



PILOT BUILDING SELECTION

REALIZE is looking for a pilot building for its United States Department of Energy (DOE) Building America award that will demonstrate how we plan to bring the clean industrial revolution to America's homes. This pilot building will be a first step and key case study in catalyzing the availability of pre-integrated, affordable, and speedy net zero energy ready retrofits.

BACKGROUND

REALIZE is developing a standardized, prefabricated, net zero energy (NZE) ready multifamily retrofit solution to be deployed in common low-income housing types across the United States. REALIZE is currently looking for a candidate pilot building (or buildings) to implement such a solution. The design will be developed through a DOE Building America award. The goals of the project are: 1) to provide the industry with a compelling case study for prefabricated retrofits, 2) to achieve NZE ready status, and 3) to develop a cost-effective approach for retrofit solution implementation. Key project team members, in addition to several industry partners, include Rocky Mountain Institute (RMI), Net Zero Energy Coalition, Passive House Institute US (PHIUS), Re:Vision Architecture, The Levy Partnership, Staengl Engineering, and CVM Engineers.

SCOPE OF RETROFIT

REALIZE plans to develop and implement a holistic, all-electric retrofit solution for low-income housing in the Northeast, Mid-Atlantic, or Midwest. This retrofit solution will address the envelope (windows, walls, roof, foundation), mechanical, electrical, and plumbing (MEP) systems, heating, ventilation, and air conditioning (HVAC) systems, domestic hot water, and, potentially, solar photovoltaic (PV) systems. The retrofit solution is designed to minimize tenant disruption and apply as much of the package as possible from the outside-in. Ideally, the façade and mechanical solutions will be integrated into a prefabricated unit that can be installed without excessive site pre-work. The vision is more fully captured in [this video](#).

BENEFIT TO OWNERS

A building renovation technology of this form offers several benefits to building owners, while the overall REALIZE program seeks to offer a suite of value to building owners. For this specific pilot certain benefits will not be initially realized, but by partnering on this effort the team can chart a path for applying these benefits to a broader portfolio of buildings beyond the one pilot site. These benefits fall into three main categories:

Project Economics, Local Integration, and Technical Solution. A description of each category can be seen in Table 1. At a fundamental level, each of these categories of benefits reduces project times and project risk.

Table 1: REALIZE Project Benefits for Owners

Project Economics	Local Integration	Technical Solution
<p>Energy Savings – financial implications of a net zero energy ready retrofit are assessed through energy modeling and optimization and will provide substantial savings on utility and maintenance expenses</p>	<p>Program Coordination – work with cities and states to improve current and future program designs to enable convenient REALIZE participation for building owners</p> <p><i>Long-term Program Element</i></p>	<p>Predesigned Retrofit Package – turnkey, yet customizable, energy conservation measures package</p>
<p>Low Income Housing Tax Credit (LIHTC) Competitiveness – additional 9% LIHTC points can be earned in many markets</p>	<p>Codes and Regulations – work with cities and states on codes and regulatory design to accommodate this style of retrofitting and accelerate project approvals</p>	<p>Reduced Contractor Risk – standards and guidelines with contractor training, using high levels of pre-integrated technologies reduce complexity and potential for error</p> <p><i>Long-term Program Element</i></p>
<p>Improved Debt Capacity – improved net operating income and the ability to capture savings through an innovative energy plan structure allows for increased debt capacity and an increased pipeline of financeable projects</p>	<p>Reduced Procurement Costs – coordinate with building owners, governments and utilities to aggregate large volumes of demand to drive retrofit costs down further</p> <p><i>Long-term Program Element</i></p>	<p>Performance Guarantee - retrofit package will include a performance guarantee to reduce risk to the owner and tenant</p> <p><i>Long-term Program Element</i></p>
<p>Reduced Tenant Displacement and Disruption – predominantly exterior based retrofit allows tenants to stay in place reducing tenant relocation costs</p>	<p>Access to Capital – work with local governments, utilities and local philanthropic organizations to unlock additional capital in support of deep energy retrofits</p>	<p>Improved Indoor Environmental Quality - improved living space comfort and indoor air quality</p>
<p>Labor Costs - off-site fabrication may yield cost savings in high-cost or supply constrained markets</p>		
<p>Access to Capital – eligibility for pools of capital organized in support of this approach to rapid retrofitting and building improvements</p> <p><i>Long-term Program Element</i></p>		

BENEFIT TO TENANTS

On average, low-income households spend three times as much as a percent of monthly income to heat and cool their homes as the average household—from [20 percent to 50 percent of their monthly earnings](#) in some parts of the country. These costs create real hardships, making living costs untenable and families more vulnerable. By improving the energy performance of buildings these families are less susceptible to large fluctuations in their utility expenditures and families can better plan their monthly expenses. Efficiency upgrades also make living environments more comfortable and healthier through things like improved thermal comfort, reduced noise, and improved air quality. REALIZE seeks to catalyze the market to improve low-income access to affordable clean energy, while improving families’ overall quality of life and upward mobility.

POTENTIAL BUILDING TYPOLOGIES

To identify commonly observed building typologies that could undergo a REALIZE retrofit, RMI undertook a typology analysis to enable the team to more accurately select a pilot building that 1) represents a large portion of the multifamily building stock and 2) will achieve the stated goal of being net zero energy ready. RMI then established the most commonly seen physical characteristics of multifamily buildings in American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE) climate zones (CZ) 4 and 5. Tables 1 and 2 illustrate the top HVAC systems that fit within the most commonly seen building typologies.

Table 2: Top HVAC Bundles for ASHRAE CZ 4 and 5 from Residential Energy Consumption Survey (RECS) 2015

	#1	#2	#3
Heating System	Steam or hot water system with radiators or pipes	Central furnace	Electric furnace / baseboards
Heating Fuel	Piped Natural Gas	Piped Natural Gas	Electricity
Air Conditioning (AC) Type	Room AC	Central AC	Central AC
Number of Units Represented	1,582,364	1,289,997	1,179,079
Percentage of Total Units	17.4%	14.2%	13%

Table 3: Top Six Multifamily Building Typologies

	Existing Conditions						Notes
Top Typologies	15 Unit Building (low-rise)			50 Unit Building (mid-rise)			<i>Most common building sizes per American Housing Survey (AHS) Census data</i>
HVAC Bundle	#1	#2	#3	#1	#2	#3	<i>HVAC bundles identified from RECS 2015 data</i>
Climate Zone	CZ 4 or CZ 5						<i>Per previous findings</i>
Unit Size (square feet)	900			850			<i>AHS Census data</i>
Foundation Type	Unconditioned basement			Unconditioned basement			
Number of Stories	3			5			<i>AHS Census data</i>

Window to Wall Ratio	20%	20%	<i>National Renewable Energy Lab data</i>
Wall Construction	Brick/masonry mass wall	Brick cladding over steel with cavity insulation	<i>RECS and New York City Technical Working Group (NYC TWG) Report</i>
Roof Construction	R-12 above deck	R-12 above deck	<i>NYC TWG Report assumptions</i>
Adjacencies	Two shared walls with adjacent buildings	Free standing	
Units	15	50	<i>AHS Census data</i>

KEY SELECTION CRITERIA

Using the six typologies as baselines, PHIUS performed an energy modeling study to determine the effect of existing conditions on the achievement of project goals. The results of this study highlighted several key pilot selection criteria that influence project success to varying degrees. In addition to these criteria, REALIZE will first target certain building characteristics so that a robust solution can be created in one segment before diversifying. The following compiled criteria describe the ideal and overall considerations for candidate buildings for the REALIZE pilot:

	Primary Condition	Secondary Condition	Level of Preference for Primary Condition
Building Size	Approximately 30 units	Two buildings of approximately 15 units or a single building with > 30	High; preference would be to retrofit one building and test panel systems for mid-rise buildings
Structure	Brick/masonry mass wall, in good condition	None	At this time, REALIZE is targeting only masonry buildings
Historic Quality	No historic or aesthetic quality that is protected by the city/state	None	High; the retrofit solution will cover the exterior of the building(s) and the façade must not be protected in any way
Lot Line Restrictions*	None, ability to expand building envelope 6-10"	Ability to remove façade depth or receive variance	High; the panelized façade solutions are expected to be ~6" thick
Geometry	Simple, no excessive architectural details	Architectural details that can be removed	Medium; simple geometries will reduce the cost of the retrofit panels
Adjacencies	2 adjoining walls	Stand-alone	Medium; fewer exposed facades will lead to reduced costs
Facade	Simple façade without balconies or patios	Removal of balconies or patios acceptable	High; simplifies panel design and its attachment and controls thermal bridging
Roof	Flat roof with secure structure for PV	East-West orientation preferred	Medium; additional structure could be added through the roof panels or

			additional PV could be added at ground or other offsite locations
Foundation	Basement with ceiling or building perimeter access	Ground contact with building perimeter access	High; the retrofit solution includes an insulated basement
Heating Fuel	Natural gas	Electricity	Medium; natural gas buildings are more common and a solution designed for such buildings will maximize impact
Heating System	Central system	Steam/hot water radiators	Low; central system buildings have existing ventilation infrastructure that can be utilized
Cooling System	Central system	Terminal AC units	Low; central system buildings have existing ventilation infrastructure that can be utilized

* This requirement could be waived should the pilot location city government be amenable to variances to support the project.

FUNDING

The REALIZE team is able to defray design costs and provide technical support for fabrication, contractor selection/project bidding, installation, and monitoring. Building owners will need to provide project capital costs for construction. It is possible the zero energy retrofit solution will come with some form of a cost-premium relative to a standard efficiency retrofit, but less cost than a standard zero energy retrofit. The team is therefore requesting a partner who is prepared to navigate this potential premium.

The team is currently researching local utility incentives to mitigate these costs while engaging in the necessary conversations with local utilities, government agencies, and philanthropic organizations to help defer costs through additional incentives and grants. Overall, the pilot will be a demonstration of construction innovation to improve the existing building stock and the team seeks project partners with a shared vision and enthusiasm for this effort. In the long-run, the vision is that the solution developed through this pilot can be applied to hundreds if not thousands of buildings, allowing for the aggregation of demand that can negotiate a net present value positive project cost with suppliers. This approach has been successfully demonstrated in the Netherlands where retrofit package costs have declined some 50%.

TIMELINE

There will be a formal request for proposals (RFP) for candidate pilot buildings during the summer and fall of 2018. After the RFP process, the REALIZE project team will conduct additional interviews and site visits to gather data. Final pilot selection will occur at the end of 2018 with formal owner acceptance of the retrofit design occurring no later than June 2019. Development of construction documents will occur in the second half of 2019, construction will occur in the first 6 months of 2020, followed by a one year monitoring period.

CONTACT US

Interested building owners or organizations can contact realize@rmi.org for more information.