Multifamily Energy Efficiency Opportunities in the States

April 2015

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Acknowledgements

The author of this paper is Anne McKibbin. The author would like to thank Marcella Bondie-Keenan, Greg Gillette, Jason James, and Katrina Lewis for their research assistance on this project. This paper was made possible through the generous support of the John D. and Catherine T. MacArthur Foundation.

I. Executive summary

More than 20 million American households live in multifamily buildings that are, on average, less energy efficient than other types of housing or commercial buildings.[1] Making energy efficiency improvements to multifamily housing has the potential to create jobs,[2] lower operating costs for the multifamily housing industry,[3] and save families hundreds of millions of dollars per year on energy bills.[4] Realizing energy efficiency's potential in the multifamily housing sector calls for taking action on surmountable market and regulatory barriers and adjusting a history of underinvestment by utility-funded efficiency incentive programs.

Comprehensive energy efficiency upgrades provide jobs for energy assessors, engineering firms, HVAC contractors, insulation and ductwork contractors, electricians, appliance installers, and administrative and marketing staff. The most rigorous available studies indicate that investing in comprehensive energy efficiency programs can result in nine to 11.6 jobs per $1 million invested, which is more than the number of jobs created by investing in energy generation and distribution, or in the general economy.[5] Additional state-level studies have found that energy efficiency investments lead to strong increases in employment in the clean energy sector, resulting in thousands of additional jobs.

The potential for savings from energy efficiency is substantial, even in areas with long-standing efficiency policies and programs. A number of recent studies show that aggressive policies and programs can yield annual electric savings of up to 2.9 percent and natural gas savings of up to 2.4 percent.[6] Saving just 2 percent of the $21 billion in energy used annually by multifamily buildings in the U.S. would yield $420 million in savings every year.

Multifamily energy efficiency also offers benefits to the private sector. It can improve the bottom line for businesses that own and manage multifamily buildings by reducing their energy bills, lowering maintenance and equipment costs, and lowering tenant turnover rates.

Energy efficiency also helps the families who live in multifamily housing save money. Lighting and appliance upgrades, HVAC improvements, and improved insulation all reduce the overall cost of housing. These improvements also increase tenant comfort, block outside noise, reduce moisture problems and freeze damage to pipes, and improve indoor air quality and fire safety. Money saved by building owners and tenants is often then reinvested in the local economy as spending on groceries, healthcare, landscaping, or other goods and services.

With the right regulations in place, energy efficiency also helps utilities in multiple ways. Efficiency programs are popular services that utilities can use to improve customer relations. Energy efficiency is also less expensive than supplying electricity or natural gas. Energy efficiency can help utilities avoid expensive system upgrades by decreasing stress on the electric grid, which can also lessen the need for system disruptions in emergencies. For example, energy efficiency frees up space to deliver additional natural gas for generating electricity when coal-fired or nuclear-powered plants must be temporarily idled. While utilities are necessarily concerned about the effect of energy efficiency on revenue, regulatory mechanisms can help ensure that utilities' incentives are aligned with robust energy efficiency programs.

The potential for multifamily energy efficiency is driven by factors that are unique to multifamily buildings and their residents. Historically, multifamily buildings have received less energy efficiency investment than other residential buildings. In most states, the proportion of energy efficiency funding that goes to the multifamily sector is lower than the proportion of the total housing stock that is made up of multifamily housing. In addition multifamily buildings house a higher proportion of America's low-income residents, who would benefit the most from the savings associated with energy efficiency.

To reach the full potential of multifamily energy efficiency, states should encourage programs that result in deep savings. Such an effort can enhance economic development, increase comfort and safety for residents, and support new job opportunities.

II. Introduction

Multifamily Energy Efficiency Opportunities in the States is presented in four parts. First, the paper examines the potential for new jobs in designing and implementing energy efficiency improvements in multifamily buildings. Second, it discusses the cost savings and other benefits that accrue to businesses that own and manage multifamily housing, their tenants, and utilities. Third, the paper reviews the factors that created this particular opportunity in multifamily housing and how studies of energy efficiency's potential can help quantify the available efficiency opportunity in a given state. Finally, the paper discusses how to use cost-effectiveness tests to ensure that energy efficiency policies and programs are a wise use of taxpayer funds.

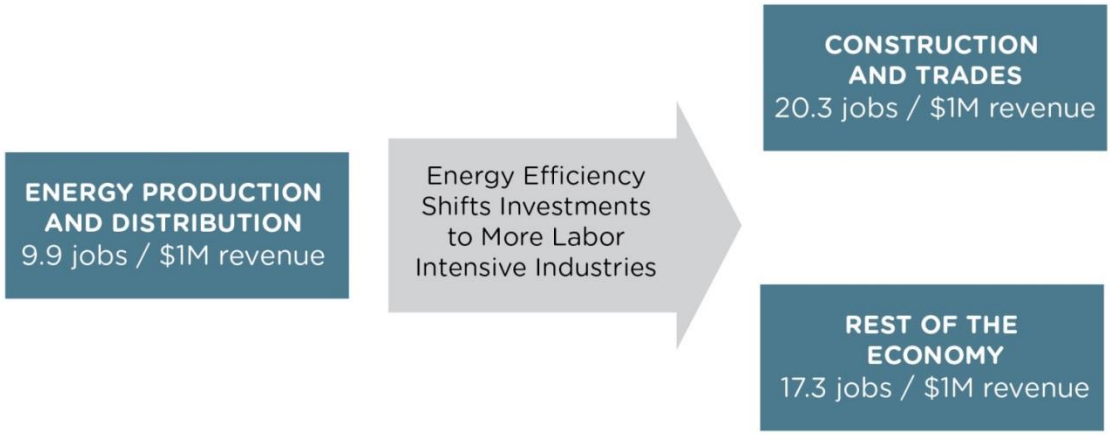
A companion paper, developed by the National Governors Association's Center for Best Practices and titled "*Governor's Roadmap on Improving the Energy Efficiency of Multifamily Buildings*," describes the challenges to energy efficiency investments in multifamily housing and provides examples of how governors can help enhance initiatives to address this sector. This includes innovative technology, policy development, and programs that help to drive the market for investments and overcome barriers.

III. Potential for new jobs from the implementation of multifamily energy efficiency programs

Increasing investments in energy efficiency, including in the multifamily sector, can help ensure a vibrant and resilient economy over the long term.[7] While economy-wide job creation effects are difficult to quantify, numerous case studies indicate that energy efficiency can stimulate local net job creation – that is, energy efficiency investments can increase "the number of jobs in an industry and its supply chain beyond the 'business as usual' reference case."[8] Energy efficiency employment is typically categorized as direct jobs, indirect jobs, and induced jobs.

Energy efficiency investments directly impact employment in several sectors, including construction and the building trades, which are responsible for installing efficiency measures and equipment. These investments also indirectly impact employment in the manufacturing and sale of energy efficient equipment and products. In addition, by reducing spending on energy resources, energy efficiency frees capital to flow to other areas of the economy, 'inducing' employment in those sectors.[9] Consequently, energy efficiency increases employment by shifting investments from industries that are less labor intensive to industries that are more labor intensive.[10]

This paper will review the types of direct jobs that are created by multifamily energy efficiency programs. It will briefly describe the methodologies that have been applied to estimate job creation, and provide references to several well-regarded sources that represent a range of job creation and retention estimates, for policy makers to consider.



A. Types of direct jobs related to energy efficiency

Multifamily energy efficiency programs directly employ workers in a variety of sectors. Programs generally fall into several categories: rebate programs, direct install programs, and comprehensive HVAC and building shell retrofit programs. These types of programs vary in their labor intensity and the type of work that is completed.

Direct Jobs

Rebate Programs	Direct Install Programs	Comprehensive HVAC and Building Shell Retrofit Programs
• Administrative • Marketing • IT	• Adminstrative • Marketing • Delivery • Installation	• Administrative • Marketing • Energy Assessors • Engineers • HVAC Contractors • Insulation and Ductwork Contractors • Electricians • Appliance Installers

Rebate programs provide building owners with a payment or reduced price on equipment purchases. Because the building owner chooses the equipment and manages installation, rebate programs only require workers to market the program and to process the rebate applications and payments. Rebate program processes are highly automated. Consequently, these types of programs employ administrative, marketing, and IT personnel and, relative to other types of energy efficiency programs, require relatively little labor.

Direct install programs require more manual labor than rebate programs, as they require workers to deliver simple energy efficiency measures to a property, such as efficient light bulbs and faucet aerators. Either the direct install program employees or the building's maintenance staff may install the measures. Most programs also educate building maintenance staff on the efficiency measures installed in their buildings. Consequently, these types of programs employ administrative, marketing, delivery, and installation workers.

Comprehensive HVAC and building shell programs are more labor-intensive than rebate or direct install programs. These programs include an assessment of the building's energy efficiency needs and may require sophisticated engineering estimates of the building's energy use and efficiency opportunities. These programs may also require the purchase and installation of HVAC equipment; pipe insulation; ceiling, attic, and wall insulation; appliance and lighting installations; sealing of all cracks and holes where air can infiltrate the building; and other building shell improvements. Comprehensive

efficiency programs employ energy assessors, engineers, HVAC technicians, insulation and ductwork contractors, electricians, appliance installers, other construction trades, and administrative and marketing personnel.

B. Existing job creation estimates represent a range of methodologies

While studies that forecast jobs created by energy efficiency investments suffer from the same complexities and caveats as similar studies in other industries, they are useful. The most rigorous studies indicate that energy efficiency investments can be a good source of job growth in related trades. There is no standard practice for conducting studies to estimate the net job creation effects of future energy efficiency investments, or to verify how many jobs have been created after an investment is made.[11] Instead, most estimates are based on one of two methods: (1) a survey of employers who have hired workers to administer an energy efficiency program or project, or (2) the use of an economic input-output model to predict the effects of an investment in energy efficiency on employment throughout the economy.[12] Both methods have strengths and weaknesses.

Comprehensive HVAC and building shell programs are more labor-intensive than rebate or direct install programs.

Comprehensive efficiency programs employ energy assessors, engineers, HVAC technicians, insulation and ductwork contractors, electricians, appliance installers, other construction trades and administrative and marketing personnel.

Surveys offer verifiable estimates of direct employment as a result of efficiency projects whose stakeholders report employment using well-defined metrics. While surveys are based on real-world evidence, they do have limitations. Surveys cannot estimate induced jobs as a result of energy bill savings that flow to other areas of the economy, and accuracy depends on a shared definition of a 'job' as well as on consistent and accurate record keeping and employer participation. Also, surveys cannot accurately estimate net job creation, which requires a comparison to a business-as-usual case.[13]

Input-output models, in contrast, allow economists to predict the effect of a change in one sector, such as an increase in energy efficiency investment, on all sectors. These models[14] use a wide variety of economic data from government and other sources[15] to predict direct, indirect, and induced employment effects. Input-output models can also show the relative labor intensities of various sectors, allowing, for example, a comparison of the electric and natural gas utilities sectors with the construction and manufacturing sectors.[16] These models are not, however, well suited to verifying job creation that has resulted from past shifts in energy efficiency spending.[17] In addition, input-output models can be sensitive to their assumptions,[18] and may rely on publicly available data that is out of date when compared to the timeline of the proposed investment.

C. Job impact estimates for policy makers to consider

The most rigorous and transparent available studies suggest that investments in energy efficiency create net employment over the short term.

In 2012, Deutsche Bank commissioned an analysis of the benefits of energy efficiency retrofits in multifamily affordable housing as part of its efforts to "encourage the financial industry to scale up financing of building energy efficiency retrofits."[19] The analysis highlighted two studies that met their criteria for timeliness and rigorous and transparent methodology.[20] These studies were the Booz Allen Hamilton's 2009 U.S. Green Building Council Jobs study[21] (USGBC study) and ECONorthwest and Bonnie GEE Yosick LLC's 2010 Economic Multipliers for Green Sector Strategies and Green Industries in Oregon study (Oregon study). Both studies used input-output models to estimate employment impacts of residential energy efficiency investments. The USGBC study, which looked at impacts at the national level, found that residential energy efficiency retrofits created 11.6 total net jobs (1.8 direct and 9.8 indirect and induced jobs) per $1 million invested. The Oregon study found that a $1 million investment would result in 9.5 total jobs, if it were invested in comprehensive residential retrofits in Oregon.[22]

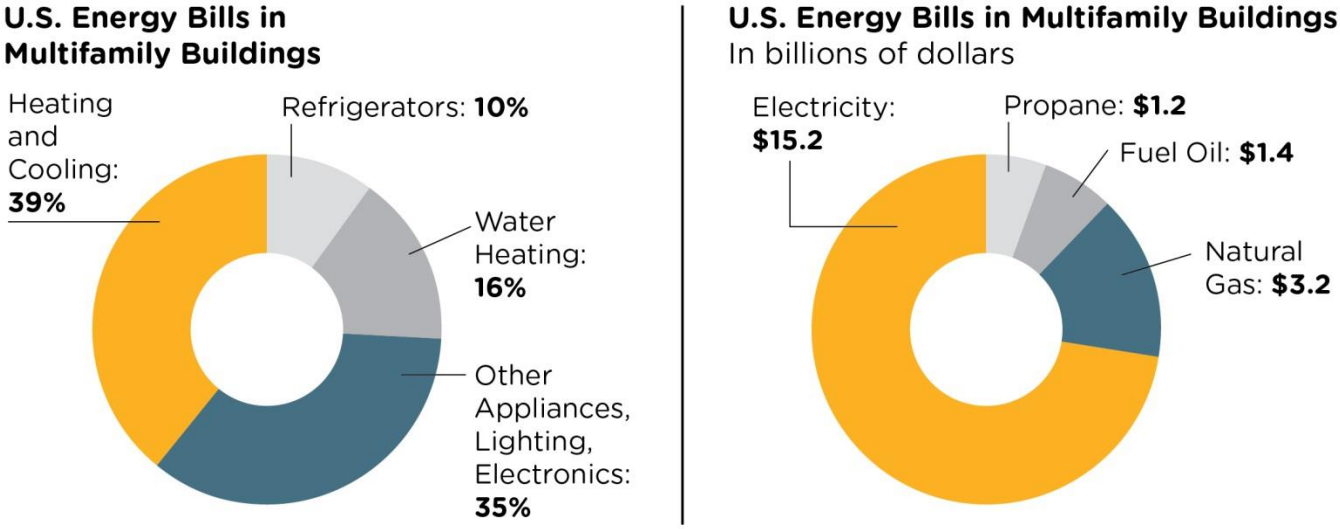
Lawrence Berkeley National Laboratory (LBNL) has estimated that the U.S. energy efficiency services sector created 6.3 direct jobs per $1 million invested in 2008.[23] LBNL's estimate used a bottom-up, case study based approach, collecting data from specific programs in selected states, and then extrapolating that information to create an estimate for the nation as a whole.[24] The study did not include an estimate for indirect or induced jobs. It did, however, note the difference between job creation effects in energy efficiency service sub-sectors, and found that low-income weatherization and insulation activities produced 8.9 direct jobs per $1 million in invested, more than other efficiency activities.[25]

	Direct Jobs per $ 1 M	Indirect and Induced Jobs per $ 1 M	Total Jobs per $ 1 M
USGBC Study	1.8	9.8	11.6
Oregon Study	-	-	9.5
LBNL	6.3 (all efficiency) 8.9 (comprehensive programs)	-	-

At the state level, the Massachusetts Clean Energy Center has used extensive survey data and input-output models to compile a report on employment and economic activity in that state's energy efficiency and renewable energy industries.[26] That report found that employment in the clean energy sector grew by 10.5 percent between 2013 and 2014 and was responsible for 2.5 percent of the states total gross state product, a total of approximately $10 billion.[27] Also, the New York State Energy Research and Development Authority (NYSERDA), has evaluated the performance of New York's system benefits charge program extensively.[28] In its 2011 evaluation, it found that New York's suite of energy efficiency programs resulted in 5,700 net additional jobs and saved participating New Yorkers more than $1 billion on their utility bills between 2007 and 2011.[29]

IV. Cost savings from multifamily energy efficiency

Multifamily energy efficiency spurs economic development by reducing household energy costs. The most recent data available from the U.S. Census shows that, in 2009, U.S. energy bills in multifamily buildings totaled $21 billion, an average of $1,141 per household.[30] 39 percent of this energy was used to heat and cool buildings while the remainder was used for water heating, refrigeration, appliances, lighting, electronics, and other equipment such as pumps and elevators.[31] $15.2 billion was spent on electricity, $3.2 billion on natural gas, and more than $2.6 billion on fuel oil and propane.[32] These multifamily building expenditures have undoubtedly increased, as overall residential energy expenditures have increased by 2.4 percent between 2009 and 2012.[33]



A. Energy efficiency benefits for building owners

Multifamily energy efficiency benefits real estate businesses across the U.S. Half of all small and medium sized apartment buildings in the U.S. are owned by individual investors. More than 80 percent of apartments in very small properties with two to four units are owned by these small businesses. Most large apartment buildings with more than 50 units are owned by limited liability corporations and partnerships.[34]

Energy efficiency improves the bottom line for multifamily building owners in three ways: direct energy savings, lower maintenance and equipment costs, and lower tenant turnover rates. Direct energy savings are particularly appreciated by building owners in cold climates, where utilities often account for the second-largest operating expense for multifamily buildings, after debt service.[35] In addition to direct energy savings, energy efficiency investments often reduce water bills as a result of efficiency measures that lower hot water use. Because aging HVAC equipment often requires frequent adjustment to work correctly, repairing an existing HVAC system can make it run more efficiently, reducing maintenance costs and potentially increasing its lifespan.[36] In addition, many owners may not realize that energy efficiency also reduces tenant turnover and related lost rents and costs to prepare apartments for new tenants. A study by the Wisconsin Division of Energy Services found that "typical turnover costs…are equivalent to two month's rent. An owner's profit margin may come *entirely* from a competitive advantage in reducing turnover." [37] By providing a more comfortable, affordable, and pleasant living space, energy efficiency can improve the bottom line for a building owner. In both subsidized and unsubsidized affordable housing, reducing the building owner's expenses decreases upward pressure on rents and frees capital for other uses.[38]

B. Energy efficiency benefits for tenants

The average household living in a multifamily building spent $1,141 on energy in 2009.[39] These expenses can be reduced with multifamily energy efficiency upgrades that target the tenant's bills, such as lighting and appliance upgrades, HVAC improvements, and improved insulation. These types of improvements reduce the overall cost of housing, which helps preserve affordable housing. Energy efficiency improvements to a multifamily building also increase tenant comfort, block outside noise, reduce moisture problems and freeze damage to pipes, and improve indoor air quality and fire safety.[40]

C. Energy efficiency benefits for utilities

Efficiency programs are popular services that utilities can use to improve customer relations. For example, utilities can capitalize on the benefits of efficiency programs, such as improved home comfort and health, to improve their own reputations. Energy efficiency is also less expensive than supplying electricity or natural gas. Energy efficiency can help utilities avoid expensive system upgrades by decreasing stress on the electric grid, which can also lessen the need for

system disruptions in times of emergency. For example, energy efficiency frees up supply of additional natural gas for generating electricity when coal-fired or nuclear-powered plants must be temporarily idled.[41] While utilities are necessarily concerned about the effect of energy efficiency on revenue, regulatory mechanisms, such as decoupling and performance incentives, can help align utilities' financial incentives with robust energy efficiency programs.

V. Assessing the size of the opportunity in multifamily energy efficiency

A. The multifamily housing market is large and ripe for efficiency investment

The multifamily building sector represents a sizeable opportunity for well-targeted energy efficiency programs. In 2013, the U.S. had more than 20 million occupied apartments and condominiums in multifamily buildings, of which more than 18 million units were renter-occupied.[42] By 2023 the total number of renters is projected to increase by 4 to 4.7 million.[43]

The American Council for an Energy Efficient Economy has found that, of 50 metropolitan areas analyzed, multifamily efficiency program spending as a share of residential efficiency spending is only proportional to its share of the housing stock in Boston, Indianapolis, and Riverside, California.[1]

The multifamily sector is ripe for efficiency investment for several reasons.

- Multifamily buildings have historically received less energy efficiency investment than other types of residential buildings.
- In most states, the multifamily sector receives proportionately less funding for energy efficiency than other sectors relative to the proportion of the total housing stock that it represents.
- Multifamily buildings house a higher proportion of America's low-income residents, who would benefit the most from the savings associated with energy efficiency.

The opportunity to reduce energy costs for multifamily building owners and tenants is significant, largely because so little has been done to date. A study by the University of Arizona documented that multifamily housing is engaged in a disproportionately small share of energy efficiency measures.[44] A 2012 report by the University of Arizona and Fannie Mae illuminates this efficiency gap, finding that there were 34 percent fewer energy efficient features in multifamily households compared to other households in 2009, and the efficiency gap between higher income and lower income multifamily households grew between 2005 and 2009.[45]

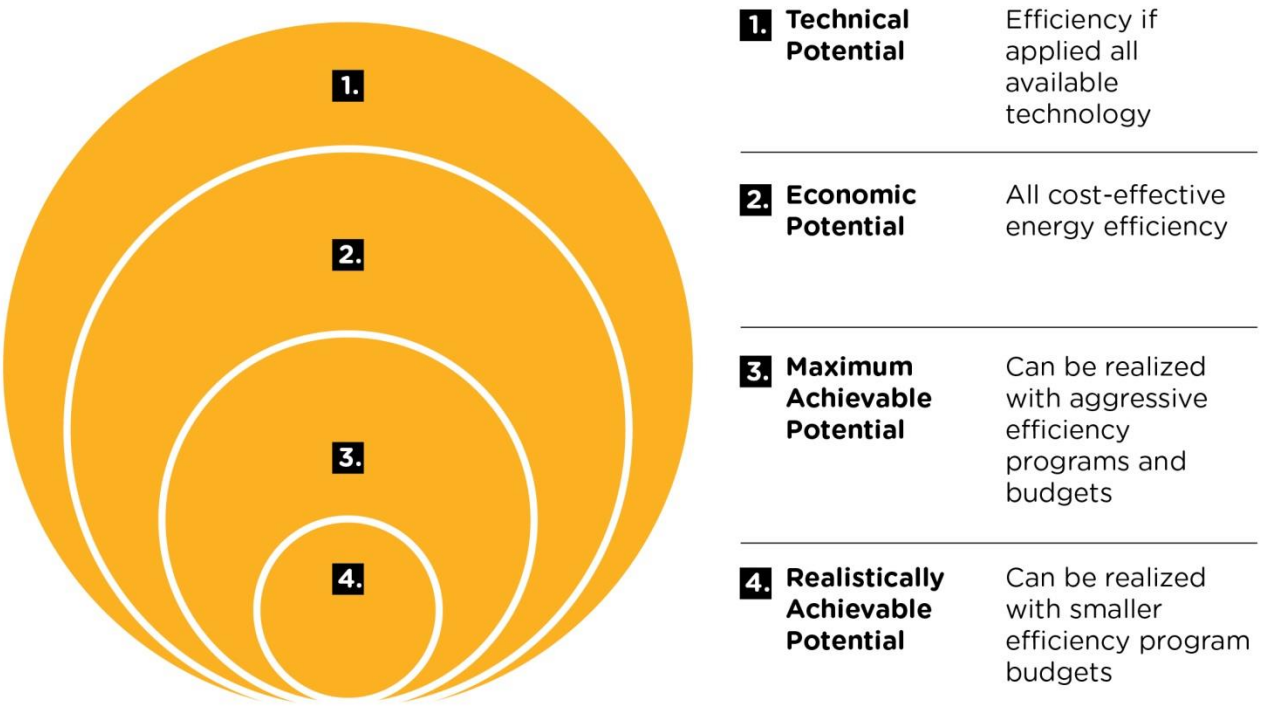
Despite the need and potential for increased energy efficiency, multifamily buildings get a disproportionately small share of utility incentive dollars in many states. The American Council for an Energy-Efficient Economy found that, of 50 metropolitan areas analyzed, multifamily efficiency program spending, as a share of residential efficiency spending, is only proportional to its share of the housing stock in three areas: Boston, Indianapolis, and Riverside, California.[46]

Finally, the multifamily building sector is ripe for energy efficiency investment because it houses a higher proportion of America's low-income residents, who benefit the most from the savings associated with energy efficiency. According to Harvard University's Joint Center for Housing Studies, "utility costs represent some 15 percent of income for renters with incomes below $15,000, but just 1 percent for those with incomes of $75,000 or more."[47] Decreased utility bills resulting from energy efficiency investments leave more money in these families' pockets to be spent locally on groceries, health care, and other expenses. Consequently, energy efficiency can make the highest impact on household finances when investments are made in multifamily buildings.

B. Studies of energy efficiency potential

Studies suggest that there is plenty of room to improve energy efficiency in the U.S., even in areas with long-standing efficiency programs. Additional efficiency investments could save 2 percent or more each year on the $21 billion in energy used by multifamily buildings, yielding savings of $420 million annually. While the opportunity for savings and other benefits from multifamily energy efficiency is high nationwide, it varies by state, based on the housing stock, climate, and the strength of existing efficiency policies and programs. Studies of energy efficiency potential are typically commissioned by state utility regulators, and can provide support for policies that encourage energy efficiency by estimating a state's savings opportunity. Studies of energy efficiency potential can help states target their efficiency policies and ensure they are capturing all available savings. Generally, these studies are best suited for short-term program development, as their accuracy declines when attempting to predict the potential for energy efficiency savings far into the future.[48]

There are four types of energy efficiency potential.[49] Technical potential is the energy efficiency available if every technically feasible energy efficiency measure was deployed. Economic potential is the portion of technical potential that is also cost-effective. That is, where the cost of the energy efficiency measures are outweighed by the potential savings. Similarly, maximum achievable potential is technically achievable, cost-effective, and can be achieved with an aggressive energy efficiency program with a high market penetration. Realistically achievable potential is always smaller, reflecting the efficiency achievable by a less aggressive, more moderate program.[50]



While studies on the potential for energy efficiency typically include conservative assumptions that result in relatively low estimates of efficiency potential,[51] the results have been found to be somewhat consistent across studies.[52] This may seem counterintuitive, since energy efficiency standards for appliances have been steadily improving and utilities have been investing billions in energy efficiency. One might expect that studies would show a decrease in efficiency potential over time. On the contrary, the results have been found to be somewhat

Studies of energy efficiency potential can help states target their efficiency policies and ensure they are capturing all available savings.

consistent over time. This suggests that energy efficiency's potential does not get 'used up' by our existing efficiency programs, but rather, is renewed as industries respond to new standards with more efficient technologies and as program processes improve.[53]

A review of 45 studies of energy efficiency's potential found that average annual maximum achievable electricity savings ranged from 0.3 percent to 2.9 percent (median 1.3 percent), and natural gas savings ranged from 0.1 percent to 2.4 percent (median 0.9 percent).[54] These ranges were consistent with a similar survey conducted a decade earlier,[55] a second study of four national and regional studies,[56] and with actual savings from efficiency program portfolios.[57] In fact, a number of states are already reaching savings levels of over 2 percent.[58] This suggests that the economic potential of energy efficiency remains substantial, even in areas with long-standing efficiency programs, perhaps because new technologies are developed and adopted over time. And, while 2 percent annual savings may seem small, saving just 2 percent of the $21 billion in energy used by multifamily buildings in the U.S. would yield $420 million in savings every year.

Comprehensive energy efficiency programs result in the highest level of energy efficiency savings and job creation. These programs require flexibility, which is assured when cost effectiveness tests are applied at the program portfolio level.

VI. Using cost effectiveness tests to ensure good value from energy efficiency

States that are interested in creating or funding energy efficiency programs often apply cost effectiveness tests to ensure that the public is getting value for its money. Typically, state public utility commissions make decisions affecting the application of the cost effectiveness tests. There are a variety of cost effectiveness tests, and each test measures cost from a different perspective. Cost-effectiveness tests can also be applied at different levels. They can be applied to the entire portfolio of energy efficiency programs, to individual programs, or to the individual efficiency measures that make up each program. Maximum value is obtained when efficiency programs convince building owners to make every cost-effective investment in energy efficiency, but the application of cost-effectiveness tests can impact the type of programs that can be considered in each state, and the savings they can achieve.[59]

Comprehensive energy efficiency programs result in the highest level of energy efficiency savings and job creation, as previously discussed. These programs require flexibility, which is assured when cost effectiveness tests are applied at the program portfolio level – that is, to all of the energy efficiency programs offered collectively. This allows the installation of every possible energy efficiency measure in one visit to the home or business. This increases savings and decreases program costs. It also allows for new, less proven programs to grow and improve.

The two most common cost-effectiveness tests are the utility-cost test and the total resource cost (TRC) test. The utility-cost test looks at the cost of a program to the utility and compares this to the benefits of generating less power. Well-designed comprehensive multifamily efficiency programs generally pass the utility-cost test.[60] The total resource cost test includes costs and benefits to utilities and to program participants. Often, however, the calculation of the TRC test does not include all of the applicable non-energy benefits such as reduced debt and operations and maintenance costs and improved comfort and safety.[61] Comprehensive multifamily energy efficiency retrofit programs may have difficulty passing the TRC test unless efforts are made to quantify all benefits, including these non-energy benefits.[62]

The Resource Value Framework is the result of a recent effort by energy efficiency industry stakeholders to harmonize the conflicts between these various cost-effectiveness tests. The framework provides a template for states to transparently determine which test best meets their energy efficiency goals and interests while ensuring that the resulting test treats the relevant costs and benefits symmetrically.[63]

Energy efficiency programs that target low-income households have particular difficulty in passing traditional cost-effectiveness tests. Often, this is because hard-to-quantify benefits that are unique or particularly pronounced in these households – such as fewer shutoffs, lower utility arrearages, improved health, and reduced sick days – are not included in the test.[64]

States approach this challenge differently. Some states adjust their cost-effectiveness tests for these programs by increasing the benefits to a certain percentage to account for these additional benefits.[65] Other states acknowledge the test's limitations related to low-income programs by exempting them from the tests altogether.

VII. Conclusion

Comprehensive multifamily energy efficiency improvements offer states a variety of economic development benefits. Energy efficiency programs can create jobs, reduce costs for businesses that own and manage multifamily buildings, reduce costs for tenants, and provide opportunities for utilities to serve their customers and reduce strain on their systems. Studies have shown the sizeable opportunity for savings nationwide that, through small annual savings levels, can return billions of dollars to states and their residents. States can use cost-effectiveness tests to ensure that public and private investments in energy efficiency yield positive financial returns, in addition to the increased quality of life for residents.

To achieve the maximum benefit from energy efficiency, states should encourage comprehensive multifamily energy efficiency programs, as they are the most labor-intensive, rather than rebate or direct install programs. Comprehensive programs can be supported in many ways, by ensuring that multifamily programs are funded proportionally to their share of the housing stock, by confirming that all benefits are included in cost-effectiveness tests, and by applying these tests at the portfolio level. States should also consider using the Resource Value Framework to evaluate their cost-effectiveness tests.

Comprehensive multifamily energy efficiency retrofit programs may have difficulty passing the TRC test unless efforts are made to quantify all benefits, including these non-energy benefits. The Resource Value Framework provides a template for states to transparently determine the cost-effectiveness test that meets their energy efficiency goals and interests

The opportunity and potential for multifamily energy efficiency is significant. Capitalizing on this opportunity can bring economic development benefits to states in the form of jobs, lower operating costs for local businesses, reduced cost of living for residents, and more resilient utilities. To unlock these benefits, states must work to encourage energy efficiency policies and programs that target multifamily housing.

[1] U.S. Census Bureau, "Table B25127" in *American Community Survey*, 2013. Compiled data. See also National Multi-Housing Council, *Quick Facts: Resident Demographics, What Type of Structures Do Renter Households Live In?,* October 2013, http://www.nmhc.org/Content.aspx?id=4708#What_type_of_structure; Gary Pivo, *Energy Efficiency and its Relationship to Household Income in Multifamily Rental Housing,* (Fannie Mae, September 2012), 1, www.fanniemae.com/content/fact_sheet/energy-efficiency-rental-housing.pdf.

[2] Casey Bell*, Energy Efficiency Job Creation: Real World Experiences*, White Paper, (Washington, DC: ACEEE, October 2012) Table A-1, 14, http://aceee.org/files/pdf/white-paper/energy-efficiency-job-creation.pdf

[3] Don Hynek, Megan Levy, and Barbara Smith, "'Follow the Money': Overcoming the Split Incentive for Effective Energy Efficiency Program Design in Multi-Family Buildings" (Proceedings of ACEEE Summer Study on Energy Efficiency in Buildings, 2012), 6–136. http://www.aceee.org/files/proceedings/2012/start.htm

[4]American Council for an Energy-Efficiency Economy (ACEEE), "Appendix B: Details of States' Energy Efficiency Resource Standards" in *The 2012 State Energy Efficiency Scorecard,* No. E12C , Report, 2012.

[5] Deutsche Bank, Living Cities, and HR&A, *The Benefits of Energy Efficiency in Multifamily Affordable Housing*, January 2012, 10-12, https://www.db.com/usa/docs/DBLC_Recognizing_the_Benefits_of_Efficiency_Part_B_1.10.pdf; ACEEE, *How Does Energy Efficiency Create Jobs?*, Fact Sheet, n.d., http://aceee.org/files/pdf/fact-sheet/ee-job-creation.pdf.

[6] Max Neubauer, *Cracking the TEAPOT: technical, economic, and achievable energy efficiency potential studies*. (Washington, DC: ACEEE, August 2014).

[7] John Laitner et al., *The Long-term Energy Efficiency Potential: What the Evidence Suggest*, No. E121, Research Report, (Washington, DC: ACEEE, January 2012).

[8] Bell*, Energy Efficiency Job Creation: Real World Experiences*, Table A-1, 14.

[9] ACEEE, *How Does Energy Efficiency Create Jobs?*

[10] Casey Bell, "Understanding the True Benefits of Both Energy Efficiency and Job Creation," *Community Development Investment Review*, (Federal Reserve Bank of San Francisco, March 2014) 111-112, http://www.frbsf.org/community-development/publications/community-development-investment-review/2014/march/benefits-energy-efficiency-job-creation/. Energy production and distribution is less labor intensive than the overall economy, employing an estimated 9.9 people per $1 million in revenue, while the economy as a whole employs 17.3 people per $1 million in revenue. Industries supported by energy efficiency investments, such as construction and trade-services, are even more labor intensive, estimated to employ 20.3 people and 18.8 people per $1 million in revenue, respectively.

[11] Bell and Barrett, *Verifying Energy Efficiency Job Creation*, 10-24; Josh Schneck et al., *Estimating the Employment Impacts of Energy and Environmental Policies and Programs*, No. NI PB 10-06, Policy Brief, Duke Nicholas Institute, December 2010, 1, http://nicholasinstitute.duke.edu/sites/default/files/publications/estimating-employment-impacts-paper.pdf.

[12] Bell and Barrett, *Verifying Energy Efficiency Job Creation*, 10-27.

[13] Bell and Barrett, *Verifying Energy Efficiency Job Creation*, 10-30.

[14] Input-output models include the IMPLAN and RIMS models. See www.implan.com for more information on the IMPLAN model software and datasets. See also ACEEE, *A Brief Methodology of the DEEPER Modeling System*, Fact Sheet, n.d., http://aceee.org/files/pdf/fact-sheet/DEEPER_Methodology.pdf. ACEEE's DEEPER modeling system is a "quasi-dynamic input-output (I/O) model of the U.S. economy" that draws on a variety of economic data.

[15] Bell and Barrett, *Verifying Energy Efficiency Job Creation*, 10-28.

[16] For example, see the comparison of labor use intensities for key U.S. sectors in Casey Bell, "Understanding the True Benefits of Both Energy Efficiency and Job Creation," Figure 1, 111.

[17] Bell and Barrett, *Verifying Energy Efficiency Job Creation*, 10-29.

[18] Schneck et al., *Estimating the Employment Impacts*, 3.

[19] "Further Projects: Study recognizes energy efficiency benefits in multifamily housing," *Deutsche Bank USA*, January 10, 2012, https://www.db.com/usa/content/en/2235.html

[20] Deutsche Bank, Living Cities, and HR&A, *The Benefits of Energy Efficiency,* Appendix, 10, 22-23.

[21] Booz Allen Hamilton, *U.S. Green Building Council Green Jobs Study*, http://www.usgbc.org/Docs/Archive/General/Docs6435.pdf.

[22] Deutsche Bank, Living Cities, and HR&A, *The Benefits of Energy Efficiency,* 10-12.

[23] Charles Goldman et al., *Energy Efficiency Services Sector: Workforce Size and Expectations for Growth*, No. LBNL-3987E, Report, Lawrence Berkeley National Laboratory, 2010, Table ES-1, 8.

[24] Goldman et al., *Energy Efficiency Services Sector*, 21-25.

[25] Goldman et al., *Energy Efficiency Services Sector*, Table 3, 25.

[26] Massachusetts Clean Energy Center, *2014 Massachusetts Clean Energy Industry Report*, http://images.masscec.com/reports/Web%20Optimized%202014%20Report%20Final.pdf

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