SUSTAINABLE CPC: A STUDY IN SAVINGS

Decarbonizing Your Retrofit Project with Solar

This case study compares the projected performance and decarbonization pathways of two pre-war buildings in NYC. Both Building A and Building B completed Integrated Physical Needs Assessments (IPNAs) to identify energy conservation opportunities and have specified on-site solar as the major decarbonization measure. Building A has chosen to add Energy Recovery Ventilators (ERVs) to deliver partially conditioned, fresh air to each apartment. Building B compeleted a scope of work which includes the electrification of domestic hot water (DHW) production. The following case study analyzes the projected consumption and associated operating costs related to the proposed measures, looking at the benefits and challenges of electrifying major building systems while supplementing with on-site energy production.

BUILDING PROFILES

BUILDING A:
Year Constructed: 1925
Size: 2 Buildings, 5 Stories, 84 Units, 289 Rooms, 68,400 Gross Square Feet
HVAC: Natural Gas-fired Hydronic Heating
Utilities Provided by Owner: Heat, Hot Water, Water & Sewer
Certifications and Incentives: EGC 2020, WAP, NY-SUN
Affordability: The existing rents in these buildings are an average of 22% of NYC 2022 AMI

CPC Loan Offering: $3 million construction loan
Total Development Cost: $22 million

BUILDING B:
Year Constructed: 1926-1931
Size: 3 Buildings, 6 Stories, 200 Units, 716 Rooms, 217,078 Gross Square Feet
HVAC: Central Heat Pump Water Heaters, Natural Gas Boilers
Utilities Provided by Owner: Heat, Hot Water, Water & Sewer
Certifications and Incentives: EGC 2020, AMEEP, HPD-NYSERDA Electrification Pilot, Solar Where Feasible
Affordability: The existing rents in these buildings average between 27-51% of NYC 2022 AMI

CPC Loan Offering: $4.2 million construction loan
Total Development Cost: $31 million

SCOPES OF WORK

BUILDING A SOW

- Install solar arrays on-site
  - Across both buildings: 114 panels, 45.6 kW-DC, 46,470 kWh/year
- Upgrade the existing steam system to hydronic heating system, replace boilers with 82% mid-efficiency unit (oil to natural gas conversion)
- Install ERV and necessary ductwork for fresh air intake to apartments and common areas
- New roofing on both buildings and roof bulkhead repairs

SHARED SOW

- Upgrade all lighting to LED
- Install ENERGY STAR refrigerators
- Install low-flow showerheads and faucet aerators
- DHW distribution pipe insulation
- Roof cavity insulation
- Comprehensive air sealing in units and common areas
- New double pane and double hung windows
- New steel/aluminum doors and frames
- Hazardous material inspection

BUILDING B SOW

- Install solar arrays on-site
  - Across all three buildings: 359 panels, 28kW-DC, 32,200 kWH/year
- One-pipe heating system retro-commissioning
  - Conduct feasibility study for heat pump conversion
- Install central heat pump water heaters for DHW in all three buildings with temperature sensors, making electrical upgrades as needed
- Install motorized makeup air vent to reduce heat loss
- Roof repairs and overlay replacement

SAVINGS SNAPSHOT

Below is a comparison between Buildings A and B's current and projected consumption and cost data. In these cases, installing more efficient or electric space-heating and water heating equipment combined with other energy efficiency measures results in decreased energy usage, and therefore lower costs, per dwelling unit.

	Current Consumption (kBtu/year/unit)	Projected Consumption (kBtu/year/unit)	% Change in Consumption	Current Cost ($/year/unit)	Projected Cost ($/year/unit)	% Change in Cost
Building A	103,281	82,575	-20%	$2,554	$2,038	-20%
Building B	123,731	115,277	-7%	$2,983	$2,941	-1.5%

FURTHER SAVINGS WITH SOLAR

Installing solar panels is a practical and efficient way to harness renewable energy and reduce utility costs. Solar panels can be mounted onto rooftops or integrated into building facades to capture sunlight and convert it into electricity. Through the installation of solar panels, Building A will produce 46,470 kWh/year (17% of owner-paid electrical load). Building B, with a smaller array, will produce 32,200 kWh/year (5% of owner-paid electrical load). **This is estimated to save Building A $15,730/yr and Building B $3,961/yr in utility savings.**

KEY TAKEAWAYS + LOOKING AHEAD:

Looking at the scopes of work completed at both buildings and assessing the differences in their electrification measures and increased electrical loads, it is clear that on-site generation is mitigating significant cost increases. When considering Building B alone, how does the decision to electrify DHW production affect operations when compared to Building A?

<u>The Cost of Electrification</u>

- The utility costs of electricity are often higher than that of natural gas. Right now, average baseline rates for NYC are 24.98 ¢ per kWh before factoring in demand and delivery charges, compared to 7.3 ¢ per kWh for natural gas.
- The initial installation costs for electric systems can be higher, especially for a retrofit project where the electrical infrastructure needs to be upgraded to handle the increased load.
- The units in Building B are 29% larger than in Building A and hot water usage would increase with more occupants per unit.

However, the grid is gradually incorporating more clean energy sources with lower GHG coefficients. Further advances in and adoption of energy storage solutions would help manage peak demand, helping to offset the higher cost of electricity compared to natural gas.

Future-proofing: As policies increasingly favor low-emission technologies, early adopters of electric systems will be ahead of regulatory changes and avoid potential costs associated with non-compliance.

<u>Increased Efficiency of Heat Pump Technologies:</u>

Comparing the coefficient of performance ratings for the heat pump hot water heater versus the natural gas boiler highlights the value of this investment, as the higher the COP, the more efficiently the system uses energy:

- Building A: The COP of the hydronic natural gas boiler is .82
- Building B: The COP of the heat pump hot water heater is 4.2 at 43° F outdoor temperature

<u>Physical Building Conditions and Comfort:</u>

- IAQ Improvement through ERV Installation: Continuous fresh air supply, reduction of indoor air pollutants and therefore healthier and more comfortable occupants, and humidity control
- Operational Benefits of Electric DHW System: Removal of on-site combustion and therefore improved air quality, built-in safety mechanisms, resilience to power outages when paired with battery storage systems

INCREASING THE VALUE OF DECARBONIZATION: LOAD REDUCTION AND ON-SITE GENERATION

Though on-site generation will always benefit the project, the return on investment is significantly higher when paired with electrification - this is adding to the load that the energy generated on-site can sustain. Energy efficiency upgrades and reducing electrical load further amplify this payback. For example, taking a deeper look at Building B, the lighting upgrade results in a decrease in energy consumption larger than the increase associated with the electric DHW system. With this comprehensive approach to load reduction and improving efficiency (lighting retrofit, DHW pipe insulation, highly-efficient appliances, etc.), Building B is maximizing the potential of its solar array.

- The lighting retrofit in Building B decreased its original electrical load by an estimated 12% while the electrification of the DHW caused an estimated 6% increase, resulting in a net decrease of 6%. The installed solar array results in an additional 5% decrease, generating almost enough energy to sustain the entirety of the DHW-related electricity consumption.

WHAT COMES NEXT? THE ROAD TO FULL ELECTRIFICATION

Both buildings have made energy efficiency upgrades without compromising affordability, laying the groundwork for next steps: fully converting to electric systems and ensuring that their electrical capacity can sustain these future loads. Though smaller upgrades result in a simple payback over a short period of time, these larger investments in clean energy infrastructure set up the building for success in the face of increasing environmental impacts, regulatory change, and insurance risk.