RetrofitNY: RiseBoro Passive House Retrofit with Tenant in Place Schematic Design

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RetrofitNY: RiseBoro
Passive House Retrofit with Tenants in Place
Schematic Design

Final Report

Prepared for: RetrofitNY

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Abstract

This report documents a real job currently underway, started 2014. Prior to this date Chris Benedict, R.A., the Architect for the job and team leader for this NYSERDA research project had seen many low energy retrofits on European tours and saw that this work could be translated to apartment buildings in New York City. She felt it was entirely possible and legal for the retrofit of existing buildings with tenants in place by installing most of the work on the outside of the building and not disrupting tenants. In 2010, due to Chris' work on the Mayor's Task Force for Greening the Code under the Bloomberg Administration, a measure allowing an addition of 8" of cladding to existing buildings was passed by City Council and this set the stage for the retrofit work to happen. After many presentations on the subject and asking potential clients if they were willing to try it, Riseboro Community Partners, formerly known as Ridgewood Bushwick Seniors Citizens Council, committed to the retrofit of 12 existing buildings in their portfolio that were slated for "Year 15" refinancing. This report contains information requested by NYSERDA regarding the physical strategy for the design, positive aspects of the strategy, and financial information for one of the buildings in the job, 104-110 Grove Street.

Keywords

RetrofitNY. Deep energy retrofit. Net-zero energy. Net-zero retrofit. Net-zero energy building. Energiesprong. Site Energy Utilization Intensity. Multifamily Energy Retrofit. Energy Efficiency.

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Acronyms and Abbreviations

ft	feet
kWh	kilowatt hours
m/s	meters per second
MW	megawatts
NYS	New York State
NYSERDA	New York State Energy Research and Development Authority
W	watts
EUI	Energy Use Intensity
NZE	Net Zero Energy
ERV	Energy Recovery Ventilator
EIFS	Exterior Insulation Finish System
PHIUS	Passive House Institute US

Glossary

Energy Use Intensity: The total amount of site energy consumed by the building on an annual basis divided by the gross floor area in kBtu/ft^2/yr.

Multifamily building: residential building with five or more residential units.

Net Zero Energy Performance: Total site energy consumed by the Building being less than or equal to the amount of renewable energy created by solar photovoltaics or other distributed energy resources located on the Building or elsewhere on the site, calculated on an annual basis.

Executive Summary

Retrofitting existing buildings to Passive House standards with tenants in place is possible and the work is happening right now. In this project, an existing building will receive a new air barrier drainage plane, energy efficient windows and insulative cladding. The cladding will cover new mechanical systems (heating, cooling, and ventilation) mounted on the roof and distributed down the exterior face of the building. Domestic hot water will be provided by highly efficient gas boilers installed into the existing distribution system. Electricity will be master-metered and then sub metered to apartment CBP boxes and roof top equipment allowing for consumption monitoring. New solar panels will be installed on the roof that will either feed the master meter or be net metered. The modeled EUI for the project is 18.1 kBtu/ft2/year. The construction cost for the energy work is $40,000 per dwelling unit and the construction period, which includes interior upgrades, is expected to be 14 months.

1 Project Narrative

Building Envelope

Key design criteria to consider	How does your design address the criteria?
Thermal performance	Designed to meet PHIUS 2015 standard with the idea of optimizing the enclosure for both heating and cooling seasons.
Sealing performance	Targeting PHIUS 2015 requirements: 0.08 CFM50/ft2 of gross envelope through new windows and liquid applied air barrier to existing exterior brick façade.
Moisture performance	Liquid water/air barrier through liquid applied air barrier to existing exterior brick façade. New European style windows are bridged to the liquid applied air/liquid water barrier on all sides for continuity. Barrier continues over parapet and connects to roof membrane. Barrier connects at cellar level where interior walls are sealed with high-density spray foam over MiraDRAIN board connected to drainage pathways at the face of the interior wall, as well as an air tight gypsum board ceiling.
Structural performance and long-term integrity of materials	No additional structure is required. EFIS is light and supported with adhesive. Expected life is 50+ years.
How will the new design affect resident life? Are there custom/atypical design features that require careful consideration?	More quiet and comfortable. Tenants will not be over-heated and under-ventilated
Maintenance of solution	The Lotusan finish on the Sto EIFS is self-cleaning, the details are done without caulk so it is not a maintenance item.
Sustainability of solution	EPS has a relatively low environmental impact as compared to other foam insulations. Optimized enclosure minimizes the overall energy load of the building. Also protects the structural body of the building from further water damage.
Replication potential at scale	Highly replicable. We see this as a cost-effective retrofit approach for any masonry building.

Other Questions	Team Response
What challenges have you encountered in designing an envelope solution that meets the RFP requirements? How are you addressing them?	It has been challenging to insulate the enclosure at the front property lines. But we have succeeded by using the constraints as design opportunities.
Are there any unresolved major issues? What would it take to resolve them?	We would very much like to see the code changed to allow for more space to add mechanical ductwork and insulation to the outside of the existing finished façade at the front property lines.

Ventilation and Indoor Air Quality

Key design criteria to consider	How does your design address the criteria?
RFP requirement of greater of 20 cfm / bathroom + 25 cfm / kitchen and 18 cfm / person	All apartments meet these requirements as they are required by the Building Code and PHIUS.
Prevention of mold, mildew, pests, and other environmental triggers of respiratory or other ailments	We will be removing existing mold and mildew contaminated GWB in the kitchens and bathrooms. We will have high R-value windows and frames that will discourage condensation. We will clad the building in an EFIS system which is back drained to a waterproofed air barrier system that is vapor permeable. The exterior insulation will 'warm up' the temperature of the original exterior wall making it more difficult for air and vapor driven condensation to occur on mold susceptible materials, such as the backside of the GWB. Additionally, the air barrier system reduces the occurrence of pressure driven convective air exchanges between the interior of the apartment and the wall cavities.
Active ventilation to reduce volatile organic compounds and other potential internal air contaminants	Paired with our exhaust is the introduction of tempered and filtered fresh air through an ERV system providing a constant air exchange which will help to eliminate internal air contaminants.
Maintenance of solution	Quarterly air filter changes at the units, which are located on the roof for easy access.
Sustainability of solution	
Replication potential at scale	ERV's are roof mounted at exhaust stacks. This is a solution that could work on most existing low- and mid-rise buildings in NYC.

Question	Team Response
What challenges have you encountered in designing an IAQ solution that meets the RFP requirements? How are you addressing them?	We have 3D modeled all duct runs to ensure that the pathways can work ahead of construction.
Are there any unresolved major issues? What would it take to resolve them?	We cannot find an outdoor rated ERV selected that is small enough for the job. We have instead specified an interior unit to be installed with an insulated cabinet around it.

Space Heating/Cooling

Key design criteria to consider	How does your design address the criteria?
Space heating/cooling EUI of not more than 11 kBtu/ft^2/year	Space heating/cooling EUI is estimated to be 1.95 kBtu/ft^2/year
Maintaining heating and cooling comfort (including humidity)	Heat pump systems will be used for both heating and cooling including humidity. Each bedroom and Living room will have its own head and zone.
Innovative ways to improve system efficiency	The system is designed so that each apartment has its own heat pump unit so that the cooling costs can be put on the tenant. This incentivizes the tenant to conserve energy and not waste by leaving the windows on while air conditioning for example.
Required sensors and controls	We need to submeter every unit and bill the tenant through a third-party application.
Maintenance of solution	Typical for a heat pump system. Daikin will provide us with additional information.
Sustainability of solution	Coefficient of Performance allows the unit to achieve >100% efficiency.
Replication potential at scale	Its already happening.

Other Questions	Team Response
What challenges have you encountered in designing a space heating/cooling solution that meets the RFP requirements? How are you addressing them?	None
Are there any unresolved major issues? What would it take to resolve them?	Creating customized remote controls that are limited to a specific temperature range.
Other comments	This approach will provide cooling and dehumidification to every apartment. This is currently not the case. We believe this presents a significant and necessary quality of life improvement that goes beyond ‘business as usual’. The threat of heat stroke is expected to rise due to climate change moving forward. Combined with building envelope upgrades, we expect the building to be safe and cool even during a power outage in the middle of a heat wave in August.

Domestic Hot Water

Key design criteria to consider	How does your design address the criteria?
DWH system design and sizing	3 x 120 gallons of storage. 199k condensing boiler.
Innovative ways to improve system efficiency (i.e. heat recovery)	We will use a high efficiency gas boiler which is more energy efficient than any other way to make DHW in an apartment building.
Required sensors and controls	We are specifying low-flow tamper proof aerating devices on all fixtures to meet Green Communities standards which are low, but not too low that tenants become dissatisfied.
Maintenance of solution	Low, and if equipment does need maintenance it is easy to repair
Sustainability of solution	A high efficiency gas boiler is more energy efficient than any other way to make DHW in an apartment building.
Replication potential at scale	Using gas to heat DHW is highly replicable. In regard to low-flow fixtures, Niagara conservation makes these and they are very cheap with paybacks in the months on the water/sewage fee alone.

Other Questions	Team Response
What challenges have you encountered in designing a DHW solution that meets the RFP requirements? How are you addressing them?	In lieu of being challenged by the RFP requirements we challenge the RPF requirements. We think it is short sighted to create 100% electric prototypes for NYC. Diversity in energy sources is a key to sustainability for NYC and we use gas responsibly in all jobs, including this one. We do not want to deliver the State's energy needs to the nuclear industry, which what 100% electric buildings will do.
Are there any unresolved major issues? What would it take to resolve them?	None

Miscellaneous Electric Loads (MELs)

Key design criteria to consider	How does your design address the criteria?
Strategies to minimize consumption of MELs (controls, motivate habit shift in occupants, replace devices with more efficient models, etc.)	Induction cook stoves replace existing gas stoves, many of which were showing unhealthy levels of carbon monoxide emissions. Switching from window AC units to heat pump is an efficiency improvement. Master meter to sub-meter setup for all electrical to monitor electric use.
Variation in consumption between occupants	We have begun to log data for tenants. Over that three-month period we see a range of use from 3-9 kWh bedroom/day, with the average at 5.6 bedroom/day. WUFI modeling baselines are closer to 3 kWh bedroom/day. Thus, there is a significant variation in use. Some of which could be accounted for in inefficient lighting.
Maintenance of solution	All of the items above require routine maintenance, but nothing unusual
Sustainability of solution	We will improve the overall energy consumption of the building, but we will have little effect on MELs. We do however create a healthier interior environment with induction ranges and continuous ventilation which is in the big picture a very positive outcome that can be linked to sustainability
Replication potential at scale	Can be replicated at scale.

Other Questions	Team Response
What challenges have you encountered in designing a MELs solution that meets the RFP requirements? How are you addressing them?	Its limited what we can do regarding plug loads. Switching to electric stoves will push the operation costs up for tenants but having gas ranges will save the monthly connection fee for gas. Electric service and apartment panels must be upgraded. We are below the EUI required by the RFP because we have saved energy in places where we have better opportunities for intervention

Distributed Energy Resources (DER)

Key design criteria to consider	How does your design address the criteria?
DER relevant to/included in the retrofit design	A 40kWh system is intended for the roof
Onsite DER capacity vs. offsite	Rise Boro (owner) intends to have a portfolio of buildings with rooftop solar capacity of 120kW. There will be no additional offsite energy at this point.
How to integrate DER into HVAC and other major end uses.	Solar power will connect on the load side of the ConEd master meter which will be bi-level allowing the meter to run backwards. That master meter covers the entire building, owner and tenants.
Structural performance	Ballasted racking system.
Efficiency degradation	90% of guaranteed min power for 10 years, 80% for 25 years.
Required sensors and controls	To be provided by vendor.
Maintenance of solution	To be provided by vendor.
Sustainability of solution	
Replication potential at scale	As a rack and ballasted system, this has already been employed at scale in the city.

Other Questions	Team Response
What challenges have you encountered in designing a DER solution? How are you addressing them?	Limited roof space, fire paths, conflicts with other roof top items, shading from roof items and parapet.
Are there any unresolved major issues? What would it take to resolve them?	none
Other comments (optional)	Site solar production per unit is limited in the city due to smaller footprints, roof areas that are interrupted by mechanical equipment, fire access, stair bulkheads, parapet shading and neighboring buildings that shade.

Building Performance + Modeling & Life Cycle Cost Analysis

Key design criteria to consider	How does your design address the criteria?
Overall site EUI of not more than 20 kBtu/ft2/year	Our EUI is 18.1 kBtu/ft2/year
Determination of operational assumptions (schedules, people densities, etc.)	We are modeling with WUFI Passive. Following their standard protocols. Typically, occupancy is counted as one person per bedroom +1.
Operation and maintenance costs	We expect maintenance costs to be cut in half at a minimum. The building will no longer require brick pointing.
Anticipated costs savings for 30 years relative to “business as usual” normal retrofit intervention	Cost savings from our modeling suggest a utility saving of $24,000 per year compared to business as usual. That totals $720,000 not including cost of maintenance or increases in energy costs.

Other Questions	Team Response
What challenges have you encountered in designing a solution that meets the RFP’s EUI requirement? How are you addressing them?	None, we have designed to the Passive House standard.
What challenges have you encountered in modeling the solution’s performance? How are you addressing them?	None, it is an iterative process that we have a lot of experience with.
What challenges have you encountered in completing an LCCA? How are you addressing them?	None
Are there any unresolved major issues? What would it take to resolve them?	None
Other comments (optional)	

Construction Budget

Key criteria to consider	How does your budget address the criteria?
Cost compression due to anticipated innovation	We are speculating that machining EPS panels off site will result in an increase in the speed of installation. It remains to be seen how this will impact cost.
Cost compression at scale	At scale we hope that this will allow for a more sophisticated level of design to the project with a cleaner higher level of execution. Also, bulk buying of mechanical equipment will create an economy of scale.
Current availability of required products	All products are available.
Anticipated future availability of required products	Future availability is anticipated.
Transportation of products/systems to project site	Truck, boat.
On-site vs. off-site labor	There will be opportunity here to off-site more of the labor time.

Other Questions	Team Response
What challenges have you encountered in producing a construction budget? How are you addressing them?	Contractors are eager to over-charge to hedge their risk. We have negotiated the bid and talked out all issues
Are there any unresolved major issues? What would it take to resolve them?	None

Construction Schedule

Key criteria to consider	How does your schedule address the criteria?
Schedule compression due to anticipated innovation	By applying all the work on the exterior of the building contractors do not have to open walls to run systems or insulate. This will allow for the work to be done in 30% of the time. Additionally, if a tenant is uncooperative, the unit can still be insulated, and new systems run to it.
Schedule compression at scale	EIFS itself is a faster install than interior insulation and with our proposed new system it can be done more neatly and quickly than usual EIFS installs.
Current availability and lead time of required products	Most products we are specifying are readily available.
Anticipated future availability and lead time of required products	The products we are using are mainstream, we do not anticipate problems with future availability.
Transportation of products/systems to project site	Products come to NYC by truck and boat.
On-site vs. off-site labor	If the EIFS system is streamlined the foam pieces can be made offsite, possibly within NYS.

Other Questions	Team Response
What challenges have you encountered in producing a construction schedule? How are you addressing them?	Exterior finishing requires weather to be above 40°F for application and curing. Construction scheduling will adapt to meet these requirements.
Are there any unresolved major issues? What would it take to resolve them?	No

2 Schematic Design Documents

The following documents can be found in Appendix A: Schematic Design Documents.

- Detailed drawings related to envelope (type and thickness of insulation, details of insulation/air sealing around difficult features like parapet), HVAC and DHW (system type + capacity + location of interior and exterior equipment, location of distribution, equipment schedules), renewables (system type and location), innovative features, significant demolition required for NZE retrofit
- Renderings
- Equipment/materials specs (HVAC, DHW, envelope, renewables)
- Details that will be critical to others doing the same work (i.e., installing high-performance windows in an existing building with tenants in place)

3 Scalability Strategy

This retrofit solution is applicable to other buildings of similar typology. When the team was hired to do this job in 2015, scalability, tenant comfort and ease of the construction were the guiding principles and most decisions were tested against them. Given the versatility of the EIFS system, a building can be re-clad using a premeasurement system such as a 3d scanning camera or can be measured by hand on the scaffold prior to EIFS installation as has been done for the past 50 years. The entire solution was conceived to be scalable both for building size and for vast amounts of buildings. There are no barriers to scalability for this retrofit approach, and it is currently planned to be replicated on 12 buildings containing 264 apartment units. The team spent time learning about 3D laser scanning and how it could augment and inform the design. Currently the technology is too expensive to do the amount of experiments preferred. But it’s expected that in the future, use of the camera will take time off production, organize installations of exteriors work including mechanical installs and will also enrich the types of designs that can be executed economically. The team expects to learn from the 12 buildings and that architects, engineers, manufacturers, regulators, utilities, and financiers will innovate this approach where needed in the future. A summary document can be found in Appendix B.

4 Budget and Financing Plan

RiseBoro used a standard YR15 HPD model as the starting point for financing. Due to the scale of the project, a 4% Bond structure worked best. RiseBoro used a combination of existing capital and a predevelopment loan from the tax credit investor. RiseBoro was committed to delivering a s tate-of-the-art renovation project to the Passive House (PH) standard. The team of CBRA, FGPH, and RB sought to address the many comments and hurdles presented by this type of project. This was accomplished through long term design and planning and outreach to all stakeholders (tenants, property management, city and state agencies, lenders and investors). With a commitment to the end goal, it was possible to navigate these challenges and bring the project to a closing, currently scheduled for May 2019.

CBRA performed thorough analysis of bid projections. They also brought the full force of their experience in cost, means and methods, and new technology to bear in discussions with the contractor. RiseBoro and CBRA were united in presenting these potential solutions. Energy performance was not to be stripped out or value engineered, only executed. Conversations with FGPH centered on how best to accomplish the goal. FGPH is an experienced plumbing and mechanical contractor. The team was able to avoid premiums on these items by incorporating their expertise.

The baseline of funding was a typical Year 15/4% bond structure. The Passive House components created a gap. Between reducing underwriting standards of energy consumption and the NYSERDA RFP, the gap was closed. RiseBoro's experience in PH building and management, along with data from existing PH projects made these changes possible.

While the team sees the potential for PH buildings to save over the 15-year financing period on labor, maintenance and water, these savings were not pursued in the underwriting model. The goal was to reduce the energy underwriting only, rather than introduce additional complexities to already reluctant partners. As PH retrofits become more common, reduced capital outlay is anticipated as a result of new technologies. These savings could then be quantified and reflected either in reductions in operational reserves or general maintenance and operations line items. The largest of these lines would be reductions in LL11 10-year façade inspection and repair costs (for buildings more than seven stories). Reductions in boiler heating equipment replacements is another potential savings. As PH becomes more prevalent in the market, reductions in insurance are expected due to decreased fire risk (electric vs. gas stoves), ability of tenants to shelter in place during utility outages, and the decrease in leaks due to hot water heating systems.

Passive House buildings have consistent thermal performance. This consistency creates predictable and smooth operating demands, which reduces wear and tear on equipment. Continuous insulation and waterproofing mitigates condensation risk within wall and façade and extends lifespan of these assemblies. The energy savings compared to current performance is more than 80%. The PH modeled savings compared to a traditional Year15 rehab is nearly a 90% reduction in underwriting standards. Expected performance is in line with our existing PH new construction work. The budget and financing plan spreadsheet can be found in Appendix C: Budget and Financing Plan.

5 Projected Construction Schedule

The preconstruction scheduling for this job was similar to any other job. During construction exterior work will be executed simultaneously to typical "Year 15" interior work, one will not hinder the other and each can be done at their own paces. This is an asset to the approach. The schedule, as currently envisioned, is shown in the appendix D, but may change as more is learned.

The level of coordination for this project will be simpler than a traditional retrofit where a building is insulated and retrofitted with all new mechanical systems, because there does not have to be coordination with tenant access and the problems that arise when a tenant refuses to allow access. While it is a goal of the project to have happy, cooperative tenants, in the rare case where this may occur, the work can proceed past an inaccessible apartment. The tenant will lose heating and cooling and ventilation in their apartment if they do not allow access. The job is simple, and in some ways, easier than normal construction for the installation of new mechanical systems and envelope upgrades. The only difference is that it is all done on the outside of the building. There will be less penetrations, less difficult spots for routing new work, and less issues with tenant access and higher levels of insulation and air sealing than ever possible be done by doing the work on the interior. The construction schedule spreadsheet can be found in Appendix D.

6 Building Performance Summary

The buildings were modeled using the Passive House US protocol software called WUFI Passive. Even though there was existing building energy use data to work from, without having tenant sub metered use the team was unable to compare the data between actual and projected in a similar approach. Therefore, WUFI Passive was used to model three scenarios: the existing building as built, business as usual retrofit, and a deep retrofit, which met the PHIUS 2015+ standard for compliance.

The WUFI Passive modeling software helped determine the building enclosure strategies and the targeted thickness of our exterior insulation on the walls and the roofs. It also helped to select the window specifications, including the target U-value, as well as the SHGC and fixed shading strategies. The goal was to cost optimize the design to fetch a good ROI while meeting the big picture climate initiatives established by the Passive House certification. As the insulation thickness increases, the net BTU energy savings per inch thickness of material diminishes. Therefore, the team worked with the energy model to try to find the sweet spot between too much and too little insulation. Adding an additional inch of insulation from 4″ to 5″ is a relatively small increase in cost when one factors in the first costs related to mobilization such as scaffolding, and installation. Alternatively, when the building enclosure is made incredibly efficient, the building is unable to shed its heat as easily. This can lead to overheating and drive up the AC loads. When building to Passive house levels, New York City becomes a cooling dominate climate. The model output suggests our heating load will drop from 50 kBTU/sq.ft to 1.0 kBTU/sq.ft. The heating load is almost entirely eliminated over the course of a year by tightening up the enclosure, eliminating direction exhaust ventilation, and optimizing the insulation and window efficiencies. Our cooling load is also reduced from about 3.3 kBTU/sq.ft to 0.9 kBTU/sq.ft. Part of the modeling process consists of testing variety of approaches to meet the target. Approximately 20 or more variations of the model were tested to reach a final decision. The decision tends to be non-linear and dynamic most of the time. What follows is a list of items and considerations used in the decision-making process:

- Set goals for the outcome, be resilient enough to rethink those goes during a design process if necessary.
- Remain educated about new products, techniques, building science findings and work going on internationally—travel, inquire, read, and research. Often manufacturers discuss with the team what is needed prior or during their product development. Also, many people inquire about products they hear about and the team responds.
- Check track record of products, techniques, building science findings—travel to wherever a product is installed to assess first-hand whether it is useful.
- Give credit to manufacturers who return phone calls, dismiss those that do not.

- Test products, techniques, building science findings against the Laws of Thermal Dynamics, dismiss products, techniques, building science findings with non-Newtonian claims.
- Understand how a particular component can fit into an entire system of a design. Does it have symbiotic relationship? Is it fighting other things? Does it replace other items as well as perform its own function, is it redundant? Be ready to rethink, readjust.
- Examine availability of products, techniques, building science findings. Choosing things that are readily available and commonly used are preferred even if they are being used differently than "normal" or their install is modified to meet particular goals, sometimes manufacturers don't even understand what their products can do.
- Examine for buildability, talk to builders about details and about the order of installation of items.
- Examine for price.
- Discuss with the Owner how certain choices effect their maintenance, billing, rents, payments, ethics, and goals.

Overall, the experience and field research has shown that conventional boilers with multistory chimneys function very poorly. It's believed that switching to a sealed combustion condensing boiler with through wall exhaust and installing tamper-proof engineered high-efficiency water use fixtures will have a significant effect on the overall gas use, which will be just dedicated to domestic hot water (DHW). The heating for the building will be provided by unit dedicated heat pump multi-split systems, which also provides the building with cooling. Unfortunately providing a high-efficiency enclosure does not eliminate the need for mechanical cooling and dehumidification. There are many days in the summer where the outdoor temperature and humidity are well above target comfort levels. Climate change projections for NYC predict a decade by decade increase in days over 90°F and more frequent and longer heatwaves. Providing AC for tenants will be an important life safety feature in apartments in the city especially. The retrofit will include energy recovery ventilators (ERVs). They now become the second largest load in the building over and above the DHW. ERVs are providing constant preconditioned filtered fresh air. Energy that was previously exhausted 'out the chimney' through the bathroom, kitchen, and corridor exhausts in now captured through the ERV energy exchanger. So overall, heating and cooling loads are reduced, but fan energy load is increased.

The team looked carefully at DHW production options and reached a conclusion that using a high-efficiency gas boiler made the most sense for this project and the client rather than an electric heat pump type hot water heater for the following reasons:

1. The Coefficient of Performance (COP) is poor in the winter, to the point where back up electric resistance heat would be needed or the system would have to be drastically oversized.
2. At a COP of one, you are using less energy by burning gas at the building than burning fossil fuel at a power plant. At any COP less than approximately three the heat pump uses more e nergy than burning fossil fuel at the building, because the grid is about 31% efficient and a condensing gas boiler is about 96% efficient when it is producing domestic hot water.
3. Renewable energy sources are far more expensive, and in many cases, not possible to install in urban areas. Renewables are not cost effective for this project and as evidenced in the report it takes many rooftops of solar panels to bring this one building to net zero energy, this is without the DWH heat pump in the design. In the near term, a 100% carbon free electric urban grid would depend upon on nuclear power production which currently still poses potentially serious environmental consequences.
4. A heat pump water heater works great in a hot climate where there is heat to pull out of the air, or in places where there is free waste heat that can be used. They are also sufficient in a large suburban house with an uninsulated basement thermally coupled to the soil. But several heat pump water heaters in a multifamily cellar will quickly cool the basement too much to make them practical.
5. If the heat pump water heaters are moved outdoors the refrigerant could be piped to indoors. But the popular models have the water outdoors, which means expensive and energy intensive heat tracing.
6. If heat pump water heaters are outdoors a water pipe must run outside and there is a risk of heat loss and/or freezing in addition to poor COP

At the current rate of electricity in the city, $0.22/KWH, a heat pump hot water heater with an annual COP of 2.5 would yield 38,800 BTU's per dollar. At the rate of gas in the city, $1.25/THERM a 96% efficient condensing boiler would yield 76,800 BTU's per dollar. Therefore, with a cheaper installation cost and an operating cost of about half that of electricity, both the owner and the design team felt that moving forward with gas DHW simply made more sense. Furthermore, a doubling of the cost of hot water would negatively impact the project's ability to underwrite net energy savings for financing.

6.1 Distributed Energy Resources Summary

Site solar production per unit is limited in the city due to smaller footprints, roof areas that are interrupted by mechanical equipment, fire access, stair bulkheads, parapet shading, and neighboring buildings that shade. The buildings at 104 -110 Grove St. are projected to each have 20kW systems with expected solar production of 46,000 kWh per year, which would lower the EUI of the building from 18.1 to 15. The system will be financed independently from the retrofit, owned by a separate entity 'RB Solar' and sold back to the building entity at a reduced rate to cover its common area lighting loads, ERV's and whole building heating loads.

6.2 Supplemental Renewables Plan

Additional renewable energy will be generated by RB Solar across nine buildings in their portfolio across Brooklyn. Overall, they expect to generate approximately 140,000 kWh per year, which equates to enough solar generated electricity to cover 88% of the total predicted annual electric load (including tenant AC, appliance and miscellaneous electric loads) for 104-110 Grove St. The following documents can be found in Appendix E:

- Building Performance Summary Spreadsheet
- 104 Grove St. WUFI Passive Site Energy Report
- 110 Grove St. WUFI Passive Site Energy Report

7 Resident Management Plan

The strategy for this job is to bring the building to the Passive House Standard with tenants in place. It is purposefully designed to have the work performed outside of the building. The residents will receive sought-after living conditions; continuous ventilation and uniform comfortable temperature in all seasons. They have given extremely positive feedback to the new façade designs and have been assured that their rent will not rise. The resident management plan can be found in Appendix F.

8 Performance Guarantee Pathway

This job will be done with a typical architect-owner-contractor relationship. The contractor will warranty the work for a year, and the owner, who already has a sophisticated management team, will maintain the buildings.

A speculative spreadsheet (See Appendix G) has been created to examine how a performance guarantee would work if the conditions mentioned above were not the case, as we are interested in becoming a solution provider. However, these conditions are such that this is feasible right now. There is no market for this work and no way to pay for it without subsidies.

9 Regulatory Barrier Summary

There are no regulatory barriers preventing us from accomplishing our design for this project site. The design is adapted to meet the current regulations that allow for up to 4" sidewalk encroachment plus some additional for decorative items and sun shading. Had the allowance been 8" there would have been more space to work with thicker and cheaper insulation and better shaped ducts, rather than 2"x9". Regulations of not mixing kitchen and bathroom exhaust also determined the design of the ERV to a certain degree. Less equipment and ducts would be feasible if this was not a regulation.

10 Resiliency Summary

Physically, a reclad adds an air barrier, a drainage plane, and a thermal barrier to the masonry building, extending the life of the building. These moves also make the building more energy efficient with the added ability to weather short-term power outages. Resiliency was not considered by itself as a design issue to solve in this project, it was incorporated into a well-developed whole system strategy for the building that delivers comfort, healthier interior environments, energy efficiency, and saves money. The resiliency summary plan can be found in Appendix I.

11 Resident Health Impact Summary

Indoor air quality is improved by providing continuous fresh air to each living room while simultaneously continuously exhausting air from kitchens and bathrooms. Fresh air will be filtered with MERV 8 filters and the ventilation will reduce accumulation of VOCs and other internal contaminants. Each apartment is pressure equalized to prevent air movement into adjacent apartments. All products used in the job will be low- or no-VOC rated.

Exterior insulation keeps the interior surfaces of the building warm, making them less likely to be condensing surfaces when there is high humidity in the apartment. All kitchens and bathrooms will be meticulously sealed to prevent the movement of pests and all cabinets will be caulked to the walls to prevent pests from living behind and below the kitchen cabinets.

12 Overall Rehab Proposal

This team is composed of an owner, architect, contractor, and manufacturer. The members of the team will approach the job in a typical fashion. The owner hires the architect and the contractor, and the architect specifies and details items in the job to prove by the manufacturer and installed by the contractor.

During construction, weekly field meetings will be held by the job team. The architect will review the work and shop drawings and certify payment. The contractor will give status and scheduling reports. No challenges to fully integrating our scope of work with this typical delivery system other than the normal risks associated with a construction job are anticiapted.

13 Bibliography

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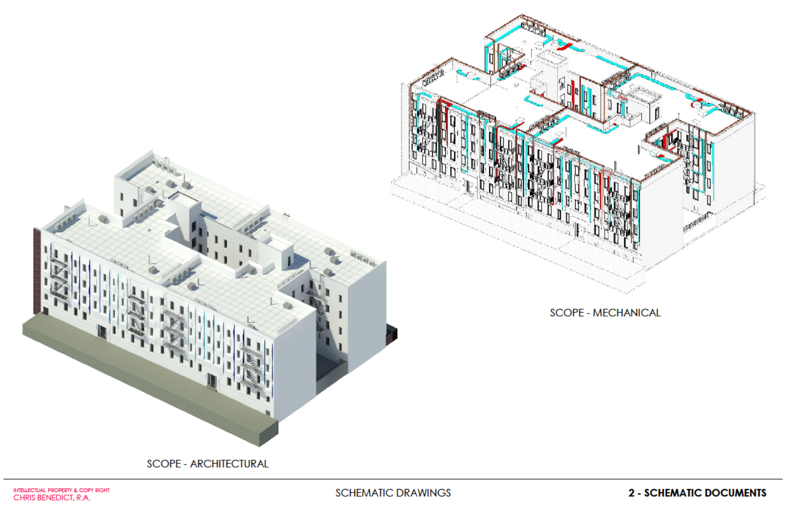
Appendix A. Schematic Design Documents

Rendering

(Click on image to access the Rendering)

Drawing set



(Click on image to access the Schematic Drawings)

Spec book and/ or cutsheets

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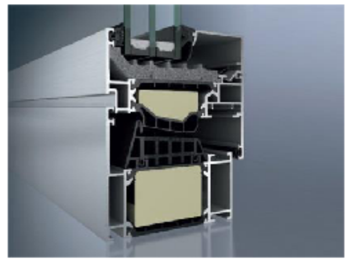
Project: CASA PASSIVA

Date: **August 7, 2018**

Location: Brooklyn, NY

Client: **Chris Benedict**

Prepared by: Thanos Psalidas (thanos@eas-usa.com)



Based on the information received the following estimate was prepared:

- Profile system: **SCHUCO AWS90.SI, ADS90.SI**
- Hardware: Schuco full perimeter locking with 2 security closures and safety lock
- Color Finish: Custom Powder Coated Color (included) – Color **RAL 7016 Anthracite Grey**
- Frame: AWS90.SI, 90mm Profile System with corresponding Uf-value of **0.18** Btu/($h \cdot ft^2 \cdot °F$)
- Glass Name: **Triple** Glazed Low E Insulated Glass - CLIMATOP Planitherm One
- Glass Spacer: Warm-Edge Spacer System Ψg-value of **0.019** Btu/(h·ft·°F)

Glazing Type	U-value	SHGC	VT
CLIMATOP PLANITHERM ONE	0.0968	0.26	0.59

(Click on image to access the cutsheets)

Appendix B. Scalability Strategy

NYSERDA RetrofitNY – Schematic Design
Scalability Strategy
Team:

+

Building System	Describe strategy for successfully measuring, producing and installing the solution at scale on similar buildings. Include detail on building system sub-components (i.e. piping, windows, etc.)	If design solutions with a better potential for scalability were considered, describe the solutions and explain why they did not make it to the final design (i.e., cost, product availability, aesthetics, etc.)
Ventilation and IAQ	- Accurately draw building - Determine any issues causing IAQ problems and address - Review and repair masonry - Install air barrier - Install exterior insulation - Prepare ventilation strategy based on existing conditions - Clean then Aeroseal existing ducts for reuse - Size ventilation equipment and ducts in coordination with allowable insulation depths as per WUFI Passive and codes - Install ERVs and ductwork on roof and exterior walls, coordinate with roof pitching and room locations - Core duct penetrations - Coordinate with other equipment on roof and facade - Control air flow with constant air flow regulators - Clean and completely air seal bathrooms and kitchens when replacing them -Install interior grills - Test air flows and check filters	- Laser measuring the building will accelerate understanding existing conditions, cost barrier for laser camera - Small outdoor ERVs can be made specifically to suit the rooftop situations – does not currently exist - Duct work made of HDPE could be used for ease of installation and waterproofness and could allow ducts to be run over roofing without interfering with roof drainage pitching – not currently allowed by code
Space Heating/Cooling	- Accurately draw building - Perform heating and cooling load calculations - Determine location of units inside and out - Coordinate with other equipment on roof and facade - Core façade for refrigerant, electrical and condensate lines - Install interior and exterior units monitoring brazing, refrigerant, and pressure test	- Laser measuring the building will accelerate understanding existing conditions, cost barrier for laser camera - smaller outdoor and indoor heads would be helpful, but not available yet

(Click on image to access the Scalability Strategy)

Appendix C. Budget and Financing Plan

NYSERDA RETROFIT NY						
Casa Pasiva						Tot
104-110 Grove Street						
LINE ITEM	BUSINESS AS USUAL (BAU) BUDGET			NET ZERO ENERGY (NZE) BUDGET		
	Unit Cost	Notes (as Needed)	Total $	Unit Cost	Notes (as Needed)	Total $
HARD COSTS						
General Requirements	-		-	-		-
Existing Cond. / Site work in HC Basis	-		292,440	-		292,440
Concrete	-		8,400	-		8,400
Masonry	-		466,560	-		459,360
Metals	-		29,000	-		29,000
Wood, Plastics and Composites	-		320,780	-		320,780
Thermal/Moisture Protection - Façade Insulation	-		11,500	-		790,340
Thermal/Moisture Protection - Roof Insulation	-		320,360	-		320,360
Thermal/Moisture Protection - All Other	-		31,060	-		31,060
Openings - Windows	-		420,300	-		560,400
Openings - Doors	-		190,680	-		190,680
Openings - All Other	-		6,420	-		10,700
Finishes	-		773,350	-		776,550
Specialties	-		42,740	-		42,740
Equipment	-		18,400	-		41,400
Furnishings	-		128,800	-		128,800
Conveying Equipment	-		-	-		-
Fire Suppression	-		-	-		-
Plumbing - DHW System	-		181,100	-		181,100
Plumbing - All Other	-		-	-		-
HVAC - Heating/Cooling System	-		228,750	-		888,300
HVAC - Ventilation System	-		46,800	-		103,800
HVAC - All Other	-		-	-		-
Electrical	-		581,300	-		636,500
Communications	-		-	-		-
Electronic Safety and Security	-		-	-		-
Earthwork	-		-	-		-
Exterior Improvements	-		-	-		-
Utilities	-		-	-		-
Electrical Power Generation	-		-	-		-
General Conditions	-	*from Bid comparison*	245,924	-	*Budget(S&U)- units*	342,987
GC Overhead (Builder's Overhead/Profit)	-			-		
GC Profit	-		-	-		-
GC Insurance/Builder's Risk	-	*from Bid comparison*	122,962	-	*Budget (S&U) units*	171,493
Performance Bond	-	*from Bid comparison*	61,481	-	*Budget(S&U)- units*	85,746
Escalation Factor	-		-	-		-
Overhead (& Profit)	-	*from Bid comparison*	327,899	-	*Budget (S&U) units*	457,316
(Reserved)	-		-	-		-
(Reserved)	-		-	-		-
(Reserved)	-		-	-		-
(Reserved)	-		-	-		-
(Reserved)	-		-	-		-
(Reserved)	-		-	-		-
(Reserved)	-		-	-		-
(Reserved)	-		-	-		-
(Reserved)	-		-	-		-
SUBTOTAL HARD COSTS (Construction Costs)	*4,857,007*		**4,857,007**	*6,870,252*		**6,870,252**
Hard Cost Contingency	8%	*of const. cost*	364,276	10%	*of const. cost*	687,025
TOTAL HARD COSTS	*5,221,282*		**5,221,282**	*7,557,277*		**7,557,277**

(Click on image to access the Budget and Financing Plan)

Appendix D. Projected Construction Schedule

Work Package	Task		Start	Days		Completion
PRECONSTRUCTION	CDs Complete	F	6/30/17	387	S	12/30/18
	Permits Pulled	F	3/01/19	21	M	4/01/19
	Construction Contract Finalized	T	1/1/19	21	F	2/01/19
	Project Closing Date	F	3/1/19	21	M	4/01/19
PROCUREMENT	Procurement Period	M	4/1/19	168	S	12/01/19
CONSTRUCTION	Site Prep and Demolition	M	4/1/19	32	W	5/15/19
	-Building Envelope	W	5/15/19	21	S	6/15/19
	-Mechanical Systems	W	5/15/19	32	M	7/1/19
	Exterior Renovation	W	5/15/19	131	R	11/21/19
	-Building Envelope	S	6/15/19	114	S	11/30/19
	-Mechanical Systems	M	7/1/19	104	S	11/30/19
	Interior Renovation	R	8/1/19	146	F	2/28/20
	-Kitchen, baths, corridors	R	8/1/19	146	F	2/28/20
	-Mechanical Systems (indoor component)	S	12/1/19	43	F	1/31/20
	Installation Onsite Renewables	W	4/1/20	22	F	5/01/20
CLOSEOUT	Equipment Start up and Testing	S	2/1/20	11	T	2/18/20
	Commissioning of Systems	F	2/21/20	15	S	3/15/20
	Punchlist Inspection	F	2/21/20	15	S	3/15/20
	Correction of Punchlist Items	S	3/1/20	32	W	4/15/20
	Final Inspection	R	4/16/20	1	F	4/17/20
	Project Complete	F	5/1/20	0	S	5/2/20

(Click on image to access the Projected Construction Schedule)

Appendix E. Building Performance Summary

Building Performance Summary

All MODELED DATA FROM WUFI STUDIES

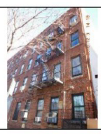
GENERAL NOTES: Miscelanous electric loads are consistent across all conditions. * areas highlit in green reflect additional data points added to the template.	Window AC, Hydronic heat, 6x's passive house air tightness. Exhaust ventilation to code. Water use to code. Inefficient boiler due to tall exhaust. Poor windows	30% lighting improvement, Energy star Refrigerator, More efficient exhaust fans. No enclosure upgrades. Air tightness through caulking to 4x's passive house, water efficient fixtures, avg	In addition, Electric induction stove, heat pumps, enclosure upgrade, ERV, high efficiency boiler. Extra water efficiencies, excellent windows	
	Existing Condition BASELINE (WUFI)	BAU RENOVATION (WUFI)	Deep Energy Retrofit (WUFI)	Deep Energy Retrofit + Solar
Utility Cost Savings ($/yr)		$ (12,878)	$ (36,521)	$ (46,679)
ELECTRICY (KWH) (including tenant)	157,296	142,208	158,206	112,035
GAS (kBTU/YR)	3,220,012	2,462,562	310,246	N/A
GAS (THERMS)	32,200	24,626	3,102	N/A
TOTAL SITE ENERGY USE (kBTU/YR)	3,756,706	2,947,776	850,045	692,602
WATER USE (GAL/YR)	3,418,000	2,110,000	2,110,000	N/A
Utility Cost Savings (%)	0	17%	49%	62%
Energy Savings (%)	0	22%	77%	82%
Energy Cost Savings (%)	0	17%	49%	62%
Energy Savings (kBTU/yr)	0	(808,930)	(2,906,661)	(3,064,104)
Energy Cost Savings ($/yr)	0	$ (12,878)	$ (36,521)	$ (46,679)
Water Savings (%)	0	38%	38%	N/A
Water Cost Savings (%)		38%	38%	N/A
Water Savings (gal/yr)	0	(1,308,000)	(1,308,000)	N/A
Water Cost Savings ($/yr)	0	$ (17,658)	$ (17,658)	N/A

104 Grove St. WUFI Model Output

PHIUS+ 2015 VERIFICATION 1

BUILDING INFORMATION

Category:	Residential
Status:	In planning
Building type:	Retrofit
Year of construction:	104 Grove St
Units:	23
Number of occupants:	75 (Design)



Boundary conditions

Climate:	NY - NEW YORK LAGUARDIA ARPT (Monthly)
Internal heat gains:	1 Btu/hr ft²
Interior temperature:	68 °F
Overheat temperature:	77 °F

Building geometry

Enclosed volume:	284,912.1 ft³
Net-volume:	187,541.9 ft³
Total area envelope:	31,054.8 ft²
AV ratio:	0.1 1/ft
Floor area:	23,544 ft²

110 Grove St. WUFI Model Output

PHIUS+ 2015 VERIFICATION 1

BUILDING INFORMATION

Category:	Residential
Status:	In planning
Building type:	Retrofit
Year of construction:	110 Grove St
Units:	23
Number of occupants:	75 (Design)

Boundary conditions

Climate:	NY - NEW YORK LAGUARDIA ARPT (Monthly)
Internal heat gains:	1 Btu/hr ft²
Interior temperature:	68 °F
Overheat temperature:	77 °F

Building geometry

Enclosed volume:	291,270.9 ft³
Net-volume:	188,645.7 ft³
Total area envelope:	30,329.5 ft²
AV ratio:	0.1 1/ft
Floor area:	23,396 ft²

(Click on images to access the Building Performance Summary and Modeling Report)

Appendix F. Resident Management Plan

Resident Management Plan

NYSERDA RetrofitNY – Schematic Design
Resident Management Plan
Team:

Please use this template to complete the Resident Management Plan. Click on the text boxes below each heading to find additional instructions.

Management Plan

Goals

Create resilient, healthy, and sustainable communities by creating and designing a plan to seamlessly integrate passive house rehabilitation with tenants in place. Ultimately accomplishing a Deep Energy Retrofit without disrupting or destabilizing current tenants.

Length of construction phase

24 Months

Length of resident management plan

48 Months

Plan for resident notifications and communication

A pioneer in community development since 1973, RiseBoro reaches across generations with innovative programs that engage seniors, empower youth, and address the needs of the public to create stable neighborhoods and an engaged community. Combining tenant engagement with social services provides an added layer of opportunity to create a stronger connection between the tenant and the RiseBoro network.

Rise Boro Resident Guidelines

(Click on image to access the Resident Management Plan)

Appendix G. Performance Guarantee Pathway

Performance Guarantee Summary

NYSERDA RetrofitNY – Schematic Design
Performance Guarantee Pathway
Team:

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Maintenance and Warranties

Which of your solution's energy performance parameters can be guaranteed (e.g. heat pump COP, on-site kWh production, Btu/person/HDD for heating, BTU/person/CDD for cooling, etc.)? Include a list that maps each parameter to its corresponding building system(s)

None can be guaranteed until two years of performance is understood for this job. After two years construction and operation issues will be documented and actionable and once we have this knowledge we could provide a performance guarantee for energy use in any unit of measure required.

We would never guarantee a heat pump COP or any efficiency particular to a manufactured item not under our control.

What are the warranty term lengths for the various building systems included in your solution?

EIFS – 15 years
Roofing - 12 years
ERMA Roof assembly – no warranty
ERVS – 2 years
Heat Pump System – 10 years
Boiler – equipment and system – 1 year
Tanks - lifetime
Ductwork – lifetime
Windows – 5 years

(Click on image to access the Performance Guarantee Summary)

Performance Guarantee Spreadsheet

Performance Guarantee Info Chart

	FIRST 15 YEAR FINANCING PERIOD PRICING (in 2018 dollars)							
SYSTEM / YEARS	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
EIFS INSULATION SYSTEM								
ERMA ROOF ASSEMBLY								
ROOFING								
ERVS			$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$
DUCTLESS SPLIT UNITS								
BOILER		$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$
DHW STORAGE TANKS								
DUCTWORK								
WINDOWS						$ 22,938	$ 22,938	$
Walk through every month	$ 12,000	$ 12,000	$ 12,000	$ 12,000	$ 12,000	$ 12,000	$ 12,000	$
Emergency calls	$ 6,000	$ 6,000	$ 6,000	$ 6,000	$ 6,000	$ 6,000	$ 6,000	$
TOTAL	**$ 18,000**	**$ 20,000**	**$ 30,000**	**$ 30,000**	**$ 30,000**	**$ 52,938**	**$ 52,938**	**$**
SUM OF 15 YEAR PERIODS								
SUM OF 30 YEAR PERIOD								
per DU (ea 15 year period)								
per du/year								

LEGEND	
(orange)	EIFS cleaning and maintenace @ $5/sf
(green)	ERMA roof assembly picked up and reinstalled when roof is replaced
(yellow)	Replacements:
(yellow)	Roofing @ $25sf
(yellow)	ERVs @ 4000 ea
(yellow)	Ductles Split Systems @ $10,000ea
(yellow)	2 Boilers @ $10,000 ea
(yellow)	Windows @ $2000 ea
(light grey)	Warranty period
(grey)	Duct cleaning $500/shaft

(Click on image to access the Performance Guarantee Pathway)

Appendix H. Regulatory Barrier Summary

N/A

Appendix I. Resiliency Summary

NYSERDA RetrofitNY – Schematic Design
Resiliency Summary
Team:

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Indicator	Design Solution
Protection: Identify strategies to reduce a building's vulnerability to extreme weather:	
Floodproofing or Flood Control	The building is in a preliminary flood zone X (minimal flood hazard zone), no flood proofing or flood control is included in the design
Sewer Backflow Prevention	Prevention of sewer backflow happens out side for the building and is not included in this scope, we have no knowledge of sewer backups at the building
Mechanical Equipment Protection and Location	Boiler for DHW is in Cellar, but building is not in a flood zone Ductless split and ERVs are on the roof for convenience and protection from vandalism
Electrical Equipment Protect and Location	Electrical equipment is in Cellar, building is not in a flood zone
Backup Power Location and Protection	There is no backup power for the building
Communications	There is no scope of work related to communications in the job, although there will be new formed social media platform to link all residents and the Owner
Envelope Protection	<e.g. measures to prevent damage to walls, windows, roof from heavy winds, hail, snow or ice, lightning> Walls have double mesh coating at street level, windows have no protection, roof is protected by ERMA roof assembly, building electrical is grounded
Fire Protection	<e.g. smoke alarms, fire suppression, explosive gas detection> smoke and CO detectors are provided as per code
Adaptation: Identify strategies that improve a facility's ability to adapt to changing climate conditions:	
Envelope Design	<e.g. ability to maintain comfort and control moisture, daylighting> The building will remain comfortable during a power outage and should not dip below 50 degrees if occupied
Mechanical Equipment	Sadly, heating and cooling equipment is oversized because units are not made small enough for the job, but this oversizing could allow the building to meet additional loads in the future if needed
Passive Cooling or Ventilation Strategies	<e.g. operable windows, shading, heat island reduction> Façade design incorporates some shading. All windows in apartments are operable. Continuous ventilation systems meet Passive house requirements
In-unit	<e.g. CO2 sensors, controls, energy awareness (submeters)> all units to be sub metered
Site	<e.g. drought tolerant landscape, surface stormwater management> There is no landscaping at the building and surface water is run to area drains and into the sewer
Backup: Identify strategies that provide critical needs for when a facility loses power or other services:	
Critical Systems with Backup	<e.g. back up for lighting, pumps, heating, cooling, elevators> There are no back up systems
Backup Power Type	Not applicable
Access to Potable Water and Sanitary Services	Street pressure may be able to deliver water to faucets and toilets during a blackout, the street pressure has not been determined

(Click on image to access the Resiliency Summary)

NYSERDA, a public benefit corporation, offers objective information and analysis, innovative programs, technical expertise, and support to help New Yorkers increase energy efficiency, save money, use renewable energy, and reduce reliance on fossil fuels. NYSERDA professionals work to protect the environment and create clean-energy jobs. NYSERDA has been developing partnerships to advance innovative energy solutions in New York State since 1975.

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STATE OF
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NYSERDA

State of New York

Andrew M. Cuomo, Governor

New York State Energy Research and Development Authority

Richard L. Kauffman, Chair | Alicia Barton, President and CEO

Appendix J. Resident Health Impact Summary

NYSERDA RetrofitNY – Schematic Design
Resident Health Impact Summary
Team:

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Indicator	Location	Intervention	
		Design Solution	Maintenance Plan
Mold	Units - Kitchens	Non-paper sheet rock and tile, caulk at tub surrounds, continuous ventilation	educate tenants to report leaks and dripping faucets, check ERVs monthly
	Units - Bathrooms	Non-paper sheet rock and tile, caulk at tub surrounds, continuous ventilation	educate tenants to report leaks and dripping faucets, check ERVs monthly
	Units - Windows and Exterior Doors	Not applicable	none
	Units - Mechanical Rooms	Existing rooms have none paper surfaces	none
	Common Areas - Windows and Exterior Doors	NA	none
	Common Areas - Mechanical Rooms	Clean drains at boiler room, no paper based gyp board	Check drains yearly
	Below Grade	Foundation has water management detail	None needed
Pests	Units	Kitchen and bathroom areas thoroughly sealed where replacements take place, caulk around perimeters of Kitchen cabinets to prevent access to roaches	none
	Common Areas	Seal all holes that are apparent	none
	Below Grade	Seal all holes that are apparent	none
	Exterior	Seal all holes that are apparent	none
VOCs (enter level of VOCs in products: conventional, low- or no- VOC)	Units - Paints	No VOC paint	None - renew with same
	Units - Coatings	No VOC coatings	None - renew with same
	Units - Primers	No VOC primers	None - renew with same
	Units - Adhesives and Sealants	No VOC adhesives and sealants	None - renew with same
	Units - Flooring Materials	No VOC wood click flooring	None - renew with same
	Common Areas - Paints	No VOC paint	None - renew with same
	Common Areas - Coatings	No VOC Coatings	None - renew with same
	Common Areas - Primers	No VOC Primers	None - renew with same
	Common Areas - Adhesives and Sealants	No VOC adhesive and sealants	None - renew with same
	Common Areas - Flooring Materials	Porcelain Tile floors	Regrout as required
Other Contaminants	Units	none	none

(Click on image to access the Resident Health Impact Summary)

Appendix K. Overall Rehab Proposal

104-110 GROVE STREET, BROOKLYN, NEW YORK		
DIV	ITEM	
2	EXISTING CONDITIONS	292,440
3	CONCRETE	8,400
4	MASONRY	459,360
5	METALS	29,000
6	COMPONENTS	320,780
7	PROTECTION	1,141,760
8	OPENINGS	748,280
9	FINISHES	776,550
10	SPECIALTIES	42,740
11	EQUIPMENT	41,400
12	FURNISHING	128,800
22	PLUMBING	178,800
23	HTG/CLG/VENTILATION	1,038,900
26	ELECTRICAL	114,900
	CONSTRUCTION TOTAL	5,322,110
	BOND	79,832
	INSURANCE	159,663
	GENERAL CONDITIONS	319,327
	O & P	425,769
	CONSTRUCTION GRAND TOTAL	6,306,701
	REMAINING PROFESSIONAL FEES	103,500
	TOTAL	6,410,201

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