

Practitioner's Guide

Oak Ridge National Laboratory National Weatherization Assistance Program Impact Evaluation- Energy Impacts for Large Multifamily Buildings

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This report presents findings from an analysis of the energy savings, cost savings, and cost-effectiveness for large multifamily buildings (buildings with 5 or more housing units) treated by U.S. Department of Energy's (DOE) Weatherization Assistance Program (WAP) during Program Years 2007, 2008, and 2009.

The guide that follows is not an executive summary. Each volume of the Weatherization evaluation by ORNL has its own excellent summary. It is meant to be a tool that guides Weatherization Assistance Program practitioners seeking to locate and apply the results of sophisticated outcome evaluations included within this evaluation report volume. It highlights findings that can be important for those who design and deliver WAP services similar to those found in this volume of the retrospective evaluation of the 2008 Program and offers page references that help readers locate specific topics, statistics, and tables.

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ORNL Report National Weatherization Assistance Program Impact Evaluation- Energy Impacts for Large Multifamily Buildings

How does WAP function in large multifamily buildings?

18% of the total units treated by WAP during the PY2007, 2008, and 2009 were categorized as units in large multifamily buildings. The report revealed building characteristics and program measures that are typically used. Additionally, the report estimated energy savings and cost-effectiveness of the measures.

What can you find in the report?

- Executive summary, introduction, and methodology (xiii-10)
- Building characteristics (pg. 11-17)
- Energy diagnostics (pg. 17-21)
- Installed program measures (pg. 21-28)
- Energy usage impacts (pg. 29-33)
- Cost savings, measure costs, and cost-effectiveness (pg. 35-38)
- Special study of New York City large multi-family buildings (pg. 29-38)

What are the key findings?

The report includes a special study of large multifamily buildings in New York City. A special study was required because large multifamily buildings in New York City accounted for 33% of all large multifamily buildings weatherized by the program, but commonly have central heating systems and common area electric usage whereas other parts of the country have unit-level systems. The New York City weatherization agencies developed special procedures for delivering weatherization services to these buildings.

Energy Usage Impacts

- The majority of buildings received both building-level measures (e.g., heating and water heating systems, roof insulation, and windows) and unit-level measures (e.g., refrigerators, CFLs, and sealing around air conditioners).
- The gross gas savings are 82 therms per year per unit, which is 12.5% of pre-program gas usage. This is compared to the gross fuel oil savings, which are estimated to be 234 therms per year per unit, which is 24.0% of pre-program fuel oil usage.
- The higher level of savings for fuel oil buildings compared to natural gas can be attributed to higher pre-weatherization usage of oil per unit and a higher rate of heating equipment replacement. Over two-thirds of the buildings heated with fuel oil had their boilers replaced, compared to only one-third of gas-heated buildings that had their boilers replaced.

- The total electric savings is 988 kWh per year per unit (16.3%). This percentage includes savings from unit and common area improvements. This large number is likely due to WAP replacing refrigerators in about two-thirds of the units and doing lighting retrofits in about half of the units.



Additional data:

Table 4.4 Gross Gas & Oil Savings- NYC

Table 4.5 Gross Electric Savings- NYC

Table 4.6 Projected Fuel & Electric Savings per Unit, by Heating Fuel- NYC

Cost Savings, Measure Costs, & Cost-Effectiveness

The analysis in the report is restricted to a comparison of the energy benefits to the service delivery costs for energy measures and incidental home repairs. As is typical for savings to investment ratio (SIR) calculations, health and safety expenditures are not calculated which prevents non-energy benefits from being included in the analysis.

- The SIR for the population of large multifamily buildings in New York City is 2.99 when only WAP program expenditures are included in the program costs.
 - The SIR for fuel oil (4.64) is more than three times the SIR for natural gas (1.27).
- The SIR for the population of large multifamily buildings in New York City is 1.94 when all sources of funding are included in the program costs. This includes the New York City required owner contribution and other leveraged monies.
 - The SIR for fuel oil (3.10) is significantly higher than the SIR for natural gas (.80).



Additional data:

Table 5.1 Spending on Large Multifamily Buildings by Funding Source & Measure- NYC

Table 5.2 Spending on Large Multifamily Buildings by Funding Source & Energy Efficiency Measure- NYC

Table 5.3a Energy Cost Savings, Efficiency Measure Costs, and Cost-Effectiveness of Measures Funded by WAP- NYC

Table 5.3b Energy Cost Savings, Efficiency Measure Costs, and Cost-Effectiveness Measures Funded by All Sources- NYC

Table 5.3c Energy Cost Savings, Efficiency Measure Costs, and Cost-Effectiveness Measures Funded by All Sources

(Exclude non-WAP Windows and Doors)- NYC

Energy Savings, Cost Savings, and Cost Effectiveness of Non-NYC Large Multifamily Buildings

The report addresses energy usage impacts for a sample of large multifamily buildings not in New York City. However, while this data is interesting to examine, it is not statistically significant. The report notes that the “final analysis sample was relatively small and does not appear to be representative of the overall population of large multifamily buildings” (pg. xvi). The report includes the energy savings information for the buildings because it reveals examples of potential energy savings experienced in some large multifamily buildings, but cautions that “these findings cannot be projected to the overall population of large multifamily buildings treated by the WAP program in PY 2008” (xvi). Cost savings, measure costs, and cost-effectiveness were not able to be calculated for large multifamily buildings outside of New York City.



Additional data:

Table 4.1 Gross & Net Gas Savings Per Unit for Gas Main Heat- Non-NYC

Table 4.2 Gross & Net Electric Savings Per Unit for Natural Gas Main Heat- Non-NYC

Table 4.3 Gross Electric Savings Per Unit for Electric Main Heat- Non-NYC

Another useful resource to supplement the energy and cost savings is an ORNL report entitled [Weatherization Works- Summary of Findings from the Retrospective Evaluation of the U.S. Department of Energy's Weatherization Assistance Program.](#) It includes a summary of energy impacts for all housing types as well as information on cost-effectiveness and non-energy impacts.

How do the program characteristics vary by type of building and climate zone?

Large multifamily buildings vary in terms of configuration, heating and water heating systems, and opportunities. The report accounts for these differences in the diagnostic tests, audit tools, and installed measures used by including charts that break the data down by climate zone and size of the building based on number of units.

Energy Diagnostic

- 56% of large multifamily buildings were assessed using an audit tool while 44% were treated using a priority list; This is compared to single family homes where 56% used a priority list and 21% used Weatherization Assistant.
- Weatherization Assistant was used most often in the Very Cold Zone.
- EA-QUIP or Treat were used most often in the Cold Climate Zone.
- In the Hot/Dry Zone, all buildings were treated using a priority list.
- 78% of subgrantees for 25+ housing units used EA-QUIP or TREAT audit.
- For units with 5-24 units, priority lists were used the most.



Additional data:

Table 3.12a Diagnostics by Climate Zone

Table 3.12b Diagnostics by Number of Units

Testing

There are substantial potential gains from improving inefficient heating and water systems in large multifamily buildings because the heating and water heating equipment handle such large volumes of space and/or water.

- Due to the difficulty of pressure testing in larger multifamily buildings, only 18% of buildings conducted pressure testing compared to 87% of single family homes.
- Duct testing, flue gas analysis of furnaces, water heater testing, and refrigerator usage metering were all done at a higher rate than in single family homes.



Additional data:

Table 3.13a Air Leakage and Insulations Diagnostics by Climate Zone

Table 3.13b Air Leakage and Insulations Diagnostics by Number of Units

Table 3.14a Equipment Diagnostics by Climate Zone

Table 3.14b Equipment Diagnostics by Number of Units

Installed Measures

Air Sealing and Shell Measures

- Many large multifamily buildings received air sealing and attic insulation. Very few received wall insulation or other insulation. Installation rates of insulation varied considerably by climate zone.

- In very cold climate units, duct sealing in buildings with ducts occurred 77% of the time as opposed to the national average of 42% for all climates.



Additional data:

Table 3.15a Air Sealing and Shell Measures by Climate Zone

Table 3.15b Air Sealing and Shell Measures by Number of Units

Heating and Water Heating Equipment Measures

- Heating system measures and duct sealing occurred at a higher rate nationally than water heating equipment measures. Over half of the buildings had a heating system measure completed.
- Showerhead replacement and faucet aerators were common measures and were used more than in single family homes.
- Furnaces, water heaters, and refrigerators were replaced in large multifamily buildings at a much higher rate than for single family homes.



Additional data:

Table 3.16a Heating and Water Heating Equipment Measures by Climate Zone

Table 3.16b Heating and Water Heating Equipment Measures by Number of Units

Door and Window Measures

- 36% of units had new windows installed compared to just 11% in single family homes.
- Door measures were less common in large multifamily units (22%) than in single family homes (40%).



Additional data:

Table 3.17a Door and Window Measures by Climate Zone

Table 3.17b Door and Window Measures by Number of Units

Electric Base Load Equipment Measures

- 81% of units received some form of energy efficient lighting, which was influenced very little by the climate location of the unit.
- 57% of units in very cold climates and 48% of units in cold climates received new refrigerators, compared to only 3% of units in the hot/dry climate. Nationally, only 12% of single family homes had a refrigerator replaced.



Additional data:

Table 3.18a Electric Base Load Equipment Measures by Climate Zone

Table 3.18b Electric Base Load Equipment Measures by Number of Units

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