

# Cost Savings from Energy Retrofits in Multifamily Buildings

*Case study finds energy retrofits save Florida multifamily building tenants from \$220 to \$500 per unit on average annual utility bills.*

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Large apartment buildings in the United States could be significantly more energy efficient, saving low-income families money and helping to keep existing rental stock affordable. According to experts, the multifamily housing stock could feasibly be nearly 30 percent more energy efficient by 2020.<sup>1</sup> Some have estimated that retrofitting the entire multifamily housing stock could save \$8 billion a year in energy costs and cut electricity consumption by about 15 percent (51,000 GWh).<sup>2</sup> That's the equivalent of the energy use by 4.7 million U.S. households annually.

For low-income families, cost savings are critical. Low-income renters spend up to eight times more of their annual incomes on energy costs than do high-income households (17 percent vs. 2 percent).<sup>3</sup> And energy costs have been rising three times faster than rents.<sup>4</sup>

Energy retrofits can also help to retain affordable housing. According to Chicago's Preservation Compact, utility bills account for a large portion of the operating costs for a multifamily building, making energy costs one of the primary challenges to maintaining affordable rental housing.<sup>5</sup>

Multifamily buildings are a prime target for retrofits because they are typically older buildings and have less efficient cooling and heating systems, older windows, and other energy-consuming features.<sup>6</sup> Yet relatively few such buildings are updated, often because owners—and the

### KEY FINDINGS

- Tenants in hot, humid climates can expect energy efficiency upgrades to save 18-29 percent in energy use annually.
- The biggest energy consumers saw the biggest annual savings.
- Energy efficiency upgrades in multifamily buildings in Orlando saved:
  - > 2094 kWh (22 percent) per apartment, per year, on average
  - > \$272 annually per tenant, on average
  - > \$68,913 total on annual electric bills across 232 apartments with upgrades.

banks that lend to them for upgrades—lack hard evidence on the cost-effectiveness of investments.<sup>7</sup> Most existing studies lean toward hypotheticals instead of measuring actual energy and cost savings from large-scale retrofits. There are also far fewer expert multifamily energy auditors than their single-family counterparts.<sup>8</sup> The “wrong pocket” or “split incentive” problem also dissuades many when owners pay the costs for upgrades while the tenants reap the savings. Finally, few energy companies offer incentives to multifamily buildings to improve efficiency.<sup>9</sup> The Orlando Utilities Commission, for example, needs assurances of expected savings, payback periods, and additional, locally relevant information before developing an incentive rebate program for multifamily properties.

The current study addresses this lack of hard evidence by measuring energy costs before and after unit-level energy efficiency retrofits in four large apartment buildings in Orlando, Florida.

## Study Design

The study compared energy use in 81 units before and after energy efficiency upgrades across four Orlando multifamily apartment complexes. The upgrades occurred between January and April 2012. A control group of 142 units in the same four complexes received no upgrades.

Upgrades included installing high-efficiency HVAC systems, ENERGY STAR® certified refrigerators, compact fluorescent lighting, and water saving showerheads and aerators. Eighty-eight percent of the units had solar window film installed. About one-half added new attic insulation and one-third had new duct work installed. The study was restricted to buildings with ten or more units, and all buildings were at least two stories.

Only units that installed new high-efficiency HVAC system along with other retrofit steps were included in the study because HVAC is the dominant residential energy end use. To avoid energy use differences across the apartments, researchers included only apartments consistently occupied by a single tenant. They also removed very high or very low energy users to avoid skewing results. The average cost of retrofits, including equipment and installation, was \$4,359 per unit with an overall expected life of 12 years for the typical package of retrofits.

## Energy Savings Are Sizable

Before the retrofits in 2011, units in both the control and treatment units were using about 9,500-9,900 kWh, slightly higher than average energy use of apartments in the Orlando Utilities' Commission's service area. The average pre-retrofit utility bill was \$1,235 per year.

After the retrofit, tenants saved on average 22 percent in energy use, or about \$272 annually on electric bills. For all four apartment complexes, energy use was reduced by 18-29 percent annually, and aggregate utility bill savings to tenants ranged from \$10,000 to \$27,500 per year. (See Table 1 for a summary of results.)

Specifically:

- Total first-year electricity savings across four apartment complexes: 530.1 MWh.
- Per unit average annual savings ranged from 1,700 to 3,811 kWh (18-29 percent) across the four complexes.
- Per unit average monthly savings ranged from 48 kWh (9 percent) in December to 340 kWh (31 percent) in August (see Figure 1).
- Tenants saved an average of \$272 per year on their electric bills, with a total savings of \$68,913 across all four complexes.
- Units with the highest electric bills before the retrofits saw the biggest annual savings, at \$400-\$500 per unit.

## Policy Recommendations

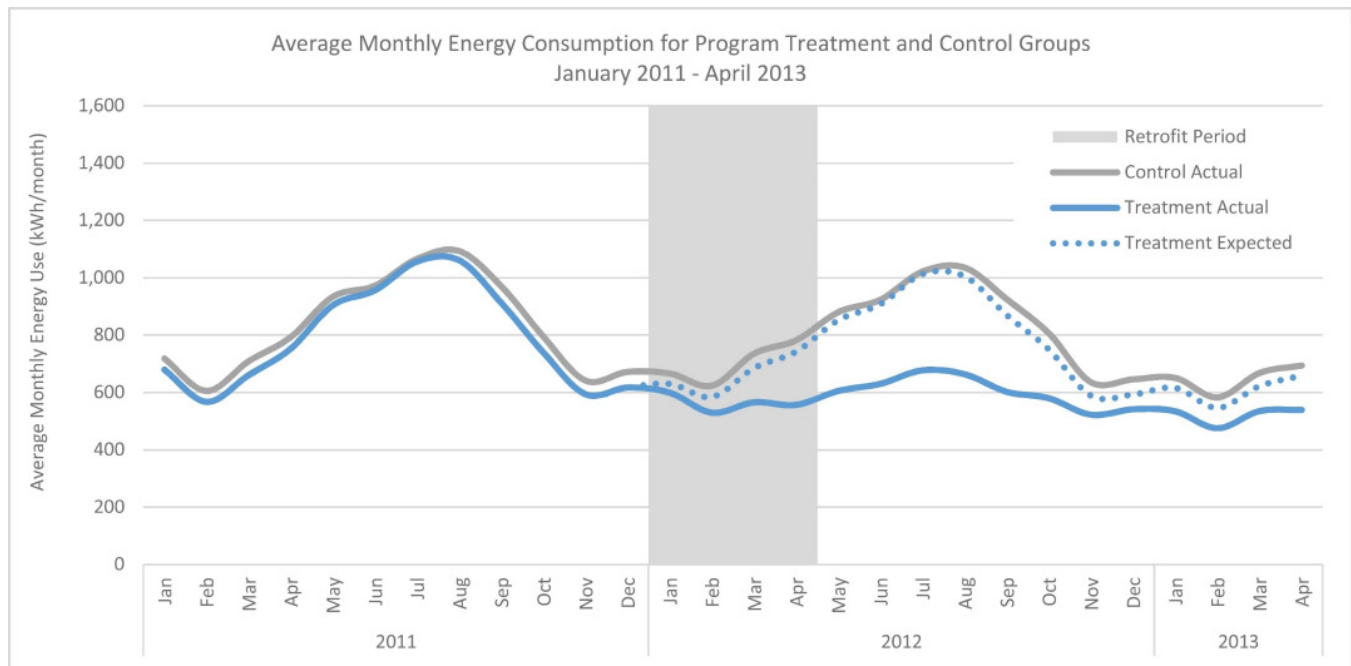
**Build the case:** This case study is among the first in the Southeast U.S. to measure and document energy use in multifamily buildings before and after significant unit-level

**Table 1. Summary Results of Retrofit Impact Analysis**

Retrofit Impact Metric	All Complexes	Complex 1	Complex 2	Complex 3	Complex 4
Total Apartment Units Retrofitted	232	108	60	44	20
Average Retrofit Cost (\$/unit)	\$4,359	\$4,681	\$3,864	\$4,075	\$4,735
Total Retrofit Cost(\$)	\$1,011,388	\$505,552	\$231,839	\$179,322	\$94,708
Overall Expected Life of ECM Packages	12 Years	12 Years	12 Years	12 Years	12 Years
Average Annual Baseline (Pre-Retrofit) Energy Consumption of Retrofit Apartments	9,499 kWh/unit	7,757 kWh/unit	10,327 kWh/unit	12,452 kWh/unit	13,072 kWh/unit
Average Annual Baseline (Pre-Retrofit) Energy Bill	\$1,235/unit	\$1008/unit	\$1,343/unit	\$1,619/unit	\$1,699/unit
Average First-Year Energy Savings (kWh)	2,094 kWh/unit	1,962 kWh/unit	1,700 kWh/unit	3,182 kWh/unit	3,811 kWh/ unit
Average First-Year Energy Savings(%)	21.90%	23.40%	18.30%	23.5%	28.80%
Total First-Year Energy Savings	530.1 MWh	211.9 MWh	102.0 MWh	140.0 MWh	6.2 MWh
Average First-Year Bill Savings	\$272/unit	\$255/unit	\$221/unit	\$414/unit	\$495/unit
Total First-Year Bill Savings	\$68,913	\$27,546	\$13,259	\$18,199	\$9,909

**Figure 1: Average Monthly Energy Consumption of All Units (one year pre- and one year post-retrofit)**

The control group had no energy retrofits. The figure also shows the difference between the treatment group's actual post-retrofit energy consumption and its expected consumption, which provides an estimate of energy savings.



efficiency retrofits. Results show that in hot, humid regions with similar housing stock and energy service equipment, multifamily building owners can expect efficiency retrofits to save 18-29 percent in energy use annually or about 22 percent on average. Tenants' annual electricity bills were cut by between \$220 and \$500 per unit following efficiency retrofits. Upgrading half of all units in each property, aggregate tenant utility bill savings ranged from approximately \$10,000 in a 40-unit apartment complex with five buildings to \$27,000 in a 216-unit apartment complex with eight buildings. With more hard evidence like this, more multifamily building owners may decide to foot the upfront costs of investments in energy efficiency.

**Train auditors, collect data:** One of the hurdles to documenting cost savings in multifamily buildings is the lack of trained auditors. There is currently no single universally accepted multifamily energy audit standard, and such audits, according to American Council for an Energy Efficient Economy, can be as much art as science.<sup>10</sup> There are also far fewer knowledgeable multifamily energy auditors than their single-family counterparts.<sup>11</sup> As part of the American Reinvestment and Recovery Act (ARRA), the Department of Energy, in conjunction with the WAP program, created an energy audit tool for multifamily buildings.<sup>12</sup> The Multifamily Tool for Energy Audits has been designed to address many of the unique features of an energy audit in a large buildings, such as multiple heating or cooling systems.

**Streamline resources:** In addition to better data, owners might undertake retrofits if resources and information were more streamlined. Programs and resources are now typically scattered across departments and organizations, each with different requirements.<sup>13</sup> Some locales have created one-stop shops with a single point of contact for building owners, which can help ensure coordination across electricity, gas, and water programs.<sup>14</sup> In Massachusetts, for example, the Low-Income Energy Affordability Network coordinates the retrofit program across multiple utilities and the affordable housing community. Utility program administrators meet regularly to align program incentives and requirements. In Chicago, a community development financial organization and energy experts bundled energy assessments for landlords with the financing to act on the findings.<sup>15</sup> The program has helped cut energy costs and preserve affordable housing in the process.<sup>16</sup>

**Continue to fund WAP:** The Weatherization Assistance Program helps home owners and multifamily building owners weatherize their buildings.<sup>17</sup> Operated by the Department of Energy, it is the largest whole-house energy upgrade programs in the country. After steady funding increases over the years, WAP was eliminated in the 2019 White House budget proposal, citing lack of effectiveness as the reason.<sup>18</sup> However, funding (\$251 million) was eventually restored during the House and Senate appropriations process.<sup>19</sup> As of 2011, WAP had helped weatherize more than 82,000 multifamily units since its inception, according to HUD.<sup>20</sup> Energy programs such as these, however, remain vulnerable.

## Endnotes

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- 7 The savings estimates commonly used to gauge cost-effectiveness are modeled rather than measured. See HUD, “Quantifying Energy Efficiency in Multifamily Rental Housing”; Energy Programs Consortium Energy Programs Consortium, “Multifamily Energy Efficiency: Reported Barriers and Emerging Practices” (Washington, DC: American Council for Energy Efficient Economy, 2013), p. 54, [https://aceee.org/files/pdf/resource/epc\\_%20multifamily\\_housing\\_13.pdf](https://aceee.org/files/pdf/resource/epc_%20multifamily_housing_13.pdf); Hannah Choi Granade et al., “Unlocking Energy Efficiency in the US Economy” (New York: McKinsey & Co., 2009), [https://www.mckinsey.com/-/media/mckinsey/dotcom/client\\_service/epng/pdfs/unlocking%20energy%20efficiency/us\\_energy\\_efficiency\\_exc\\_summary.ashx](https://www.mckinsey.com/-/media/mckinsey/dotcom/client_service/epng/pdfs/unlocking%20energy%20efficiency/us_energy_efficiency_exc_summary.ashx).
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- 9 K. Johnson and E. Mackres, “Scaling Up Multifamily Energy Efficiency Programs: A Metropolitan Area Assessment.” Research no. E135. (Washington, DC: American Council for an Energy-Efficient Economy, 2013), p. 105, <http://www.aceee.org/sites/default/files/publications/researchreports/e135.pdf>; National Housing Trust, “Partnering for Success: An Action Guide for Advancing Utility Energy Efficiency Funding for Multifamily Rental Housing” (Washington, DC: National Housing Trust, 2013), p. 44, <http://energyefficiencyforall.org/resources/partnering-success-action-guide-advancing-utility-energy-efficiency-funding-multifamily>.
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## ABOUT THE HOW HOUSING MATTERS TO FAMILIES AND COMMUNITIES RESEARCH INITIATIVE


This brief summarizes research funded by the John D. and Catherine T. MacArthur Foundation as part of its How Housing Matters to Families and Communities Research Initiative. The initiative seeks to explore whether, and if so how, having a decent, stable, affordable home leads to strong families and vibrant communities. By illuminating the ways in which housing matters and highlighting innovative practices in the field, the Foundation hopes to encourage collaboration among leaders and policymakers in housing, education, health, and economic development to help families lead healthy, successful lives. The views expressed herein are not necessarily those of the MacArthur Foundation.

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