RetrofitNY

A Report of Findings and Lessons Learned

The RetrofitNY program funded carbon neutral retrofit and building electrification pilot projects in the affordable multifamily building stock with the goal of innovating standardized, scalable solutions that will improve the aesthetic and comfort of New York's buildings while dramatically improving their energy performance.

Multifamily buildings and affordable housing face unique challenges to electrification and deep energy retrofits, including upfront costs and space constraints. Forging public-private partnerships is critical to overcoming these barriers and advancing and scaling building decarbonization solutions in this growing market. RetrofitNY facilitated partnerships between building owners and leading manufacturers and solution providers on projects that demonstrate transformative technologies to reduce energy use and greenhouse gas emissions, providing replicable pathways for existing multifamily buildings to decarbonize.

The program funded three demonstration projects in New York State. Two demonstration projects were located in New York City and one in Phoenix New York for a total of 102 dwelling units. Details on the projects can be found on the NYSERDA **website**.

This document contains information on the market transformation methodology the program utilized along with information on program design, market barriers, program activities, market analysis and feedback, and lessons learned from the program.

The RetrofitNY Approach

RetrofitNY sought to adapt the industrialized, productized model for rapid deployment of Net Zero Energy (NZE) retrofits developed by the Dutch Energiesprong borrowing a modular, packaged deep energy retrofit (MPDER)approach.

An MPDER consists of:

- offsite manufactured high-performance wall and roof panels with pre-fitted fenestration to rapidly bring a building's envelope to passive house levels of performance (R-30 with 1.0 ACH50)
- integrated electrified mechanical systems that provide building heating, cooling, ventilation, dehumidification and DWH production
- onsite renewable energy source typically consisting of rooftop PV

Together these measures are capable of rapidly bringing a substantial portion NYS' residential building stock to or approaching NZE performance (e.g., a 70% or greater reduction in energy use from heating and cooling). These measures can be generated from a single building scan and produced offsite, with minimal onsite installation times allowing retrofits to be performed with residents in place, minimizing resident disruption, installation, insurance, and construction loan costs. Shifting production from the field to the factory are also predicted to increase productivity (productivity has decreased in the construction sector by 20% over the past 60 years compared to all other sectors increasing on average 150%) and this has resulted in higher costs and decreased buying power to building owners.[1] Additionally, automating production and providing indoor, technology-based workforce opportunities for a sector reporting increasing shortages throughout the trades can significantly contribute to the projected 236,000 new jobs needed to meet NYS' climate goals in the building sector by 2050.[2]

Analysis of the market found that cost reduction on the order of 40% (from a baseline of $125,000 per unit) is possible for deep energy retrofits through technologies and practices that addressed excesses in transaction costs, installation costs, and risk allocation. This finding was the result of interviews with numerous industry experts (manufacturers, providers, technology companies). Furthermore, there was broad consensus among those interviewed on the cost drivers and their contributions to the costs of an individual project.

For substantial upgrades a $75k per unit deep energy retrofit solution can win in the market against conventional upgrade offerings, being the default choice for building owners (e.g., $40k per unit of equity plus $35k per unit of financing against value streams). This is due to the impact of the eleven value streams of a deep energy retrofit on the building's financial performance. See feasibility study showing the impact of the eleven value streams identified by ADL with a performance guarantee transferring risk from the building owner to an insurance product. As seen above, a $75k deep energy retrofit solution is achievable.

1 Five Decades of Decline: U.S. Construction Sector Productivity, August 2025

2 JTWG Jobs Study March 2023 Vintage Update, Table 15]

NEW YORK STATE | NYSERDA
New York State Energy Research and Development Authority

Original Program Design

RetrofitNY tested if simplified solutions (e.g., packaged solutions with known prices) to conduct deep-energy retrofit are developed, then more buildings will be retrofitted to a high level of efficiency.

There is an appetite among industry players to adopt business models, most notably the solution providers, manufacturers and building owners qualified through the RetrofitNY RFQLs, that allowed for more efficient project delivery and the ability to develop turnkey solutions and designed the program around those innovative companies. However, these companies need support to make needed investments in building capacities and developing packaged solutions. Packaged solutions allow for faster price discovery, lower risk, and lower friction in the financing process.

If potential demand for deep-energy retrofits is aggregated, clearly demonstrating to the industry that a large potential market exists for deep-energy retrofits in existing multifamily buildings, then the industry will invest the time and resources required to develop comprehensive deep-energy retrofit solutions. Aggregation of soft demand (building owners stating an interest or signing a pledge) is limited in utility. Effective aggregation will use an entity to stand between the construction firm and the building owner to facilitate the transaction, group buildings of similar typologies and scopes, and group projects under bulk contracts. Such a transaction facilitator also needs a viable financial product so that projects can go to construction.

If solutions are built and tested through pilots, then the industry will streamline the solutions reducing costs and improving performance. Packaged solutions allow for fast pricing discovery and lower cost as well as more confidence in performance. There is a need to support prototyping. This gives the ability for companies in the value chain to develop solutions in a low-risk environment. It also gives them the ability to design solutions that can be applied across many buildings. Companies are not willing to bear this expense on their own, and for good reason. Development of prototypes of replicable retrofit solutions for buildings of the same typology reduces costs, reduces barriers for installers and increases transparency of pricing.

There is a need to support the adoption and acquisition of technologies that will lower the cost of project delivery. Packaged solutions allow for fast pricing discovery and lower cost as well as more confidence in performance.

Market Barriers Explored

Deep-energy retrofits in multifamily buildings are currently not cost effective, are complex, not easily replicable, and are highly disruptive for tenants.

There has been little focus on the barriers to investment for companies in the value chain, yet investment by these companies is needed to develop cost effective solutions. Interventions that aim to lower the barriers to investment in the value chain have been proposed by the team.

Solution providers qualified by RetrofitNY uncovered ways to drive down the cost of solutions, substantially improving project economics. The feasibility study conducted by ADL identified a way to monetize the value of a deep energy retrofit. These two trends — steadily decreasing project costs and an ability to capture additional value through insurance products — suggest that it is possible to make deep energy retrofits cost effective and show the specific steps to make them so.

Barrier 1: High-efficiency building components necessary for conducting retrofits are not readily available in the U.S.

Outcome: Some progress made developing partnerships with Advanced Buildings NextGen HVAC Challenge, Natural Carbon Solutions Innovation Challenge and DOE:

DOE Advanced Building Construction

- Topic 1: Integrated Building Retrofits
  - University of Central Florida (HVAC System)
  - Fraunhofer (Wall Panel Blocks)
  - Oak Ridge National Lab (Panelized System)
  - Syracuse University-tkFabricate (HVAC System)
  - Home Innovation Research Lab (Panelized System)
  - National Renewable Energy Lab (Digital Installation Technology)
  - Rocky Mountain Institute (Panelized + HVAC System)

NextGen Buildings Innovation Challenge

- Round 4 (Appendix A), Round 5 (Appendix B), Round 6 (Appendix C)
  - Dextall (HVAC System)
  - Taitem/Clivet (HVAC System)
  - Signetron (Panelized System)
  - Cycle Retrotech (Panelized System)
  - Firomar (Panelized System)

Natural Carbon Solutions Innovation Challenge (Appendix D)

- Round 1 (in development or contracting)
  - CleanFiber (Panelized System)
  - Syracuse University (Panelized System)

Barrier 2. Regulatory and code barriers exist

This makes the implementation of deep-energy retrofits more complex and costly. For example, building or retrofitting a building to a high-level of efficiency might require obtaining a number of code variances.

Outcome: Some progress made with NYC code revisions to allow more external insulation on buildings. The 11.07.2022 revisions to the NYC Construction Code now allow insulated over-cladding systems to project 8" past building lot line where previous code only allowed 4" (see BC 3202.2.5).

Barrier 3: Typical financing may not be available.

The more comprehensive scopes of work required to reduce the energy consumption of a multifamily building beyond 50% typically have a longer payback period. Traditional lenders are not yet ready to bear this risk over 20 years.

Outcome: Lenders citing lack of data on buildings specifically with high-performance electrification of buildings. Building owners are unwilling to accept performance risk for most solutions that will improve the performance of their buildings and this is unlikely to change as this position is wise (it's better for risk to be transferred away from them). NYSERDA's support for performance guarantee products from insurers is necessary for deep energy retrofits and most other building efficiency solutions to be viable in the market. Quantifying existing value streams will increase building owner motivations and lower building owner upfront capital requirements.

RetrofitNY Activities

To create a self-sustaining marketplace for the deep-energy retrofits of tenanted multifamily buildings in New York State, NYSERDA completed the following activities:

Defined criteria needed for retrofits. (Achieved)

Conducted extensive market research to investigate needed performance levels and relevant target building typologies.

SWA market studies:

- Cost Compress Study - Phase I [PDF]
- Cost Compress Study - Phase II [PDF]
- Mid-Rise Typology Addendum [PDF]

Syracuse University Market Characterization study:

- Market Characterization Report [PDF]
- Typology 8 Addendum [PDF]
- Dormitory Typology Report [PDF]

Created Demand by aggregating a large number of units to be renovated. (Achieved)

Developed and launched the RetrofitNY Pledge (Appendix E) which served as a vehicle to identify possible early demand of 10,264 multifamily buildings and 416,425 units for the industry players.

Organized and Ran a Design-Build Competition. (Achieved)

Launched two rounds of funding under Retrofit NY which resulted in 7 initial design pilots with 3 moving to construction and supported a Syracuse University pilot through construction. In addition, spurred industry action by qualifying potential team members for prospective pilots:

- Solution Provider RFQL (Appendix F)
- Manufactures RFQL (Appendix G)
- Building Owner RFQL (Appendix H)
- Syracuse University Pilot

Developed Supply Chain of High Efficiency Components. (Achieved)

Partnered internally and externally to support innovation in the supply chain.

- **DOE:**
  - ***Advanced Building Construction (ABC) FOA:*** Support DOE's ABC initiative that invests in new technologies that enable cost-efficient and high performing buildings for new construction and retrofits. RetrofitNY also supports ABC Collaborative through engaging with key industry players to tackle related challenges, including workforce training, business models, demand growth, and service delivery. DOE awarded $31.8M for 7 project teams that will demonstrate the next generation of low-carbon retrofit solutions.
  - ***BENEFIT FOA:*** Support to DOE's $45M FOA in qualifying projects that will research and develop high-impact, cost-effective technologies and building retrofit practices.
- **NYCHA:** Support to NYCHA's first deep energy retrofit, qualifying design teams through RFQL 4234.
- **NYSERDA Awards:**
  - ***NextGen Buildings Innovation Challenge:*** Through 3 rounds of partnership with the Innovation team that provides funding to innovative HVAC technologies and business models, of 37 projects, representing over $28M in funding, RetrofitNY qualified and recommended 11 projects, representing over $11M to innovative solutions such as Energy Pod, Panelized System and Midrise HVAC. Of 11 recommended projects, 4 projects have been awarded, 5 in negotiation and remaining 2 did not go to contract.
  - ***Natural Carbon Solutions Innovation Challenge:*** Of 10 projects and $12.3M recommended for funding to support research, development and demonstration approaches through innovative technologies, novel business models and scalable strategies, RetrofitNY qualified and recommended 2 projects that focus on developing carbon-negative insulated panel system, which represent over $3M in funding.

Identified and Addressed Regulatory Barriers. (Pending)

Identified multiple regulatory barriers with mixed results in addressing.

- Prior code NYC building code only allowed 4" projection of insulative over-cladding past building lot line before a variance from NYC DOT needed to be applied for and which was rarely obtained (recent increase to 8" projection is cited below).
- Tin ducting required for HVAC distribution systems rather than less expensive and less obtrusive plastic ducting now available and currently allowable in other districts.

Develop Financial Solutions to Finance the Retrofits. (Achieved/Pending)

Initiated needed industry research on insurance products to support the development of financial products.

- Supported the market entry of innovative lenders into NYS (Tallarna; Perl Street).

Leverage Philanthropic Funding and Other Grants. (Unsuccessful)

While there was some limited indirect engagement through the Rockefeller Foundation (through NYCEEC), it has been difficult to garner the attention from the philanthropic funders.

Goals Prior to Exit

Goal 1. Solutions meeting all defined criteria are available for building owners to purchase and install.

Status: Solutions in market, but not at the anticipated/ needed price points to scale.

- Dextall panels
- Advanced Building Solutions panels
- Sto panels
- Tremco panels
- Ephoca HVAC system

Goal 2. Financing solutions exist for building owners to purchase these solutions with minimal upfront cost.

Status: Some solutions in market, but additional work needed on risk mitigation products (performance guarantees).

Goal 3: A self-sustaining market for retrofit packages exists and NYSERDA financial incentives are no longer needed to implement the retrofits.

Status: Pending

- There is still a need to support prototyping (installing components of a deep energy retrofit on an empty or dummy building). This gives the ability of companies in the value chain to develop solutions in a low-risk environment. It also gives them the ability to design solutions that can be applied across many buildings. Companies are not willing to bear this expense on their own, and for good reason. Development of prototypes of replicable retrofit solutions for buildings of the same typology to reduce costs, reduce barriers for installers and increase transparency of pricing.
- There is a need to support the adoption and acquisition of technologies that will lower the cost of project delivery.

Analysis

What did we think of as our market barriers as we launched this program? What did we get right/wrong in this analysis?

- Deep-energy retrofits in multifamily buildings are currently not cost effective, are complex, not easily replicable, and are highly disruptive for tenants. There has been little focus on the barriers to investment for companies in the value chain yet investment by these companies is needed to develop cost effective solutions.
- High-efficiency building components necessary for conducting retrofits are not readily available in the U.S.
  - Some progress made through partnerships with Advanced Buildings NextGen HVAC Challenge and DOE Advanced Construction Collaborative.[3]
  - Regulatory and code barriers exist: This makes the implementation of deep-energy retrofits more complex and costly. For example, building or retrofitting a building to a high-level of efficiency might require obtaining a number of code variances.
  - Some progress made with NYC code revisions to allow more external insulation on buildings.
- Typical financing may not be available: The more comprehensive scopes of work required to reduce the energy consumption of a multifamily building beyond 50% typically have a longer payback period. Traditional lenders are not yet ready to bear this risk over 20 years.
  - Lenders citing lack of data on buildings specifically with high-performance electrification of buildings Building owners are unwilling to accept performance risk for most solutions that will improve the performance of their buildings and this is unlikely to change as this position is wise (it's better for risk to be transferred away from them). NYSERDA's support for performance guarantee products from insurers is necessary for deep energy retrofits and most other building efficiency solutions to be viable in the market.
  - Quantifying existing value streams will increase building owner motivations and lower building owner upfront capital requirements.

3 DOE Awards $32 Million to Accelerate Next-Generation Building Upgrades

- The barriers assumed at launch and encountered throughout the program are comparable to those encountered by US DOE's Advanced Building Construction team, RMI's REALIZE programs in MA and CA, as well as the other European teams in NL, UK, FR, DE and IT, all of whom are seeking to introduce the Energiesprong model.

- In addition, the following systemic barriers were also discovered:
  - Initial lack of buy-in from affordable housing agencies to support approval of projects, prioritize their closings, disclose term sheet or provide transparency on overlapping scope areas (envelope and mechanical) to standardize incremental cost model and develop ramp to compression, develop a pipeline of projects optimal for NZE retrofits to scale up and reduce costs [cooperation certainly improved over time, though the complications resulting from covid greatly offset the benefits of increased buy in from agencies though many of the same underlying issues just listed still persisted.
  - Protracted lead-times to introduce new envelope and MEPs products to the market, or import those already existing from overseas and a general lack of interest/ skepticism by foreign manufacturers about entering the US market prior to (and even after) 2020.
  - Reluctance of contractors qualified for public procurements to bid innovative projects competitively given prospective scaling opportunities such projects offered by committed owners (SUNY and NYCHA) but rather building in a sizable cushion due to unfamiliarity with product or approach given exorbitant rate scales required for project (typically at least 3x or more standard rates).
  - Difficulties for public procurement to adopt the project delivery method most conducive to success (DB, CMAR, IPD) or to learn from the failure of past projects from not doing so.
- Unexpected barriers unique to the COVID pandemic were also encountered that resulted in supply chain disruptions, commodity pricing volatility, labor availability fluctuations, project interruptions:
  - Construction stop and contractor default.
  - Affordable housing pipeline slowdown.
  - Double and triple digit percent increases in construction materials and overall pricing, order delays or product unavailability.

What did we get right/wrong in our program planning?

- Innovators and early adopters among affordable housing owners were very interested in demonstrating high performance retrofits on their buildings, but applying these to a single building in a financing cluster proved a stumbling block and would have been easier to integrate across a cluster (eliminating need for a separate project architect, general contractor, agency reviews, and NYSERDA funding being segregated from the rest of the project capital stack).
- Solution provider teams were primarily design-led, reflecting the prevalence of DDB delivery throughout the industry, which in turn led to a project-based approach rather than a productized approach scalable through the owner's portfolio and beyond to portfolios with like typologies.
- Design-led solution provider teams were constrained to utilizing existing technologies at prohibitive price points to achieve target performance levels. An adjustment in target EUI from 20 to 30 significantly reduced cost from above $40k/dwelling unit incremental cost to just within that program cap (pre-COVID).
- Financing structures were not in place to meet this new approach, and only a few frontrunners in sustainable financing like New York City Energy Efficiency Corporation (NYCEEC) and Community Preservation Corporation (CPC) provided active support of the RetrofitNY initiative.
- Efforts to provide the market with large scale opportunities like access to publicly-owned and managed facilities were ineffective due to those entities procurement restrictions against DB/CMAR/ IPD project delivery and reluctance on the part of large-scale builders to whom such projects are restricted to risk providing competitive pricing on innovative projects given the elevated rate scales that apply on public projects.
- Aggregating demand through the RetrofitNY Pledge meant to signal to the supply-side the enormous prospective market for NZE retrofits proved highly successful in garnering signatories but ultimately ineffective since post-covid the affordable housing sector and construction cost volatility created such disarray that translating those soft commitments into actual viable projects at competitive prices points proved unfeasible.

Target Market Characterization

How did we define the target market segments, market participants, market-readiness and value to the customer?

- The initial target market consists of affordable housing buildings owned by Public Housing Authorities, and privately owned multifamily affordable housing buildings regulated, financed or subsidized by affordable housing agencies such as New York State Homes and Community Renewal (HCR), New York City Housing Preservation and Development (HPD), the New York State Housing Finance Agency, and the New York City Housing Development Corporation (HDC).

NYSERDA defines existing multifamily affordable housing as buildings in which at least 25% of the units are occupied by households earning not more than 80% of the area or state median income, whichever is higher.

What did we get right, and what did we get wrong in our analysis?

- Our initial analysis was proven substantially correct. However, a parallel track that included market-rate projects might have also been beneficial to mitigate the problems associated with regulated affordable housing. Notably, (1) procurement practices and bonding requirements raising costs and disincentivizing development of turnkey providers (2) the inability to charge rent premiums in exchange for higher air quality, increase comfort and lower energy bills and (3) uncertain and protracted financing periods with the housing agencies. Housing agency procurement processes and bonding requirements limit companies taking needed steps in this market and favors a small number of incumbents with minimal interest in changing their practices or in developing packaged solutions.
- The initial focus on the building owner as opposed to the value chain was a strategic error. Seeking willing building owners but not encouraging providers to develop effective solutions leaves building owners without good options.
- We were initially mistaken about the degree to which the supply chain was not set up to support an industrialized retrofit approach. In turn, the program was pivoted to more directly support supply chain development by forging alliances with NYSERDA's Innovation Team and the DOE Building Technology Office (BTO). Our original assumption that viable solutions would emerge as a result of "design competitions" proved to be wrong. Viable scalable solutions entail a value chain willing and able to support an industrialized retrofit approach, which in turn requires investments into specific capabilities to lower costs (plant and equipment investments) and streamline project delivery (either through vertical integration or joint ventures and financing partners). This type of market action is not spurred by the design competitions initially envisioned in the Investment Plan.

Market Feedback

How was the market for MPDERs when the program started, and how is it today? How has the RetrofitNY program been perceived and utilized?

There was no market for MPDERs prior to the launch of RetrofitNY since the concept did not exist in the US. The RetrofitNY program help accelerate the allocation of resources nationally to further development in this sector. The program was instrumental in launching a national effort through the US DOE's Buildings Technologies Office (The Advanced Building Construction Collaborative). In close collaboration with the US DOE, the RetrofitNY market learnings and strategy was disseminated to a national level where additional 10s of millions in additional resources was allocated for R&D and market support in the industrialized construction sector.

In addition, the RetrofitNY program was successful in forging internal collaborations with NYSERDA's Innovation teams that resulted in an R&D pipeline supporting the industrialized retrofit space which includes more cost-effective panel products, integrated MEP approaches and insurance products.

- **IMS PON 4359 (Appendix E)**
  - ***Enervee:*** launch a statewide LMI marketplace and build and integrate new instant discount and financing solutions to empower the roughly 3.5 million households in the LMI segment to shop energy smart at scale.
  - ***Sustainable Tompkins:*** a pilot study to convert 100 LMI rental units in the City of Ithaca to heat pumps from natural gas in 1-4 unit buildings. The project will track the impact of stacked incentive packages, tenant education/engagement, social diffusion of success stories, energy performance, and concurrent Ithaca Green New Deal programming on uptake by landlords.
    - » ***Bright Power, Inc:*** develop data-driven underwriting standards for low-carbon multifamily buildings in NY State.

- ***Tallarna:*** support NY state and its qualified partners in securing risk-managed, private funding for energy efficiency retrofits. This is achieved through our unique combination of energy analytics, insurance, and ESG funding, enabling performance-as-a-service.
- ***UPROSE:*** a pilot project of a new model for community-led and owned DERs and regenerative building transitions in disadvantaged communities (DACs).
- ***NextGen Buildings Innovation Challenge***
  - » Round 4 (Appendix A)
  - » Round 5 (Appendix B)
  - » Round 6 (Appendix C)
- ***Dextall (HVAC System):*** a prefabricated panel with standardized mechanical system integration.
- ***Taitem/Clivet (HVAC System)***
- ***Signetron (Panelized System):*** a 3D laser scanning system for panelizing midrise buildings in NYS.
- ***Cycle Retrotech (Panelized System):*** a lightweight panelized over-cladding system.
- ***Firomar (Panelized System):*** a lightweight panel system that provides structural, energy-efficient, expanded polystyrene/graphite polystyrene exterior envelope panels.

- **Natural Carbon Solutions Innovation Challenge (Appendix D)**
  - Round 1
    - » ***CleanFiber (Panelized System):*** Carbon Sequestering Biogenic Insulating Exterior Wall Panels.
    - » ***Syracuse University (Panelized System):*** a carbon-negative insulated panel systems made with mycelium.

What feedback are we receiving from industry? (not just those who want access to NYSERDA funds)

Most of the feedback received come from innovators looking to enter the market and seeking NYSERDA funding. Some points of feedback from "outside stakeholders" include:

- A general excitement about pushing the construction industry forward using new technologies.
- Healthy skepticism as to applicability (which buildings).
- Concerns about job displacements from an industrial approach.
- Difficulty in project financing.
- Lack of building performance data for lenders.

Retrospective — I wish that I knew what I know now, when I was younger.

What were the biggest surprises?

- There is such an acute need to lower the barrier to investment by companies in the value chain as such investments are critical to developing packaged solutions with known prices and the ability to deliver projects effectively.
- The unique value of deep energy retrofits are heavily discounted due to the unwillingness by building owners to accept performance risk and the degree to which a modest intervention (a capital reserve fund from NYSERDA to support the release of a performance guarantee by insurers) would largely resolve the issue.
- The expressed willingness of industry to make substantial investments in building capacity if they had greater visibility on the direction of the market.
- The degree to which the existing design bid build model drives up the cost of projects.
- Timing of contract bids (avoiding the busy summer season for GCs) had a substantial impact on project costs.
- The overheated construction market over the last few years and the GC's lack of familiarity with innovative products substantially increased quoted project costs.

- The opacity of the estimating process, the variation in scopes, the delta in opex savings depending on the existing building's fuel type, the siting of the building, its existing envelop condition and mechanical distributions systems, unit counts and unit size, all cause such huge variations in price that arriving at a standardized metric for pricing to track cost compression was next to impossible for initial pilots and proofs-of-concept prototypes. For instance, the two Casa Pasiva pilot buildings were identical in every way and conjoined with each other, yet there was a 50% variation in pre-retrofit site EUI (one 80 and the other 120).
- Lack of detailed intel about our existing building stock which RetrofitNY's efforts significantly corrected, first with the publication of the SU-Pratt Market Characterization study that was commissioned, and then with the Analytics Dashboard NYSERDA commissioned from Radiant Labs as a direct result of RetrofitNY team demand and input.

What happened that we didn't, or couldn't, foresee?

- Inability or unwillingness of industry to rapidly introduce an offsite manufactured high-performance envelope wrap panel intermediate between EIFS and SIPs, either by adapting their existing product line or importing this from overseas OEMs where this is already available (Tremco/Dryvit being the exception). This was a major market need cited by PNNL in their report on high performance retrofits with NYS an ideal test market, so it was surprising few manufacturers jumped at this opportunity.
- Difficulty in cooperation from affordable housing agencies in creating a project pipeline given the significant subsidies NYSERDA offered for this and the benefits to them of the programming.
- Difficulties arising from segregating a single building for NZE retrofit from the larger project cluster.
- Lack of interest from ESCOs in adopting this model. While two major ESCOs, Ameresco and Engie (who had done Energiesprong UK projects) became qualified solution providers under RetrofitNY, their participation in the program ultimately proved minimal rather than leading the vanguard.
- The entrenchment of the Design-Bid-Build project delivery into the construction industry, which is not only deleterious to the turnkey productized retrofit model but highly indicative of the inefficiencies ingrained in the construction industry.
- The limited capital reserves for public housing authorities and SUNY campuses to undertake renovations.
- The need to target substantial rehab projects doing significant work to their envelope and mechanical systems, which were the optimal for proofs-of-concept pilots with sizeable underlying allocation for these line items, but which proved to be very few in number.
- The significant decline in affordable housing renovations projects post-2019 due to agency staffing shortages and capacity constraints along with exorbitantly inflated construction costs that either limited available funding, trimmed scopes, or caused delays while budgets were renegotiated.

If we were to design the program again today, what would we have done differently?

- Launch the program in phases:
  - ***Phase 1 Innovation challenge:*** develop prototypes to include needed R&D, testing, technology mock ups installs in a low risk environment (dummy site, vacant building etc.).
  - ***Phase 2 Market Scaling:*** issue subsidy capital through a public-private partnership that clustered buildings by typology and solution, and rewarded providers of packaged solutions meeting cost thresholds.
- The initial focus on the building owner as opposed to the value chain was a strategic error. Seeking willing building owners but not encouraging providers to develop effective solutions leaves building owners without good options.
- Include market rate buildings to mitigate problems associated with regulated affordable housing, which include lengthy pipelining and financing processes coupled with ridged procurement rules.

Lessons Learned / Lookahead

What did we learn internally from a program design and management perspective? Market intervention perspective? Inter-departmental coordination perspective (Buildings Innovation)? What worked well? What didn't work well?

- Energiesprong was able to retrofit 14,400 units to NZE and build 5,000 additional new NZE units within its first few years while reducing costs by 40%. It did so with a unified strategy, charismatic leadership, the full support of the government and social housing agencies and a multidisciplinary staff of 60. In contrast, RetrofitNY's team of 4 was not set up for success to integrate an entire authority, form interagency partnerships and revolutionize an entire industry. Given capacity and funding limitations the program was forced to expend substantial time and effort to garner ground up internal buy in to leverage other program budgets for needed market development.

Structurally, what did this program experience tell us about how NYSERDA is internally positioned? Our success metrics when it comes to market transformation activities?

- NYSERDA's focus on $/ton leads to a default strategy limited to delivering the most projects with the least number of measures at the lowest cost. This is insufficient for meeting NYS' mandated climate goals certainly with respect to the built sector. Once all the low-hanging fruit is exhausted, the process will hit a wall.
- A cogent strategy is needed starting with the 2050 end-state and working backwards. There needs to be a balance with programs that target what is buildable today vs what is needed for the 2050 end state. The focus at NYSERDA has been heavily skewed towards the former.
- An effort needs to be made to better integrate the needed elements of the market (supply-side, demand-side, financing, regulation, stakeholder socialization, etc.) to develop synergies and reduce frictions.
- NYSERDA needs to do a better job at trying to influence the market on a regional level. Supply chains are built regionally and markets are rarely bounded by state lines. Developing more clarity/standardization regionally will benefit the industry resulting in better project costing from economies of scale.
- An initiative like RetrofitNY is not well served in NYSERDA's Market Development portfolio. Given the work to be done (supply chain development & prototyping) such an effort is best positioned in NYSERDA's Innovation portfolio that does not have the simultaneous pressure of project/unit volume.

What are the current cost metrics for a MPDER?

NZE Construction Costs

Round-1 (Costs per dwelling unit)

AVERAGE	$137,149
MEDIAN	$142,942
HIGH	$168,216
LOW	$88,130

Round-2 (Cost per dwelling unit)

AVERAGE	$130,986
MEDIAN	$136,785
HIGH	$154,101
LOW	$94,976

Appendix

Appendix A: NextGen HVAC PON 3519 (Round 4)

Appendix B: NextGen HVAC PON 3519 (Round 5)

Appendix C: NextGen HVAC PON 3519 (Round 6)

Appendix D: Innovative Market Strategies PON 4359

Appendix E: RetrofitNY Pledge

Appendix F: RetrofitNY Solution Provider RFQL 4553

Appendix G: RetrofitNY Component Manufacturer RFQL 4551

Appendix H: RetofitNY Building Owner RFQL 4552