Preserving Affordable Multifamily Housing through Energy Efficiency

Non-Energy Benefits of Energy Efficiency Building Improvements

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Contents

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Executive Summary

Multifamily housing retrofits provide a rich opportunity to reap energy efficiency (EE) savings. A 2009 report by McKinsey and Company estimated that there is an untapped $16 billion in energy cost savings in the sector. Despite this potential, the multifamily market has not captured investment needed to realize the energy savings, and the affordable housing sector faces additional investment barriers. This paper will make the case for the implementation of energy retrofits in affordable multifamily buildings by presenting the non-energy benefits (NEBs) associated with such upgrades. Specifically, we discuss:

Societal Non-Energy Benefits
- Environmental and air quality
- Economic

Utility Non-Energy Benefits
- Decreased costs

Owner Non-Energy Benefits
- Operations and maintenance savings
- Decreased vacancy
- Decreased energy bills

Tenant Non-Energy Benefits
- Health
- Comfort
- Financial stability

Societal, owner, and tenant benefits are also presented in a case study conducted during summer 2012 in Chicago, Illinois. The case study evaluates the NEBs of three affordable multifamily buildings, totaling 70 housing units. Highlights of the findings include that the buildings saw a 17 percent reduction in maintenance costs one year post retrofit and two-thirds of tenants felt that their units stayed cooler in the summer and warmer in the winter. Furthermore, a 19 percent reduction in gas usage post-retrofit represents $12,624 in savings, which is the equivalent to a 27 percent decrease in rental vacancy loss as a percent of potential receipts. The 70 units are individually heated by forced air furnaces. This case study confirms that significant NEBs to owners are possible even in the presence of a split incentive situation where the majority of energy cost savings goes to the tenants.

Introduction

The preservation of affordable rental housing has become an increasingly important topic in the wake of the economic downturn. Renters make up a substantial 44 percent of households in Cook County (Preservation Compact, 2012). From 2007 to2011, the City of Chicago saw a decrease of 11.6 percent in owner-occupied households and an increase of 10.3 percent in rental-occupied households. Similarly, suburban Cook County saw an increase of 11 percent in rental-occupied households.

This is not the result of families leaving homes that they own for luxury rental condos. Chicago families living in 70 percent of the increased rental-occupied households make less than 50 percent of the area median income for Chicago (IHS, 2013). And in Cook County, 80 percent of all renters are rent-burdened, spending more than 30 percent of their income on housing costs. This demonstrates an intense need for truly affordable rental housing.

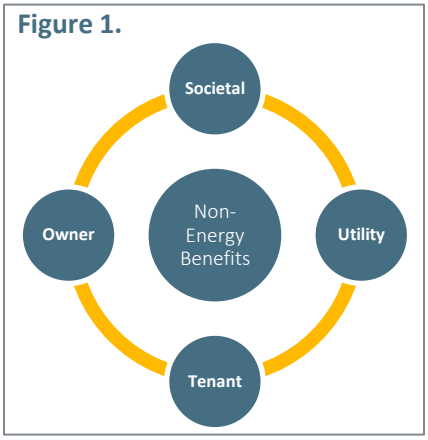
Improving the energy efficiency of the existing housing stock is an essential strategy to preserve affordable rental housing. While the majority of this paper will focus on the overall effect of energy efficiency on preserving affordable housing, it is particularly important to focus on existing buildings. One reason is that rehabbing current buildings is substantially less expensive than new construction. One study (Brennan et al, 2013) revealed that rehabbing affordable multifamily housing is $41,000 to $70,000 per unit less expensive than new construction.

Improving energy efficiency is an effective tool for preserving affordable housing, in part, because energy efficiency can produce significant non-energy benefits (NEBs). This paper explores NEBs in affordable housing and presents a case study that demonstrates practical metrics that others can use to track the NEBs of energy efficiency retrofits.

What are Non-Energy Benefits?

Non-energy benefits, sometimes referred to as non-energy impacts, are any positive consequence of energy efficiency improvements outside of saving energy. Discussions of NEBs have been present in consumer behavior and program evaluation spheres since the mid-1990s (Mills & Rosenfeld, 1995; Brown et al, 1993). The benefits are expansive, but can generally be divided into four different categories: societal, utility, tenant, and owner. Other studies (Skumatz et al, 2000; Schweitzer and Tonn, 2003) have chosen to combine owner and tenant NEBs into one "ratepayer" category or a "participant" category (Lazar and Colburn, 2013). However, due to the complexity of multifamily

Figure 1.



buildings, we have decided to keep tenant and owner benefits separate. In addition, we categorize energy cost savings as a non-energy benefit since saving energy does not necessarily lead to cost savings in all circumstances. Each of these categories will be discussed at length in the following section.

Societal NEBs

In this paper, societal benefits include both environmental and economic benefits that affect a larger community. This definition is used by Schweitzer and Tonn (2003) and Lazar and Colburn (2013).

The environmental benefits of energy efficiency include the amount of carbon dioxide equivalent (CO_2Eq) emissions avoided and a decreased use of water. The amount of CO_2Eq saved is reported in metric tons; it is the environmental NEB traditionally reported, partly because CO_2Eq is relatively simple to calculate. Reduction of CO_2Eq emissions is important in reducing the impacts of climate change, but there are other environmental benefits to the community as well. Other detrimental pollutants include fine particle emissions ($PM_{2.5}$). The San Francisco Bay Area's 2010 Clean Air Plan calculated that 80 percent of the health benefits from energy efficiency measures were the result of $PM_{2.5}$ reductions (SFBA, 2010).

The economic benefits of energy efficiency (EE) are broken down further into three types of economic impacts. *Direct effect* relates to the initial spending and purchases made by the first entity, which results in an economic benefit to a second business. *Indirect effect* occurs when the second business purchases services and goods in order to produce the product that the first business wants. *Induced effect* is the spending that employees make from their income (DBLC, 2010). The job creation aspect is especially important when you consider that the majority of power generation jobs are not local, and that the direct and indirect jobs created by energy efficiency tend to be local, often in construction or trade services sectors. The Deutsche Bank/Living Cities (2010) report cites two studies specifically. The first is the 2009 U.S. Green Building Council Jobs Study authored by Booz Allen Hamilton (BAH). They deduce that for every $1 million dollars invested in residential EE retrofits, $477,849 in direct gross domestic product (GDP) and $785,157 in indirect and induced GDP is created (BAH, 2009). BAH also states that 11.6 jobs are created per $1 million dollars invested.

Utility NEBs

NEBs experienced by utilities tend to reduce their own labor and costs. Skumatz et al (2000) describes them at length, citing reduction in size of bad debt written off, reduction in emergency gas shutoff calls, reduced collection costs, and avoidance of rate subsidies as some of the key utility NEBs resulting from energy efficiency. These benefits have the potential to be multiplied in affordable multifamily housing as investment in a single building will yield savings for multiple accounts. There is also the potential benefit of reduced power outages if demand is significantly reduced (Lazar and Colburn, 2013).

Tenant NEBs

Tenant comfort is most often discussed as it relates to commercial energy efficiency and increased worker productivity (Pearson and Skumatz, 2002). But comfort is just as important for residents of affordable multifamily housing who may already be experiencing heightened stress levels due to economic pressure. Increasing indoor comfort is also a key step toward preventing household fires started by candles or stoves that are being used as a heating mechanism.

One key benefit of energy efficiency to tenants is lower bills. This is especially relevant to affordable housing tenants who are often struggling to stay afloat financially. Research from Children's Health Watch (2010) showed that 25 percent of families with children age three or younger were energy insecure. Energy insecurity occurs when a household has experienced at least one of the following in the previous year:

- A threatened utility shutoff or refusal to deliver heating fuel,
- An actual utility shutoff or refused delivery of heating fuel,
- An unheated or uncooled day because of inability to pay utility bills, or
- Use of a cooking stove as a source of heat.

Energy insecurity is especially dangerous as it is often coupled with food insecurity and families are often forced to choose to "heat or eat." Decreasing the burden of energy costs has been shown to have positive effects on young children. Children in homes that receive Low Income Housing Energy Assistance Program (LIHEAP) funding were "less likely to be at risk for growth problems, had healthier weights for their age, and were less likely to be hospitalized when seeking care for acute medical problems at an emergency department." (Children's Health Watch, 2010)

Owner NEBs

While lower energy bills may be the most tangible and easy to measure benefit of energy efficiency to owners, there are other non-energy benefits such as decreased vacancy rates and operations and maintenance (O&M) savings.

One of the difficulties associated with encouraging energy efficiency upgrades in multifamily buildings is the "split-incentive" (Bird and Hernandez, 2012). Some owners do not feel they will reap the benefits from the investment if the tenants receive the utility bill savings. This makes it especially important to effectively measure and communicate owner NEBs. Michael Burton, asset manager for the Bickerdike Redevelopment Corporation, which owns the buildings featured in the case study, discussed the split incentive in the following terms.

"As a community-based, not-for-profit organization, we have a double bottom line of creating financially sustainable projects and serving low-income families who have limited means to pay rent. Energy retrofits allow us to fulfill both of these goals. When tenants have savings, they're

more stable in their homes and are able to reallocate those savings to other household necessities. It also positively affects our operations because rent is more likely to be received on time, and it also reduces our expenses as we no longer have to service and maintain old, outdated furnace systems," said Burton.

Lower maintenance costs can make up a significant portion of owner NEBs. In 2012, "the estimated O&M savings from energy efficiency measures installed [in Vermont] equaled two-thirds of the total utility systems costs, and one-third of total costs (Lazar and Colburn, 2013)." Regardless of the mechanism, increased cash flow from savings or lower vacancy gives the owner more money to invest in the building or put in reserves.

Case Study: Boulevard Apartments, Bickerdike Redevelopment Corporation

Bickerdike Redevelopment Corporation (Bickerdike) is a member-based, nonprofit community development corporation. The organization works for the redevelopment of communities on the northwest side of Chicago by and for low and moderate-income people. Bickerdike owns over 1,100 units of rehabbed and new construction multifamily property and, as of the end of 2013, will have retrofitted over 290 units with energy saving measures such as air sealing, insulation, and furnace replacement.

Bickerdike retrofitted these units through the Energy Savers program, run by Elevate Energy and Community Investment Corporation. Initiated in January 2008 as part of The Preservation Compact, the Energy Savers program offers a variety of services that enable building owners to make efficiency improvements in affordable multifamily buildings with five or more units. Services include an energy audit, financial guidance and financing options for the recommended renovations, support in managing renovation construction, and annual savings reports.

The energy audits cover a range of possible improvements, and recommends cost effective measures specific to each building. For example, recommended measures may include replacing heating units, installing air sealing measures, altering hot water distribution systems, and adding insulation to the roof cavity. After receiving the energy audit report the building owner works with Energy Savers staff to obtain the financing and expert advice needed to make the recommended changes.

This case study focuses on three buildings, named the Boulevard Apartments. The apartments were built in 1930 and then purchased and gut rehabbed by Bickerdike in 1991. They contain a combined total of 70 units and a total square footage of 75,759 ft^2. Three units house tenants with Housing Choice Vouchers and 12 units have tenants with Housing Assistance Payment contracts.

Methodology

Building and Energy Savings Information

Building-level data was collected in survey form from the owner and from Elevate Energy's records of the construction work that had been done as part of the Energy Savers program in 2011. Energy use data was provided by the local gas and electricity utility providers. Pre- and post-retrofit, weather normalized, whole-building energy savings were calculated through analysis of measured energy use from gas and electricity meters for the owner and tenants over the calendar years 2010, 2011 and 2012. Usage records were not complete for every tenant, so where gaps were present, usage data was extrapolated based on the average usage of other units with a similar floor plan. In this study, only the gas savings is reported, as the measures installed in the buildings were gas-specific. CO_2Eq reductions from first year therm savings were calculated using emissions factors from The Climate Registry.

Owner Benefits

In order to accurately report the benefits to the owner, we conducted an in-person interview and a survey modeled off the 2012 Rental Housing Finance Survey sponsored by HUD and administered by the Census Bureau. The owner also provided information on the square footage and rent charged for each unit.

Tenant Benefits

Tenant benefits were measured through a survey mailed to each unit in English and Spanish. The survey design was influenced by various occupant comfort surveys such as the ACF Weatherization Survey, and the Elevate Energy/USGBC Occupant Comfort Survey. The energy insecurity questions were taken directly from Children's Health Watch, formerly C-SNAP. Tenants were given a $50 Target gift card for returning a completed survey.

Results

The Boulevard Apartments are composed of three Chicago buildings at 929 to 935 N. Sacramento Blvd., 1930 to 1935 N. Sacramento Blvd., and 2212 to 2214 N. Sacramento Blvd./3001 to 3003 W. Lyndale St. They were built in 1930 and purchased and gut rehabbed by Bickerdike in 1991. There are 70 units across the three buildings and the median unit size is 646 ft^2. On average, tenants have been living in their units for 5.25 years. Tenants pay for gas and electricity.

Table 1. Boulevard Apartments Indicators

Year of construction Year of gut rehab	1930 1991
Number of units	70
Median size of units	646 ft^2
Total square footage	75,759 ft^2
Average length of tenancy	5.25 years

Energy and Environmental NEBs

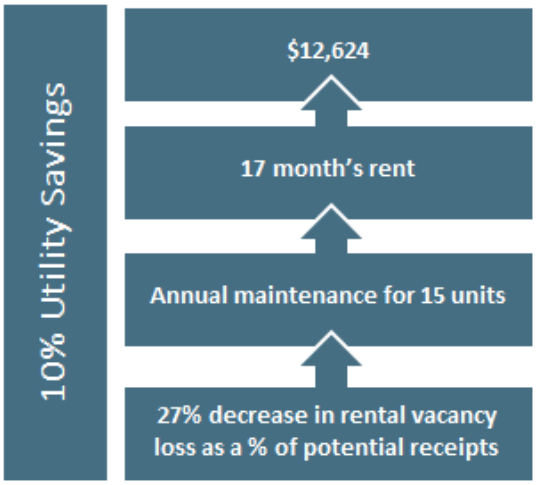
All three buildings were retrofitted through the Energy Savers multifamily program during 2011. Improvements included air sealing, roof cavity insulation, and furnace replacement. The program often focuses on gas measures in order to maximize savings. "Since the weather in Illinois and the Midwest is cooler than other areas of the United States, space heating makes up a greater portion of energy use compared to the U.S. average and air conditioning makes up only 2 percent of energy use (Energy Information Administration, 2013)." The proportion of energy use (kBtu) resulting from space heating is even greater in Chicago where the majority of housing stock was built prior to the introduction of building codes and there is often little to no insulation (Farley and Ruch, 2013).

In this paper, we only report the therms savings because the retrofit measures were primarily focused on gas savings. The breakdown of the energy savings (therms), therms per bedroom and square foot, and percent changed post-retrofit is provided below in Table 2. As the data show, the percentage of therms used did not decrease evenly across the buildings after the retrofit. This could be the result of variations in occupancy or tenant behavior. Another potential reason for the inconsistency is that the development company only replaced tenant furnaces and not common space furnaces. This could explain the lower decrease in 2212 to 2214 N. Sacramento Blvd. since there are fewer units in this building than in the other buildings. The development company is currently considering replacing common space furnaces to maximize savings. There was an anticipated increase in electricity consumption due to the installation of air conditioning units in apartments that previously did not have cooling equipment. The three buildings did, however, see an average gas savings of 19 percent from 2010 to 2012. This is the equivalent of a 10 percent reduction in overall utility expenses and 65.5 metric tons of avoided CO_2Eq.

Table 2. Pre/Post Retrofit Energy Savings (Therms)

	Units	Year	Therms	Therms/ unit	% change	Therms/ bedroom	Therms /ft^2
929-935 N Sacramento	26	2010	19,468	749		309	0.61
		2012	11,541	444	-41%	183	0.36
1930-1938 N Humboldt	30	2010	27,674	922		393	0.96
		2012	23,378	779	-16%	332	0.81
2212-2214 N Sacramento	14	2010	11,730	838		391	0.80
		2012	11,631	831	-1%	388	0.79
Average					-19%		

Figure 2.



Utility data collection and analysis is a significant challenge for the multifamily energy efficiency industry. As noted above, normalization was completed for weather variation but not for tenant occupancy changes over time. The U.S. EPA is currently working on providing an ENERGY STAR score for multifamily buildings that includes normalization for occupancy. Methodologies and data standards are evolving, and more research is needed to ensure consistent, quality energy savings information for this sector.

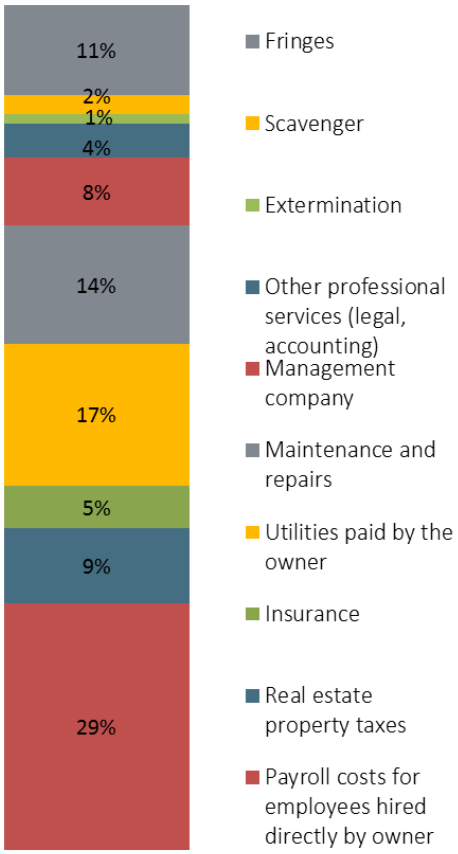
Owner NEBs

While Bickerdike is a mission-driven organization that prioritizes affordability, they also focus on the financial sustainability of their buildings. The Boulevard Apartments are considered affordable, with a 2012 median rent of $647 compared with the Cook County median of $1,000. The buildings also have significantly lower annual maintenance costs per unit of $836 compared to a national average of $1,084. Rental vacancy losses as a percentage of potential receipts are 8.2 percent compared with a national average of 11 percent. All national comparisons are from the 2012 Rental Housing Finance Survey.

As mentioned above, the post-retrofit energy savings, shared between owner and tenants, are the equivalent of 10 percent of the buildings' total utility expenses. In 2012, this would be the equivalent of $12,624, 17 months' rent for one unit, annual maintenance for 15 units, or a 27 percent decrease in rental vacancy loss as a percentage of potential receipts (Figure 2).

Chart 3 depicts the percentage of operating expenses allocated to a variety of categories in 2012. Notable expenses include 17 percent for utilities and 14 percent for maintenance and repairs. Post-retrofit, the Boulevard Apartments saw a 17 percent decrease in maintenance and repair expenses. The combination of owner and tenant paid utilities can be found in Chart 4.

Chart 3.
2012 Operating Expenses, Boulevard Apartments

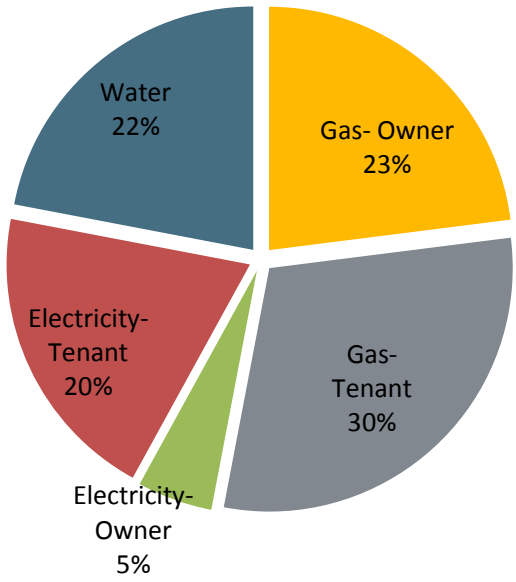


Bickerdike's asset manager, Michael Burton, is responsible for many of the functions that an owner would assume at other organizations. In our interview, we asked him what they often did with the money saved from the decrease in maintenance costs and utility savings. He explained that when these buildings were "underwritten 15 or 20 years ago, all expenses were trended at 4 percent annual increase and income at 3 percent. What we know about expenses like taxes and insurance and gas, until a couple years ago, they definitely outpace that." The buildings "were ok as far as money coming in and money coming out, but in terms of reserves- …they're now on a little better footing because of a capital infusion…and also they do a little better in terms of setting money aside for reserves for repairs and capital replacements."

Tenant NEBs

Tenant NEBs are especially important to measure in part due to the desire for fair, affordable housing, but also because stable tenants and lower vacancy rates make owning multifamily housing more desirable to owners and developers. There were 27 respondents to the survey out of a possible 63 current tenants (42 percent response rate). The vast majority of respondents lived in their unit when the retrofit was completed in 2011.

Chart 4.
2012 Utility Expenses, Boulevard Apartments



Below (Table 3) are a few key findings linked to tenant comfort and the preservation of affordable housing. The tenants were pleased with insulation of their units. The majority said that their units stayed cool inside when it was hot outside (66.7 percent) and hot when it is cold outside (80.8 percent). The latter was of great interest due to the energy use-intensive winters in Chicago. The vast majority of tenants (89 percent) said they would ask about energy efficiency if they moved to a new building, although it seems unlikely that many will move since 70 percent said they were likely or very likely to renew their lease. A third of tenants said that they felt more comfortable and less stressed paying rent and utility bills after the retrofits.

Table 3. Key Findings from the Tenant Survey

66.7% of tenants said that their unit stays cool when it's hot outside[1] and 80.8% said it stays hot when it's cold outside.[2]
89% of tenants said they would ask about energy efficiency if they move to a new building.[3]
70% of tenants said they were likely or very likely to renew their lease.[4]
About a third of tenants said that they felt more confident and less stress paying rent and utility bills after the energy efficiency work was done to their building.

Confidence Intervals (95%): 53.18 - 80.22% [1]; 69.52 - 92.08%[2]; 80.01 - 97.99%[3]; 56.83 - 83.17%[4]

In addition to these findings, about a third of tenants were 'energy insecure' as defined by the Children's Watch Network. Therefore, despite the relief that the retrofit provided, there is still a significant need for rents to stay affordable if these tenants are going to be able to afford their bills and food.

Conclusion

Energy Efficiency in multifamily buildings is a valuable component of efforts to preserve affordable housing in Chicago. NEBs are continuing to gain a prominent place in program evaluation and regulatory discussions. Currently, researchers at Oak Ridge National Lab are evaluating the NEBs of the American Recovery and Reinvestment Act funded period of the Weatherization Assistance Program (WAP). Another useful application for NEBs is a more accurate Total Resource Cost (TRC) test. The TRC, which utilities use to decide if certain energy efficiency measures will be included in utility-funded efficiency programs, is meant to consider all costs and benefits. However, it is often the case that costs are most thoroughly recorded, while harder-to-measure benefits such as health impacts are left out. This means it is even more critical to record easier-to-measure benefits, such as reductions in operation and maintenance costs, so that more energy efficiency measures are found cost-effective and thus implemented by utilities.

While this paper begins to examine the effects of NEBs on affordable housing, there is still much work to be done. For example, neither study in the Deutsche Bank paper breaks out the economic impact for multifamily buildings specifically. This represents a significant gap in the literature that should be addressed in future research.

In the future, building owners, energy efficiency program providers, and utilities should consider incorporating metrics discussed here such as operation and maintenance savings, decrease in rental vacancy loss as a percentage of potential receipts, likelihood to renew lease, and confidence in the ability to pay bills. Measuring these benefits early will only strengthen the case for improving energy efficiency in the affordable housing stock.

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