



## Building America Case Study Efficient Solutions for New and Existing Homes

# Bay Ridge Gardens—Mixed Humid Affordable Multifamily Housing Deep Energy Retrofit

Annapolis, Maryland

### PROJECT INFORMATION

**Construction:** Existing

**Type:** Apartment building:  
Bay Ridge Gardens  
Annapolis, MD  
[www.bayridgegardens.com](http://www.bayridgegardens.com)

**Size:** 12 apartment units, 713 ft<sup>2</sup> and  
909 ft<sup>2</sup> each

**Year of construction:** 1970s

**Date completed:** 2013

**Climate Zone:** Mixed-humid

### PERFORMANCE DATA

Pre-retrofit annual energy use  
(normalized): 28.4 kilowatt-hour per  
square foot (kWh/ft<sup>2</sup>)

Post-retrofit annual energy use  
(normalized): 16.3 kWh/ft<sup>2</sup>

Percent energy savings: 43%

Incremental cost of energy efficiency  
measures: \$85,996

Monetized annual energy savings:  
\$6,900

Savings to Investment Ratio: 1.1

Significant energy savings—43% in this case—are possible in older multifamily buildings through standard, non-invasive retrofit measures, representing an enormous opportunity for savings nationwide. The Bay Ridge Gardens Apartments in Annapolis, Maryland, comprise multiple three-story buildings typically containing twelve apartments each. The apartments are between 700 ft<sup>2</sup> and 925 ft<sup>2</sup> and include two or three bedrooms. In total, the complex consists of 198 units. Although all of the units underwent a base scope energy retrofit, the U.S. Department of Energy Building America Partnership for Improved Residential Construction (BA-PIRC) team concentrated on a deep energy retrofit (DER) of one building (twelve units).

The building as well as the nature of the DER project itself is typical of many throughout the United States. It is a 1970s-era three-story walk-up, concrete masonry unit structure with a partial brick façade and sheetrock interior. As is also typical, the DER project was done with the tenants in place. Working in occupied units precludes significantly invasive retrofit measures that would render the apartments unsafe or uninhabitable during construction. The team also investigated “risk factors” and regulatory issues, and their roles in determining what energy efficiency measures may not be viable because they would jeopardize building performance or occupant health, or trigger cascading regulatory requirements.

Beginning with a savings target of 30%, the BA-PIRC team identified a set of minimally invasive retrofit measures that, once implemented, achieved 43% energy savings for the twelve-unit DER apartment building. The savings were based on monitoring and post-retrofit utility bill data.



Building exterior

## Key Energy Efficiency Measures

### HVAC

- Hybrid heat pump, 8.50 heating seasonal performance factor, 92.5 annual fuel utilization efficiency 2-stage furnace backup; 15 seasonal energy efficiency ratio, 1.5 ton air conditioning; resident pays for electricity and has incentive for reducing energy use
- Aerosolized duct sealing for up to 63% reduction in total leakage
- Air sealing and insulating duct bulkhead, which was exposed to the adjacent attic space above
- Energy recovery ventilator for balanced, continuous ventilation and minimal ventilation-induced airflow between apartments

### ENVELOPE:

- Air sealing for 63% improvement (average post-retrofit air leakage was 6.4 ACH50)
- Ceiling insulation from R-19 to R-49
- Windows from old, poorly functioning (U=0.5) to new, low-e vinyl replacement windows (U=0.35)

### LIGHTING, APPLIANCES, AND WATER HEATING:

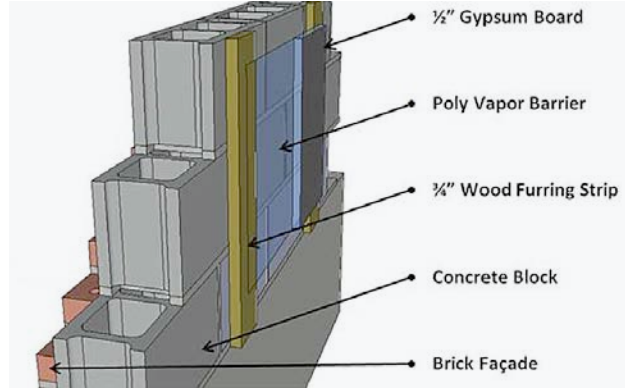
- Lighting from 100% incandescent to 100% compact fluorescent lighting
- New ENERGY STAR® refrigerator
- Water heater, replace central 100 gallon gas water heater (0.54 energy factor) with 100-gallon, 95% thermal efficiency
- Solar thermal rooftop system; flat panel collector
- Energy dashboard for homeowner education regarding energy use

For more information, see the Building America report, *Bay Ridge Gardens—Mixed Humid Affordable Multifamily Housing Deep Energy Retrofit* at [www.buildingamerica.gov](http://www.buildingamerica.gov)

Image credit: All images were created by the BA-PIRC team.

## Lessons Learned

- Approximately 43% energy savings can be achieved in a 1970s multifamily building through standard, non-invasive retrofit measures, representing enormous opportunity for savings nationwide due to the number of buildings of similar character.
- Measure selection may depend on factors other than installation cost and energy savings. These include occupant health and safety, unintended building performance consequences, regulatory requirements, and age of component or equipment.
- Contractors may have limited experience and/or motivation to implement energy retrofit measures carefully and thoroughly. One solution may be a performance-based approach for measures such as air sealing in addition to a detailed specification.



Exterior wall assembly



Application of membrane and spray foam to seal ductwork and air leakage pathway

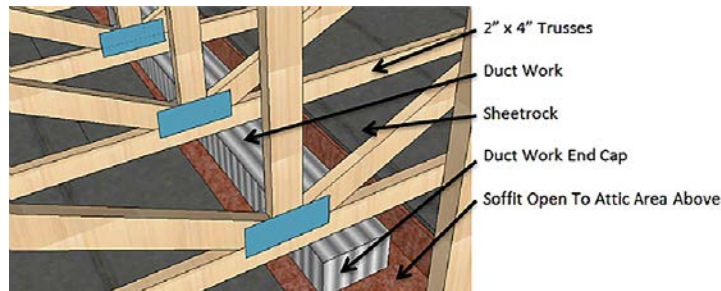


Diagram of bulkhead and duct trunk line open to attic

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