ENERGY EFFICIENCY FOR ALL

Quantifying and Capturing the Large Efficiency Potential in the Multifamily Affordable Housing Sector

THE JPB FOUNDATION

ENERGY FOUNDATION
building a new energy future

NATIONAL HOUSING TRUST

NRDC

ELEVATE ENERGY

Annika Brink
National Housing Trust

Presented at the 2015 ACEEE National Conference on Energy Efficiency as a Resource

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National Housing Trust

NHT **protects and improves** existing affordable rental homes so that low income individuals and families can live in quality neighborhoods with access to opportunities.

ADVOCACY

REAL ESTATE DEVELOPMENT

LENDING

ENERGY EFFICIENCY FOR ALL

Resident Stories

"I'm a single father with a son named Jayden. My building was improved and now my son can focus on learning his ABCs instead of worrying about being cold."

Dewitt Hood, affordable housing resident, speaking to D.C. Public Service Commissioners

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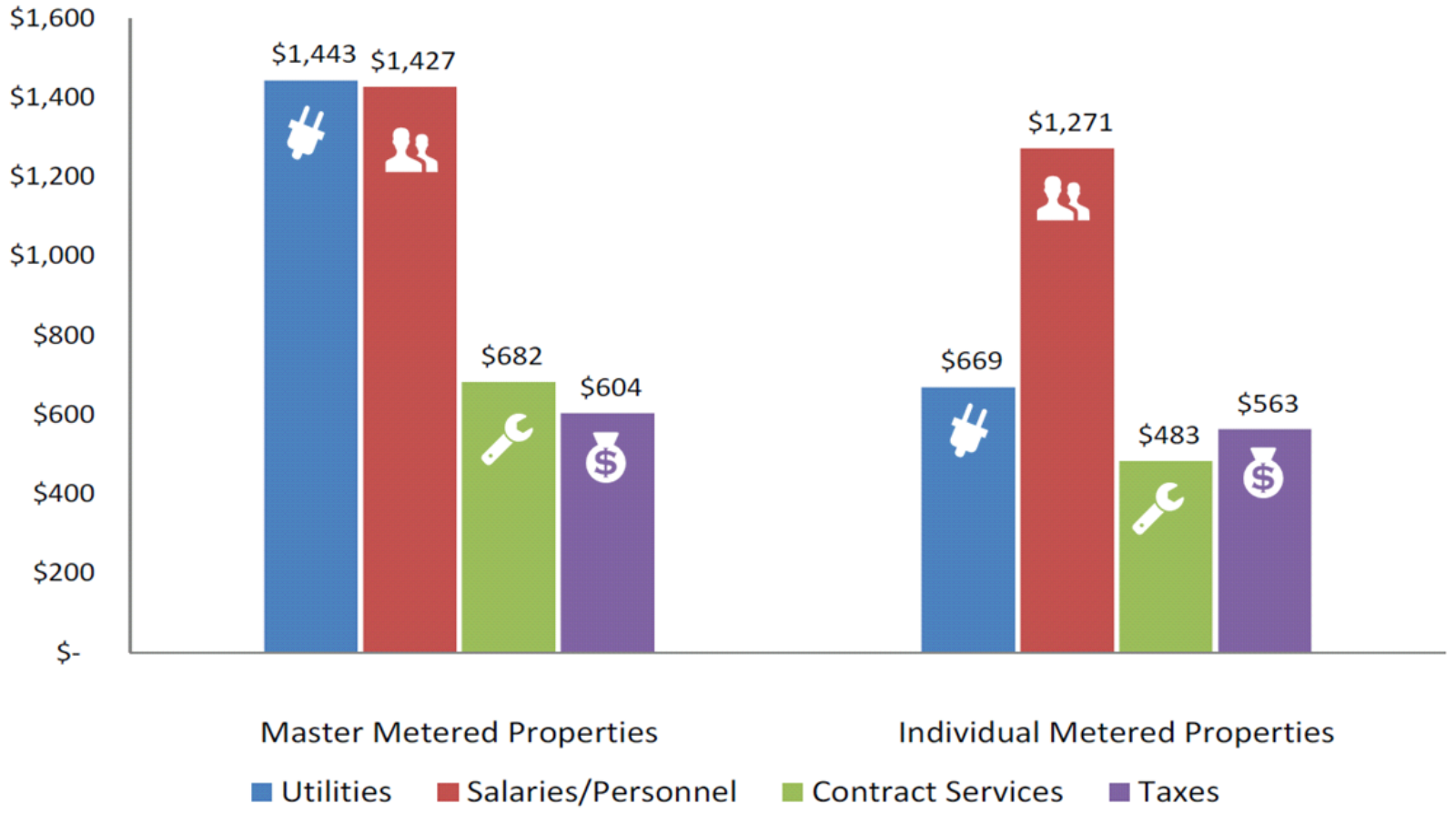
Energy costs present the best opportunity to reduce operating expenses and help sustain affordable housing



Credit: NAA

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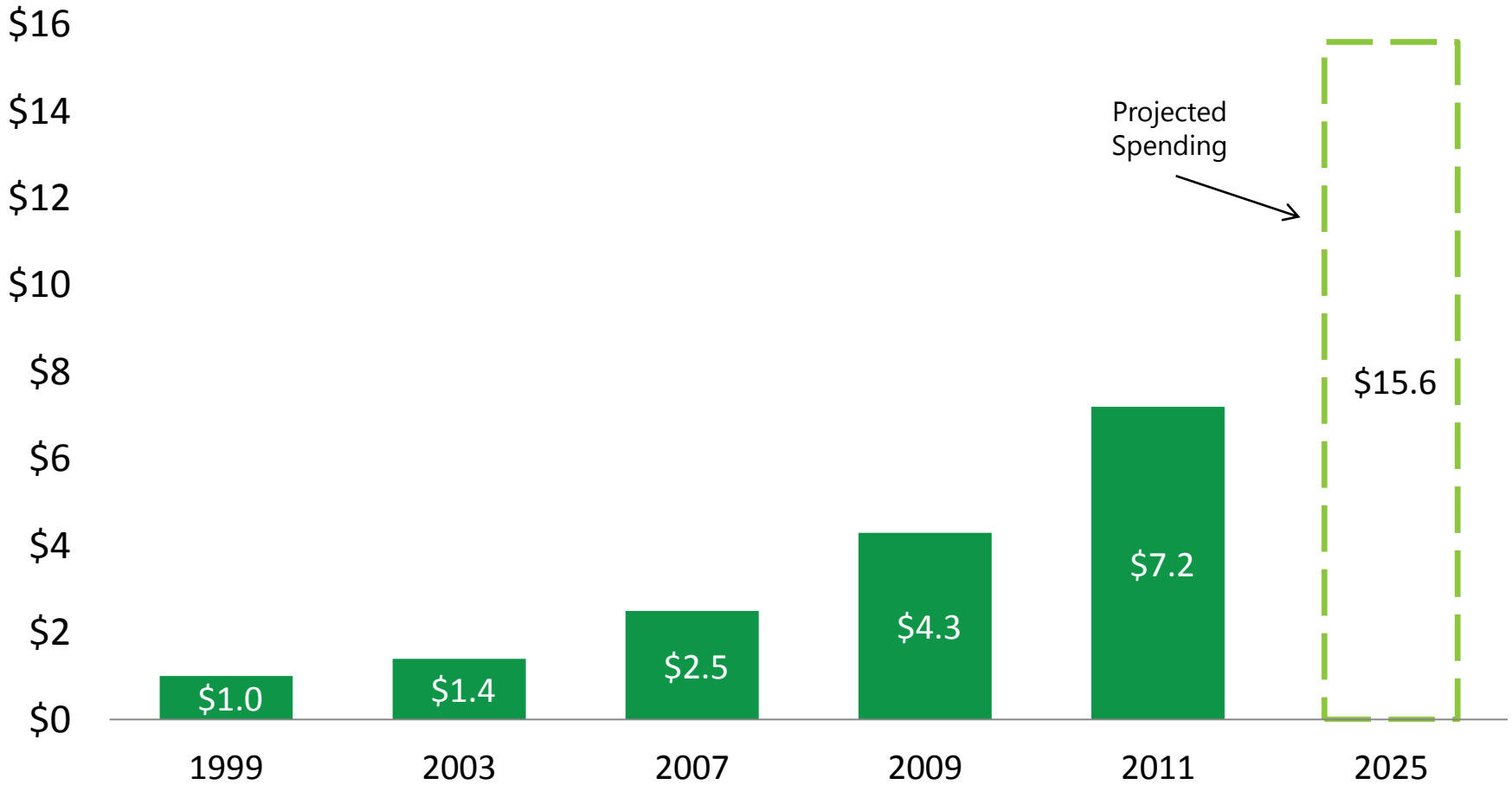
Annual Utility Energy Efficiency Program Spending (in Billion $)



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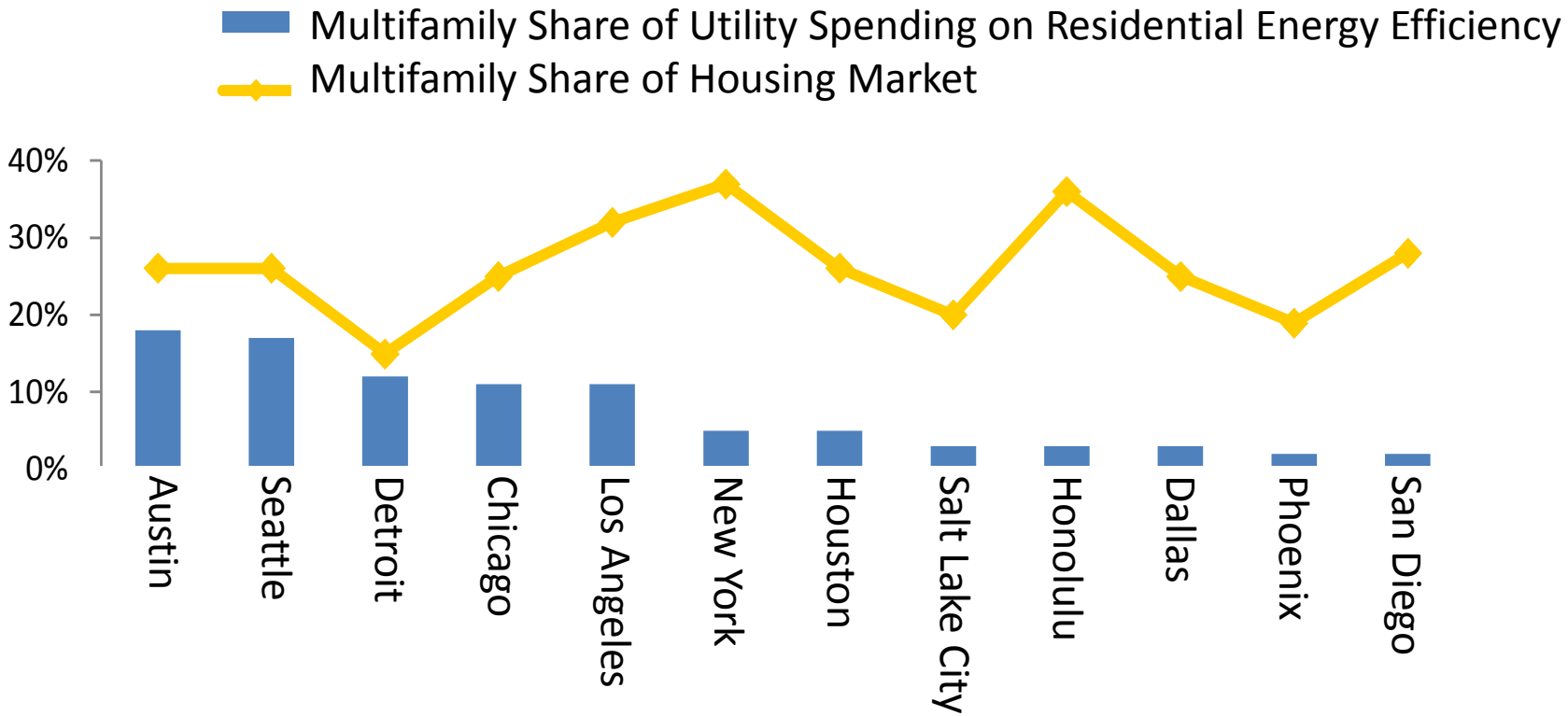
Multifamily is often overlooked



Credit: ACEEE

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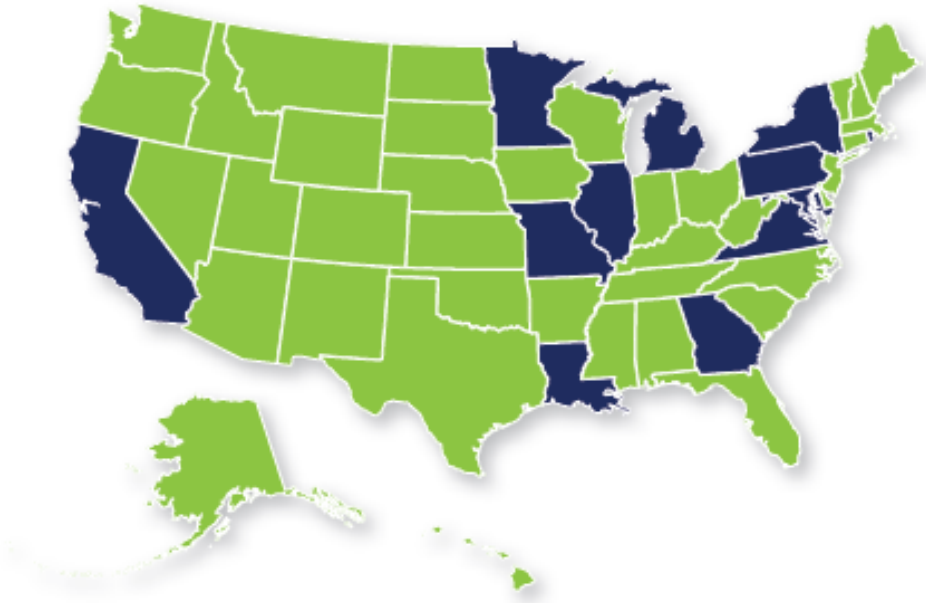
Energy Efficiency for All

Mission: making multifamily homes healthy and affordable through energy efficiency



Working to reach 5 million homes in twelve states across America

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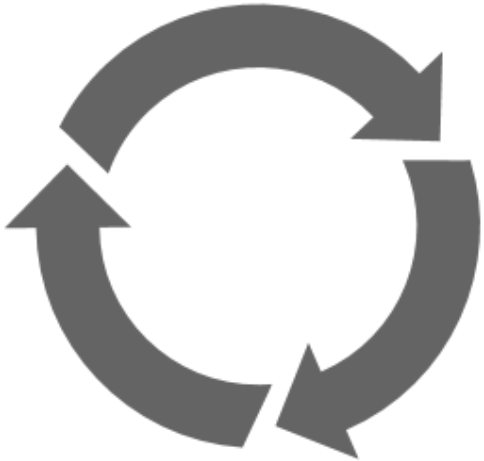
Our Approach

Energy Efficiency Stakeholders



Affordable Housing Stakeholders

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Our Approach

Energy Efficiency Stakeholders

Affordable Housing Stakeholders

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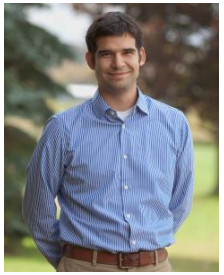
Optimal Energy

Founded in 1996, Optimal Energy provides a full range of energy efficiency consulting services to investor and municipally owned utilities, program administrators, state and federal energy offices, regulatory commissions, advisory councils, and advocacy groups.

Optimal ENERGY
Integrated Energy Resources

Phil Mosenthal



Matthew Socks, LC, CEM

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Shortcomings of Existing Analyses in the Multifamily Affordable Housing Segment

- Undervalue NEBs in cost-effectiveness screens
- Lack comprehensive approach in terms of the measures and practices considered – often omit common area/whole building measures
- Often driven by what PAs actually intend to do
- Often apply policy constraints such as budget limits; don't really estimate what is achievable

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Study Overview

- Estimates the economic and maximum achievable energy efficiency potential in affordable multifamily housing in nine states (GA, IL, MD, MI, MO, NC, NY, PA, VA)
- Estimates for electric utility service territories
- Estimates potential for three fuels – electric, natural gas, and fuel oil (NY only)
- 20-year analysis period (2015-2034)

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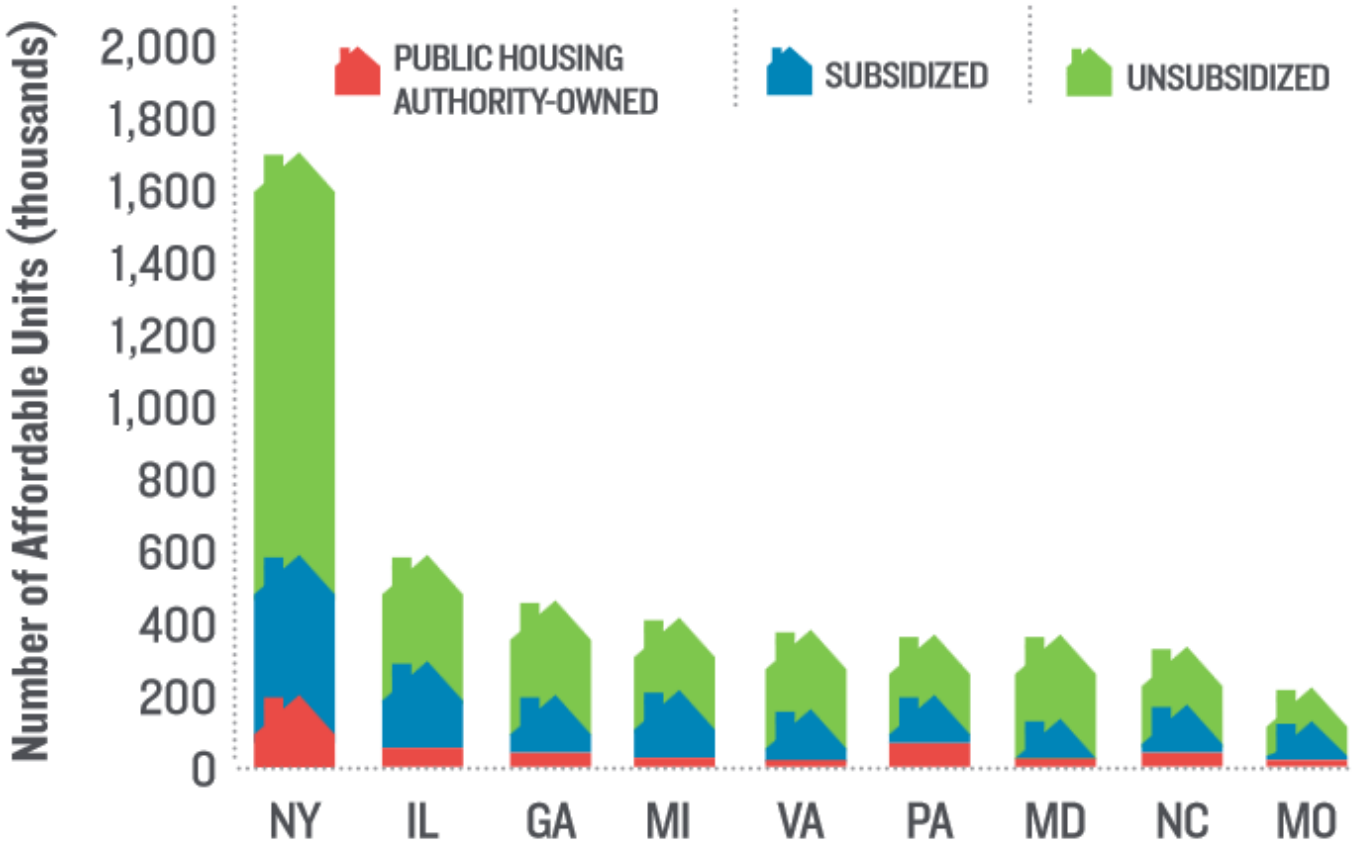
Size of the Opportunity: Affordable Multifamily Housing Units by State and Subsidy Type



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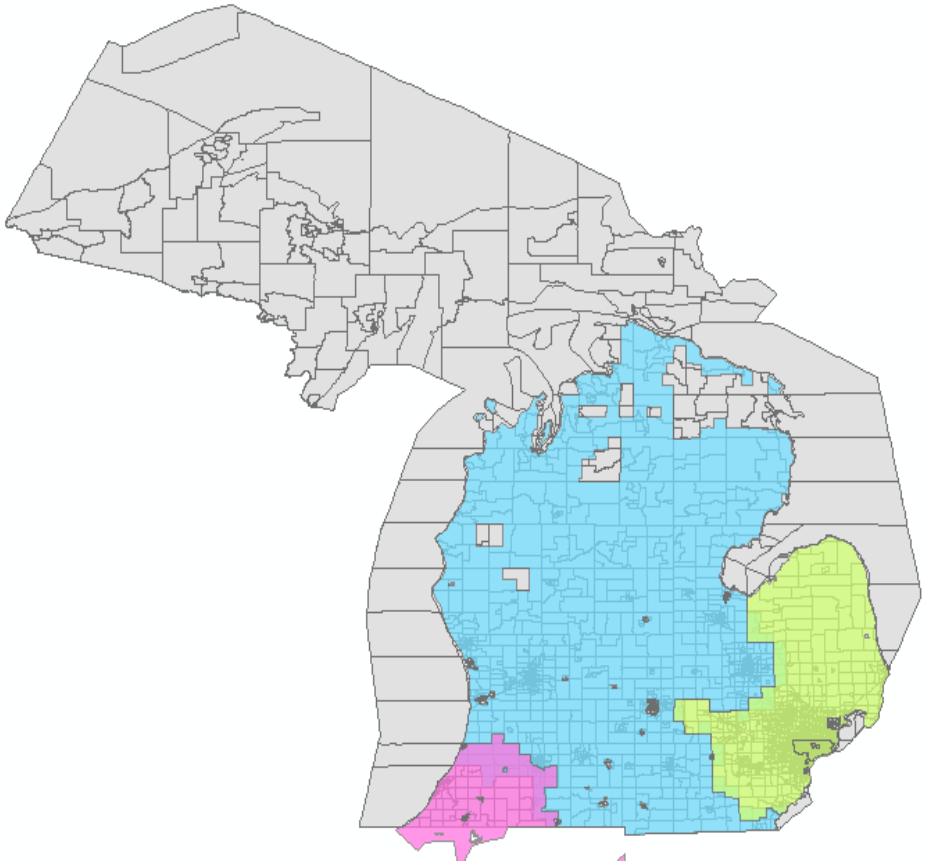
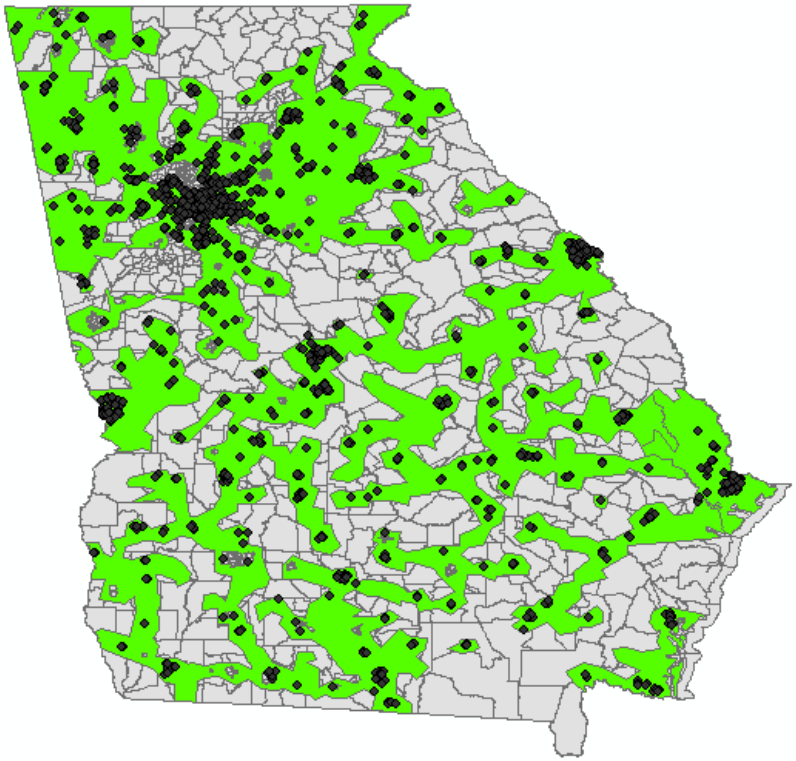
Size of the Opportunity: Units Across Utility Service Territories





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Methodology – General Approach

- "Bottom-up" analysis
- Developed per-housing unit costs and savings by measure
- Screened measures for cost-effectiveness against state/utility specific avoided costs
- Allocated opportunities to state/utility territory using unit counts, fuel share, and equipment saturation data provided by Elevate Energy and the National Housing Trust
- Limited adjustments for state/utility-territory level variation in equipment saturations and current efficiency baselines
- Applied appropriate measure penetration profiles over the study period to estimate economic and max achievable potential

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Methodology (Cont.) – Characterizing Measures

- Defined measure list
- Developed one set of measure level screening inputs (e.g., costs, savings, measure lifetime, baseline assumptions)
- Leveraged existing multifamily potential studies and technical reference manuals
- Developed 182 individual measures

State	Market/Baseline Study	Potential Study	Technical Reference Manual
Study States			
GA			
IL		✓	✓
MD	✓		
MI	✓	✓	✓
MO		✓	
NC		✓	
NY		✓	✓
PA	✓	✓	✓
VA			
Other			
CA	✓		
ID, MT, OR, WA	✓		✓
MA		✓	✓
MN	✓		

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Five Key Findings

1. There is significant energy savings potential in every state studied.
2. Measures to reduce energy usage for heating and cooling contribute to nearly half of projected electric energy savings.
3. The vast majority of natural gas usage is from space heating and water heating.
4. The total benefits to society from pursuing the outlined energy efficiency substantially exceed the costs.
5. The inclusion of non-energy benefits (NEBs) can have a significant impact on maximum achievable potential.

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Results – Cumulative Electric Savings Potential, 2034

State	Economic				Maximum Achievable			
	No NEBs		High NEBs		No NEBs		High NEBs	
	GWh	% of Load	GWh	% of Load	GWh	% of Load	GWh	% of Load
GA	1,200	26%	1,579	34%	804	17%	1,071	23%
IL	1,085	32%	1,264	37%	744	22%	879	26%
MD	846	28%	1,085	36%	578	19%	739	25%
MI	761	37%	881	43%	529	26%	649	31%
MO	530	23%	664	28%	358	15%	459	20%
NY	2,768	34%	3,257	40%	1,981	24%	2,513	31%
NC	946	29%	1,266	39%	629	19%	852	26%
PA	774	29%	936	35%	532	20%	671	25%
VA	905	30%	1,128	38%	620	21%	838	28%

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Results – Cumulative Gas Savings Potential, 2034

State	Economic				Maximum Achievable			
	No NEBs		High NEBs		No NEBs		High NEBs	
	BBtu	% of Load	BBtu	% of Load	BBtu	% of Load	BBtu	% of Load
GA	1,987	22%	2,678	30%	1,175	13%	1,562	17%
IL	5,574	26%	7,379	35%	3,311	16%	4,390	21%
MD	2,894	30%	3,337	35%	1,716	18%	1,978	21%
MI	4,163	18%	5,772	25%	2,440	11%	3,410	15%
MO	990	29%	1,380	41%	590	17%	827	24%
NY	14,123	23%	18,654	31%	8,019	13%	10,765	18%
NC	607	36%	807	48%	362	22%	474	28%
PA	2,737	18%	3,439	22%	1,614	10%	2,028	13%
VA	1,800	23%	2,532	32%	1,059	13%	1,497	19%

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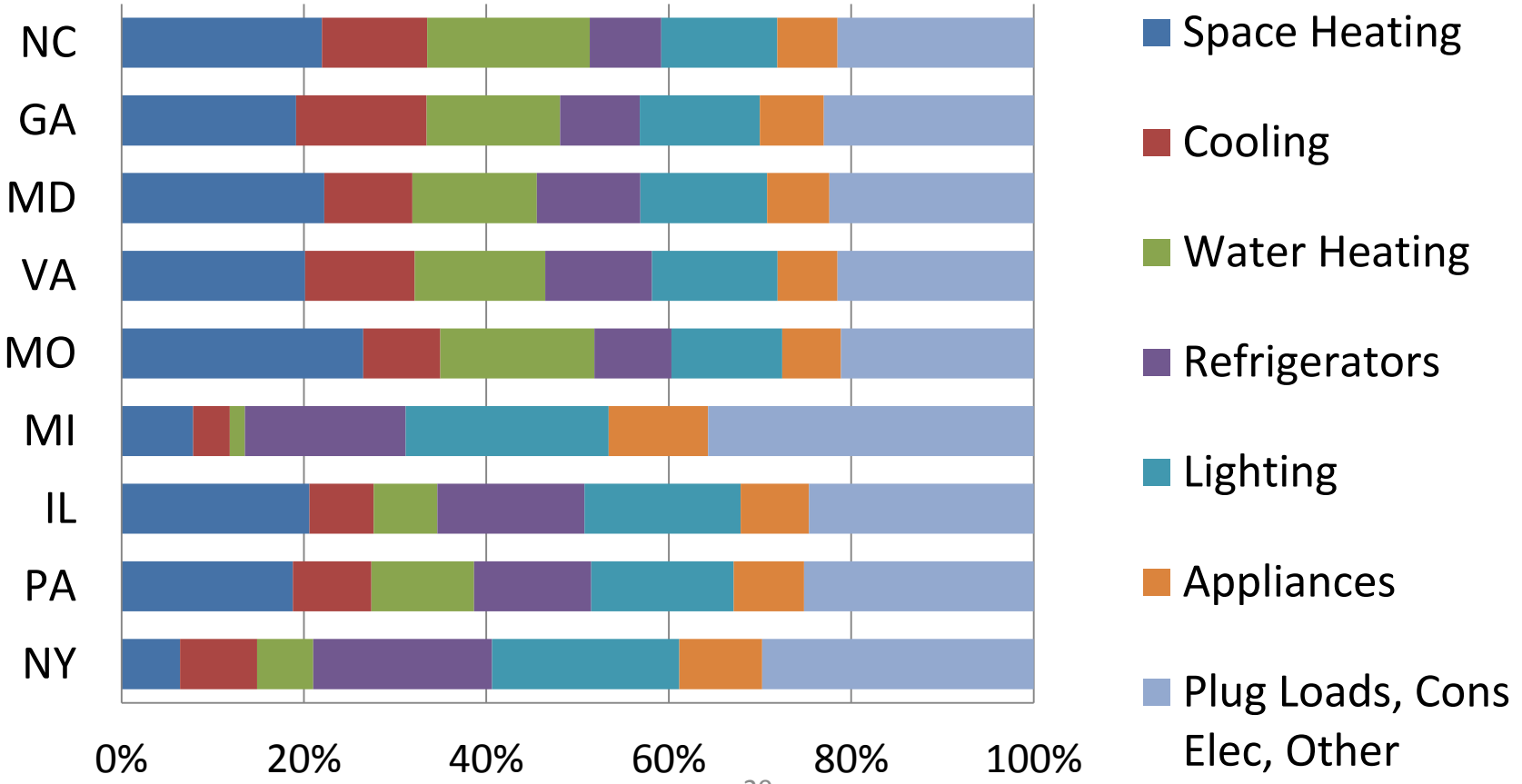
2

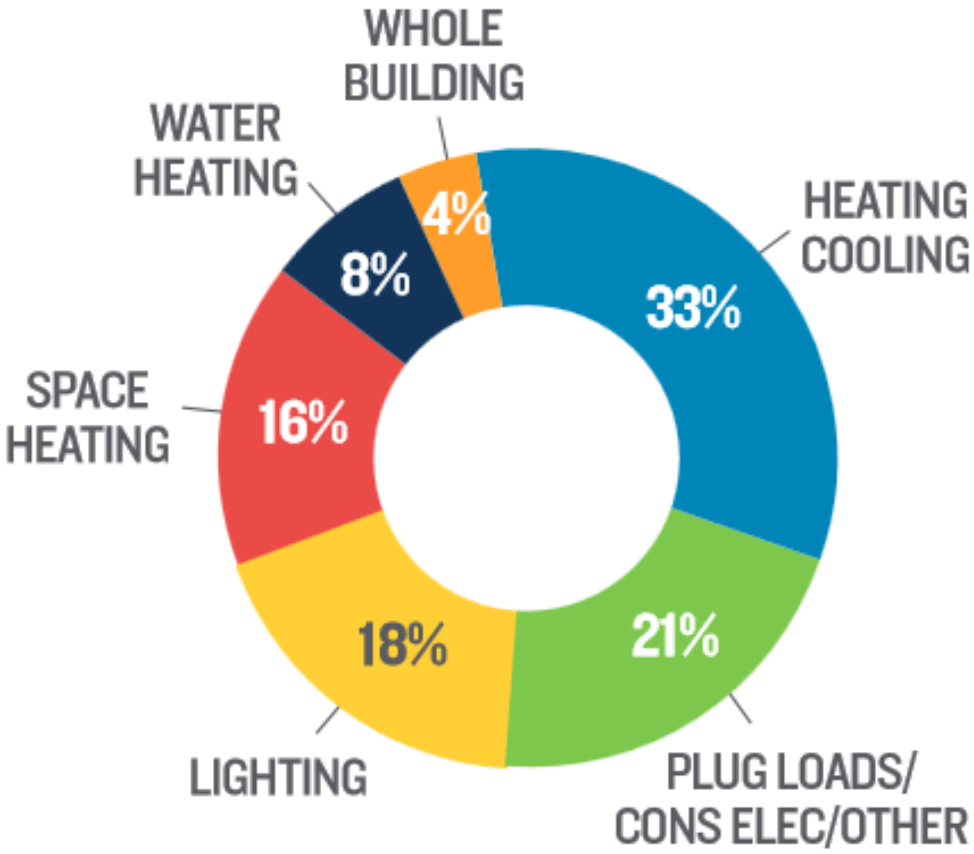
Affordable Multifamily Electric Consumption Distribution by State and End Use



ENERGY EFFICIENCY FOR ALL

2

Results – Cumulative Electric Energy Savings by End Use, 2034



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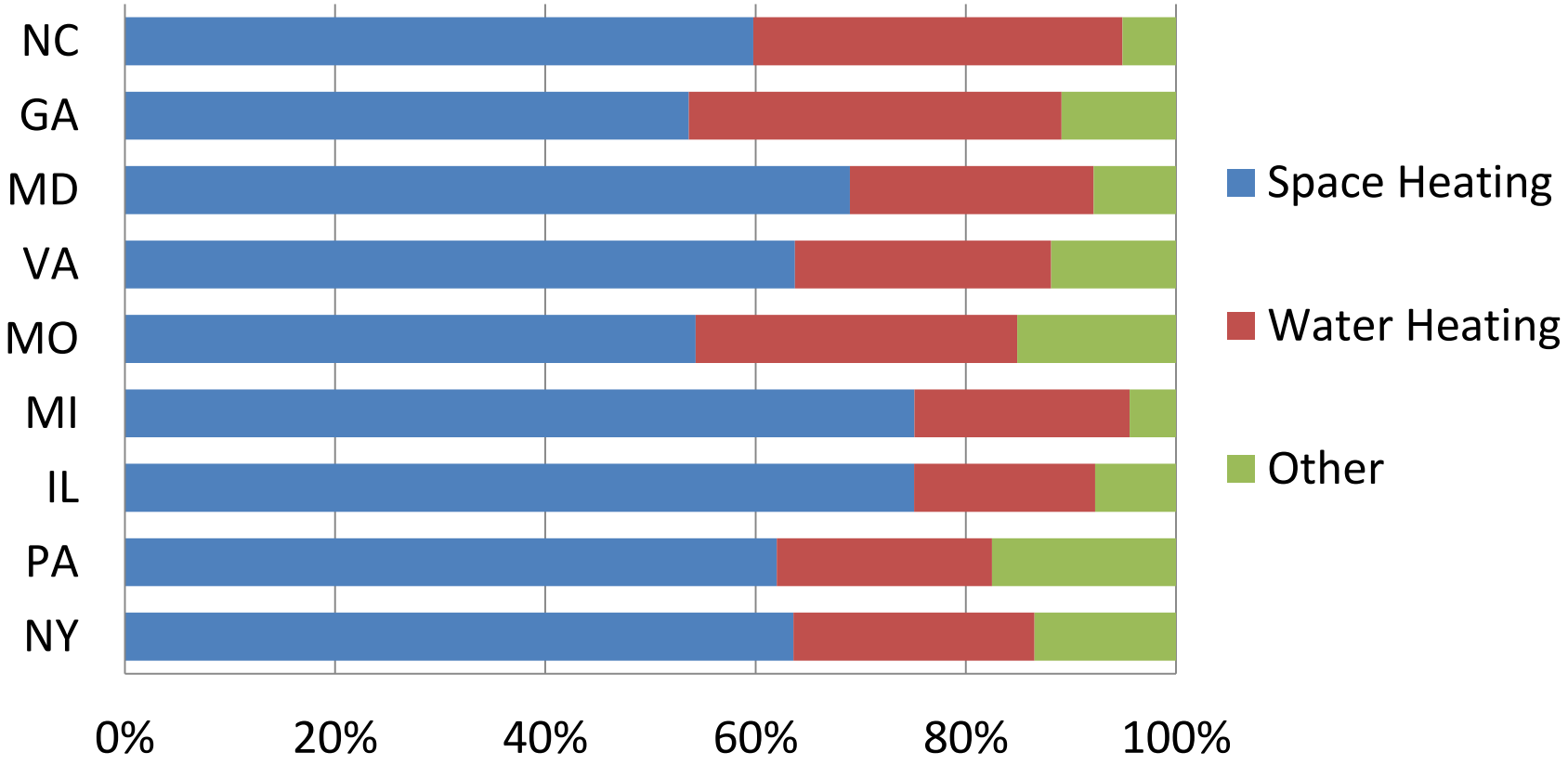
3

Affordable Multifamily Natural Gas Consumption Distribution by State and End Use



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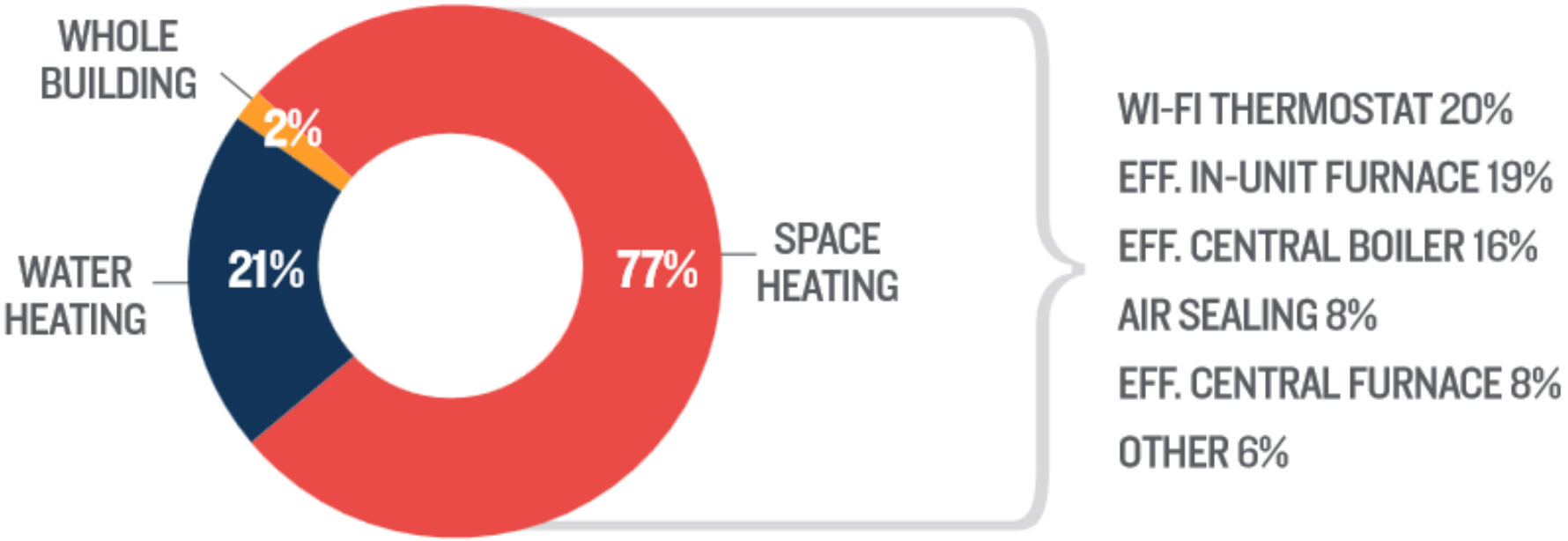
3

Results – Cumulative Natural Gas Energy Savings by End Use, 2034



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4

Results – Electric Costs and Benefits, Maximum Achievable Scenario

	No NEBs				High NEBs			
State	Total Costs	Total Benefits	Net Benefits	BCR	Total Costs	Total Benefits	Net Benefits	BCR
GA	$332	$699	$367	2.1	$812	$2,602	$1,790	3.2
IL	$336	$617	$281	1.8	$536	$2,132	$1,596	4.0
MD	$278	$698	$420	2.5	$628	$2,050	$1,422	3.3
MI	$246	$597	$352	2.4	$572	$1,789	$1,217	3.1
MO	$178	$336	$158	1.9	$348	$1,134	$786	3.3
NY	$976	$2,169	$1,193	2.2	$2,298	$6,739	$4,441	2.9
NC	$272	$577	$305	2.1	$656	$2,088	$1,433	3.2
PA	$252	$526	$274	2.1	$537	$1,724	$1,187	3.2
VA	$277	$551	$274	2.0	$700	$2,052	$1,352	2.9

Note: All dollars are present value 2015 Million $

ENERGY EFFICIENCY FOR ALL

Results – Gas Costs and Benefits, Maximum Achievable Scenario

	No NEBs				High NEBs			
State	Total Costs	Total Benefits	Net Benefits	BCR	Total Costs	Total Benefits	Net Benefits	BCR
GA	$73	$172	$99	2.4	$114	$372	$258	3.3
IL	$235	$481	$246	2.0	$379	$1,058	$680	2.8
MD	$112	$242	$129	2.2	$147	$480	$333	3.3
MI	$171	$354	$182	2.1	$288	$794	$507	2.8
MO	$35	$66	$31	1.9	$63	$171	$108	2.7
NY	$586	$1,240	$654	2.1	$941	$2,650	$1,709	2.8
NC	$21	$49	$28	2.3	$33	$108	$76	3.3
PA	$117	$247	$130	2.1	$171	$506	$335	3.0
VA	$65	$146	$81	2.2	$113	$340	$228	3.0

Note: All dollars are present value 2015 Million $

ENERGY EFFICIENCY FOR ALL

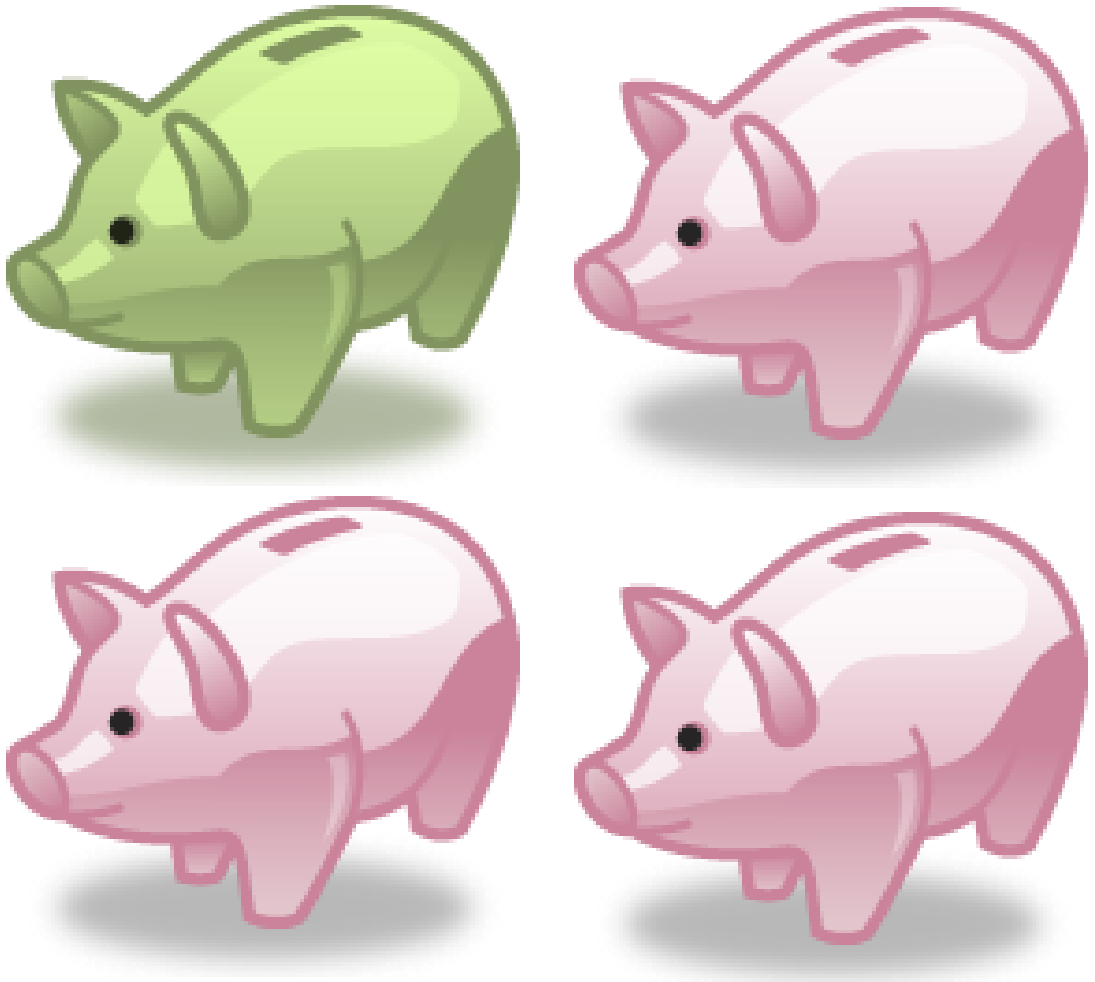
4

Results – Total Costs and Benefits, Maximum Achievable Scenario

State	No NEBs				High NEBs			
	Total Costs	Total Benefits	Net Benefits	BCR	Total Costs	Total Benefits	Net Benefits	BCR
GA	$405	$872	$467	2.2	$926	$2,975	$2,048	3.2
IL	$571	$1,098	$527	1.9	$915	$3,190	$2,276	3.5
MD	$391	$940	$550	2.4	$775	$2,530	$1,755	3.3
MI	$417	$951	$534	2.3	$860	$2,584	$1,724	3.0
MO	$213	$402	$190	1.9	$412	$1,305	$894	3.2
NY	$2,178	$5,293	$3,114	2.4	$3,883	$13,435	$9,552	3.5
NC	$293	$625	$332	2.1	$688	$2,197	$1,508	3.2
PA	$369	$773	$404	2.1	$708	$2,230	$1,522	3.2
VA	$342	$697	$354	2.0	$813	$2,392	$1,579	2.9

Note: All dollars are present value 2015 Million $

Non-Energy Benefits



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5

Non-Energy Benefits

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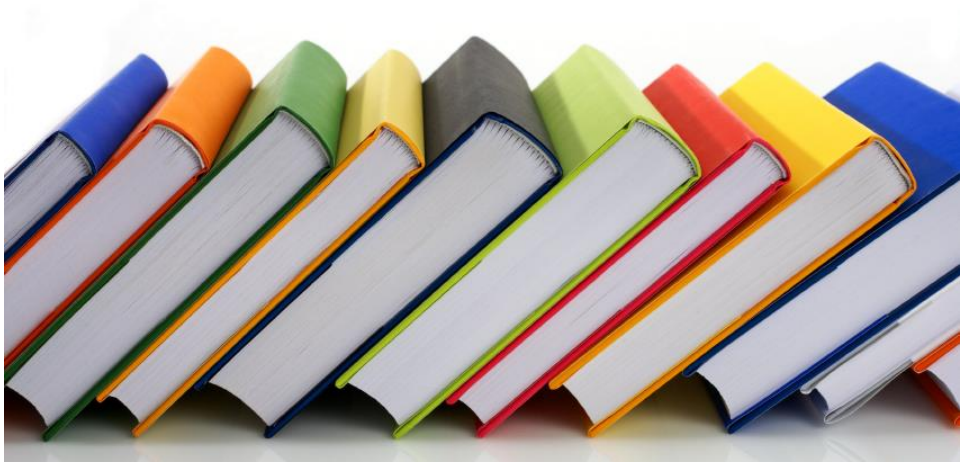
5

Non-Energy Benefits



300 studies

18+ states

Credit: Lisa Skumatz/SERA

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Advocacy

- Utility program design
- Utility energy efficiency program filings
- Clean Power Plan advocacy with state Housing Finance Agencies and other housing partners

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For more information

www.EE4A.org

www.prezcat.org

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Thank you

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Appendix

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Affordable Multifamily Barriers

- Unfamiliar building type
- Complicated meter arrangements
- Owner bandwidth
- Lack of information
- Financing barriers
- Regulatory barriers

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Affordable Multifamily Housing?

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Affordable Multifamily Housing?

"Affordable" generally =

1. Household pays no more than 30% of income for rent + utilities
2. Low-income household makes 80% of Area Median Income

…but also % of Federal Poverty Level and more…

Often close interaction with state Housing Finance Agency

"Multifamily" = buildings of 5+ units

Within affordable…

1. Public Housing
2. Subsidized Housing
   - HUD
   - USDA
   - LIHTC
3. Unsubsidized Housing

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Methodology (Cont.) – Characterizing Measures

- Capture major drivers of differences, e.g.,
  - climate (e.g., equipment full load operating hours, degree days),
  - labor and equipment costs,
  - in unit lighting hours of use,
  - population of affordable multi-family buildings/units,
  - avoided costs
- Developed a set of "regionalization factors" that differed by state/utility territory

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Methodology (Cont.) – Characterizing Measures

- As appropriate, develop characterizations for two building segments (i.e., 5-49 units and >49 units)
- Develop "per-housing unit" costs and savings, by measure
  - Central system or common area measures (e.g., boilers) are prorated to housing unit
- Enables application of methodology to different states/utility territories based on unit counts

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Methodology (Cont.) – Developing Avoided Costs

- Developed range of avoided costs representative of states in the study
- For electricity, developed low and high sets of avoided costs and for both high coincidence and low coincidence measures
- For natural gas, developed low and high sets of avoided costs
- For fuel oil a single set of avoided costs was used (NY only)
- A single water avoided costs is assumed for all regions
- Avoided costs based on values published in potential studies, utility filings, proprietary data, or scaled from retail rates.
- Avoided costs assume 1% escalation rate

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Methodology (Cont.) – Estimating Economic Potential

- Screen all permutations of measures, weather, measure costs, lighting hours of use, and avoided costs for cost-effectiveness at the unit level
- 20-year program delivery period
- Total Resource Cost (TRC) test, 3% Real Discount Rate
- Use Elevate Energy/NHT data to build total economic potential estimates at the state/utility territory levels
- Each territory uses a unique assigned value for weather, measure costs, lighting operating hours, and avoided costs
- For economic, analysis assumes all cost-effective retrofit measure are implemented in year one.
- Market-driven replacement measures are implemented at the rate of turnover.

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Methodology (Cont.) – Estimating Maximum Achievable Potential

- Develop budgets and penetration rates
- Estimated non-incentive program costs from MA and RI low-income programs
- Assume incentives cover 100% of measure costs
- Retrofits: establish maximum ultimate penetration levels and curves
- Market-driven replacements: penetrations reflect portion of eligible market in each year applied to turnover rate
- Perform externality scenario analysis

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Results – Missouri Total Costs and Benefits, Maximum Achievable, Low NEBs Scenario

Utility	Total Costs	Total Benefits	Net Benefits	BCR
MO Total	$335	$845	$511	2.5
Ameren Missouri	$142	$347	$205	2.4
Empire District	$13	$35	$22	2.8
Kansas City Power & Light	$107	$262	$155	2.4
City Utilities of Springfield	$20	$56	$36	2.8
Other	$53	$146	$93	2.8

Note: All dollars are present value 2015 Million $

DRAFT- Study Forthcoming

www.EE4A.org

STUDY FACT SHEET:

Potential for Energy Savings in Affordable Multifamily Housing

ABOUT THE STUDY:

The Natural Resources Defense Council (NRDC) commissioned Optimal Energy to conduct a study to estimate the potential energy savings from the implementation of efficiency measures in affordable multifamily housing[1] in nine states – Georgia, Illinois, Maryland, Michigan, Missouri, New York, North Carolina, Pennsylvania, and Virginia. The analysis includes savings for electricity, natural gas, and fuel oil usage over a 20-year period, 2015 to 2034.

FINDINGS:

There is significant energy savings potential in the affordable multifamily sector in every state studied.

- Maximum achievable potential for electricity energy savings ranges by state from 15% to 26% by 2034.
- The maximum achievable potential for natural gas is lower than electricity, ranging from 10% to 22% relative to forecasted load in 2034.

Measures to reduce energy usage for heating and cooling contribute to nearly half of projected electric energy savings.

- The heating and cooling end uses (i.e., heating/cooling, space heating, and cooling) contribute a combined 49% of total electric energy savings by 2034. The savings potential is achieved primarily through the introduction of smart thermostats, efficient windows, and air sealing.
- Equipment plugged directly into an outlet (plug load), of which consumer electronics are a major part, contributes a significant 21% of the total potential.
- Energy efficiency measures for lighting contribute 18% of the electric potential.
- After lighting, the next largest end use savings contributions come from improvements in water heating (8%) and whole-building measures (4%), such as behavioral initiatives and making improvements in existing equipment (retro-commissioning).

[1] For the purposes of this study, affordable multifamily housing is defined as households in buildings with five or more units occupied by people with household incomes at or below 80% of the area median income.

[2] Maximum achievable potential is the amount of savings that can be realized if all cost-effective efficiency measures are implemented given existing market barriers. "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.

DRAFT- Study Forthcoming

Natural gas usage in the affordable multifamily housing sector is largely limited to space heating, water heating, and cooking.

- Space heating accounts for 77% of the gas savings, with an additional 21% from water heating measures. The remaining 2% are from retro-commissioning activities.
- Smart thermostats, efficient in-unit and central furnaces, central boilers, and air sealing contribute the vast majority of space heating savings.
- Commercial clothes washers, water heater pipe wrap, and low-flow showerheads and faucet aerators are the principal measures contributing to gas water heating savings.

The total benefits to society from pursuing energy efficiency in affordable multifamily housing substantially exceed the costs.

- The maximum achievable potential scenarios for all states and fuels are highly cost-effective from a Total Resource Cost Test perspective; that is, the total resource benefits of energy efficiency substantially exceed the costs.
- Statewide benefit-to-cost ratios (BCR) range from 1.8 to 2.8 depending on the state and fuel.
- For New York, total benefits from all fuels amount to $5.3 billion from an investment of $2.2 billion, resulting in net benefits of approximately $3.1 billion. The ratio of benefits to costs is such that the energy efficiency spending would return $2.40 to the New York economy for every dollar invested.

The inclusion of non-energy benefits (NEBs) can have a significant impact on maximum achievable potential, especially for the affordable multifamily housing sector.

- Energy efficiency improvements can result in non-energy benefits for low-income participants, including: reduced arrearages; reduced customer calls and collection activities; reduced safety related emergency calls; higher comfort levels; increased housing property values; and health related benefits.
- Accounting for the full value of NEBs increases the overall benefit-to-cost ratio from 2.2 to 3.3 for all states studied.

ABOUT ENERGY EFFICIENCY FOR ALL

We are a partnership of organizations blending expertise in affordable housing, energy efficiency, finance, building owner and utility engagement. We work closely to support local groups by bringing tools and resources that help make multifamily homes healthy and

y.

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