

#### 4.2.1 Questions for Manufacturers

Before contacting the manufacturers, SWA’s team members compiled a list of questions to ask all representatives in an effort to better understand the intermediary cost markups added from plant to field with the hope of deducing possible measures for reducing expenses. All representatives were asked the following:

1. What are steps from manufacturer to install? (labor, transport, markups, etc.)
2. What are pain points for cost? (supply chain issues, what drives cost up)
3. What are other markets where you've had success? Why? What are lessons learned? (regions, incentives/policy, etc.)
4. What would it take to see cost compression in our market? (demand, transit costs, insurance, certifier fees, chemicals, etc.)
5. What kind of training/support do they provide for contractors? (to offset high labor costs for unfamiliarity)
6. What sets their product apart from competitors?
7. What's coming out on the horizon? What are they working on? (priorities)
8. Quantity per project—how does pricing change if 10/yr?
9. Market segments—how does pricing change if market share grows?
10. Do distributors have equipment in stock, or do they order known quantities on demand?
11. Do you have a local rep?

#### 4.2.2 Summary of Responses

Products come to the market through a variety of channels. Some products are sold directly to contractors through distribution channels and have little public-facing marketing. Other products rely on a network of representatives (reps) who work for manufacturers and with engineers, contractors, building owners, and other stakeholders. The rep network adds cost to products, but also increases sales and is seen as necessary by manufacturers of equipment where market education is important. This has spurred a few trends, one is that reps tend to have an significant impact in the design process and the other is that reps have direct communications to the manufacturer and can get answers to technical questions from the design community.

Each set of hands a product passes through adds cost. The manufacturer may or may not include transportation costs, volume discounts, etc. depending on the company and product. The distributor and/or rep networks typically add 10–20% markups to the material costs. The contractor will then buy the product and add another 10–15% onto its current price. If the purchasing contractor is a subcontractor, the general contractor will add another 10–20%. In these cases, minimizing the number of transfers will be key in reducing costs to the consumer.

#### **4.2.2.1 Prefabricated Façade Panels**

There are far fewer high-performance envelope panel manufactures/suppliers in the United States than there are HVAC suppliers. The two targeted for this report were Eastern Exterior Wall Systems (EEWS) and Ecocor. SWA was only able to speak with EEWS at the time this report was compiled; however, through email communication, the owner of Ecocor expressed a strong interest in working with NYSERDA in their quest for a high-performing façade panelized approach to net zero retrofits. SWA advises NYSERDA to follow up on this lead.

EEWS also expressed interest in being part of the conversation with respect to panelized options for net zero retrofit buildings. According to EEWS, costs for panelized façade components are driven by a couple of factors. The first noted was exterior finish choice: the heavier the finish, the higher the cost and the more fragile the finish, the higher the cost. Systems using exterior insulation finishing systems (EIFS, also known as stucco) are the least expensive, while fiber cement finishes tend to be the highest depending on the textures and finishes chosen.

The need for a crane is also a big cost driver due to the need for a special operator. If the crane can be eliminated either by using what is referred to as a “mini-crane” or by making the panels smaller so that manual installation is possible without the need for a crane, the costs could be significantly reduced.

The business model is somewhat different for panel manufacturers in that they prefer to install the panels on the purchaser’s site.. This reduces fees when passing a product from manufacturer to distributor to trades person, but at scale could pose a labor issue for the manufacturers themselves. If replicable systems are possible, producing instructions for tradespersons and positioning an employee on site to train the subcontractors and oversee the installation could be a viable option. However, in general, the manufacturers prefer to be the installers.

Besides the cost reduction strategies noted above, price decreases are generally a matter of efficiency in ordering. If, for example, 100,000 ft<sup>2</sup> of panel materials are ordered, and there are significant variations in the panel design, prices will be high.

#### **4.2.2.2 Domestic Hot Water**

The DHW manufacturers interviewed had different responses on most questions, which makes it impossible to draw global conclusions about strategies to lower cost across the market. Colmac manufactures products in the U.S. (with some lower cost components sourced internationally), and the company sees little room for cost compression. Sanden manufactures products in Japan and would see costs come down with domestic manufacturing but needs market growth to relocate production. Shipping for the Sanden products can be expensive, and the cost of the coupled storage tank is a pain point.

Both companies are looking at meeting market needs in different ways. Colmac is struggling with development of new products using new refrigerants and with educating the marketplace on heat pump water heating. Sanden is trying to optimize a product for the residential drop-in replacement market and to develop a product to serve whole-house loads.

Colmac representatives pointed to the challenge of growing market share in New York City where electricity costs are so much higher than gas per unit of energy. This spread was their largest hurdle identified. Sanden viewed the problem from the other end and suggested upstream incentives to bring down installed costs of equipment as a way to grow the market in New York State.

#### **4.2.2.3 Heating and Cooling**

The heating and cooling manufacturers identified several common cost drivers. Daikin and LG both expressed frustration with the Energy Efficiency Rating (EER)/Seasonal Energy Efficiency Rating (SEER) certification process. Both manufacturers feel that the EER metric does not properly represent year-round performance, and that SEER, while improved, still has flaws in evaluating the part-load efficiency of heat pumps. As a result, the manufacturers must oversize compressors for favorable efficiency ratings. This adds cost. Daikin and LG would like to see an industry-wide move to performance ratings that are more tailored for heat pumps.

Fujitsu, Mitsubishi, and LG identified advanced, direct-from-manufacturer orders as a key component in cost compression. All manufacturers that SWA interviewed operate through a distributor or rep network, which adds costs. Large volume orders placed well in advance to give ample time for production are placed directly with the manufacturer, reducing both middle-man overhead and transportation costs. Daikin mentioned that their close relationship with distributors would prevent them from openly endorsing a direct-from-manufacturer approach; however, they would work with the distributors and contractors to cut costs where possible for large orders.

The ongoing research and development varied significantly between manufacturers. Fujitsu and Mitsubishi are both focusing on “total home solutions” that would allow a single ducted heat pump to comfortably heat and cool a single-family home with multiple zones. LG is looking to refine and advance their inverter compressor technology for efficiency gains. Daikin is looking to introduce a web-enabled learning home thermostat that reduces energy use by compensating for the habits and preferences of the homeowners.

#### **4.2.2.4 Ventilation**

Zehnder USA and UltimateAir provide heat recovery and energy recovery ventilation units for residential and light commercial applications. Zehnder has representatives in both the northeast and northwest. Most of the business they do in the Northeast is single-family and multifamily related, particularly where tax credit programs adopted passive house (PH) for points. The companies see most of their sales in cold climates, and set themselves apart based on (1) the high efficiency of their units, which prevents the need to recirculate air to defrost the core, (2) the flexibility of their control systems, and (3) how quietly the systems operate. Some of their units are self-balancing, making this attractive where certification programs require balancing by third parties.

UltimateAir holds a similar market and sets themselves apart with higher than average sensible effectiveness, the flexibility of their controls, and lower costs—50% less expensive than Zehnder. In addition, they have had the same ownership for 25 years.

Both companies expressed the pain point to be demand and selling only a few units at a time. If bulk purchases were more common, they would be able to significantly reduce costs. Zehnder noted they could reduce costs by up to 35% for orders of 1000 unit. UltimateAir offered projected reductions in the range of 40% for orders of 75 or more to the trades.



The other issue that drives up Zehnder's prices is that the units change hands many times traveling from the Netherlands to Germany and then to Buffalo in the U.S. At each exchange there is an additional fee added to the product. They are hoping to get a factory running in Buffalo in the near future. In general, the cost of their unit compared to most others is at least double and can be triple if all system components are purchased from Zehnder.

SWA also talked to Swegon about their high-performance ventilation system options. While they do offer unitized residential and light commercial options overseas, the products available in the U.S. are intended for larger applications. SWA sees Swegon ERVs/HRVs on multifamily buildings that employ centralized ventilation systems and commercial buildings. They have a Passive House certified unit—the Gold unit—that provides up to 5,000 cfm of ventilation air. Their larger units, while not certified, typically have an effectiveness of 80% and higher.

Swegon noted that their pain points include a shortage of engineering resources and the size of their factory in Toronto. They experienced growth at the range of 130% last year. They are currently redesigning the factory to operate more like that of an automobile factory, which will allow them to greatly increase production and quality control.

Price pinch points for them include the coatings for the energy recovery wheels that aid in achieving such high efficiencies and sheet metal costs. Reduction in pricing generally comes from increases in demand. If sales double, that generally results in a 40% cost savings to Swegon which would equate to an approximate price savings of 25% to the market.

### **4.3 Recommendations for Reducing Costs**

With respect to the façade panel costs, price reductions will be a function of replicability first and foremost. It is crucial that the manufacturers be able to minimize differences in panel design and construction across a significant market. Eliminating the need for cranes is another big area for cost reductions. If panels can be made light enough and small enough to be set by hand, it would decrease costs and installation time.

For the mechanical solutions investigated, the opportunities for cost reduction are varied by manufacturer. Interviews with manufacturers uncovered that each had different pain points and different product accounting structures. For example, some companies do not track different types of overhead directly. They instead consider the numerous line items to be part of the cost of doing business—rolling them under one larger corporate overhead heading.

Products are manufactured worldwide. Components for high-performance equipment may be manufactured anywhere and assembled anywhere. The supply chains are complicated when each component is inspected. Many products contain components with a variety of cost and shipping fees, so the final cost to consumer may be impacted only very slightly by components purchased from far away. The cost compression opportunities vary greatly by product and are not necessarily tied to vertical integration, since the cost of many sourced common components is not high.

Manufacturers who do identify specific areas for cost reduction tend to not agree with their competitors on those areas. Manufacturers such as Zehnder, Sanden, and others discussed the ability to drive prices down with greater sales volume. These companies could move manufacturing to the U.S. if they reached a larger market share, and the resulting transportation and handling savings would be significant. Establishing a new manufacturing line requires a consistent stream of orders, and the domestic market is not close to those levels yet.

Some manufacturers interviewed stated market scale was not a significant driver in product cost. This is noted as a counterpoint to the experience of Zehnder, Sanden, and others—some competitors in the same segments were not hurt by their low-market shares.

Representative networks and markups assessed at each level of the supply chain were discussed at length. Typically, manufacturers distribute through their local representatives, and those reps then sell to the contractors in their market. Each set of hands adds a markup to the equipment cost as discussed above. The compounding markups result in the equipment cost expanding by approximately 15% three times over, or about 50% from the manufacturer's charge.

Using reps is not purely an added expense, though, as there is value associated with the cost, such as the need to pay more to get products to market if the networks were not in place. The manufacturers would also expect to lose some market share by not having locally placed sales representatives. This then triggers increasing prices for those who see their product cost tied to market share.

Interviewees had varying opinions on how to achieve cost compression and market growth. Some manufacturers pointed to the success of upstream incentives in other markets as a way to magnify savings. Decreasing the first cost of the product will decrease the markups added by downstream parties, so any incentive dollar would result in approximately \$1.50 savings to the consumer per the example above. The pipeline is somewhat leaky, though, and success with upstream incentives in other markets is a stronger predictor of efficacy.

Note that SWA was not able to discuss the cost effectiveness of original equipment manufacturer (OEM) packaging of solutions into mechanical pods since these do not exist today. A decrease in labor cost associated with pre-mounted racked equipment is likely, but a counter increase in materials cost for coordinating component streams from various manufacturers will offset the savings to some degree at least in the early phases. Several manufacturers expressed interest in producing some type of whole-home solution, but none has the in-house manufacturing or assembly of all components. It is also expected that one manufacturer aggregating components from another would add some markup, in the same way that the rep network does now.

The other side of the lack of mechanical pods on today's market is that every RetrofitNY project solution was custom. The site-specific analysis and product selection going into each proposal is costly. Soft costs were seen to be large drivers in some projects and streamlined commodity retrofits could be positioned in a manner to reduce those costs.

# Appendix A. Project Team Questions and Responses

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## A.1 Bright Power

For this project, there are several issues that make it difficult to directly compare the proposed solution and financial analysis provided in the midterm report with the final report. First, the midterm report is based on one 21-unit building, whereas the final report is based on two buildings consisting of 42-units making a cost comparison difficult if not impossible. Additionally, the BAU cost estimate also changed from midterm to final. Scope changes between the two phases included a reduction in the amount of EIFS to be applied and the use of cladding attachments. The EIFS scope was included in the masonry costs, whereas waterproofing, air barrier and air sealing scope were included in thermal and moisture protection costs. Some additional changes included the following:

- Demolition cost increases in final for VRF system.
- Cost for hot water heater/DHW controls/fixtures triple from midterm BAU to final BAU,
- There is no appliance replacement at BAU final.
- Door, frames, hardware-exterior increased by four times from midterm to final, even though the building size only doubled.

Bright Power critical notes:

- Midterm shows 21 units: (1x cellar, 4x 1st flr, 4x/flr on 2-5th floors) at 300 E 162nd St.
- Final drawings show 42 units: (1x 1st flr, 4x/flr on 2-5th floors).

SWA Question: Can midterm costs be doubled to align with final and final BAU?

BP/Volmar: It might be a bit ambiguous to directly double to align with final BAU. The reason being there have been some changes to BAU scope between midterm and final along some cost refinement.

### A.1.1 Division 1: General Conditions: General Requirements

SWA Question: Why does BAU (\$431,000) to final (\$494,000) cost increase? What changed about scope?

BP/Volmar: Scaffolding was included in the scope to carryout masonry repairs on the exterior façade (\$50,000). Also, the unit cost of dumpsters and cleaning per month was increased from \$1700 to \$3000 to account for actual costs thus increasing the cost of cost of dumpsters and cleaning by \$13,000.

SWA Question: Why are BAU costs different?

- Midterm BAU budget "Preliminary Budget\_300 E 162\_rev1.pdf" lists as \$322,000.
- Final BAU budget: "04. RetrofitNY—Budget and Financing Plan" lists as \$431,000.

BP/Volmar: The difference is due to refining the budget and changing the manpower required on the project. are the changes:

- Project Management team was changed from part-time to full-time during the project, increasing the cost by \$90,000.
- The cost and time of general labor required on the project was reduced from \$10,000 to \$8,000 / Month and 12 months to 10 months respectively, thus reducing the overall cost by \$40,000.
- The cost of dumpsters and cleaning on the project was refined from lumpsum of \$10,000 to \$1,700 for 10-month duration of the project, thus increasing it by \$7000.
- The cost of sidewalk shed was increased from \$25,000 to \$50,000.
- The cost of final cleaning and punch list was increased from \$3,000 to \$10,000.

### **A.1.2 Division 2: Sitework: Demo/Site Work/Earthwork/Exterior Improvements**

SWA Question: Why is there a BAU (\$100,000) to final (\$310,000) cost increase? What changed about scope?

BP/Volmar: the final scope involves more demolition with the VRF system.

SWA Question: Why are BAU costs different?

- Midterm BAU budget "Preliminary Budget\_300 E 162\_rev1.pdf" lists as \$155,200
- Final BAU budget: "04. RetrofitNY—Budget and Financing Plan" lists as \$100,000

BP/Volmar: Did you mean \$310,000 and a difference of \$154,800? SWA reply: Yes!

BP/Volmar: The budget was refined to account for 2 buildings in scope and reflect anticipated work based on the actual scope. Below are the details:

- Selective demolition was divided to include Kitchen/ Bath and Boiler/ Water heaters, thus increasing the cost from \$151,200 to \$ 260,000.
  - SWA Follow-up Question: Can cost for boiler/water heater demo be separated?
  - BP/Volmar: The boiler and water heater demolition costs were estimated to be around \$50,000.
- Street Tree protection was removed \$4,000.
- Asbestos abatement was included at \$50,000.

### **A.1.3 Division 3: Concrete**

SWA Question: Why is there no cost in BAU or final in final budget? Midterm BAU budget "Preliminary Budget\_300 E 162\_rev1.pdf" lists as \$15,750

BP/Volmar: none of these scopes includes any concrete work.

- SWA Follow-up Question: Confirm “foundation, concrete floor cellar” from midterm was dropped from final BAU and final scopes.
- BP/Volmar: Yes. Trash Chute Footings and cellar concrete floor finishing was dropped from scope.

### **A.1.4 Division 4: Masonry: Repair/Re-Pour, Brick**

SWA Question: Why is there a BAU (\$60,000) to final (\$150,000) cost increase? What changed about scope?

BP/Volmar: This is due to change in scope. Trash chute was taken out of scope and masonry repairs and repointing on the exterior were included.

SWA Question: Why does cost decrease from midterm (\$369,308) to final (\$150,000)?

BP/Volmar: Midterm had EIFS on side and rear walls while Final does not have any EIFS.

SWA Question: Why are BAU costs different?

- Midterm BAU budget "Preliminary Budget\_300 E 162\_rev1.pdf" lists as \$20,000
- Final BAU budget: "04. RetrofitNY—Budget and Financing Plan" lists as \$60,000

BP/Volmar: The scope was changed from including trash chute to masonry repairs on the façade, increasing the cost.

### **A.1.5 Division 5: Metals: Lintels, Fire Escapes, Rain Screen**

SWA Question: Why is there a midterm (\$369,626) to final (\$114,400) cost decrease? What changed about scope?

BP/Volmar: the major change (~\$200,000) is because our midterm scope had exterior insulation of the front façade including girts and cladding.

- SWA Follow-up Question: What else is included in midterm/final scope?
- BP/Volmar:
  - Lintels changed to selective replacement—Cost reduced to \$20,400 from \$40,000 in midterm
  - Cost of interior steel stairs and railings reduced to \$20,000 from \$30,000 in midterm
  - Exterior fire escapes cost reduced to \$24,000 from \$90,000 earlier
  - Curbs and dunnage for VRF added—20,000
  - Perimeter roof railing added—\$20,000

SWA Question: Why are BAU costs different?

- Midterm BAU budget "Preliminary Budget\_300 E 162\_rev1.pdf" lists as \$361,100
- Final BAU budget: "04. RetrofitNY—Budget and Financing Plan" lists as \$40,400

BP/Volmar: The scope and costs were refined. Including removal of metal rain screens in front façade, interior steel stairs and railings, exterior steel stairs and fire escape and inclusion of roof perimeter railing and changing all lintels replacement to 50% lentil replacement.

### **A.1.6 Division 6: Wood and Plastics: Blocking, Cabinetry, Windowsills**

SWA Question: Why is there a BAU (\$47,600) to final (\$114,400) cost increase? What changed about scope?

BP/Volmar: The final NZE cost is \$89,600 for both buildings, not \$114,000 (you probably read \$114,000 as the total of Division 5). \$47,600 is for the kitchen and bathroom upgrades in BAU and windowsill add \$41,300 in the final NZE scope (windowsills don't have to be replaced in the BAU because new windows are similar to existing).

SWA Question: Why is there a midterm (\$187,425) to final (\$114,400) cost decrease? What changed about scope?

BP/Volmar: The no. of units considered were refined to reflect 2 buildings and actual site conditions and scope was changed. The changes are below:

- Kitchen cabinets and counter tops replacement was removed from scope—reduction of \$149,100
- Wood blocking in Kitchens and bathrooms was included for 2 buildings—increase of \$21,000
- No. of units changed from 21 to 42 to include both buildings so bathroom cabinetry cost increased from \$10,500 to \$21,000
- Windowsills increased from 159 to 172 to reflect 2 buildings in scope

SWA Question: Why are BAU costs different?

BP/Volmar: see below.

- Midterm BAU budget "Preliminary Budget\_300 E 162\_rev1.pdf" lists as \$187,425. BP/Volmar:
- Includes the following for only one building:
  - Kitchen Cabinets—\$119,700
  - Kitchen Counter Tops—\$29,400
  - Bathroom Cabinetry—\$10,500
  - Windowsills—\$27,825
- Final BAU budget: "04. RetrofitNY—Budget and Financing Plan" lists as \$47,600
- BP/Volmar: There was an error in entry here it should have been \$42,000. That reduction in cost is due to reduction in scope accounting for only wood blocking in Bathrooms and Kitchens and bathroom cabinetry.

### **A.1.7 Division 7: Thermal and Moisture Protection: Above Grade Walls**

SWA Question: Why does final budget "04. RetrofitNY—Budget and Financing Plan" still have cost for wall insulation?

BP/Volmar: This is was water proofing and air barrier, air sealing.

SWA Question: In the midterm price, what is shown for Waterproofing/air barrier? Does it include aero barrier? Does it include fluid or sheet applied air barrier at exterior face of brick?

BP/Volmar: we were planning fluid or sheet applied air barrier at exterior face of brick.

SWA Question: Is façade uninsulated in midterm? No EIFS cost noted in budget. Above lists cost for Waterproofing/Air Barrier/ Façade only.

BP/Volmar: EIFS is included in Division 4: Masonry.

- SWA Follow-up Question: What is the EIFS cost?
- BP/Volmar: \$349,308.00 at \$27.90/ sq. ft.



## **SWA Question: Where is Midterm Pricing for Fiberglass Girts (by Smart Ci)?**

ML: in Division 5: metal.

- SWA Followup Question: What is the girt cost?
- BP/Volmar: It was included in total cost of exterior insulation of \$199,626. Cannot deduce the specific component cost at this point.

### **A.1.8 Division 7: Thermal and Moisture Protection: Below Grade Walls**

SWA Question: In midterm: Cut sheets indicate BG insulation. Is BG + AG pricing combined?

Can it be separated?

BP/Volmar: we could but we would need some more time.

SWA Question: Was BGW insulation dropped from final scope?

BP/Volmar: Yes.

### **A.1.9 Division 7: Thermal and Moisture Protection: Other/Aerobarrier**

SWA Question: Why are BAU thermal/moisture protection costs different?

BP/Volmar: Change in scope to include both buildings and reduced unit prices.

- Midterm BAU budget "Preliminary Budget\_300 E 162\_rev1.pdf" lists as \$329,780 –
- BP/Volmar: this is the total cost including roof, interior insulation, firestopping, caulking, waterproofing.
- Final BAU budget: "04. RetrofitNY—Budget and Financing Plan" lists as \$224,000 –
- BP/Volmar: This is just for roof insulation.

SWA Question: Does midterm price include aero barrier? Noted in cut sheet package but not specifically referenced in midterm budget, "Preliminary Budget\_300 E 162\_rev1.pdf."

BP/Volmar: aerobarrier is not included in any of our scopes.

### **A.1.10 Roof**

SWA Question: How does scope change from midterm to final? Price difference substantial (\$122,500 at midterm and \$224,000 at final)?

BP/Volmar: no change. \$122,500 was for one building and \$224,000 was for 2.

### **A.1.11 Division 8: Openings: Windows**

SWA Question: Why does cost from midterm to final increase 4x (\$79,500 to \$299,200)? Does midterm line "Doors, Frames, Hardware—Exterior" cost include window frames? Can this be separated?

BP/Volmar: \$79,500 is for one building (\$159,000 for both). Cost includes frames. We got bulk pricing from vendors difficult to separate at this point.

SWA Question: Why are BAU costs different?

BP/Volmar: we refined our cost estimates.

- Midterm BAU budget "Preliminary Budget\_300 E 162\_rev1.pdf" lists as \$183,500
- BP/Volmar: for one building
- Final BAU budget: "04. RetrofitNY—Budget and Financing Plan" lists as \$417,180
- BP/Volmar: for two buildings

### **A.1.12 Division 8: Openings: Doors**

SWA Question: Why does the cost from midterm to final decrease by half (\$95,000 to \$38,000)?

BP/Volmar: because midterm scope included replacement of all apt doors while final included selective replacement.

### **A.1.13 Division 8: Openings: Storefront**

SWA Question: Why does "Openings—All Other" costs consist of in the final "04. RetrofitNY—Budget and Financing Plan"?

BP/Volmar: storefronts

SWA Question: Can an equivalent cost be separated out from another line in the midterm budget?

BP/Volmar: \$7,500 for storefronts.

#### **A.1.14 Division 8: Openings: Other**

SWA Question: What does other window costs consist of in the final "04. RetrofitNY—Budget and Financing Plan"?

BP/Volmar: I don't see this line item.

- SWA Follow-up Question: Confirm budget row 31 is storefront.
- BP/Volmar: It includes cost of material and installation

SWA Question: Can an equivalent cost be separated out from another line in the midterm budget?

BP/Volmar: same as above.

#### **A.1.15 Division 9: Finishes: Interior Finishes**

SWA Question: Why are BAU costs different?

BP/Volmar: midterm BAU includes full bathroom and kitchen renovation while final BAU only includes selective repairs.

- Midterm BAU budget "Preliminary Budget\_300 E 162\_rev1.pdf" lists finishes as \$348,398
- Final BAU budget: "04. RetrofitNY—Budget and Financing Plan" lists finishes as \$165,548

#### **A.1.16 Division 10: Specialties**

SWA Question: Why are BAU costs different?

- Midterm BAU budget "Preliminary Budget\_300 E 162\_rev1.pdf" lists specialties as \$31,150.
- BP/Volmar: For one building.
- Final BAU budget: "04. RetrofitNY—Budget and Financing Plan" lists specialties as \$41,100.
- BP/Volmar: For 2 buildings. Signage price refined to reflect actual cost.
  - SWA Follow-up Question: Why is there a decrease in final BAU (\$41,100) to final budget (\$26,400)?
  - BP/Volmar: Toilet accessories taken out of scope - \$7,350. Signage cost reduced from \$15,000 to \$8,400.

### **A.1.17 Division 11: Equipment: Appliances**

SWA Question: Why are appliances not in final BAU budget "04. RetrofitNY—Budget and Financing Plan", but in midterm (\$31,350 for both BAU and midterm) budgets "Preliminary Budget\_300 E 162\_rev1.pdf"?

BP/Volmar: we assumed no appliance replacement at all for the final BAU scope.

SWA Question: Why is final price so high? Almost \$6k/unit and not even replacing refrigerators. Are clothes washers/dryers being purchased?

BP/Volmar: What you are looking at is for both buildings, so the cost comes down to \$2,950/apartment and represents the replacement of electric stoves.

### **A.1.18 Division 12: Furnishings**

SWA Question: Are window treatments omitted from final scope? Cost in midterm.

BP/Volmar: I'm seeing the same cost (\$34,000) for final BAU and NZE scope.

SWA Question: Why are BAU costs different?

BP/Volmar: midterm cost was for one building and final was for both. The difference is because we refined our cost estimates.

- Midterm BAU budget "Preliminary Budget\_300 E 162\_rev1.pdf" lists furnishings as \$19,875
- Final BAU budget: "04. RetrofitNY—Budget and Financing Plan" lists furnishings as \$34,000

### **A.1.19 Division 22: Plumbing: HW Heater/DHW Controls/Fixtures**

SWA Question: Why is midterm budget (\$146,650) indicate significantly lower than final (\$268,800)?

BP/Volmar: midterm cost was for one building and final was for both.

SWA Question: Does these include costs for low flow fixtures, pipe insulation, pumps, or controls?

BP/Volmar: costs include low flow plumbing fixtures, pipe insulation as well as new piping for new laundry rooms and water leaks monitoring system.

SWA Question: Why are BAU costs very different?

ML: midterm cost was for one building and final was for both. Then, to explain the remaining difference, the midterm BAU did not include water leaks monitoring.

- Midterm BAU budget "Preliminary Budget\_300 E 162\_rev1.pdf" lists as \$91,650
- Final BAU budget: "04. RetrofitNY—Budget and Financing Plan" lists as \$291,800
  - SWA Follow-up Question: Does this Final BAU include low flow fixtures, pipe insulation? Confirm no new piping for new laundry room.
  - BP/Volmar: Yes. Some piping included for domestic water in laundry room

### **A.1.20 Division 23: HVAC: Heating/Cooling and Ventilation**

SWA Question: Does midterm price truly reflect Swegon & Daikin VRF unit? Midterm budget (\$118,000 BAU and \$210,080 midterm, combined with H/C system) indicate significantly lower costs, almost half compared to final (\$423,760)?

BP/Volmar: midterm cost was for one building and final was for both. Both include Swegon ERV and Daikin VRF.

SWA Question: Midterm notes indicate an exhaust fan. Is this reflected in the final?

BP/Volmar: the final still includes separate exhaust and supply for the laundry rooms.

- SWA Follow-up Question: Is this reflected in the ventilation pricing (midterm and final)?
- BP/Volmar: Yes

SWA Question: Can these H/C and V costs be separated in midterm?

BP/Volmar:

- In baseline budget—Heating—\$80,000 and ventilation—\$38,000. No changes to cooling system considered.
  - SWA Follow-up Question: That's \$118,000 for BAU at midterm. At final BAU is \$150,000 for heating/cooling only. Confirm final BAU scope doesn't include ventilation.
  - BP/Volmar: Confirmed
- In Energy Efficient scope—Heating and cooling—\$165,680/ Building and Ventilation—\$44,400/ Building

SWA Question: Do costs include costs of ductwork and duct insulation, controls, and refrigerant line?

BP/Volmar: yes.

## A.1.21 Division 26: Electrical

SWA Question: Does midterm budget cost include solar?

BP/Volmar: yes

SWA Question: Why is cost so great in midterm budget (\$898,000) compared with final (\$543,600)? Did scope change?

BP/Volmar: \$543,000 does not include solar while \$898,000 includes solar. Also, unit costs were refined to reflect more accurate costs including some changes to scope of work.

- SWA Follow-up Question: What do these include? Does midterm electric only cost \$523,000 (\$898k - \$375k solar)? It includes the following:
  - Main Service—\$ 175,000.00
  - Distribution Wiring Kitchen \$ 63,000.00
  - Distribution Wiring Bathrooms \$ 31,500.00
  - Panelboards/Risers \$ 105,000.00
  - Light Fixtures \$ 112,500.00
  - Equipment Wiring—Includes Mechanical and Laundry Room \$ 36,000.00

SWA Question: Why are BAU costs very different?

BP/Volmar: This is due to changes in scope and refining the costs to reflect both buildings as detailed below:

- Midterm BAU budget "Preliminary Budget\_300 E 162\_rev1.pdf" lists electrical as \$277,500.
- BP/Volmar: Includes the following:
  - Distribution wiring for Kitchen for one building—p \$63,000
  - Distribution Wiring Bathrooms for one Building—\$31,500
  - Panel boards for one building—\$105,000
  - Light Fixtures for one building—\$75,000
  - Laundry room equipment wiring—\$3,000
- Final BAU budget: "04. RetrofitNY—Budget and Financing Plan" lists electrical as \$119,600.
- BP/Volmar: includes the following
  - Light Fixtures in Apartments, Both Buildings  
\$89,000
  - Light Fixtures in Common Areas, Both Buildings  
\$10,000
  - Laundry Room Equipment Wiring, Both Buildings  
\$20,000

### **A.1.25 SWA Follow-up Question:**

Where does pricing for distribution wiring in kitchen/baths, and panel boards come in?

BP/Volmar: This was taken out of scope

### **A.1.26 Division 26: Electrical: Safety and Security**

SWA Question: Where is this cost in final budget (for both BAU and final)?

BP/Volmar: site safety and OSHA controls are in Division 1 General Conditions

SWA Question: Looking for final alarm system. Noted as \$40,000 in midterm. Is the cost the same for BAU and final?

BP/Volmar: Fire alarm taken out of scope in final.

### **A.1.27 Division 48: Elec Power Generation: Solar PV**

SWA Question: Did scope change from midterm to final?

BP/Volmar: no

SWA Question: Why did cost increase from midterm (\$375,000) to final (\$404,000)?

BP/Volmar: \$375,000 was shown for one building in the midterm scope and \$404,000 was shown for two buildings. \$375,000 was meant to be for both buildings. Then the change between \$375,000 and \$404,000 is due to the team refining costs.

### **A.1.28 GC Overhead, Profit, Insurance**

SWA Question: Why did cost increase from midterm (\$627,156) to final (\$860,058)?

BP/Volmar: It's actually a decrease because midterm cost was for one building while final cost is for two buildings. The decrease is due to reduction in overall cost. All these costs are considered a percentage of total hard cost. Also, reduction in insurance cost as a percentage of total cost, reduction in GC profit from 10% to 8% and increase in overheads from 4% to 5% have contributed to it.

## **A.2 Chris Benedict, RA**

SWA reached out to this team with a few questions, but the team did not provide answers. Areas which still require clarification include:

- The wall and roof costs reduced significantly from midterm to final without a clear reason.
- The cost decrease in interior finishes between midterm to final reports has not been explained.
- The final costs for appliances appear to exclude range hood and refrigerator costs.
- It is unclear if the final plumbing cost is for plumbing fixtures only or combined with the hot water heater cost.
- ASHP costs increased from midterm to final, despite no apparent scope change.
- There was a 2/3 cost decrease in the ventilation scope from midterm to final SWA could find no obvious scope change.
- Electrical costs for MEP wiring almost tripled from midterm to final.

### **A.2.1 Scaffolding**

SWA Question: What are the scaffolding costs for BAU, midterm, and final?

### **A.2.2 Division 2: Sitework: Demo/Site Work/Earthwork/Exterior Improvements**

SWA Question: Why does cost increase from BAU (292,440) to midterm (\$679,160)?

SWA Question: What was included in the midterm cost that was excluded from BAU and final?

### **A.2.3 Division 6: Wood and Plastics: Blocking, Cabinetry, Windowsills**

SWA Question: Is scope in midterm (roof joists/wood subframe @ new windows/kitchen cabinets/interior trim) similar to final scope?

### **A.2.4 Division 7: Thermal and Moisture Protection: Above Grade Walls**

SWA Question: What wall insulation type was specified in midterm?

### **A.2.5 Division 7: Thermal and Moisture Protection: Below Grade Walls**

SWA Question: What is the midterm scope?

SWA Question: Is below grade walls insulation cost included in cost above grade walls cost?



### **A.2.6 Division 7: Thermal and Moisture Protection: Flashing and Trim/Specialties/Sealants and All other thermal**

SWA Question Are scopes for midterm ("Flashing and trim/specialties/sealants", \$75,140) similar to final ("All other thermal", \$31,060)?

SWA Question Is there any comparable BAU costs that can be provided separately?

### **A.2.7 Division 7: Thermal and Moisture Protection: Roof**

SWA Question: What wall insulation type is specified in midterm?

SWA Question: Why is final (\$320,360) price lower than midterm (\$490,160)?

SWA Question: Why are BAU and final costs identical (\$320,360)?

### **A.2.8 Division 8: Openings: Windows**

SWA Question: What window type and manufacturer were specified in midterm?

### **A.2.9 Division 8: Openings: Other**

SWA Question: What is defined as other-openings costs?

SWA Question: There is no separate cost in the midterm budget. Is this combined with another budget line item?

### **A.2.10 Division 9: Finishes: Interior Finishes**

SWA Question: Cost decreased from midterm (\$963,950) to final (\$776,550)? What changed in scope

### **A.2.11 Division 11: Equipment: Appliances**

SWA Question: What are the final refrigerator and hood costs? The "Appendix E\_ Building Performance Summary" doc indicates they're being replaced.

### **A.2.12 Division 22: Plumbing: HW Heater**

SWA Question: Why is final (\$181,000) price higher than midterm (\$158,800)? What changed about scope?

SWA Question: Does this include costs for pipe insulation, pumps, or controls?

### **A.2.13 Division 22: Plumbing: Fixtures**

SWA Question: What were final fixture cost? Is it combined with DHW system in the final budget?

### **A.2.14 Division 23: HVAC: Heating/Cooling**

SWA Question: Why is final (\$888,300) price higher than midterm (\$746,100)?

SWA Question: Do costs include costs of ductwork and duct insulation, and refrigerant line?

### **A.2.15 Division 23: HVAC: Ventilation**

SWA Question: Who is manufacturer for midterm?

SWA Question: Why is final price (\$103,800) lower than midterm (\$359,000)?

SWA Question: Does cost include ductwork?

### **A.2.16 Division 26: Electrical**

SWA Question: Why is final (\$636,500) price higher than midterm (\$221,900)?

SWA Question: Why does cost decrease from BAU (\$581,300) to midterm (\$221,900)?

SWA Question: How much of cost can be attributed to wiring for MEP versus standard electrical scope?

### **A.2.17 Division 26: Safety and Security**

SWA Question: What are the BAU and final costs?

## **A.2.18 GC Overhead, Profit, Insurance**

SWA Question: Why did cost increase from midterm (\$512,342) to final (\$714,555)

## **A.3 Levy Partnership**

Various envelope items were inconsistent between reports. Changes between midterm and final included:

- one side wall and the bulkhead were omitted from calculations, causing EIFS costs to appear lower.
- Below grade wall insulation was removed after the midterm, due to high cost and relatively minimal energy impact.
- Windows changed from triple pane in the midterm to double pane in the final, reducing costs by more than half.
- Questions about the BAU roof insulation costs remain unresolved.
- Heat pumps were changed from Daikin to LG at final due to MEP preference and costs dropped.

There are a few other inconsistencies in cost separation, scope changes, and missing information. It is unclear what falls into specialties division, other than that it excludes energy related scope. BAU costs for DHW water and space heating in the plumbing scope were not separated out. Additional changes can be found in the Q&A section.

### **A.3.1 Division 2: Sitework: Demo/Site Work/Earthwork/Exterior Improvements**

SWA Question: Can BAU and final demo and scaffolding costs be separated?

Levy:

- Hanging scaffolding for BAU façade work is listed in final “Budget and Financing plan at \$9,500.”
- Demo for BAU
  - \$2,100 to remove cooking units (\$100/unit)
  - \$4,725 to remove refrigerators (\$225/unit)
  - \$7,500 to remove boiler if replaced with condensing
- All other demo costs are for energy related work scope.

### **A.3.2 Division 3: Concrete**

SWA Question: Where is the cost in the midterm budget?

Levy:

- All concrete costs are for BAU measures.
- Page 33, “Non-energy scope items”
- \$18k “concrete paving at sidewalk”
- \$15k “repair retaining walls to basement entrance”

### **A.3.3 Division 4: Masonry: Repair/Re-Pour, Brick**

SWA Question: Where is the cost in the midterm budget?

Levy:

- Nearly masonry work is for the BAU measures (Non-energy scope items, page 33)
- Some of this will be eliminated by over cladding with EIFS, but some work will still be required on front façade where code restricts over cladding.
- ~\$32k for “rake out packed joints and point façade elevation”
- ~40% of this will still be required.
- The only masonry work for the energy retrofit is for channeling through the brick to bring refrigerant lines down to the apartments. This was estimated at 40k, but includes the cost of hanging scaffolding, channeling through and replacing the brick, and running the refrigerant lines. We only have the cost of hanging scaffolding broken out (\$9,500)

### **A.3.4 Division 7: Thermal and Moisture Protection: Above Grade Walls**

SWA Question: Why did cost change from midterm (\$120,040) to final (\$148,172)?

Levy: SF area was missed at the midterm calculation (exposed rear side wall, and bulkhead), and as such these costs were not reflected in the midterm above grade wall costs for EIFS.

### **A.3.5 Division 7: Thermal and Moisture Protection: Roof**

SWA Question: Final: "06. RetrofitNY—Building Performance Summary—The Levy Partnership" lists R-37 total but R-25 insulation in cell I13. What is the R-value?

Levy:

- R-37 is counting the 6” of Fiberglass batt insulation below roof plank in dropped ceiling.
- R-25 is 4” of added polyiso continuous insulation above roof for energy retrofit.

SWA Question: BAU cost changes. Why?

- Midterm: \$63,500 in "LevyPartnership\_RetrofitNY\_ConceptualDelivery.pdf"
- Final: \$85,444 in "04. RetrofitNY—Budget and Financing Plan—The Levy Partnership"
- Levy: We used the IPNA cost for BAU in the midterm but updated this to the per/SF price (without adding insulation) we were using for roof work for the retrofit for a more direct comparison.
  - SWA Follow-up Question: Not seeing a cost change from BAU to final cost in the above final 04 document. Both are listed as \$85,444 in cells H27 and O27 despite having different descriptions (roof, roof drain; and Roof membrane / insulation, respectively). Should BAU be different?
  - Levy: I'll need to revisit this.

### **A.3.6 Division 8: Openings: Windows**

SWA Question: Does midterm scope/budget reflect installing all triple pane windows?

Levy: Yes, midterm costs are for triple pane windows. Although the cost difference between double and triple pane was not that great (\$100,331 vs. \$110,280)

- SWA Follow-up Question: What is the frame material at midterm and final (metal or uPVC)?
- Levy: uPVC for both

### **A.3.7 Division 8: Openings: Doors**

SWA Question: Who is door manufacturer?

Levy: For midterm budget, doors are listed under “storefront glazing”, and manufacturer is Wythe windows. Interior doors costs were taken from the IPNA and confirmed with CTA’s cost database, with no manufacturer specified.

SWA Question: Can pricing be split into exterior and interior doors?

Levy:

- “replace exit doors” \$5,000
- “replace/repair basement door to stairwell” \$900
- “Replace hollow core doors. Replace closet doors” from BAU budget, \$16,625

SWA Question: In midterm, is this combined with the window cost?

Levy: See above, midterm door costs are broken out in BAU scope, and under “storefront glazing” for retrofit scope.

### **A.3.8 Division 9: Finishes: Interior Finishes**

SWA Question: Where is the cost in the midterm budget?

Levy: Listed under non-energy scope items on page 33.

- SWA Follow-up Question: Where does basement bathroom upgrade (\$20,000) go in the final budget?
- Levy: This should be included in “Finishes”

### **A.3.9 Division 10: Specialties**

SWA Question: Where is the cost in the midterm budget?

Levy: Unsure what falls into this category, but they are likely listed under non-energy scope items.

### **A.3.10 Division 11: Equipment: Appliances**

SWA Question: BAU scope differs change. Why did it decrease by so much, aside from removing induction cooktops?

- Midterm Refrigerators = \$14,152 + ranges \$28,245  
"LevyPartnership\_RetrofitNY\_ConceptualDelivery.pdf"
- Final: \$28,500 "04. RetrofitNY—Budget and Financing Plan—The Levy Partnership"
- Levy:
  - Midterm BAU, From IPNA, listed on non-energy scope items
    - “replace ranges and range hoods” \$16,800
    - “upgrade refrigerators to energy star” \$11,739
    - These add to BAU appliance upgrade costs of ~\$28,500
  - Midterm retrofit scope for appliances:
    - Induction cooking, \$20,769
    - Refrigerators \$12,600
    - Total cost of \$33,369,
  - Cost in final delivery of \$29,400 is reduced due to induction.

### **A.3.11 Division 22: Plumbing: HW Heater/DHW Controls/Fixtures**

SWA Question: Does the midterm low flow cost (\$5,460) include cleaning drain line costs?

Levy: No, just the cost of toilets and low flow fixtures.

SWA Question: In final report (BAU and schematic budgets), both are combined, and costs are higher (\$20,160 and \$21,210, respectively).

Levy: These costs combine drain line cleaning with low flow fixtures / toilets. Slightly higher cost of Retrofit scope accounts for higher quality fixtures than what would have been included in BAU. These low flow fixtures had been used by our MEP on hotels and other high-end applications and recommended.

SWA Question: Does these include costs for low flow fixtures, pipe insulation, pumps, or controls?

Levy:

- DHW controls, \$2,000
- SWA Followup Question: "04. RetrofitNY—Budget and Financing Plan—The Levy Partnership" shows the below. Are DHW controls being double counted?
- Levy: No, the \$1,000 cost increase is from higher quality low flow fixtures. Controls should just be included under DHW system.

A		B	N	O	P
1		NYSERDA RETROFIT NY			
2		The Levy Partnership			Tot
3		439 West 125th Street, New York, NY			
4					
5		NET ZERO ENERGY (NZE) BUDGET			
6		Notes (as Needed)		Total \$	
18		Plumbing - DHW System	Saniten HPWH, controls		36,685
19		Plumbing - All Other	Low flow fixtures, drain lines		21,210
20		HVAC - Heating /Cooling System	VRF		308,000

- Low flow toilets / fixtures, \$5,460
- Clean drain lines, \$9,450
- Not sure where the extra \$4,300 came from, digging into that.

SWA Question: BAU scope changes. Why?

- Midterm: 2 storage tanks \$39,600 in "LevyPartnership\_RetrofitNY\_ConceptualDelivery.pdf"
- Levy: The gas-fired storage tank DHW system costs are lumped in with the condensing boiler in the IPNA. As the DHW system has a shorter EUL, it needed to be broken out for the LCCA. This is an assumed cost based on replacement cost data we use for IPNA's.
- Final: no change/low flow fixtures \$20k in "04. RetrofitNY—Budget and Financing Plan - The Levy Partnership"
- Levy: For the BAU comparison in the budget and financing plan of the final report, these costs were left lumped in with the condensing boiler.

### **A.3.12 Division 23: HVAC: Heating/Cooling**

SWA Question: Is Daikin cheaper than LG or did scope change from midterm (\$220,236) to final (\$370,000)?

Levy: I'm seeing \$308,000 for VRF costs in the Final budget and financing plan. \$220,236 was an estimate provided by Daikin via. an estimating tool they have. The \$308,000 was a budget estimate provided by a contractor and is a more reliable number.

SWA Question: Ok. \$370,000 includes \$308,000 VRF + \$62,000 for Channeling / covering refrigerant lines, Commercial space heat pumps, basement heaters (\$40k for channeling)

- SWA Follow-up Question: Why did the design switch manufacturers from midterm to final?
- Levy: Modelling was done with Daikin and believe this is what was included in midterm. LG was preferred by our MEP.

SWA Question: Do costs include costs of ductwork and duct insulation, controls, and refrigerant line?

Levy: Ventilation cost includes ductwork

- SWA Follow-up Question: What about duct insulation and controls? Confirm this is part of VRF package.
- Levy: Cost of channeling refrigerant lines through brick is under "HVAC All other", Estimated at \$40k

### **A.3.13 Division 23: HVAC: Ventilation**

SWA Question: Ventilation budget (pg 32) and LCA (pg 36) conflict in Conceptual report. LCA seems way too low. See "LevyPartnership\_RetrofitNY\_ConceptualDelivery.pdf"

Levy: Looks like labor costs were not included for ventilation in the LCA. This adds \$100k to retrofit lifetime cost of Ventilation.

SWA Question: Do costs include costs of ductwork and duct insulation, and controls?



Levy: In final budget, yes.

- SWA Follow-up Question: Were they included in the midterm budget?
- Levy: See H/C reply.

SWA Question: BAU scope changes:

- Midterm indicates change air filter, replace/upgrade exhaust \$6 + \$18k in "LevyPartnership\_RetrofitNY\_ConceptualDelivery.pdf"
  - I'm seeing 20k for TAB adjustments of exhaust dampers in apartments in midterm budget, not sure where the \$6k or \$18k are?
  - Levy: See BAU at end of pg 36.
- Final lists TAB only at \$15k in "04. RetrofitNY—Budget and Financing Plan - The Levy Partnership"
- Levy: This was likely an updated estimate for the final budget vs. from IPNA.

#### **A.3.14 DIVISION 26: Electrical**

SWA Question: Where is the BAU in conceptual report? "LevyPartnership\_RetrofitNY\_ConceptualDelivery.pdf"

Levy: Page 33, non-energy scope items. It looks like in-unit electrical work is not identified/broken out as a line item in IPNA. This is likely not accurate and may be an added cost.

SWA Question: Why is wiring for induction a cost added?

Levy:

- Electrical ranges need a dedicated 220v circuit; this will need to be run from the electrical panel.
- While not the case for us, In some situations this added electrical load may require the in-unit electrical panel to be upsized, and potentially the whole-building electrical service to be upsized.
  - SWA Follow-up Question: If not the case for this project at midterm design upon evaluation, what is the adjusted midterm project cost be for electrical scope?
  - Levy: I believe midterm cost is still accurate. The 3k/unit is cost to wire a dedicated 220v circuit to the kitchen from in-unit panel. The in-unit panel itself did not need to be upgraded.

#### **A.3.15 Division 26: Electrical: Elevator**

SWA Question: Where is the cost in the midterm budget?

Levy: Page 33. "non-energy scope items" \$50k

### **A.3.16 Division 26: Electrical: Safety and Security**

SWA Question: Where is the cost in the midterm budget?

Levy: Page 33. “non-energy scope items” \$30k, was moved to “not pursuing” as a cost save.

- SWA Follow-up Question: Was this scope that was added back in at final for \$16,800? Upgrade security system. Replace cameras and monitors.
- Levy: Yes
- SWA Follow-up Question: Where is \$5,000 for sprinkler heads in final? Listed in midterm.
- Levy: Removed from final scope.

### **A.3.17 Division 48: Elec Power Gen: PV**

SWA Question: What size is the ballasted system in BAU?

Levy: This was 25.5kW at 4\$/watt based on available roof area.

### **A.3.18 GC Overhead, Profit, Insurance**

#### **A.3.19 SWA Question:**

Where is the cost in the midterm budget (pg 32 LevyPartnership\_RetrofitNY\_ConceptualDelivery.pdf)?

Levy: Catch-all 20% for soft costs at the bottom of budget on page 32.

## **A.4 ICAST & AOW**

Changes to team and scope between the midterm and final were the focus of several questions. This project prorated costs for comparison between midterm (six units) and final scope (37 units).

There are several scope changes in envelope items. Above grade wall costs decreased by about 25% from midterm to final, although the specification remained the same. Doors change from Wythe doors at midterm to standard swinging opaque at final due to budget.

The midterm scope includes central Sanden HPWH with drain water heat recovery and a solar thermal water heater. The final scope changes to an in-unit Rheem HPWH with smaller solar thermal water heater and no drain water heat recovery system.

Various other scope items changed throughout the project development. Appliances costs decrease from midterm to final. Electrical costs omitted from final but included in midterm and BAU (from final report). Furnishing, interior finishes, and specialties costs were included only in the BAU costs.

The ICAST team was unable to separate costs for the following items in most cases: wall and roof insulation; for windows and doors; and for heating/cooling and ventilation. A more detailed cost separation would provide deeper insight into the project's cost drivers.

- Prorated cost by unit for comparison between midterm scope (six units) and final scope (37 units).

#### **A.4.1 Division 2: Sitework**

SWA Question: What is the BAU sitework scope? Does it include more than removal of existing cavity insulation?

ICAST/AOW: Includes earthwork, fencing, landscaping, sidewalks, paving, site concrete and site signage.

#### **A.4.2 Division 3: Concrete**

SWA Question: What is the BAU concrete scope? Does it include more than concrete foundations, power wash, and seal?

ICAST/AOW: Includes foundations, slabs, and rebar.

#### **A.4.3 Division 4: Masonry**

SWA Question: What is the BAU masonry scope?

ICAST/AOW: Includes masonry- bricks/sill (replacement on new/existing windows), retaining walls, and pavers.

#### **A.4.4 Division 5: Metals**

SWA Question: What is the BAU metals scope?

ICAST/AOW: Includes railings and pavilions (picnic and basketball).

#### **A.4.5 Division 6: Woods and Plastics**

SWA Question: What is the BAU Woods and Plastic scope?

ICAST/AOW: Includes carpentry, roof truss, trim, wall, stairs, millwork and community room work.

#### **A.4.6 Division 7: Thermal and Moisture Protection**

SWA Question: What is the BAU thermal and moisture protection scope? Does it include more than cavity/façade insulation, weather resistive barrier, and roof blown in R-55?

ICAST/AOW: Includes spray foam insulation, siding, roofing, gutters, sealants, and air barrier.

SWA Question: Can these costs be separated (above grade, below grade, roof)?

ICAST/AOW: No way to separate insulation costs.

#### **A.4.7 Division 8: Openings**

SWA Question: Confirm these windows are U-0.28 and SHGC-0.27.

ICAST/AOW: U-0.27 and SHGC-0.30 or 0.27.

SWA Question: Does this cost include standard steel insulated doors and air sealing?

ICAST/AOW: See spray foam around windows in Thermal and Moisture Protection scope. Aluminum storefront doors included in this scope.

SWA Question: Can these costs for windows, doors, and air sealing be separated?

ICAST/AOW: No

#### **A.4.8 Division 9: Interior Finishes**

SWA Question: What is the BAU interior finishes scope?

ICAST/AOW: Includes drywall/taping, flooring, ACT ceiling, Wood cloud ceiling, ceramic tile, painting and, soffits.

#### **A.4.9 Division 10: Specialties**

SWA Question: What is the BAU specialties scope?

ICAST/AOW: Includes signage, knock box, wall protection, toilet accessories, mailboxes, shelving, and fire extinguishers.

#### **A.4.10 Division 11: Equipment**

SWA Question: What is in the BAU equipment scope?

ICAST/AOW: Includes appliances only, excludes common clothes washers and dryers.

SWA Question: Can these costs be broken out by cooktops/ovens, refrigerators, and washers/dryers?

ICAST/AOW: No.

#### **A.4.11 Division 15: Plumbing**

SWA Question: What is the BAU plumbing scope? Does this include piping, and pipe insulation? Anything else?

ICAST/AOW: Excludes controls (thermostat under HVAC scope). Includes pumps.

#### **A.4.12 Division 15: HVAC**

SWA Question: What is the BAU HVAC scope? Does this include boiler and bath fans? Anything else?

ICAST/AOW: Includes furnace, fans, ductwork, and HVAC piping.

SWA Question: Can the heating and ventilation costs be separated?

ICAST/AOW: No.

#### **A.4.13 Division 16: Electrical**

SWA Question: What is the BAU electrical scope? Does this include new electric and gas meters? Anything else?

ICAST/AOW: Includes provisions for meters (provided by National Grid).

## **A.5 King + King**

A few of the major changes between the midterm and final scopes for this project include:

- Sheds were added to final design but are not in midterm.
- Entry enclosure and lighting costs (\$20k per entry) may have been omitted from midterm cost.
- Window scope (screens, shipping, taxes, entry corridor wall, etc.) and design between the midterm and final remained the same yet the cost increased.
- DHW in the midterm design was to be supplied by a WaterFurnace GSHP which was switched to an air source heat pump in the final. Costs dropped almost in half with a central Sanden AWHP.

Additionally, the project team noted that final costs for plumbing fixtures may span finish and plumbing scopes. A more detailed cost separation would provide deeper insight into the project's cost drivers. Attic insulation, air sealing in garage/workshop are in the roof budget, not separated out into insulation and air sealing. Electrical budget consists of work associated with ASHPs, ERV, DHW system, and entry lighting. Heating, cooling, and ventilation costs are combined, so ventilation costs could not be separated.

### **A.5.1 Division 1: General Conditions: General Requirements and Scaffolding**

SWA Question: What is midterm cost?

King: General requirements were 7% of construction costs. See Purcell net zero budget breakdown in Conceptual Design Report.

- SWA Follow-up Question: OK for midterm. General requirements don't get line itemized in the NZE budget breakdown in the final report. It increases to 9.8% in BAU in final (\$174,057/\$1,772,550). Is this % increase in line with what you'd expect?
- King: In line yes but inflated a bit to cover some unknowns after Purcell came back with a bit more detail after conceptual.

### **A.5.2 Division 2: Demo/Site Work/Earthwork/Exterior Improvements**

SWA Question: How did sitework scope change from midterm (\$97,500, called sitework and demo) to final (\$25,000, called demo)?

King: Site work is called Earthwork in Schematic Design and is reduced from \$97,500 to \$60,800 because of the change from frost wall foundations for the entry way and sheds to helical piles. The \$25,000 for demo is the same between both deliverables.

SWA Question: Can cost for HVAC shed be provided separately?

King: See answer below.

### **A.5.3 Division 3: Concrete**

SWA Question: How did concrete scope change from midterm (\$42,750, called mechanical pads and concrete) to final (\$19,230, called concrete)?

King: Changed from frost wall foundations for entry way and sheds to helical piles—see drawings.

SWA Question: Can cost for HVAC shed provided separately?

King: Unfortunately, this level of detail cannot be provided at this time.

### **A.5.4 Division 6: Wood and Plastics: Blocking, Cabinetry, Windowsills**

SWA Question: What is carpentry scope in final and BAU?

King: Unfortunately, this level of detail cannot be provided at this time.

- SWA Follow-up Question: Is the Carpentry scope (\$97,900) in the midterm report the same scope as the Wood, Plastics, Composites in the BAU (\$35,650) and Final (\$296,415)?
- King: Yes, woods, plastics, comp = carpentry. Sheds were not in conceptual design, added for final.

SWA Question: Does this include any HVAC shed scope? If so, can it be separated?

King: Yes, and unfortunately this level of detail cannot be provided at this time.

### **A.5.5 Division 07: Thermal and Moisture Protection: Above Grade Walls and Air Sealing, Garage/Workshop Improvements**

SWA Question: Where is final air sealing cost?

King: Thermal/Moisture Protection—All Other. For the apartments and office, the total air sealing cost is \$58,800 (attic air sealing for garage/workshop is included under attic insulation—see below).

SWA Question: Is that big a jump from in price from midterm (\$87,750, called siding and trim, air sealing, garage/workshop improvements) to final (\$492,842, called façade ins and other insulation) expected? Or was the conceptual estimate unrealistically low?

King: \$425,452 of this scope is the BAU budget that not included in the Conceptual Design net zero budget.

- SWA Follow-up Question: Confirm midterm budget for AGW is \$20,400 + \$425,452.
- King: Confirmed, \$425k is BAU, plus \$20,400 for air sealing etc.

SWA Question: Is attic insulation included in this cost?

King: Yes, attic insulation for the garage/workshop is included under Thermal/Moisture Protection - Roof Insulation. Attic insulation and air sealing for the garage/workshop is \$8,850.

SWA Question: Below ground walls 2-inch EPS is noted in midterm and final reports. Is this included in above ground walls pricing? Can it be separated?

King: The 2-inch EPS exists. This is not included in the scope.

SWA Comment: OK, see page 15 of midterm report.

### **A.5.6 Division 07: Thermal and Moisture Protection: Roof**

SWA Question: Why did the roof price change from midterm to final if the insulation spec is the same?

King: Roofing in the Conceptual Design is for the sheds. Roofing included in the Thermal/Moisture Protection—Roof Insulation Schematic Design is for some work included in the BAU and the attic insulation/air sealing in the garage/workshop.

### **A.5.7 Division 08: Openings: Windows**

SWA Question: Why did the window price change if the spec remained the same (Zola U-PVC) for midterm and final?



King: It's being reported differently between the two deliverables due to different reporting requirements by NYSERDA. Screens, shipping, taxes, entry corridor wall, etc. included in schematic design to further refine the numbers.

- SWA Follow-up Question: Does the midterm window cost include?
- King: Some window replacement items were redesigned, and the costs were adjusted. Couldn't get more specific.

### **A.5.8 Division 08: Openings: Other**

SWA Question: What is the "other openings" in the BAU and final that is not in conceptual cost?

King: Openings - All Other costs are all BAU costs for things like interior doors.

- SWA Follow-up Question: Confirm midterm cost is \$75,660.
- King: Yes. Tom thinks it's the cost of the "entry enclosure." Maybe \$20k per entry. Tom to confirm.
- King: Please see response below regarding "other openings." Seems like there is a slight error in our calculating (or something was double counted). There is a large allocation of interior and closet doors (\$50,000) in the BAU budget, and a few other smaller items that amount to +/- \$60,000.
  - Conceptual Design Window and Door Net Zero Budget: \$323,455: This is full cost, not incremental, but it does not include the cost for closet doors \$25,000 and interior doors \$25,000.
  - Schematic Design Window and Door Net Zero Budget: \$328,817: This is full cost, not incremental, but it does *not* include the cost for the closet doors \$25,000 and interior doors \$25,000.
  - As you can see there is actually no real change in the total cost for the scope that we included in the net zero budget between conceptual and schematic. Individual item changes and/or were added/deleted, but the overall budget is basically the same.
  - Total project budget schematic design = \$328,817 + \$50,000 = \$378,817: Total project budget listed in Budget and Financing Plan = \$395,087, this is incorrect because the BAU costs of \$75,600 listed is double counting Exterior Unit Doors (-\$18,000) and Exterior Common Doors (-\$7,660) but Access Doors (\$6,765) and Insulated Air Attic Hatch (\$1,825) are left out. This would bring us to \$378,017 so something else is a little askew but it's close.

### **A.5.9 Division 9: Finishes: Interior Finishes**

SWA Question: Why are "interior finishes" costs so low in midterm (\$78,390) compared with final (\$425,120, called finishes and furnishings) and BAU (\$358,370, called finishes and furnishings)?

King: The budget in the Conceptual Design is for the net zero scope only. The cost in the Schematic Design includes BAU and net zero scope.

- SWA Follow-up Question: Confirm midterm NZE cost should be approximately \$78,390 + BAU \$358,370.
- King: Yes, confirmed.

### **A.5.10 Division 11: Equipment: Appliances**

SWA Question: What is appliance cost breakdown in final?

King: The Schematic Design includes \$7,500 for Energy Star clothes washers under Equipment. The rest of the cost for this line is BAU for which we do not have a breakdown at this time.

SWA Question: What is refrigerator midterm cost?

King: No refrigerators included in net zero scope.

### **A.5.11 Division 22: Plumbing: HW Heater**

SWA Question: Is plumbing insulation and recirc pump in cost for DHW at all pricing sets (BAU, midterm, and final)?

King: Yes.

- SWA Follow-up Question: In BAU is this in the DHW plumbing (33,600) cost or other (\$1,500)?
- King: King adopted this budget from another architect, didn't originally come up with BAU costs. Tom thinks BAU for HW heater cost is replacing electric resistance DHW heaters as needed, not total replacement cost.
- SWA Follow-up Question: In the final, is this Sanden cost (\$168,000) or WaterSense fixtures/ other plumbing cost (\$1,500)
- King: Confirmed. Fixtures maybe partially covered in BAU costs in finishings.

### **A.5.12 Division 23: HVAC: Heating/Cooling**

SWA Question: Who is manufacturer for midterm HP?

King: No manufacture selected.

SWA Question: Why does cost drop in half from midterm to final?

King: It doesn't change. ASHP are the same between Conceptual Design and Schematic Design (\$316,000).

SWA Comment: Ok. Broken out page 70 of midterm report.

SWA Question: Are all HPs ductless?

King: Yes – see drawings.

### **A.5.13 Division 23: HVAC: Ventilation**

SWA Question: Are costs for both vent schemes shown in midterm budget?

King: Unclear what the question is here. Look at Conceptual Design report and there is the budget for different options included.

SWA Comment: Ok. Broken out page 70 of midterm report.

SWA Question: Can costs be separated for Heating/Cooling and Ventilation in midterm budget?

King: Unfortunately, this information cannot be provided at this time. The budget for the central ERV/ASHP option, which has been selected and included in the Schematic Design was the same between Conceptual and Schematic.

SWA Question: Do costs include costs of ductwork and duct insulation?

King: Yes.

### **A.5.14 Division 26: Electrical**

SWA Question: What does electrical budget consist of?

King: For the Schematic Design it includes all electrical work associated with the ASHPs, central ERV, and central DHW system as well as the new entry way lighting.

SWA Question: Why does cost jump from \$1,100 at midterm to \$87,300 at final?

King: Conceptual Design electrical was \$40,000 for the ASHP and Central ERV and an additional \$11,000 for GSHP DHW (\$51,000 in total). This increased to \$63,700 in Schematic Design (the \$87,300 includes BAU budget).

- SWA Follow-up Question: Does midterm scope include comparable entryway lighting? Did electrical cost for DWH from midterm to final increase?
- King: May have been oversight during conceptual phase. Most site lighting is currently LED, sprinkling of CFLs. Tom thinks the light level needed to be increased, so add a couple fixtures but not replace everything. King relied on Purcell to put together the costs for HPs, thinks that they did in fact increase electric component of cost.

### **A.5.15 Division 26: Electrical: Safety and Security**

SWA Question: Why is BAU cost so high (\$33,732, called fire suppression, electronic security)?

King: We have not looked at this in much detail since it is included in the BAU budget and was not associated with the net zero retrofit, our understanding is that new fire alarm panels need to be installed.

SWA Question: Why was it omitted from midterm budget?

King: It isn't included in the net zero budget, so we didn't include it in our Conceptual Design net zero budget.

SWA Question: What is electronic security and fire suppression scope in the final (\$2,750, called smoke detectors)?

King: This is BAU scope, but our understanding is that it is that it is for upgrades to the ADA units for smoke/heat detectors.

- SWA Follow-up Question: In retrospect, should the ADA unit upgrades be included in the midterm costs?
- King: Yes, they should be, because the upgrades need to be included (as part of BAU).

### **A.5.16 Division 48: Electric Power Generation: Solar PV**

SWA Question: Solar PV listed in final spec but not included in budget breakdown. What is the cost?

King: Solar PV is not included in the Schematic Design budget because our project is looking to work with National Grid on a pilot project where they would install and own the solar PV asset. As such, we do not have a budget since it is outside of our scope. In provide Purcell Const. Schematic budget there is an additional alternate that shows PV estimate if we were to include in our scope.

## **A.6 SWBR**

There were several specification changes from midterm to final. A portion of existing roof was replaced between the midterm and final, so budget was slightly reduced. At midterm, the water heater was a geothermal domestic hot water system. The final design was scaled back to in-unit electric water heaters system replaced on an as-needed basis, also reducing the final electrical costs.

There are some areas where cost separation and further clarity could provide deeper insight for cost analysis. It is unclear if Aerobarrier is included in the midterm costs for above grade wall thermal and moisture protection. Heating, cooling, and ventilation costs at midterm are combined by HVAC contractor, so ventilation costs could not be separated. A final window manufacturer has not been selected, though several viable options meet specs and budget.

### **A.6.1 Division 1: General Conditions: General Requirements and Scaffolding**

SWA Question: Why did midterm (\$71,209, called landscaping and sitework) to final (\$197,258, called added earthwork (slab edge excavation), exterior improvements, Rest. after slab edge, at geotherm) cost increase? Can costs be separated for comparison?

SWBR: I don't know where you are seeing a number of \$197K. I agree the retrofit portion at midterm was \$71,209, but for the final, Conifer LeChase is showing \$56,564. Are you also including some of the

non-retrofit renovation costs? Are these comments based on the budget submitted with the Retrofit Presentation Power Point dated 2019-02-27?

### **A.6.2 Division 6: Wood and Plastics: Blocking, Cabinetry, Windowsills**

SWA Question: Why did midterm (\$10,173 called rough/finish carpentry) to final (\$110,006, called sheathing repairs, window trim) cost increase by 10x?

SWBR: Again, I believe you are looking at the retrofit only portion at midterm and the combined retrofit and rehab numbers at the final. The retrofit only number of \$101,173 did not change.

### **A.6.3 Division 07: Thermal and Moisture Protection: Aerobarrier**

SWA Question: What is midterm cost?

SWBR: Same cost as at final; \$20,516.

### **A.6.4 Division 07: Thermal and Moisture Protection: Roof**

SWA Question: Why does cost drop from midterm (\$281,310) to final (\$120,635)? Did scope change?

SWBR: The final section of existing roof was replaced by the owner between the midterm budget and the final budget. It is all calling for Protected Roof Membrane Assembly (PRMA) now.

### **A.6.5 Division 08: Openings: Windows**

SWA Question: Who are window manufacturers in midterm and final?

SWBR: A final manufacturer has not been determined yet; there are a few that will meet our specs and budget. Alpen, Klearwall and Wasco were the windows that met the budget and can meet code and are Zone 6 Certified PHIUS windows.

SWA Question: Why does cost increase so much from midterm (\$39,625) to final (\$70,000)? Were they PH in midterm?

SWBR: Again, you are looking at the retrofit only portion at midterm and the combined retrofit and rehab numbers at the final. The retrofit only number did not change.

### **A.6.6 Division 08: Openings: Doors**

SWA Question: Why does cost increase so much from midterm (\$25,030) to final (\$127,695)? Were they PH in midterm?

SWBR: Same comment as the windows.

### **A.6.7 Division 9: Finishes: Interior Finishes**

SWA Question: Why does cost increase so much from midterm (\$34,908, called gyp, painting) to final (\$226,142, called drywall for new HVAC)? Are these 2 scopes truly the same or can they be separated?

SWBR: Where are you seeing a number of \$226,142? CLC's budgets are showing the same \$34,908 for both the midterm and final retrofit numbers.

### **A.6.8 Division 10: Specialties**

SWA Question: What is midterm cost?

SWBR: The renovation portion is \$13,760; the retrofit portion is \$0. Same for the final.

### **A.6.9 Division 11: Equipment: Appliances**

SWA Question: What appliances are being replaced? High cost/unit.

SWBR: Refrigerators, dishwashers, ranges (drop-in at ADA units), range hoods, disposals. Regarding the cost/unit, if you know where to get better pricing on the Conifer-specified GE products rather than buying them factory-direct, we're open to suggestions.

SWA Question: What is midterm cost?

SWBR: The renovation portion is \$30,057; the retrofit portion is \$0. Same for the final.

### **A.6.10 Division 12: Furnishings**

SWA Question: What is midterm cost?

SWBR: The renovation portion is \$8,725; the retrofit portion is \$0. Same for the final.

### **A.6.11 Division 22: Plumbing: HW Heater**

SWA Question: What is midterm design?

SWBR: The midterm design consisted of a geothermal domestic hot water system. The system contained two water-to-water heat pumps, three 120-gallon storage tanks, geothermal circulations pumps and domestic hot water recirculation pumps.

SWA Question: Who is manufacturer for midterm and final designs?

SWBR: The Basis-of-Design for the geothermal system were Water Furnace Model NEW066 water-to-water heat pumps and Water Furnace 120-gallon Geo Storage tanks. The Basis-of-Design contained within the final submission are AO Smith ENT-40, 40-gallon electric water heater/storage tanks.

SWA Question: Is plumbing insulation and recirc pump in cost for DHW at all pricing sets (BAU, midterm, and final)?

SWBR: The insulation and recirc pump cost are in the midterm budget only. Design changed for final.

### **A.6.12 Division 23: HVAC: Heating/Cooling**

SWA Question: Is there a dedicated ASHP system for heating/cooling of units or is the heating/cooling handled by the DOAS? Schematic report describes both.

SWBR: Please reference the updated HVAC set (attached) which clearly identifies the indoor conditioning of the units via the local ASHP (FCU) as was indicated in our Schematic design narrative.

SWA Question: Why does cost drop from midterm (\$469,639, called All HVAC) to final (\$404,294, HPs)? Can Heating/Cooling be separated from Ventilation in midterm.

SWBR: We agree with the midterm number but for the final, Conifer LeChase is showing \$470,651, the slight increase due to switching to a non-geothermal ERV and the removal of the wellfield and additional ventilation. See breakout comment below under Ventilation.

SWA Question: Who is manufacturer in midterm and final?



SWBR: Midterm: Mitsubishi, Final: LG.

SWA Question: Does pricing include ductwork and insulation?

SWBR: Yes.

### **A.6.13 Division 23: HVAC: Ventilation**

SWA Question: What is the midterm design and cost? Not broken into the "2018-09-17 Portville Sq base and retrofit budget" pdf.

SWBR: The HVAC contractor priced this as an entire project; we do not have the heating cooling separated out from the ventilation at this time.

SWA Question: Who is manufacturer at midterm and final?

SWBR: Midterm: Trane, Final: Trane.

### **A.6.14 Division 26: Electrical**

SWA Question: Why do costs drop from midterm (\$251,614, called electric) to final (\$141,448, called added wiring (HPs, etc.), "site lighting, utilities")?

SWBR: The retrofit portion at midterm was \$251,614, but for the final, Conifer LeChase is showing \$325,186. The cost increase was for the upsizing of the solar power system. We are not sure where you are getting the \$141K number from.

### **A.6.15 GC Overhead, Profit, Insurance**

SWA Question: Why is midterm (\$269,560) so low compared to final (\$413,852)?

SWBR: Again, you are looking at the retrofit only portion at midterm and the combined retrofit and rehab numbers at the final. The retrofit only number for the final is \$245,375. It went down because the overall cost went down.



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