MAY, 2015

# The Potential for Energy Savings in Affordable Multifamily Housing

## Key Findings

1. **There is significant energy savings** potential in the affordable multifamily sector in each of the nine states studied.
2. **The total benefits to society**, as defined by the Total Resource Cost Test,[1] from pursuing energy efficiency in affordable multifamily housing substantially exceed the costs.
3. **Including non-energy benefits** (NEBs) can have a significant impact on maximum achievable potential for the affordable multifamily sector.[2]
4. **Measures to reduce energy usage** for heating and cooling contribute to nearly half of projected electric energy savings; measures to reduce energy usage for space heating account for more than three-fourths of savings in natural gas use.[3]

## BACKGROUND

The National Housing Trust, Natural Resources Defense Council, Energy Foundation, and Elevate Energy have launched the *Energy Efficiency for All (EEFA)* project with the goal of making multifamily homes healthy and affordable through energy efficiency. EEFA is working with electric and gas utilities, program administrators and their regulators to advance innovative energy efficiency programs and advising housing finance agencies on best practices in obtaining building-owner participation and energy efficiency financing. EEFA is also collaborating with building owners and managers, businesses, and advocates to achieve energy savings in multifamily properties.

Electric and gas utilities in the United States invest billions of dollars annually to help their customers become more energy efficient, often by making repairs and improvements to customers' homes and buildings. These investments are smart — they improve lives by reducing energy expenses, create healthier, more comfortable homes and offices, and improve community building stock. The resulting energy efficiency produces a better utility system with less pollution, creates local jobs, and delivers other public benefits.

However, utilities rarely target affordable multifamily housing for their energy efficiency investments. Perceived as "hard to reach," this part of the nation's building stock is diverse and faces multiple market barriers. It is, however,

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full of untapped energy potential with buildings frequently in need of efficiency improvements and tenants who could substantially benefit. To better evaluate this untapped potential, EEFA contracted with Optimal Energy, an energy efficiency consulting firm, to conduct a detailed assessment of the potential in the sector. The resulting study analyzed the savings that could be realized from implementing all cost-effective efficiency measures for electricity, natural gas, and fuel oil in the entire existing affordable multifamily housing stock in each of nine states for the 20-year period from 2015-2034.

A synopsis of the study, including key parameters, findings, and the methodology employed, follows.

## STUDY PARAMETERS

### Geography

Evaluated the potential for nine states – Georgia, Illinois, Maryland, Michigan, Missouri, New York, North Carolina, Pennsylvania, and Virginia

### Time frame

Estimated potential over a 20-year period from 2015-2034

### Targeted housing stock

Considered all buildings, both subsidized and unsubsidized affordable, with five or more units occupied by people with household incomes at or below 80 percent of the area median income

### Levels of potential

Estimated two types of potential energy savings, economic potential and maximum achievable potential, with the focus on the latter

- economic potential – savings that can be realized if all cost-effective efficiency measures are implemented
- maximum achievable potential – the portion of economic potential that can be realized taking into account constraints such as program ramp-up times, the natural turnover of the housing and appliance stock, and the difficulty of engaging building owners

### Energy types

Estimated potential from electric, natural gas, and fuel oil, with fuel oil only applicable to one state, New York[4]

### Savings scenarios

Estimated the benefits associated with efficiency improvements for three scenarios

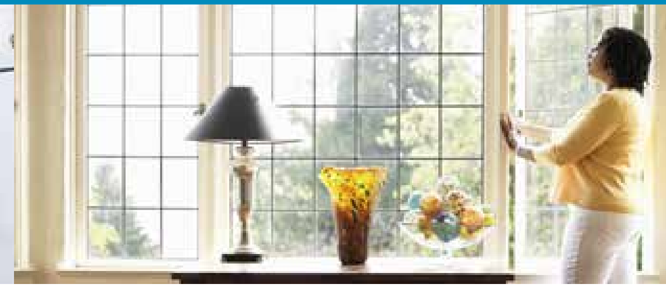
- The "Base Case" scenario considers only the benefits associated with energy, water, and operations and maintenance savings.
- The "Low" and "High" non-energy benefits (NEBs) scenarios take into account non-energy benefits, including those related to health, increased property values, higher comfort levels, and reduced arrearages, customer calls, safety-related emergency calls, and collection activities.[5]

### Data

Drew on secondary sources, in some cases referencing experience in non-study states

### Measures

Considered 182 energy efficiency technologies and practices that were then screened for cost-effectiveness

## SUMMARY OF FINDINGS

Four critical findings emerged from the study.

1. **There is significant energy savings potential in the affordable multifamily sector in each of the nine states studied.** Rather than a marginal strategy to reduce energy usage, improving the energy efficiency of the affordable multifamily housing stock represents a very significant opportunity for utilities and other stakeholders.
   - The maximum achievable potential varies significantly by state. The differences in potential savings reflect variations in avoided energy supply costs, the mix of fuels used, equipment saturations, climate, measure costs, and other factors.
   - In absolute units of energy saved[6], the potential is highest in New York, primarily due to the high concentration of affordable multifamily homes in New York City.

**TABLE 1. Maximum Achievable Potential Net Benefits by NEBs Sensitivity Scenario and State, All Fuels**

| State | Base Case Net Benefits ($millions) | Low NEBs Sensitivity Scenario Net Benefits ($millions) | High NEB Sensitivity Scenario Net Benefits ($millions) |
|---|---|---|---|
| Georgia | $467 | $1,223 | $2,048 |
| Illinois | $527 | $1,344 | $2,276 |
| Maryland | $550 | $1,132 | $1,755 |
| Michigan | $534 | $1,111 | $1,724 |
| Missouri | $190 | $511 | $894 |
| New York | $3,114 | $6,291 | $9,552 |
| North Carolina | $332 | $893 | $1,508 |
| Pennsylvania | $404 | $938 | $1,522 |
| Virginia | $354 | $941 | $1,579 |
| **TOTAL** | **$6,472** | **$14,384** | **$22,858** |

2. **The total benefits to society, as defined by the Total Resource Cost Test, from pursuing energy efficiency in affordable multifamily housing substantially exceed the costs.** This is true for all three scenarios (Base Case, Low NEBs, and High NEBs) as well as for all fuel types and all states.
   - Statewide benefit-to-cost ratios (BCR) for the Base Case range from 1.8 to 3.1 depending on the state and fuel.

3. **Including non-energy benefits can have a significant impact on maximum achievable potential for the affordable multifamily sector in every state studied.[7]** The effect on net benefits of including NEBs is summarized in Table 1.

**TABLE 2. Cumulative Maximum Achievable Potential by NEBs Sensitivity Scenario and State**

| State | Base Case % of Sales Forecast | Low NEBs Sensitivity Scenario % of Sales Forecast | High NEB Sensitivity Scenario % of Sales Forecast |
|---|---|---|---|
| **Electric (GWh)** | | | |
| Georgia | 17% | 20% | 23% |
| Illinois | 22% | 26% | 26% |
| Maryland | 19% | 22% | 25% |
| Michigan | 26% | 27% | 32% |
| Missouri | 15% | 19% | 20% |
| New York | 24% | 27% | 31% |
| North Carolina | 19% | 23% | 26% |
| Pennsylvania | 20% | 23% | 25% |
| Virginia | 21% | 25% | 28% |
| **Natural Gas (BBtu)** | | | |
| Georgia | 13% | 17% | 17% |
| Illinois | 16% | 20% | 21% |
| Maryland | 18% | 20% | 21% |
| Michigan | 11% | 14% | 15% |
| Missouri | 17% | 23% | 24% |
| New York | 13% | 18% | 18% |
| North Carolina | 22% | 28% | 28% |
| Pennsylvania | 11% | 13% | 13% |
| Virginia | 13% | 18% | 19% |
| **Petroleum Fuel (BBtu)** | | | |
| New York | 15% | 15% | 15% |

Table 2 summarizes the cumulative maximum achievable potential savings as a percentage of sales forecast by state and by fuel. The maximum achievable potential varies significantly by state, reflecting differences in avoided energy supply costs, the mix of fuels used (fuel shares), equipment saturations, climate, measure costs, and other factors. The study finds significant potential in the affordable multifamily sector in all states. In absolute units of energy saved, the potential is highest in New York due primarily to the enormous number of affordable multifamily units in New York City.

Tables 3 and 4 provide additional detail on the impact of NEBs on the state-level costs, savings, and benefit cost ratios (BCR).

- For the Low NEBs, total net benefits for all states and fuels analyzed increase by 122 percent from $6.5 billion to $14.4 billion with an increase in BCR from 2.2 to 3.0.
- For the High NEBs, total net benefits increase by 253 percent from $6.5 billion to $22.9 billion with an overall BCR shift from 2.2 to 3.3.

**TABLE 3. Sensitivity for Low NEBs, Maximum Achievable Potential Costs and Benefits, All Fuels**

| | Low NEBs Sensitivity Scenario | | | | Base Case | | | |
|---|---|---|---|---|---|---|---|---|
| **State** | **Costs ($millions)** | **Benefits ($millions)** | **Net Benefits ($millions)** | **BCR** | **Costs ($millions)** | **Benefits ($millions)** | **Net Benefits ($millions)** | **BCR** |
| Georgia | $575 | $1,799 | $1,223 | 3.1 | $405 | $872 | $467 | 2.2 |
| Illinois | $866 | $2,210 | $1,344 | 2.6 | $571 | $1,098 | $527 | 1.9 |
| Maryland | $500 | $1,632 | $1,132 | 3.3 | $391 | $940 | $550 | 2.4 |
| Michigan | $531 | $1,642 | $1,111 | 3.1 | $417 | $951 | $534 | 2.3 |
| Missouri | $335 | $845 | $511 | 2.5 | $213 | $402 | $190 | 1.9 |
| New York | $2,764 | $9,055 | $6,291 | 3.3 | $2,178 | $5,293 | $3,114 | 2.4 |
| North Carolina | $430 | $1,324 | $893 | 3.1 | $293 | $625 | $332 | 2.1 |
| Pennsylvania | $515 | $1,453 | $938 | 2.8 | $369 | $773 | $404 | 2.1 |
| Virginia | $520 | $1,461 | $941 | 2.8 | $342 | $697 | $354 | 2.0 |
| **TOTAL** | **$7,036** | **$21,421** | **$14,384** | **3.0** | **$5,179** | **$11,651** | **$6,472** | **2.2** |

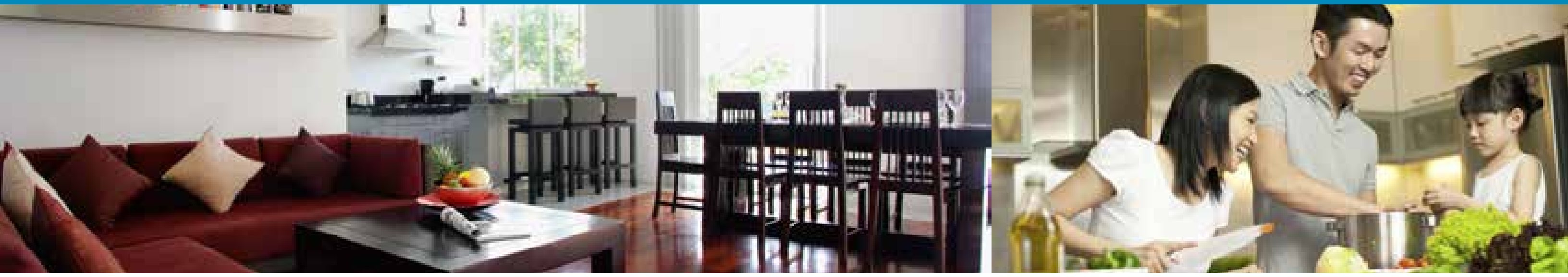


**TABLE 4. Sensitivity for High NEBs, Maximum Achievable Potential Costs and Benefits, All Fuels**

| | High NEB Sensitivity Scenario | | | | Base Case | | | |
|---|---|---|---|---|---|---|---|---|
| **State** | **Costs ($millions)** | **Benefits ($millions)** | **Net Benefits ($millions)** | **BCR** | **Costs ($millions)** | **Benefits ($millions)** | **Net Benefits ($millions)** | **BCR** |
| Georgia | $926 | $2,975 | $2,048 | 3.2 | $405 | $872 | $467 | 2.2 |
| Illinois | $915 | $3,190 | $2,276 | 3.5 | $571 | $1,098 | $527 | 1.9 |
| Maryland | $775 | $2,530 | $1,755 | 3.3 | $391 | $940 | $550 | 2.4 |
| Michigan | $860 | $2,584 | $1,724 | 3.0 | $417 | $951 | $534 | 2.3 |
| Missouri | $412 | $1,305 | $894 | 3.2 | $213 | $402 | $190 | 1.9 |
| New York | $3,883 | $13,435 | $9,552 | 3.5 | $2,178 | $5,293 | $3,114 | 2.4 |
| North Carolina | $688 | $2,197 | $1,508 | 3.2 | $293 | $625 | $332 | 2.1 |
| Pennsylvania | $708 | $2,230 | $1,522 | 3.2 | $369 | $773 | $404 | 2.1 |
| Virginia | $813 | $2,392 | $1,579 | 2.9 | $342 | $697 | $354 | 2.0 |
| **TOTAL** | **$9,980** | **$32,838** | **$22,858** | **3.3** | **$5,179** | **$11,651** | **$6,472** | **2.2** |

**4 Measures that reduce energy usage for space heating and cooling contribute the majority of potential energy savings.**

- Measures that reduce energy usage for space heating and for combined heating/cooling contribute 49 percent of total electric energy savings (Figure 1) and 77 percent of gas savings (Figure 2). Electric savings are achieved primarily through the introduction of Wi-Fi thermostats, efficient windows, and air sealing. Gas savings are largely from efficient in-unit and central furnaces and central boilers, new efficient windows, and air sealing.

**FIGURE 1 I CUMULATIVE ELECTRIC ENERGY SAVINGS BY END USE, 2034**

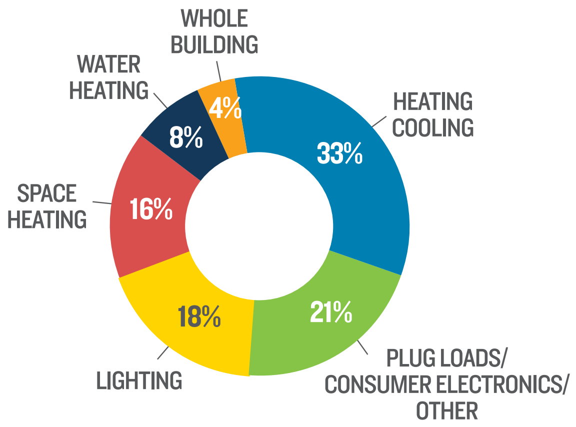
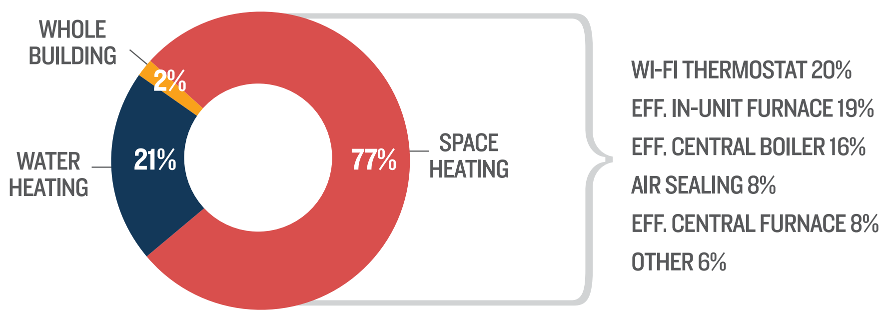


**FIGURE 2 I CUMULATIVE NATURAL GAS SAVINGS BY END USE, 2034**




- Equipment plugged directly into outlets – largely consumer electronics — contributes a significant 21 percent of the total electric potential savings, with the bulk coming from advanced power strips.
- Efficiency measures for lighting contribute 18 percent to the potential electric savings.
- Improvements in water heating (8 percent of electric savings and 21 percent of gas savings) and whole building measures (4 percent of electric savings and 2 percent of gas savings) such as behavioral change and retrocommissioning (improving existing equipment) constitute significant additional end-use savings.

## Methodology

The basic methodology entailed the following six steps:

1. Estimate the number of affordable multifamily housing units by state, utility service territory, building size (i.e., buildings with 5 to 49 units and buildings with 50 or more units) and subsidy types (unsubsidized affordable, subsidized affordable, and public housing authority-owned).
2. Estimate baseline energy consumption for affordable multifamily housing units in the nine states, for each energy type (electricity, natural gas, and fuel oil) for the period 2015-2034.[8]
3. Characterize efficiency measures by estimated costs, savings, and lifetimes. Then screen the comprehensive list of 182 measures for cost-effectiveness using the Total Resource Cost Test. The costs included all those incurred by participants and program administrators, and for all incentive and non-incentive programs.

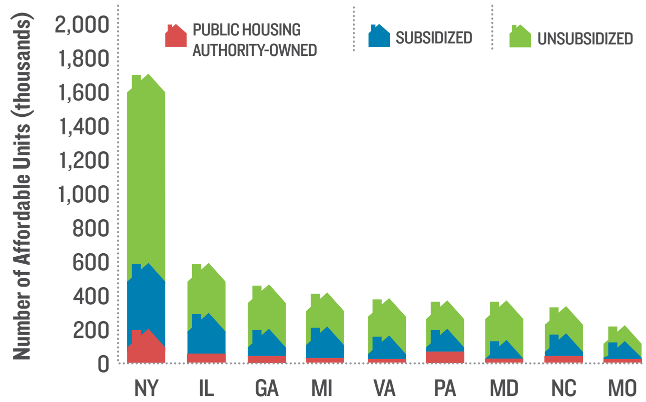
4 Identify location-dependent parameters that could affect measure characterizations for each electric utility service territory. Parameters included climate, hours of lighting use, measure cost adjustment factors, and avoided energy supply costs.

5 Develop, for each electric utility service area, measure penetrations (the extent to which each measure is implemented).

6 Adjust for measure interactions.[9]

The total potential was estimated by applying the measure level costs and savings to the population of affordable multifamily housing units both statewide and by utility service territory, adjusted for location-dependent parameters, measure penetrations, measure interactions, and other factors.

**FIGURE 3 I AFFORDABLE MULTIFAMILY HOUSING UNITS BY STATE AND SUBSIDY TYPE**




A complete discussion of the methodology used for this study can be found in the full report, pp. 37-50. http://www.energyefficiencyforall.org/efficiency-potential

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Endnotes:

1 The TRC test considers the costs and benefits of efficiency measures from the perspective of society as a whole. The principles of this cost test are described in: Governor's Office of Planning and Research, *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects* (State of California, July 2002), http://www.calmac.org/events/SPM_9_20_02.pdf.

2 "Potential" here refers to the savings that would result from the adoption of energy-efficient technologies that would not occur without funded programs to promote their adoption.

3 Some measures such as envelope improvements and heat pump upgrades would affect both heating and cooling usage while measures such as boiler controls would only affect heating usage.

4 The assessment of fuel oil potential was limited to opportunities in New York State, which is the only state that satisfied the study's criterion that a fuel represent more than 5 percent of the total residential heating fuel market share in a given state.

5 The NEB scenarios were based on a 2012-13 Massachusetts study of state-administered low-income residential programs. Our Low NEBs scenario assumed non-energy benefits equivalent to 50 percent of the Massachusetts values; the high NEBs scenario assumes benefits equivalent to 100 percent of the Massachusetts values.

6 With all savings converted to site MMBtus.

7 Detailed data for maximum achievable potential by utility service territory can be found in the full report, Tables 10 – 27.

8 These estimates, primarily based on data from the U.S. Energy Information Administration's *Residential Energy Consumption Survey (2013)*, were used both to inform measure characterizations and to report potential estimates as a percentage of total load.

9 The reported electricity savings reflect adjustments to account for interactions between lighting and electric heating and cooling usage. The reported gas and oil savings were not similarly adjusted, however, gas and oil benefits were adjusted for these interactions. This reporting convention is used to avoid understating the natural gas and fuel oil potential due to the impact of aggressively pursuing efficient lighting. In cases where efficiency programs are not integrated across fuel types, this is especially important.


## ACKNOWLEDGMENTS

The primary author of this Study are Phil Mosenthal and Matt Socks of Optimal Energy. Glenn Reed of Energy Futures Group provided critical support and input. The contents of this Study include and reflect the original ideas and contributions of Michael Bodaken and Todd Nedwick of the National Housing Trust, Abigail Corso and her team at Elevate Energy, and the experience and input of NRDC's team including Dylan Sullivan, Raya Salter, Rebecca Stanfield, and Cai Steger.

This project was made possible with funding support from The JPB Foundation.

Many thanks to Tanja Bos and Debby Warren for skilled help producing this Study.