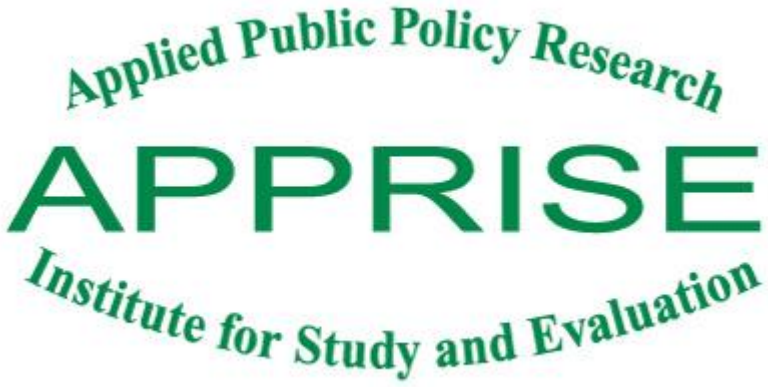

Low-Income Energy Efficiency

Opportunities Study

December 2017

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Acronyms

ACEEE	American Council for an Energy Efficient Economy
ACS	American Community Survey
AMI	Area Median Income
APEEP	Air Pollution Emission Experiments and Policy
APPRISE	Applied Public Policy Research Institute for Study and Evaluation
ARRA	American Recovery and Reinvestment Act (2009)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers.
BA	Building Analyst
BCAP	Building Codes Assistance Project
BEA	Bureau of Economic Analysis
BPI	Building Performance Institute
BPU	Board of Public Utilities
CAP	Customer Assistance Program (PA)
CARE	Colorado Affordable Residential Energy Program
CBO	Community Based Organization
CDFI	Community Development Financial Institution
CEIP	Clean Energy Incentive Program
CEO	Colorado Energy Office
CEU	Continuing Education Unit
CFL	Compact Fluorescent Light
CPP	Clean Power Plan
CRA	Community Reinvestment Act

CRA	Comprehensive Resource Analysis (NJ)
CSG	Community Solar Garden
DCEO	Department of Commerce and Economic Opportunity (IL)
DHA	Denver Housing Authority
DHHS	Department of Health and Human Services
DOE	Department of Energy
DSM	Demand Side Management
EAP	Emergency Assistance Program
ECA	Energy Coordinating Agency
ECM	Energy Conservation Measure
EDC	Electric Distribution Company
EDF	Environmental Defense Fund
EEAHCP	Energy Efficient Affordable Housing Construction Program (IL)
EE&C	Energy Efficiency and Conservation Plan
EECLP	Energy Efficiency and Conservation Loan Program
EEPS	Energy Efficiency Portfolio Standard
EERS	Energy Efficiency Resource Standard
EETF	Energy Efficiency Trust Fund (IL)
EIA	Energy Information Administration
EM&V	Evaluation Measurement and Verification
EOC	Energy Outreach Colorado
ERC	Emission Rate Credits
ESA	Energy Service Agreement
ESAP	Energy Savings Assistance Program (CA)

ESCO	Energy Service Company
ESPC	Energy Saving Performance Contract
FEJA	Future Energy Jobs Act (IL)
FFY	Federal Fiscal Year
FPIG	Federal Poverty Income guidelines
FPL	Federal Poverty Level
GDP	Gross Domestic Product
GHHI	Green and Health Homes Initiative
GJGNY	Green Jobs Green New York
HELP	Home Energy Loan Program (PA)
HEP	Home Energy Professional
HPwES	Home Performance with Energy Star
HVAC	Heating Ventilation and Air Conditioning
ICC	Illinois Commerce Commission
IOU	Investor-Owned Utility
LED	Light Emitting Diode
LIEE	Low-Income Energy Efficiency
LIHEAP	Low-Income Home Energy Assistance Program
LIURP	Low-Income Usage Reduction Program (PA)
LMI	Low- to Moderate-Income
LRAM	Lost Revenue Adjustment Mechanism
NASCSP	National Association for State Community Services Programs
NATE	North American Technician Excellence
NEBS	Non-Energy Benefits

NEEP	Nonprofit Energy Efficiency Program (CO)
NEID	New Energy Improvement District (CO)
NGDC	Natural Gas Distribution Company
NHEC	New Hampshire Electric Coop
NJCP	New Jersey Comfort Partners
NJCEP	New Jersey Clean Energy Program
NJNG	New Jersey Natural Gas
NRC	National Research Council
NRDC	Natural Resources Defense Council
NYSERDA	New York State Research and Development Authority
OBF	On-Bill Financing
OBR	On-Bill Repayment
OMB	Office of Management and Budget
PAAD	Pharmaceutical Assistance to the Aged & Disabled (NJ)
PACT	Program Administrator Cost Test
PACE	Property Assessed Clean Energy
PAYS	Pay as You Save
PCT	Participant Cost Test
PSNH	Public Service of New Hampshire
PUC	Public Utility Commission
PUMS	Public Use Microdata Sample
RECS	Residential Energy Consumption Survey
RESP	Rural Energy Savings Program
RHA	Rockford Housing Authority

RIM	Ratepayer Impact Measure
RIMS	Regional Input-Output Modeling System
RPS	Renewable Portfolio Standard
RUS	Rural Utilities Service
SASH	Single-Family Affordable Solar Homes (CA)
SBC	Societal Benefits Charge / Systems Benefit Charge
SCF	Survey of Consumer Finances
SCT	Societal Cost Test
SELF	Solar and Energy Loan Fund (FL)
SIR	Savings to Investment Ratio
SJG	South Jersey Gas
SMI	State Median Income
TOB	Tariffed On-Bill
TRCT	Total Resource Cost Test
TRM	Technical Reference Manual
UCT	Utility Cost Test
USDA	United States Department of Agriculture
USECP	Universal Service and Energy Conservation Plan (PA)
USF	Universal Service Fund
VEIC	Vermont Energy Investment Corporation
WAP	Weatherization Assistance Program

Foreword

"It's nice for the poor to make ends meet. It's even nicer to make them overlap a bit." Roger D. Colton, Fisher, Sheehan & Colton

That quote is at the end of every email signature that I have ever received from Roger, a brilliant attorney and economist who first introduced me to the importance of advocacy driven by data. I am not sure if he is the appropriate person to provide credit for this quote, but it provides a good reminder for me every time I see it.

This Low-Income Energy Efficiency Opportunities Study is an exciting new resource to inform critical advocacy efforts by providing data and analysis to help educate stakeholders and policymakers committed to providing affordable, reliable and accessible clean energy to families across the country.

Addressing poverty and environmental issues are two great challenges of our time. Although they often appear in tension, solutions do exist to address them together, in order to ensure our most vulnerable communities come out on top. This is no less true when it comes to clean and affordable energy.

As an energy advocate at Energy Outreach Colorado (EOC), a statewide nonprofit whose mission is to ensure that all Coloradans have access to home energy, my vision is to live in a community where everyone benefits from affordable energy.

In pursuit of this vision, I was pleased to introduce staff at the Environmental Defense Fund, known for their commitment to “finding practical and lasting solutions to the most serious environmental problems,” and the staff at APPRISE, known for their thorough and thoughtful research to improve low-income energy assistance and efficiency programs.

With increasing urgency around state level action, EDF envisioned pursuing a project to help support ongoing efforts at the state level to reduce greenhouse gas emissions while simultaneously improving access to affordable clean energy for vulnerable families across the country. EDF expressed a desire to work in partnership with APPRISE and advocates in key states — including my organization, Energy Outreach Colorado — to fulfill this vision by providing robust analysis to identify strong policies and best practices for an intentional effort to deepen investment in low-income efficiency solutions.

This *Low-Income Energy Efficiency Opportunities Study* serves as a foundation for this effort. The study provides rigorous, data-driven analysis of policies and programs that serve vulnerable households in diverse states including Colorado, Illinois, New Jersey and Pennsylvania. It contains recommendations for policymakers, advocates, and service providers to offer more comprehensive, scaled-up efficiency solutions to low-income families in these states and more. Although these states have a variety of regulatory policies, utility programs, public/private sector partnerships, fuel generation mixes, and energy costs, I believe bringing in-depth information from

all four states together will provide a platform for readers to identify new low-income energy efficiency solutions regardless of the state in which they operate.

There is tremendous potential for significant investments to expand energy efficiency across low-income households — investments that can save families money and energy while improving air quality and helping mitigate the disproportionate impacts of climate change on vulnerable communities. Yet, it has historically been difficult for many low-income families to connect with these benefits. While the Department of Energy's Weatherization Assistance Program has been a critical resource for hundreds of thousands of families since its inception, it has only scratched the surface compared to the need for affordable, efficient electricity to heat homes and serve other critical uses. Volatile energy costs, aging building stock, increasing housing costs, stagnant wages, increased energy burdens, changing utility rate designs due to improved technology and more distributed resources, and the imperative to reduce greenhouse gas emissions are all driving the need for more comprehensive energy policies that ensure low-income families are able to share in the benefits of affordable energy and a healthier environment. Energy efficiency programs that prioritize our most vulnerable families and neighbors can reduce energy bills, preserve affordable housing, and make homes safer and healthier all at once.

Together, through rigorous, intentional, and innovative policy design informed by relevant case studies and sound analysis, we can work to ensure that customers across all income brackets reap the benefits of energy efficiency to save money, secure a more stable climate, and ensure healthier homes.

Jennifer Gremmert
Executive Director
Energy Outreach Colorado
Denver, Colorado
November 28, 2017

Executive Summary

The Environmental Defense Fund contracted with APPRISE to develop information on opportunities for Low-Income Energy Efficiency (LIEE) in four target states and around the country. The research assessed policy and program design changes that are necessary to overcome barriers and fully realize the benefits of LIEE programs.

Research Conducted

The goals of the research were to develop data and information that provide advocates with key insights to advance new LIEE policies and programs. Research was conducted through review of LIEE literature and research reports, including previous APPRISE studies, and interviews with key program actors. The following topics were covered.

- Regulatory and Program Structure of LIEE offerings
- Energy Costs and Energy Burden for Low-Income Households
- Energy Efficiency Funding and Opportunities
- Barriers to Investment in LIEE
- Policies and Financing Mechanisms
- Evaluation of LIEE Programs
- Best Practices for LIEE Programs

Regulatory Background and Program Structure

The regulatory requirements and administrative structure for LIEE programs can have a large impact on program design, efficiency, and effectiveness. Specific legislation, regulation, and programs were studied in Colorado, Illinois, New Jersey, and Pennsylvania. These states were chosen because they all have well-developed LIEE programs, but the programs are organized, managed, and delivered in very different ways. As such they provide diverse examples of potentially success models for LIEE delivery.

States that have specific spending or saving requirements for LIEE have generally directed more resources to low-income households. PA has the largest amount of resources directed to electric LIEE programs both in terms of the total amount of funding allocated and the funding per potentially eligible participant. Their high level of funding relates to the requirements for LIEE programs focused on both affordability and usage, and additional electric efficiency programs focused on reductions in usage with requirements for low-income carve-outs.

Only investor-owned utilities are generally mandated to offer LIEE programs. However, public utilities and electric cooperatives together provide 25 percent of the total electric consumption in the U.S., and are therefore an important target for LIEE. Because energy efficiency programs are usually regulated by the state Public Utility Commissions who often do not oversee municipal and rural utilities, it may be challenging to develop LIEE programs through these utilities. There may be opportunities, as some of these utilities have invested

in energy efficiency to delay investments in power plants and some public power utilities in CA, FL, IA, NE, NY, SC, TX, VT, and WA have adopted their own energy efficiency goals.

LIEE programs generally provide income-eligibility based on 200 percent of the federal poverty level (FPL) or 80 percent of area median income (AMI), or of state median income (SMI). While the FPL-based requirements do not change based on the characteristics of the locality, the AMI and SMI are related to the area- or state-level economies.

Third-party evaluation is an important component of LIEE programs to ensure that expected savings are realized and that programs are operating efficiently and effectively. An assessment of energy savings should be conducted with a billing analysis using utility energy usage data. While CO and IL provide projected savings estimates through their Technical Reference Manual (TRM), NJ has recently conducted evaluation using utility billing analysis in 2013 and 2017, and PA requires utilities to conduct an annual billing analysis for their LIURP program. The PA Act 129 Program uses TRM analysis.

All four researched states have some degree of coordination in their LIEE programs. Colorado has the most extensive coordination through Energy Outreach Colorado (EOC), as utility ratepayer funding is coordinated with WAP, state severance tax, and other available funds. New Jersey effectively coordinates between gas and electric utilities as they jointly deliver these services, and they are working to increase coordination with WAP. Illinois has transferred their LIEE programs from the state to the utilities (beginning in January 2018), which may result in reduced program coordination. Pennsylvania has challenges coordinating programs due to varying usage requirements and targeting procedures, but some utilities have actively worked to increase coordination with WAP and other utilities by removing such requirements on coordinated jobs.

Low-Income Energy Efficiency Needs and Opportunities

Analysis of Residential Energy Consumption Survey (RECS) data provided in the Low-Income Home Energy Assistance Program (LIHEAP) Home Energy Notebook showed that 54 percent of all low-income households' energy expenditures was for electric end uses including energy used by appliances, refrigeration, and cooling. For households that also use electric water heating, electricity represented 68 percent of energy usage, and for households that use electricity for both water heating and space heating, electricity represents all end uses.

Over the past ten years, there has been an increase in the percentage of households who heat with electricity. For low-income households, the increase was from 31.8 percent in 2005 to 36.7 percent in 2009 (from the RECS). Low-income households use electric heating at a higher rate than non-low-income households. The 2015 American Community Survey (ACS) showed that 42 percent of low-income households across the U.S. used electricity as their main heating fuel.

Electric heating usage by low-income households varied in the four target states.

- Colorado: 31 percent below 150 percent of FPL used electric heat.
- Illinois: 22 percent below 150 percent of FPL used electric heat.

- New Jersey: 17 percent below 150 percent of FPL used electric heat.
- Pennsylvania: 27 percent below 150 percent of FPL used electric heat.

About two-thirds of the low-income electric heating households were renters and about half of the low-income electric heating households were in multi-family buildings, indicating that these are important targets for reducing electric usage among low-income households.

The analysis also demonstrated that low-income energy burden is much higher than non-low-income energy burden. While the average burden for electric heaters with income below 150 percent of the FPL was 12 percent, the average for those below 80 percent of state median income (SMI) was seven percent, and the average for all households was three percent.

Table ES-1 shows that in each of the four target states, 17 to 20 percent of the households had income below 150 percent of the FPL, 24 to 29 percent were below 200 percent of the FPL, 27 to 33 percent were below 60 percent of SMI, and 34 to 44 percent were below 80 percent of SMI. The table shows that while over 345,000 households in Colorado had income below 150 percent of the FPL, 964,000 in Illinois, 537,000 in New Jersey, and 988,000 in Pennsylvania had income below 150 percent of the FPL.

Table ES-1
Number and Percent of Households
At Various Income Levels

Income Level	Colorado		Illinois		New Jersey		Pennsylvania		United States	
	#	%	#	%	#	%	#	%	#	%
<150% FPL	345,372	17%	964,552	20%	537,445	17%	988,130	20%	25,557,010	22%
<200% FPL	511,231	25%	1,367,685	29%	756,946	24%	1,427,31	29%	36,121,537	31%
<60% SMI	565,298	27%	1,448,792	30%	1,039,924	33%	1,513,726	31%	34,911,350	30%
<80% SMI	803,528	34%	1,969,925	41%	1,398,300	44%	2,097,807	42%	48,016,733	41%
All HH	**2,074,739**	**100%**	**4,794,513**	**100%**	**3,187,963**	**100%**	**4,956,033**	**100%**	**118,208,212**	**100%**

We conducted an analysis to estimate the amount that could be cost-effectively spent on an electric heating energy efficiency project (based on electric savings with or without a non-energy benefit adder) under various assumptions. Under the most conservative approach (with respect to pre-treatment usage, measure life, and without a non-energy benefit adder), we estimated that $3,321 could be cost-effectively spent and under the most aggressive approach, we estimated that $6,231 could be cost-effectively spent.

If the average LIEE cost per home was $5,000 (slightly above the midpoint of the potential range described above), and with the state's current total electric efficiency budget, Colorado could serve a total of 1,770 households and PA could serve a total of 15,152 households. PA and NJ currently have large enough electric efficiency budgets to serve ten percent of the top 30 percent of electric heating energy users under 150 percent of the FPL annually and still

provide electric energy efficiency services to non-electric heaters. To serve ten percent of the top 30 percent of electric heating households under 80 percent of AMI, CO would need 380 percent of their current annual budget, and PA would have just about enough budgeted annually to serve these households.

Barriers to Low-Income Energy Efficiency

Many barriers are encountered when attempting to provide energy efficiency services to low-income communities. Economic barriers, technical barriers, social barriers, and informational barriers are explored in this report. The barriers that have the greatest detrimental impact on LIEE are summarized below.

- Economic Barriers: Energy efficiency services are expensive and require a large up-front investment before cost savings are realized, often over a period of ten to 15 years. As a result, low-income households are unlikely to participate in LIEE programs that require a monetary contribution. Low-income households are dependent on ratepayer-funded programs and raided energy efficiency funds may present a large barrier to LIEE service provision. Additional economic barriers to LIEE discussed in this report include the landlord/tenant split incentive, use of asymmetric cost-effectiveness tests, utility rates designed with high fixed costs, and other utility disincentives.

- Social Barriers and Transactions Costs: There are many significant barriers to no-cost LIEE participation as well. The transactions costs of application, obtaining landlord permission, readying the home for services, and being at home during the weekday for service delivery are large. Additionally, households may not be aware of available options or understand the potential benefits of energy efficiency. There can be challenges in gaining acceptance and participation in no-cost LIEE programs, which may be related to language barriers, literacy, or immigration status.

- Health and Safety Barriers: Home issues including mold, asbestos, knob and tube wiring, pests, clutter, and structural issues can prevent installation of important energy efficiency measures. The prevalence of these issues in low-income homes can be high, reducing the savings that can be achieved. Additional funding for remediation of these issues is needed.

- Data and Information: A fundamental challenge with analyzing LIEE programs and providing an assessment of who is and is not served, the services that are provided, and the results that are achieved, is a lack of data and information. Two key areas where information is needed are participant and program statistics and evaluation results that utilize utility billing data (as opposed to TRM analysis).

Policies and Financing Mechanisms

Additional policies and financing mechanisms are needed to increase investment in LIEE and to ensure that the low-income population is adequately served, acknowledging that these households contribute to the costs of ratepayer-funded program in their energy rates.

The most common LIEE delivery models are in-home audits and installation of energy efficiency measures, completed in single-family homes or in multi-family building common areas and individual apartments. However, other types of investments have potential for overcoming some of the barriers to energy efficiency or providing services on a broader scale or in a more targeted fashion. These other approaches include heat island reduction programs, community solar, and school-based energy efficiency, and may meet additional goals of serving Environmental Justice communities.

In addition to WAP and ratepayer funding, funding for LIEE may be provided through LIHEAP; rate case and merger settlements; Cap and Trade revenue; disaster resiliency programs; and other models that combine donations, volunteer labor, and other leveraged grants, such as that used by Grid Alternatives.

Many different types of financing are available for low-to-moderate-income households, but education and outreach are needed to inform households that these funds are available and encourage and assist them in undertaking these investments. Additionally, it is important to ensure that sufficient safeguards in place including positive cash flow, guaranteed savings, customer protection from utility shutoff, and additional financial assistance to reduce participant costs.

Financial models that may increase low-income participation in energy efficiency include On-Bill Lending, Pay as You Save (PAYS), Property Assessed Clean Energy (PACE), Energy Saving Performance Contracts (ESPCs), Energy Service Agreements (ESAs), financing from Community Development Financial Institutions (CDFIs), and Rural Electric Utility program financing.

Reliable and timely utility cost recovery and mechanisms including decoupling, Energy Efficiency Resource Standards (EERS), and performance incentives can remove impediments and/or provide incentives for utilities to implement and improve LIEE programs.

Evaluation of Low-Income Energy Efficiency Programs

Third-party LIEE program evaluation should be conducted on a regular basis to ensure that the expected savings are achieved and to assess how the program can be improved. Whenever possible, energy savings should be estimated based on analysis of pre- and post-treatment weather-normalized, comparison group adjusted utility energy usage data. Use of TRMs or engineering estimates does not provide an assessment of the true impact of energy efficiency services on energy savings, and therefore does not ensure that the expected environmental and affordability benefits of LIEEs are realized.

Process evaluation should be conducted to assess why programs are performing to their current level and how performance can be improved. Performance measurement, a cyclical process of assessment, refinement, testing, and re-assessment is required to achieve and document improvement in implementation over time and to confirm that program refinements lead to greater energy savings.

Cost-effectiveness testing should provide a balanced approach to the analysis, with all costs and benefits included in the calculation. Benefits should include energy savings, other resource savings, health and safety impacts, economic impacts, environmental impacts, and any other measurable benefits from investments in the particular fuel that accrue to participants or society.

Cost-effectiveness testing for LIEE differs from general energy efficiency in the following ways.

- Many states do not require LIEE programs to meet cost-effectiveness tests as they do for other energy efficiency programs. This is the case in three of the four target states studied – Illinois, New Jersey, and Pennsylvania. The rationale is that these programs provide many other important benefits for participants and that they have other social benefits.

- LIEE should use a baseline that relates to the equipment present in the home, as opposed to the current practice or code, as low-income households are unlikely to replace the equipment until it fails.

- LIEE has greater non-energy benefits than general energy efficiency, as low-income households often have health, safety, and comfort issues that are improved in the process of weatherizing the home. Colorado, the one target state that does use cost-effectiveness testing for LIEE programs provides a higher non-energy benefit adder for the LIEE programs.

- LIEE programs may have lower marketing costs than other energy efficiency programs, improving their cost-effectiveness.

- LIEE programs may have higher health and safety investments that are necessary to undertake prior to installing energy efficiency measures. Policymakers should consider excluding these costs from the cost-effectiveness testing.

Findings and Recommendations

Findings and recommendations from this study are summarized below.

Program Administration and Regulatory Structure

Program goals, design, management and coordination, and utility rate design and incentives are discussed below.

- LIEE Design Framework: Goals are needed for the LIEE programs to direct, assess, and improve the program. The program should be designed with a focus on the goals and opportunities.

    - LIEE Goal Design: LIEE goals should relate to the program's mission, be concrete and specific, include an outcome measure and measurement plan, and provide an achievable challenge.

  - Program Environment: The unique characteristics of the jurisdiction are critical in LIEE program design. LIEE programs must assess the environment in which they are operating to determine best practices. Factors which will impact the design that is most successful include geography/weather, political and social factors, and available resources.

- Program Management and Coordination: Energy efficiency programs can be managed by the state regulatory agency, an energy office, an independent organization, a utility collaborative, or by individual utilities. The entity chosen for program management will have implications for flexibility, coordination, and program refinement. Program designers should assess these advantages of the various models and choose the one that best aligns with its goals. Whichever model is chosen, the designer should use other mechanisms to overcome the disadvantages of the particular approach.

  - Coordination: The ability to coordinate between electric and gas utilities and with WAP will be heavily impacted by the management decision. Coordination has clear advantages for the participant because it reduces the participant's transactions costs and provides more comprehensive service delivery. When the ratepayer funds are managed or can be directly accessed by the WAP administrator, coordination with WAP is more likely. When the gas and electric ratepayer funds are jointly administered, or administered through a centralized organization, coordination between electric and gas services is facilitated.

  - Customer Data: Utilities have important data on energy usage, low-income program participation, and bill payment problems that can be used in targeting LIEE. These data may not be available or up-to-date when programs are delivered by non-utility entities. However, well-designed systems and procedures can provide external access to utility data.

  - Community Focus: When delivered by a local community organization, households may be more likely to accept services. Models are more conducive to community-level education and/or delivery when local agencies can directly access utility funds, as in Colorado, or are used to deliver ratepayer-funded services, as is the case for some utilities in Pennsylvania and is planned in Illinois.

- Rate Design, Cost Recovery, and Utility Incentives: The regulatory structure and legislation relating to rates, program costs, and other mechanisms can have a large impact on incentives for LIEE.

  - Fixed and Variable Rates: Rate designs that minimize the percent of bill that is fixed, as opposed to the percent that varies with energy usage, will best encourage energy efficiency.

  - Cost Recovery: Cost recovery for LIEE should be equivalent to cost recovery for supply-side investments, both in terms of the monetary return and the level of risk.

- Utility Incentive: Decoupling, Energy Efficiency Resource Standards (EERS), and Performance Incentives may be used to reduce the utility's "throughput incentive" and increase incentives for LIEE investments. An EERS can provide an incentive for energy efficiency by requiring that the utility meet a specified energy usage reduction target within a designated timeframe. To provide for low-income participation, specific targets must be set with respect to income-eligible households.

- Measurement: The EERS and Performance Incentives should include specific LIEE targets and require use of utility billing analysis or other extensive confirmation of engineering estimates for energy savings.

Funding, Participant Costs, and Financing

Findings and recommendations in this area include LIEE funding, participant costs, and financing.

- LIEE Funding: The total amount of annual funding needed for the LIEE program depends on the comprehensiveness and cost of measures installed, and the percent of eligible customers to be reached each year.

- Raided Funds: LIEE resources may be less likely to be raided for other purposes if they are not segregated into an efficiency-specific account and the utility is required to fund programs based on an EERS or a funding requirement.

- Participant Costs: Programs are unlikely to serve the lowest-income households when participants are required to contribute to the costs of energy efficiency measures. No-cost energy efficiency programs are critical to ensure participation in energy efficiency by the lowest-income households.

- Financing: When programs have a participant contribution for low-income households, on-bill repayment may be an opportunity to generate participation, at least for households in the more moderate income categories. However, additional research is needed to understand the income levels where such an approach can be successful.

  On-bill programs for the lower-income groups should utilize appropriate measures of credit-worthiness for loan approval, provide credit enhancements, provide loan terms that are at least as long as the payback period for the efficiency measures, increase incentives to reduce the loan amount required, share risk for energy savings with implementers or contractors, and provide education through community-based organizations (CBOs).

Eligibility, Targeting, and Outreach

Program design issues include income eligibility and targeting, energy usage eligibility and targeting, and outreach.

- Income Eligibility and Targeting: More restrictive income guidelines mean that a greater percentage of the lowest-income households can be served. This may be important when

funding for LIEE programs is more limited or the programs are relatively new. If the program has been implemented for many years and there has been difficulty locating a sufficient number of high energy users to target for energy services, then increasing the income eligibility limit will expand the number of households who can be served, and may allow the program to treat higher users and achieve greater savings. Households with income between 200 and 400 percent of the FPL are unlikely to participate in energy efficiency if there is not a specific program that provides no-cost or highly subsidized services.

A broader income-eligibility limit, with discretion to target the lowest-income subgroups if warranted, may be the best approach that maximizes the advantages of higher and lower income eligibility requirements.

- Energy Usage Eligibility and Targeting: Households who use more energy achieve greater savings due to their potential for cost-effective energy efficiency measures. Focusing on high users can help programs achieve EERS goals and cost-effectiveness goals. Low-income, high users will often have difficulty paying for their energy usage, so this method can also have a greater impact on improving energy affordability.

- Home Type: Programs should aim to treat all homes with potential for energy savings, but treating certain types of multi-family buildings may require technical expertise that contractors serving the majority of participants do not have. Specialists should be recruited when needed to ensure that energy saving opportunities are realized.

- Outreach: LIEE programs often face challenges recruiting customers for service because of a lack of awareness, understanding, or trust. Outreach within the community by organizations that are known and trusted can be the most effective means of overcoming these barriers. Program outreach should promote the non-energy benefits of energy efficiency including improved comfort, health, and safety, as well as long-term energy affordability.

LIEE Services

Service considerations include level of service, measure selection, health and safety improvements, and energy education.

- Comprehensiveness: If programs are targeted to the highest usage customers, efforts should be made to provide the most comprehensive services possible to provide high energy savings, achieve the most cost-effective delivery, and impact energy affordability. Spending should be undertaken to overcome health and safety barriers. If the program is

going beyond the highest-usage households, energy services should be targeted based on the level of usage and the level of opportunities for savings.

- Measure Selection: Contractors need detailed program guidelines to effectively implement LIEE services. Programs can maximize the savings achieved by installing as many cost-effective major measures as possible.

  - Measure Selection Guideline: Contractors should be provided with a list of standard approved measures and preferred materials, but should have flexibility to perform custom measures or use alternate materials depending on the unique situations in the home.

  - Spending Guideline: The program should provide guidelines for determining when to install measures. A spending guideline that is based on the household's pre-treatment usage can do a good job of targeting measures to cost-effective opportunities, such as the amount to be spent on air sealing and insulation. However, there should be room for flexibility and spending overrides if the auditor assesses that there are particularly good opportunities in a home. Specific guidelines should be provided for some measures, such as metered refrigerator usage or occupant-reported hours of lighting usage.

  - Diagnostic Testing and Work Orders: An educated and experienced auditor should use the blower door and other diagnostic equipment to pinpoint the best opportunities and provide specific information on priorities in a detailed work order for the installer. .

  - Major Measures: Major measures including blower-door guided air sealing, especially at the top and bottom of the envelope, attic insulation, wall insulation, basement insulation, heating system replacement, and refrigerator replacement should be installed when cost-effective opportunities are available.

  - Cost Threshold: Expenditures per household should not be set based on a cost threshold, as such thresholds do not take individual household circumstances into account, and spend too little in some homes and more than what is cost-effective in some homes.

- Health and Safety Improvements: A key barrier faced in LIEE is the inability to address health and safety issues that prevent comprehensive home weatherization services. Because of these barriers, many programs have found reduced opportunities for treating low-income households.

  - Health and Safety Investment: Where possible, spending should be undertaken to overcome health and safety barriers to allow for comprehensive service delivery. Depending on program regulations, this may be done by conducting an assessment of the maximum level of health and safety spending that will still allow for cost-effective service delivery or by locating other sources of funding that can cover these repair costs.

- Funding Coordination: Additional investment is needed to coordinate funding, overcome health and safety barriers, and provide comprehensive LIEE services.

- Energy Education: Energy education is an important component of LIEE service delivery. The education serves the following purposes.

  1. Measures Installed: The participant may need education on how to effectively use the installed measures.
  2. Energy-Saving Behaviors: The participant can learn how to make adjustments to energy usage behavior that can result in energy savings.
  3. Energy Bills: An understanding of energy bills allows the participant to make decisions about energy usage based on the costs of those uses. If the participant understands how to read the energy bill and determine when usage is decreasing, it provides positive re-enforcement for energy-saving actions.

  - Education Partnership: A partnership approach should be considered. The partnership model explains the program's role in providing energy efficiency services, the provider's role in discussing usage with the participant and identifying potential energy-saving actions, and the participant's role to take those actions to reduce energy usage.

  - Action Plan: During the visit, the auditor should work with the participant to identify potential energy-saving opportunities and assess which are feasible and the participant is willing to undertake. The output from the education should be a usage-reduction goal for the participant and an action plan. The action plan provides motivation and direction for customers to reduce energy usage.

  - Follow-Up: The program should follow-up with the participant to assess any issues with implementing the action plan, provide adjustments if usage increases, and commend the participant if usage declines.

Service Delivery

Service delivery decisions include the implementation organization and the type and level of quality control.

- Implementation Organization: Energy efficiency delivery organizations include private, for-profit contractors, weatherization agencies, and other nonprofit organizations. Private contractors can be more effective at managing cash flow, have the ability to more quickly hire additional staff if needed, and have more sophisticated data management tools and capabilities. Private contractors may have less knowledge or experience with other public programs and may have less ability to coordinate programs or refer participants to other needed services. Also, for-profit contractors may be focused on profit at the expense of service quality.

  Weatherization agencies often provide ratepayer-funded LIEE service delivery for multiple utilities, as well as WAP service delivery. The WAP agencies' involvement in

multiple programs can create a greater ability to provide joint service delivery of electric and gas utility programs and/or WAP.

Because WAP has an extensive set of policies, procedures, and training, these agencies can reduce administrative costs for utility managers who often choose to conform to these technical and administrative procedures in their own programs.

- Service Delivery Organization: Program managers should assess these advantages and disadvantages and consider using a combination of various types of service providers.

- Oversight: The WAP agencies' experience can be a large benefit for a small utility program that does not have the level of expertise within their LIEE staff. However, the utilities should still be sure to provide adequate supervision and quality control to ensure that their priorities are followed and their goals are met.

- Training and Certification: Home energy efficiency auditors and inspectors should have proper training and certification to provide high-quality and effective service delivery. Building Performance Institute Building Analyst (BPI BA) certification or Home Energy Professional (HEP) certification are recommended for auditors and inspectors.

- Quality Control: Third-party quality control is an integral aspect of delivering high-quality energy efficiency services.

  - Quality Control Components: Quality control assessments should go well beyond determining whether invoiced measures are present in the home and ensuring that there are no health and safety issues. The quality control reviews should assess the comprehensiveness of the installed measures, whether there were any important missed opportunities, and the effectiveness of the implemented services. Diagnostic testing should be included, at least on a sample of the inspected jobs, to review safety and quality of installations.

  - Participant Interviews: Interviews with program participants during the quality control visit will furnish important information on energy education provided as part of service delivery, and the extent to which the contractor communicated with the client to assess the circumstances in the home and provide the most effective service delivery.

  - Education: The program should take advantage of this participant communication to follow up on energy education and provide additional recommendations for behavior changes where warranted.

Data and Evaluation

Data systems, evaluation, and cost-effectiveness testing are important components to ensure that the program is implemented effectively and meets its goals.

- Data Systems: The data tracking system is a critical aspect of any energy efficiency program, as it plays a role in efficient and effective program management, operations, and evaluation. The LIEE administrator needs program data to ensure that the program meets performance requirements, verify the program's fiscal integrity, potentially coordinate with other programs, and provide required reports to regulatory bodies and/or stakeholders. The administrator, service delivery contractors, and quality assurance contractors need information to ensure that the program operates efficiently and effectively. Researchers need data to assess participation, targeting, home characteristics, comprehensiveness, inspection results, projected impacts, and measured impacts.

    - Database: One central database should be used for the program.

    - In-Field Data Collection: Computerized in-field data collection where a tablet with pre-loaded participant data is used on site to enter participant, home, and audit data should be considered.

    - Key Data Fields: Key fields should be databased so that they can be analyzed, relationships can be explored, and summary statistics can be reviewed.

    - Streamlined Data: The data system should be streamlined to include only those fields that have an identified purpose with respect to program management, operations, reporting, or evaluation.

- Evaluation: Third-party evaluation is critical to ensure that the program is maximizing its efficiency and effectiveness.

    - Evaluation Regularity: Evaluation should be conducted on a regular basis to ensure that the program is implemented efficiently and effectively, and that expected results are achieved.

    - Billing Analysis: The impact evaluation should use utility usage data that is weather-normalized and a comparison group to control for other changes in usage outside of program influences. A TRM or engineering approach cannot provide an accurate assessment of savings to ensure that climate and affordability impacts are achieved.

    - Process Evaluation: The process evaluation should provide additional information on why the program is or is not meeting expectations; and how performance, participant satisfaction, and energy savings can be improved.

    - Performance Measurement: A cyclical process of assessment, refinement, testing, and re-assessment is required to achieve and document improvement in implementation over time and to confirm that program refinements lead to greater energy savings.

- Cost-Effectiveness Testing: Several different cost-effectiveness tests are used to evaluate the costs and benefits of energy efficiency programs. The test that is most commonly used is the Total Resource Cost Test that takes the utility and participant perspectives into

account and assesses whether the total costs of energy will decline as a result of the program. While this test theoretically takes all benefits that impact the utility and the participants into account, jurisdictions generally do not factor the non-energy benefits into the assessment, including other fuel and water savings, reduced maintenance costs, health, safety, and comfort.

- Balanced Cost-Effectiveness Testing: A test that accurately estimates the net benefits of the program would provide a balanced approach, factoring in the non-energy benefits or including an adder to account for non-energy benefits that relate to the impacts of the investments for each fuel.

- Low-Income Baseline: The baseline for low-income households should be the equipment that is present in the home, as these households are constrained and are unlikely to replace that equipment until it fails. Using the current code as the baseline for LIEE would place a high bar on the level of energy savings needed for the measure to be considered cost-effective.

- Measure Prioritization: Cost-effectiveness testing can be used effectively to prioritize measures that will provide the greatest reduction in energy usage for the lowest cost. However, research is needed to confirm and validate that expected savings from prioritized measures are realized.

Additional Research

This report attempted to draw conclusions and make recommendations as to the best practices for LIEE design and delivery. However, the study identified several areas where additional research is needed to provide firm recommendations for program implementation. Some of the key areas for additional research are summarized below.

- Utility Incentives: What are the best strategies to provide incentives for utilities to furnish the most effective LIEE programs? How do decoupling, EERS, and performance incentives best work together?

- Financing: Will low-to-moderate-income households take advantage of financing offerings at a significant rate, or is no-cost programming imperative to achieve commensurate low-income participation? Which financing methods have the most potential for low-income households?

- Raided Funds: LIEE resources may be less likely to be raided for other purposes if they are not segregated into an efficiency-specific account and the utility is required to fund programs based on an EERS or a funding requirement. Is this method sufficient to ensure that planned resources are directed to LIEE programming? Are there other models that provide greater assurance of continued program access to dedicated LIEE funding?

- Coordination: What are the most successful models for improving coordination between various LIEE funding sources and can they be replicated?

- Health and Safety Investments: What is the right level of investment in health and safety issue remediation and how can the necessary funding be made available for this purpose?

- Non-Energy Benefits: What levels of NEBs can be expected from LIEE and can an adder be used rather than continued investment in expensive research to document the magnitude of these benefits? What level NEB adder is most appropriate in various environments?

- Innovative Methods: Which new approaches have achieved significant savings and should be replicated as part of the LIEE comprehensive investment strategy?

- Environmental Justice: Are LIEE programs effectively reaching this population segment? If not, how can their reach be improved?

- LIEE Savings: What level of energy savings can be achieved through the implementation of various LIEE program models? More studies using billing analysis compared to the TRM approach are needed.

- Relative LIEE Savings and Cost-Effectiveness: It is often claimed that LIEE programs do not save as much energy and are not as cost-effective as general residential energy efficiency programs. We argue that LIEE programs can save as much or more energy than market rate residential programs when health and safety barriers can be overcome. Savings in low-income homes can be higher because these properties have greater opportunities for energy savings, and the low-income baseline is a lower level of efficiency. Additionally, when using the TRC, the participant and program costs must be included in the cost side of the equation, so full program funding as opposed to shared participant funding does not impact the test. Last, market rate programs may have higher marketing costs that LIEE programs. Additional research should be conducted to compare these savings and costs.

I. Introduction

APPRISE conducted research for the Environmental Defense Fund to document low-income energy efficiency (LIEE) programs in four states and around the country. The research assessed policy and program design changes that are necessary to overcome barriers and fully realize the benefits of low-income energy efficiency.

A. Research

The goals of the research were to develop data and information that provide advocates with key insights to advance new LIEE policies and programs. Research was conducted through review of LIEE literature and research reports including previous APPRISE studies, and interviews with key program actors. The following topics were covered.

- Regulatory and Program Structure of LIEE offerings
- Energy Costs and Energy Burden for Low-Income Households
- Energy Efficiency Funding and Opportunities
- Barriers to Investment in LIEE
- Policies and Financing Mechanisms
- Evaluation of LIEE Programs
- Best Practices for LIEE Programs

B. Organization of the Report

Ten sections follow this introduction.

1) *Section II: Program Objectives* – Description of many potential goals for LIEE programs and how to evaluate the extent to which a program is meeting those goals.

2) *Section III: Regulatory and Program Structure of LIEE Offerings* – Overview of the requirements and structure of LIEE programs in Colorado, Illinois, New Jersey, and Pennsylvania.

3) *Section IV: National Energy Costs and Burden* – Analysis of energy costs and burden for low-income households and a comparison to all households in the United States using data from the Residential Energy Consumption Survey (RECS) and the American Community Survey (ACS).

4) *Section V: Energy Costs and Burden in Target States* – Analysis of low-income households' demographic and housing characteristics, energy costs, and energy burden under various definitions of low-income.

5) *Section VI: Energy Efficiency Funding and Opportunities* – Analysis of current funding available for LIEE and potential opportunities to increase the amount of cost-effective investment in LIEE in the four target states.

6) *Section VII: Barriers to Investment in LIEE* – Assessment of economic, technical, social, and informational barriers to providing effective energy efficiency services to low-income households.

7) Section VIII: Policies and Financing Mechanisms – Analysis of program models, policies, and financing mechanisms that have potential for increasing investment and participation in LIEE.

8) Section IX: Evaluation of LIEE Programs – Description of how LIEE programs are evaluated and how the research can provide information on program achievements and potential refinements to increase program efficiency and effectiveness.

9) Section X: Best Practices for LIEE Design and Implementation – Assessment of best practices for LIEE design and implementation based on review of the literature, research, and evaluations.

10) Section XI: Findings and Recommendations – Summary of findings and recommendations from all of the research and analyses conducted in this project.

APPRISE prepared this report under contract to the Environmental Defense Fund (EDF). Any errors or omissions in this report are the responsibility of APPRISE. Further, the statements, findings, conclusions, and recommendations are solely those of analysts from APPRISE and do not necessarily reflect the views of EDF.

II. Program Objectives

There are many potential goals for LIEE programs. While some are complementary, others are conflicting. Therefore, program designers must be clear in identifying and prioritizing their goals when they set out the parameters for their programs, and they should frame the evaluation to assess whether the program is meeting its specified goals. In this section we describe many potential goals for the program and how to evaluate the extent to which a program is meeting those goals.

A. Energy Savings

One of the most common goals for LIEE programs is to maximize the amount of energy saved. This goal is complementary to some of the other goals, including improving energy affordability and reducing greenhouse gas emissions.

Based on extensive research on LIEE programs, the best methods to maximize energy savings are as follows.

1. Treat high energy users. Where there is high usage, there is usually the most opportunity for savings.
2. Install as many cost-effective major measures as possible. These usually include air sealing, insulation (attic, wall, basement, other), HVAC replacement, and refrigerator replacement.[1]
3. Ensure high quality work is delivered. This includes confirming that air sealing treats all significant opportunities, sealing at the top and bottom of the building is prioritized, and insulation is installed thoroughly and evenly.

Examples of concrete and specific outcome goals for energy saving include the following.

- Save an average of 20 percent of pre-treatment usage for electric heaters.
- Save an average annual amount of 4,500 kWh per home for electric heaters.

These goals can be measured through an impact evaluation that uses pre- and post-treatment weather-normalized billing data with a comparison group. A challenge with this approach is that there must be lag between program implementation and goal assessment, because close to one year of post-treatment usage data is needed to assess the amount of energy saved.

B. Peak Demand

LIEE programs can contribute to goals for reducing peak demand. If they are successful, they can help to defer building new generation or transmission upgrades.

Measures that can address peak energy usage include those that improve the air conditioning efficiency and the ability of the home to maintain its temperature through air sealing and insulation, or those that reduce electric heating usage in areas where there is a heating peak.

[1] This practice also prevents a need to return to the home and duplicate costs for outreach, application, and qualification.

A reduction in peak demand is not usually a primary goal for LIEE programs, as other types of programs that focus on shifting load or load reduction during specific times or periods of extreme weather, can be more effective in reducing peak demand. These other programs can encourage participation by the full residential class of customers, including low-income customers, and provide financial incentives for customers to use electricity at non-peak times or to allow the utility to cycle equipment during the times of highest demand.

An example of a concrete and specific goal for peak energy savings includes a total reduction in peak demand of 3 MW among the low-income sector.

Goals can be measured through an impact evaluation that uses hourly meter reads to assess the impact of the program on peak energy usage and on the load shape. If hourly data are not available, peak coincident demand factors can be used to estimate the peak reduction after energy savings are estimated. However, it is important to recognize that load shapes can differ for low-income and non-low-income households because low-income households may be more likely to be home during the day and they may have other differences in energy usage characteristics.

It can be difficult and complicated to estimate peak demand savings because times of peak energy usage vary by geographic region and even by utility within region.

C. Cost-Effective Service Delivery

Another goal is to ensure that service delivery is cost-effective. This can mean that the entire energy efficiency portfolio is cost-effective, the sector (residential, low-income, and/or C&I) is cost-effective, the program is cost-effective, or the measure is cost-effective. The most restrictive goal to reach is to ensure that every installed measure is cost-effective. This would increase the cost-effectiveness of the program and portfolio overall, but would mean that the total amount of energy savings is lower, as the program can still be cost-effective as a whole if some measures that save energy but are not cost-effective are included.

When cost-effectiveness is the goal, several parameters must be specified.

- Which test will be used – the TRC, UCT, SCT, RIM, or PCT.
- Whether, what, and how NEBs will be included and measured.
- Other important assumptions or measurements, including the discount rate, avoided costs, baseline, and measure life.
- Whether the goal relates to the measure, the program, or the portfolio as a whole.
- The standard that must be met. Whether the standard is to be cost-effective at 1.0 benefit-to-cost ratio, or at some higher level.
- Whether certain programs will be exempt from the goal.

D. Households Served – Total, Vulnerable, and Environmental Justice

Some programs have a primary goal that is to serve a particular number of homes each year or each quarter. These programs may not provide enough flexibility to address homes with

severe problems and may need to leave some energy-saving opportunities unresolved. Additionally, this goal does not relate to the impact of the program.

Vulnerable Households

Vulnerable households, such as those with elderly members, disabled members, or young children, are more adversely affected by extreme heat or cold, so it can be critically important that they are able to keep their homes at a safe and comfortable temperature. Weatherization services can help homes to achieve this standard by improving the home's heating efficacy or efficiency, and by improving the ability of the home to maintain its desired temperature.

By definition, the target related to this goal will be an output rather than an outcome. Examples of potential goals for this priority are as follows.

- At least 25 percent of households served have an elderly member.
- At least 75 percent of households served have a vulnerable member.
- Vulnerable applicants are served within one month of program application.

Rural Households

Serving rural homes can be a challenge and can be expensive because of the distance needed to travel to perform the audit, install measures, and return for a quality control inspection. Additionally, there may be fewer organizations and/or contractors who are able or willing to provide services in more remote locations. But rural households are more isolated from their neighbors and may face greater health and safety problems if their heating systems are not operable or are not performing at an acceptable level, or if they cannot keep their homes at a safe temperature. Programs can set goals to ensure that a certain percentage of the homes that they serve are in rural areas.

Environmental Justice

Environmental Justice addresses vulnerable communities' disproportionate exposure to pollution, where vulnerable communities are defined as those with a high proportion of low-income, racial minorities, and less-educated inhabitants. The LIEE literature does not frequently address this issue. With respect to equity, the literature is primarily focused on income, poverty level, and energy burden.

One specific area in which a lack of focus on Environmental Justice can have particularly adverse impacts on vulnerable populations is carbon trading. This approach monetizes carbon reductions through a carbon trading market that focuses on the lowest cost approach, rather than on who benefits or on how the benefits are distributed. If the costs associated with carbon reduction are higher in vulnerable communities, this approach can exacerbate pollution hot spots. Aggregate CO2 reductions may be achieved, but there may be an increase in Environmental Justice communities, and the CO2 co-pollutants will have adverse local health impacts.[2]

[2] Martinez, Cecilia. Environmental Justice and the Clean Power Plan: The Case of Energy Efficiency, 41 Wm. & Mary Envtl. L. & Pol'y Rev. 605 (2017), http://scholarship.law.wm.edu/wmelpr/vol41/ iss3/4

Another reason why Environmental Justice communities may not be served by energy efficiency is due to greater barriers with respect to home conditions, infrastructure, and neighborhoods. As discussed in the barriers section of this report, low-income homes frequently have health and safety problems that prevent implementation of important energy efficiency measures, and providers may be wary of delivering services in neighborhoods that are perceived as high-crime.

However, some specific types of programs discussed in the Heat Island Reduction Program section of this report, do address the issue of Environmental Justice. Heat Island Reduction Programs target urban communities where low-income and minority households are concentrated and are most impacted by heat islands.

Programs can set goals to ensure that a certain percentage of the clients that they serve are in these types of vulnerable communities or set goals to provide services to address problems unique to these areas, with additional funding for health and safety remediation or recruiting providers that are from Environmental Justice communities. If such measures are a goal for the program, it would be important to collect data to assess the racial distribution of energy costs and benefits, and refine programs if such distributional objectives are not realized.

Programs can also set goals, measure, and assess the level of Environmental Justice community member participation that is present in program planning. In most jurisdictions, such involvement has not been a priority.

Climate Change Vulnerability

Climate Vulnerability often affects the same vulnerable communities as Environmental Justice. Climate impacts also disproportionately affects poor and vulnerable communities, but the measures of climate vulnerability are different than traditional pollution measures, and include risks from floods, hurricanes, and other extreme weather events. Programs that address some of these issues were also included in the Heat Island Reduction Program section of this report. Key examples are programs that require permeable pavement technologies that allow storm water to filter and drain into the ground rather than collecting on hard surfaces or draining into the sewer system. Other initiatives include catch basins to capture water and funnel it into the ground and proper grading and pitch to facilitate drainage.

E. Health and Safety

Energy efficiency programs can improve health and safety by directly addressing unsafe conditions in the home and by making improvements that indirectly lead to improved health and safety. Direct interventions include removal of mold or reduction of moisture issues; improved venting of dryers, kitchens, or baths; improved whole house ventilation; and remediation of carbon monoxide or gas leaks. Indirect improvements can result from a safer or more comfortable home temperature which leads to improved health or improved energy affordability, which leads to more funds available for food and healthier eating.

This goal can be measured by examining inputs, outputs, or outcomes, but the outcomes can be difficult to measure. Examples in each category are as follows.

- Inputs: Provide up to $5,000 per home for health and safety measures when needed.
- Outputs: Remediate mold conditions in ten percent of homes served.
- Outcomes: Twenty percent more participants than before service delivery say that their homes are comfortable and are not too cold in the winter or too hot in the summer. To measure this impact most effectively, it would be important to conduct a survey before and after the intervention and to have a comparison group of similar households who did not receive service delivery during the pre- or post-assessment period.

F. Energy Affordability

LIEE programs that reduce energy usage can reduce energy bills and improve energy affordability. Efficiency can be an effective affordability intervention when energy usage is high and income is not too low. Efficiency services will still be important for the lowest income households if they have high energy usage, but these households may also need energy bill payment assistance to achieve an affordable energy bill.

Energy affordability can be best assessed through an examination of energy burden, the percent of income that is spent on energy. A specific goal for energy affordability can be to reduce the average energy burden for electric heating households by two percentage points, so if pre-treatment burden averages ten percent, post-treatment burden averages eight percent. The ability to reduce burden will directly relate to the ability to provide effective services and reduce energy usage and costs.

G. Environmental Impact

Some programs may be focused on the environmental impact of the usage reduction and will want to target and measure these impacts. Programs can have the greatest impacts if they target households who use dirtier fuels and who live in more urban areas. Environmental impacts can be measured in the following steps.

1. Calculate the reduction in energy usage by fuel type. This should be done with a weather-normalized, comparison group adjusted, billing impact analysis.

2. Estimate the amount of avoided emissions by pollutant. Published data sources can be used to estimate the emissions avoided as a result of energy usage reductions. The analysis can estimate the total tons of avoided CO2, SO2, NOx, PM 2.5, and VOC emissions in the state due to the energy savings.

3. If desired, transform the amount of pollutants avoided to a value of avoided emissions by using the Office of Management and Budget (OMB)[3] and Air Pollution Emission

[3] Office of Management and Budget. "Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis." May 2013. p18.

Experiments and Policy (APEEP) Model[4] as recommended by the National Research Council (NRC) in its 2010 report to Congress[5]. These monetized estimates then can be used in the cost-effectiveness analysis.

The APEEP Model calculates the marginal damage of emissions by first calculating total damages due to all sources at a baseline level, and then re-computing total damages after adding one ton of one pollutant from one source. The modeled physical effects include premature mortality, illness, reduced timber and crop yields, and other impacts. A dollar value is then assigned to each effect, the market value of goods and services, the values attributed to chronic illness from the nonmarket valuation literature, or the value of a statistical life.

The APEEP Model computes exposures by multiplying county-level populations by county-level pollution concentrations. It is necessary to account for population because the amount of damage caused by any pollutant is greater in an area that is more highly populated, as more individuals are affected.

Highly populated areas are also exposed to more emissions because the pollutants that result from burning natural gas are released from all homes and buildings where natural gas is consumed, not from a single location such as a power plant. It is therefore necessary to determine the level of avoided emissions in each county to determine the amount of damage in each county. To do this, state-wide levels of avoided pollutants should be weighted by county population using U.S. Census Data. The APEEP damage values for each county can then be multiplied by these weighted values.

Goals for the program can be to reduce emissions by a certain amount for each type of pollutant or by a certain percent of the baseline value. The environmental impacts analysis can determine whether these goals were achieved.

H. Economic Development

Energy efficiency programs can provide new jobs and increase output in a locality or state. Programs result in such benefits because they shift expenditures from industries that have lower multipliers in the local economy to industries that have higher multipliers.

1. Energy efficiency program expenditures replace general retail expenditures when program funding is derived from additional charges for each Therm or kWh of energy consumed. These expenditures are likely to replace other retail purchases that would have been made in the absence of these charges. Because expenditures on energy upgrades create more economic activity than expenditures on retail goods, this results in economic development.

[4] Muller, Nicholas. Air Pollution Emission Experiments and Policy Analysis Model (APEEP) Data. 2008. Accessed June 2015.
[5] National Research Council. *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use.* The National Academies Press, Washington, DC. 2010, p241.

2. Retail expenditures replace energy expenditures when the program reduces energy usage and energy costs for program participants who undertake the energy efficiency improvements. When energy costs decline as a result of the program, low-income participants are especially likely to increase spending on retail goods. Because expenditures on retail goods create more economic activity than expenditures on energy, this results in economic development.

These differences result from the labor-intensity of each industry and the percentage of expenditures that are made within the geographic area of interest.

Economic activity can be maximized by investing in the types of services that create the most local jobs, such as comprehensive in-home energy efficiency delivery. Programs can include requirements that contractors hire and train a certain number of staff members from the local area.

The macroeconomic effects of any economic activity can be calculated using economic multipliers that show the change in jobs or output that result from a change in final demand in any given industry. One can estimate the impact of energy efficiency on output and employment by comparing the multipliers for the industries that are most impacted by the energy efficiency program to those that would have been affected in the absence of the program.

Each source of economic impact can then be matched with the appropriate industry multipliers. The multipliers used in the analysis are obtained from the Regional Input-Output Modeling System II (RIMS-II) produced by the Bureau of Economic Analysis (BEA). To calculate the RIMS-II multipliers, the BEA uses a set of national input-output accounts that record the goods and services used by each industry.

Goals can be set for creating a certain number of jobs or increasing output by a certain amount or percentage.

I. Innovative Methods

Some programs have a goal to explore innovative usage reduction measures or program delivery systems. These programs allow for the opportunity to test new measures or systems that may prove to be cost-effective in the long run and may lead to a great improvement in efficiency or effectiveness. Some programs that are facing challenges and are not achieving their goals may need to pilot such methods to take their program to the next level. However, due to the initial learning curve and possibly to an investment in research, the program may not be as cost-effective in the shorter term.

One example of an innovative approach that is needed in the LIEE industry at the current time is to determine how to provide extensive health and safety repairs that will allow energy efficiency measures to be undertaken. Many LIEE programs are facing increasing challenges serving customers due to the prevalence of health and safety problems that prevent major measures from being installed. As a result of serious issues in the home, households must be

deferred or are treated with only minor services, and high-usage homes with good potential for savings do not participate or only achieve low energy savings.

The target and measurement for this goal will depend on the specific type of intervention that is being tested. In the case of health and safety approaches as described above, performance measures may include the following.

- Average amount spent on health and safety.
- Percent of homes where health and safety issues were resolved to allow for full weatherization delivery.
- Energy savings achieved in these homes where health and safety services were delivered.
- Cost-effectiveness of serving these homes. Even in the case where there are large health and safety expenditures, services may be cost-effective when pre-treatment usage and energy savings are high.

III. Regulatory and Program Structure of LIEE Offerings

The regulatory requirements and administrative structure of Low-Income Energy Efficiency (LIEE) programs can have a large impact on program design, efficiency, and effectiveness. This section of the report documents the regulatory background and program structure for Colorado, Illinois, New Jersey, and Pennsylvania, and assesses how these characteristics have affected the implementation of LIEE programs.

A. Regulatory Background and Program Authorization

This section provides an overview of the regulatory history of LIEE programs in each state.

- Colorado: Legislation requires all investor-owned utilities to develop demand-side management (DSM) programs with specific savings goals for electric utilities and spending targets based on a percentage of revenue for gas utilities. While utilities are required to include a low-income program in their offerings, there are no specific low-income savings goals or spending requirements. Energy Outreach Colorado (EOC), a statewide nonprofit organization, administers the low-income programs for the utilities and coordinates rebates for the Colorado Energy Office (CEO) and other organizations that receive utility rebates for their programs.

- Illinois: New legislation passed in 2016 and enacted in 2017 transferred LIEE program administration from the state to the utilities and increased electric energy efficiency spending requirements. New program operations begin in January 2018. Two previous bills provided for past energy efficiency funding and directed investment in LIEE.

- New Jersey: Electric restructuring legislation in 1999 and a 2001 Board of Public Utilities Order made the New Jersey electric and gas utilities and representatives of the Natural Resources Defense Council (NRDC) responsible for implementing programs to reduce the amount of electricity and natural gas used in New Jersey and to reduce the summer peak demand for electricity. The Utility Residential Low Income Program Working Group (comprised of investor-owned utility representatives) designed the Comfort Partners Program to contribute to usage reduction goals and to improve energy affordability for low-income customers.

- Pennsylvania: Electric and natural gas utilities individually run LIEE programs that were codified into law with 1997 utility restructuring legislation. Additional legislation requiring electric usage reduction, a percentage of measures targeted toward low-income households, and a percentage of savings from the low-income segment increased LIEE on the electric side beginning in 2008.

Colorado

House Bill 07-1037 was enacted in 2007 and directed the Colorado Public Utilities Commission (PUC) to establish cost-effective energy savings protocols for investor-owned electric and gas utilities with the goals of reducing customer energy usage and cutting peak

demand. The bill established energy savings and peak demand reduction goals for investor-owned electric utilities to be met by 2018. HB17-1227 extended the energy reduction goals to be met through the utilities' DSM programs through 2028.

The legislation required the PUC to commence a rule-making proceeding to develop expenditure and savings targets, funding and cost-recovery mechanisms, and a financial bonus structure for the DSM programs. The resulting regulations require all investor-owned utilities (IOUs) to develop DSM programs.

Electric utilities may collect DSM program costs through a cost adjustment clause. Electric utilities do not have a minimum spending requirement but they receive a disincentive offset and a performance incentive if they exceed the savings and demand reduction goals stipulated by the PUC.

Natural gas utilities are required to spend at least 0.5 percent of their revenues on cost-effective DSM programs. Gas utilities may recover their costs through an on-bill rider. They are not required to file a rate case to do so and have the choice of expensing DSM expenditures or adding them to rates. Residential program costs are to be collected only from residential customers and nonresidential costs are to only be collected from nonresidential customers.

Utilities are required to include LIEE as part of their DSM plan. The legislation states that "The Commission shall ensure that utilities develop and implement DSM programs that give all classes of customers an opportunity to participate and shall give due consideration to the impact of DSM programs on nonparticipants and on low-income customers." However, there are no usage reduction goals or spending requirements specific to the low-income sector.

The legislation allowed utilities to either directly provide programs that target low-income households, or to provide financial support for LIEE programs administered by the state. All regulated utilities operate their own LIEE programs. Xcel Energy and Black Hills Energy operate both electric DSM and gas DSM programs that include low-income components.

Energy Outreach Colorado (EOC), formerly known as the Colorado Energy Assistance Foundation, was created through a governor's executive order in 1989 as a centralized 501(c)(3) nonprofit organization that could raise private funds and expand low-income energy services. The governor and legislature transferred the existing low-income utility programs and their associated funding to EOC. EOC leverages funds from federal, state, and utility sources, and supplements those funds with corporate, foundation, and individual contributions. EOC also successfully advocated for legislation to allow it to receive additional funding through utility bill insert donations (legislated, C.R.S. Title 40, §8.7-102-112) and utility fines and settlements (regulatory).[6]

In 2010, Colorado passed the Community Solar Gardens Act. A community solar garden is a shared solar array with grid-connected subscribers in or near the community. Subscribers

[6] Energy Outreach Colorado, Case Study, EPA, https://www.epa.gov/sites/production/files/2016-06/documents/energy_outreach_colorado_case_study_6-1-16_508.pdf

may purchase a portion of the power produced and receive a credit on their electric bill. The Act requires that five percent of new shared solar projects be reserved for low-income customers.

Illinois

With the passage of the Future Energy Jobs Act (FEJA) in December 2016, and its enactment in June 2017, LIEE programs are in a state of transition in Illinois. The following describes the history of Illinois' energy efficiency legislation.

Renewable Energy, Energy Efficiency and Coal Resources Development Law (1997)

The Renewable Energy, Energy Efficiency, and Coal Resources Development Law of 1997 established the Energy Efficiency Trust Fund (EETF). Electric utilities and alternative retail electric suppliers contribute a pro rata share of a total amount of $3 million based upon the number of kilowatt-hours sold in the 12 months preceding the year of contribution. The fund is administered by the Illinois Department of Commerce and Economic Opportunity (DCEO) to fund LIEE and public-sector energy efficiency programs.

The law requires the funds to be spent on projects that promote residential energy efficiency with an emphasis on low-income households. However, this funding has not been consistently directed to low-income programs or even to DCEO. It appears that the funding was used in the general state budget.

The EETF provides a source of funds that DCEO can direct toward customers outside of the investor-owned utility markets. For example, EETF funds were used to provide energy efficiency measures for public housing authority projects served by cooperative and municipal utilities.

Illinois Power Agencies Act (2007) and Public Act 96-33 (2009)

The 2007 Illinois Power Agency Act provides the governing statutes for the energy efficiency and demand response programs for the electric investor-owned utilities in Illinois. Public Act 96-33 added the gas utility statutes in 2009.

The legislation specified that 25 percent of each utility's DSM portfolio would be administered by the DCEO. Specific requirements were included for LIEE programs. The legislation required the utilities to coordinate with DCEO to develop LIEE spending proportionate to the share of total annual utility revenues in Illinois from households at or below 150 percent of the poverty level. (The share of revenue from low-income customers is approximately 26 percent for electricity, and ranges from 18 to 37 percent for gas, depending upon the utility.)

The LIEE programs were to target customers at or below 150 percent of the federal poverty level (FPL). However, the gas Act passed in 2009 targeted programs to households at or below 80 percent of Area Median Income (AMI). Following this gas Act, the electric statute was amended to target low-income households at or below 80 percent of AMI to match the gas statute.

The Act required utilities to develop plans that included a proposed cost-recovery tariff mechanism to fund the energy efficiency and demand-response programs.

The DCEO was responsible for implementing the LIEE segments and programs targeted at publically owned facilities (schools, government buildings, etc.). The DCEO administered the program through the DCEO Energy Projects Fund starting in 2008, but it was determined that the DCEO did not have authority to hold the ratepayer funds. In 2012, the Energy Efficiency Portfolio Standard (EEPS) Fund was established to hold the funds collected by utilities and transferred to the DCEO.

The annual EEPS fund from 2014 to 2017 was approximately $54 to $55 million for electric and $21 million for gas. The LIEE program had an annual EEPS funds budget in 2014 to 2017 of approximately $13.2 million for electric and $5.3 million for gas.

IL utilities administered 75 percent of the energy efficiency budget and 25 percent was administered by the DCEO through their Illinois Energy Now program. The 25 percent administered by the DCEO covered all energy efficiency for the public sector and the low-income sector.

Future Energy Jobs Act (2016)

The Future Energy Jobs Act (FEJA) was signed into law in December 2016 and took effect June 1, 2017. This Act amended the Public Utilities Act, including the sections regarding energy efficiency and demand response programs for utilities. As a result, the state closed its energy efficiency program, Illinois Energy Now, and transferred the administration of public sector and LIEE programs to the utilities. The act also stipulates that, when practical, program implementation should be contracted out to third parties with demonstrated capabilities, with a preference for not-for-profit or government agencies with experience working with low-income communities.

The main changes pertaining to LIEE programs were as follows.

1. The DCEO will cease to administer programs using ratepayer funds via the EEPS fund and utilities will take over the implementation of programs for low-income households and public-sector facilities.
2. There are new minimum funding levels for ComEd and Ameren. The Act results in a large increase in energy efficiency funding and reduced risk for the funds to be used as part of the state budget.
3. Savings goals will be measured differently. Utilities will now be permitted to include voltage optimization in their energy efficiency plans.

FEJA allows for utilities to profit from their energy efficiency benefits and raised the spending cap on energy efficiency programs from two percent of total energy sales to four percent by 2030. FEJA mandates a 21.5 percent energy reduction by 2030 for ComEd, and a 16 percent energy reduction by 2030 for Ameren. However, Ameren requested a 27 percent reduction

to those targets and the Illinois Commerce Commission approved a smaller reduction in September 2017.[7]

The FEJA legislation included provisions specific to low-income customers. All electric utilities with more than three million retail customers (ComEd) must provide at least $25 million per year towards funding LIEE measures and those serving less than three million, but more than 500,000 retail customers (Ameren), are required to spend at least $8.35 million on LIEE.

The Act also requires a LIEE advisory committee to participate in the design and evaluation of LIEE programs. The committee must be comprised of electric utilities, gas utilities, LIEE contractors, and representatives of community-based organizations (CBOs).

The committee recommended several goals for themselves including the following.[8]

- Program delivery responds to the needs of the low-income population.
- Program design is tailored to needs of low-income population.
- Programs are delivered by groups that have on-the-ground experience in low-income communities.
- Programs are monitored and optimized in an ongoing fashion, by stakeholders with strong ties to low-income communities who can provide a continual gap analysis to find new marketing, outreach, design, and innovation opportunities.
- LIEE programs co-deliver and integrate with natural gas and solar programs and health and safety upgrades.
- Allocation of funding for LIEE programs is, at a minimum, commensurate with Section 8-103B of the Public Utilities Act, including ensuring that the allocation of dollars for LIEE is consistent with the revenue contributions of persons whose annual incomes are at or below 80 percent of AMI in the utility's service territory.

Cost-recovery for utilities providing energy efficiency programs is provided by an automatic adjustment clause tariff. This tariff must be filed with and approved by the Illinois Commerce Commission (ICC) and established outside the context of a general rate case. The Illinois Power Agency Act capped this tariff at two percent of customer rates, but FEJA increased this cap to four percent. This tariff is reviewed every year, along with actual program costs to determine adjustments to the annual tariff factor to match energy efficiency measure expenditures. Failure to meet savings goals results in a penalty that differs by utility and over time.

FEJA also established the Illinois Solar for All program. Solar for All includes low-income solar deployment. The program provides incentives for community solar projects, rooftop

[7] https://www.utilitydive.com/news/illinois-regulators-approve-lower-efficiency-goals-for-ameren/504741/
[8] Low-Income Energy Efficiency Advisory Committee Stakeholder Memo. March 23, 2017. http://ilsagfiles.org/SAG_files/Subcommittees/Low_Income_Advisory_Committee/Meeting_Materials/04112017_April/UtilityLIAdvisoryCommitteeMemo_03.23.17.pdf

solar on low-income homes, and rooftop solar on non-profits and government agencies that serve low-income households.

FEJA also creates three jobs training programs that are collectively allocated $30 million in funding. The ICC approved ComEd's Workforce Development Implementation Plan in fall 2017. The Solar Training Pipeline plan includes creation of 2,000 jobs for foster care alumni and former incarcerated citizens, and a focus on trainees from Environmental Justice communities. The Multi-Cultural Jobs program funds six community-based diversity-focused organizations. The Solar Craft Apprenticeship Program offers solar training into apprenticeship programs at Illinois Green Economy Network partner community colleges and at underserved high schools that will guide students towards apprenticeships.[9]

New Jersey

The New Jersey utilities implemented a portfolio of DSM programs beginning in 1982.

The Electric Discount and Energy Competition Act of 1999 established the Universal Service Fund (USF). The Act directed the NJ Board of Public Utilities (BPU) to determine the USF level of funding and the purposes and programs to be funded. The Act stated that the BPU would determine, "the level of funding and the appropriate administration of the fund; the purposes and programs to be funded with monies from the fund; which social programs shall be provided by an electric public utility as part of the provision of its regulated services which provide a public benefit; … and whether new charges should be imposed to fund new or expanded social programs."

This bill provided that the funding for the DSM programs would initially be held at 1999 levels, and then required the BPU to undertake comprehensive resource analysis (CRA) to determine the appropriate level of funding for energy efficiency and renewable energy programs. The Act also required that the CRA be undertaken every four years, provide opportunity for public comment, and public hearing, and then the BPU, in consultation with the Department of Environmental Protection, must determine the appropriate level of funding for energy efficiency and renewable energy programs.

According to the Act, the BPU was responsible for determining the programs to be funded by the societal benefits charge (SBC), the level of cost recovery and performance incentives for old and new programs, and whether the recovery of DSM programs' costs may be reduced or extended over a longer period of time. The BPU was directed to take into account the "…existing market barriers and environmental benefits, with the objective of transforming markets, capturing lost opportunities, making energy services more affordable for low-income customers and eliminating subsidies for programs that can be delivered in the marketplace without electric public utility and gas public utility customer funding…"

The Electric Discount and Energy Competition Act of 1999 and the March 1, 2001 Final Decision and Order by the BPU made the New Jersey electric and gas utilities and

[9] http://blogs.edf.org/energyexchange/2017/10/12/this-utility-is-training-workers-for-the-clean-energy-future-with-an-eye-on-inclusion-and-equity/

representatives of the Natural Resources Defense Council (NRDC) responsible for implementing programs to reduce the amount of electricity and natural gas used in New Jersey and to reduce the summer peak demand for electricity. The Utility Residential Low-Income Program Working Group (Working Group), comprised of representatives from the investor-owned utilities, designed the Comfort Partners Program to contribute to the usage reduction goals and to improve energy affordability for low-income customers.

The BPU sets the budget for the utilities, ensures that the utilities work within that budget, and ensures that spending conforms to the individual budget categories. The Working Group decides upon most program policies including measures, procedures, and health and safety spending.

Pennsylvania

In 1988 Pennsylvania's Public Utility Commission (PUC) mandated a statewide, utility-sponsored residential Low Income Usage Reduction Program (LIURP) designed to provide weatherization and energy education for low-income households to reduce energy consumption and lower energy bills.[10] The program is overseen by the Pennsylvania Public Utility Commission (PUC) which requires Pennsylvania's 15 largest electric distribution companies (EDCs) and natural gas distribution companies (NGDCs) to provide LIURP services to low-income households. Each utility administers LIURP programs individually using non-profit agencies and/or private contractors to implement the program. Programs are funded through a distribution charge on all residential customers.

The Electricity Generation Customer Choice and Competition Act (effective January 1, 1997) and The Natural Gas Choice and Competition Act (effective July 1, 1999) restructured the utility industry and opened markets to competition. The Acts included provisions for the Universal Service and Energy Conservation programs previously mandated by the PUC. The Acts required the PUC to continue the Universal Service and Energy Conservation programs, including LIURP, bill payment assistance programs, service termination protections, and customer education. Furthermore, the Acts required the PUC to ensure that these services and programs were appropriately funded and available in each utility distribution territory. While the Acts further codified the oversight responsibilities of the PUC, the administration of the programs and services remained the responsibility of the utilities.

A target annual funding level was computed at the time of the PUC's initial approval of each utility's proposed LIURP program. The utility was required to continue funding the program at that level until the PUC acted upon a petition from the utility for a revised funding level, or until the PUC reviewed the need for program services and revised the funding level through an order that addressed the recovery of program costs in utility rates. Utilities have individually negotiated LIURP budgets with the PUC and budgets have been temporarily or permanently increased upon merger agreements or rate cases.

Revisions to LIURP funding were to consider the following factors.

[10] 52 Pa. Code, Chapter 58, amended January 2, 1998, effective January 3, 1998, 28 Pa.B. 25

- The number of eligible customers that could be provided with cost-effective usage reduction services, taking into consideration the number of homes that previously received services or were not in need of services.
- The expected customer participation rates for eligible customers based on historical participation rates.
- The costs of providing services.
- A plan for providing program services within a reasonable period of time, with consideration of contractor capacity and the impact on utility rates.

LIURP costs are included in utility rates as part of the distribution cost. Recovery of program expenses was to be subject to PUC review of the "prudence and effectiveness of a utility's administration of its low income residential usage reduction program."

Utilities are required to file a three-year Universal Service and Energy Conservation Plan (USECP) on a triennial basis with the PUC.[11] These plans are required to outline each utility's program description, eligibility requirements, projected needs assessment (based on census and utility data), projected enrollment levels, program budget, plans to use community-based organizations, and the organizational structure of the staff responsible for implementing the programs. The plans do not specify savings or cost-effectiveness targets. Plans cannot be implemented or changed without PUC approval.

Utilities are required to submit LIURP program data and energy savings results from an analysis of utility billing data to the PUC on an annual basis. Current reporting requirements became effective upon the enactment of the Electricity Generation Customer Choice and Competition Act and the Natural Gas Choice and Competition Act.

Act 129, signed into law in 2008, imposed new requirements on PA's largest EDCs with mandated savings and demand reduction goals. The Act covers all EDCs with at least 100,000 customers. Implementation of the Act proceeded in three phases.

- Phase I began on 6/1/2009 and ended on 5/31/2013.
- Phase II began on 6/1/2013 and ended on 5/31/2016.
- Phase III, the current five-year phase, began on 6/1/2016 and will end on 5/31/2021.

Act 129 covers electric usage reduction across all segments of the market, and includes requirements specific to the low-income residential market. All three phases required that LIEE programs provide measures for eligible households that were equivalent to the low-incomes sector's share of usage. With the start of Phase III, the Act required 5.5 percent of the mandated reductions be achieved through programs specifically serving low-income customers.

[11] 52 Pa. Code Chapter 54.74 for EDCs and 52 Pa. Code Chapter 62.4 for NGDCs

Act 129 directs the PUC to develop a cost recovery mechanism that ensures that the customer class that finances measures received the benefit of those measures. EDC plans must include cost estimates and a proposed cost-recovery tariff mechanism. The total cost of the plan cannot exceed two percent of the EDC's total annual revenue as of December 31, 2006, excluding LIURP. All EDCs must recover costs on a full and current basis through a reconcilable adjustment clause.

EDCs are currently required to file semi-annual reports regarding their progress toward compliance targets. The Act 129 Statewide Evaluator monitors and verifies data collection, quality assurance, the results of each EDC's Energy Efficiency and Conservation Plan (EE&C), and the EE&C program as a whole.

While utilities are encouraged to coordinate LIURP and Act 129, they are independent programs with separate goals, funding streams, and oversight. They are often administered by the same staff at the EDCs, and Act 129 is often used to provide additional electric reduction measures, such as additional lighting or refrigerator replacement, to LIURP participants.

B. LIEE Program Descriptions

Program organization, administration, and funding varies significantly by state. This section describes the programs available in each state, including funding, administration, eligibility, program investment, participation, and savings goals.

Programs and Services

This section describes the LIEE programs available and the services offered in each state. Table III-1 displays the types of program services available in each state.

- Colorado offers a variety of LIEE programs with services including whole house weatherization, appliance rebates, and energy savings kits.

- Illinois utility plans for new programs beginning in 2018 include single-family retrofits, multi-family retrofits, affordable housing new construction, public housing services, energy-saving kits, and lighting discounts.

- The New Jersey Comfort Partners program offers whole house weatherization services for single-family homes and multi-family buildings up to 14 units.

- Pennsylvania LIURP and Act 129 programs offer low-income customers whole house weatherization services, appliance rebates, energy usage reports, and energy efficiency kits. Details vary by utility.

Table III-1
Program Delivery

	Colorado	Illinois	New Jersey	Pennsylvania
Whole House	X	X	X	X
New Homes		X		X
Appliances	X			X
Conservation Kits	X	X		X
Home Energy Reports	X			X
School Education	X			X

Colorado

CO utilities have contracted out administration of their LIEE programs to EOC. EOC offers a portfolio of energy assistance and LIEE programs funded by utilities and other sources, coordinates LIEE efforts across the state, operates through a central office, and maintains a network of over 100 nonprofit organizations. Participants can apply for these programs at any of the delivery organizations including EOC, the WAP agency, or the local CBO.

EOC provides the following LIEE programs, separate and in addition to the ones provided by CBOs and by the Colorado Energy Office (CEO).

- Nonprofit Energy Efficiency Program (NEEP): Whole building custom energy efficiency for nonprofit organizations serving low-income communities.
- Affordable Housing Program: Custom utility rebates for energy efficiency work in affordable housing, including boiler replacements and insulation work.
- Colorado's Affordable Residential Energy (CARE) Program: No-cost energy efficiency services including air sealing, insulation, hot water heaters, refrigerators, efficient showerheads/aerators, furnaces, thermostats, and storm windows.

The CEO is the state WAP grantee and operates a sub-grantee network of eight regional agencies to provide single family weatherization services in Colorado using WAP, LIHEAP, State Severance Taxes, and utility funding. The CEO aggregates the work that the WAP agencies perform and submits the list of utility-funded measures to EOC. EOC pays the CEO for the measures that this group of organizations completes each month and the CEO invests these funds back into the LIEE program.

The CBOs provide direct install programs, single-family weatherization, individually metered multi-family weatherization, WAP, and the Crisis furnace/boiler replacement program. EOC submits the measures implemented in their own programs, by WAP agencies, and by CBOs to the utilities for reimbursement. Some of these CBO's are part of CEO's network of regional agencies and also receive rebates through EOC from the utilities, and some of these CBOs are not part of CEO's network but do receive rebates through EOC from the utilities.
Table III-2A displays the LIEE programs offered in CO by the electric utilities.

Table III-2A
LIEE Programs
Colorado Electric Utilities

Utility	Program	Administrator
Xcel Energy	Energy Savings Kit	Xcel Energy
	Multi-family Weatherization	EOC
	Non-Profit	
	Single-Family Weatherization	
Black Hills Energy	Direct Install	EOC
	Multi-family Weatherization	
	Non-Profit	
	Single-Family Weatherization	

Sources: DSM Annual Status Report, Xcel Energy, 2016
Black Hills Energy, Annual Status Report, Energy-Efficiency Programs, 2016

Xcel Energy provides the following electric efficiency measures.

- Energy Savings Kit: Eight CFLs, showerhead, and two aerators.
- Single-Family Weatherization Electric Measures: Air sealing, attic insulation, wall insulation, duct sealing, evaporative coolers, LEDs, and refrigerators.
- Multi-Family Weatherization: Custom energy efficiency projects.

Black Hills Energy Single-Family Weatherization measures include air sealing, attic insulation, wall insulation, floor insulation, crawlspace wall insulation, belly insulation, duct sealing, water heater blankets, evaporative coolers, low-flow fixtures, storm windows, LEDs, CFLs, and refrigerators. Customers may receive up to $1,500 in measures provided by Black Hills Energy.

Table III-2B displays the services offered by each CO gas utility. Prior to 2017, Atmos Energy, SourceGas, and Colorado Natural Gas formed a collaborative to implement a joint LIEE program marketed as Partners in Energy Savings (PIES). In 2016, SourceGas was purchased by Black Hills Energy. Beginning in 2017, the gas utilities began to implement independent LIEE programs.

Table III-2B
LIEE Programs
Colorado Gas Utilities

Utility	Program	Administrator
Xcel Energy (Public Service Co. of Colorado)	Energy Savings Kit	Xcel Energy
	Multi-family Weatherization	EOC
	Non-Profit	
	Single-Family Weatherization	
Black Hills Energy (Colorado Gas Co.)	Affordable Housing	EOC
	Non-Profit	
	Single-Family Weatherization	
Atmos Energy	Energy Savings Kit	EOC
	Multi-family Weatherization	
	Non-Profit	
	Single-Family Weatherization	
	Propane-to-Gas Conversion	
Black Hills Energy (SourceGas)	Energy Savings Kit	EOC
	Multi-family Weatherization	
	Non-Profit	
	Single-Family Weatherization	
	Propane-to-Gas Conversion	
Colorado Natural Gas	Energy Savings Kit	EOC
	Non-Profit	
	Single-Family Weatherization	
	Propane-to-Gas Conversion	

Sources: DSM Annual Status Report, Xcel Energy, 2016; Black Hills/Colorado Gas Utility Company,Energy-Efficiency Programs Annual Report 2015; Atmos Energy Natural Gas DSM Plan, 2016 Annual Report; Black Hills Gas Distribution (formally known as SourceGas Distribution) Natural Gas DSM Plan 2015 Annual Report; Colorado Natural Gas, Natural Gas DSM Plan, 2016 Annual Report

Illinois

Prior to the Future Energy Jobs Act (FEJA), the State administered the LIEE programs through the Department of Commerce & Economic Opportunity (DCEO). The DCEO program, known as Illinois Energy Now, included four LIEE programs directed to customers based upon their housing type.

- The Energy Efficient Affordable Housing Construction Program (EEAHCP). This program provided grants ranging from $1,800 to $4,500 per housing unit for single-family and multi-family affordable housing gut rehabs or new construction. Measures focused

on insulation, air sealing, ventilation, and high efficiency heating, hot water, and air conditioning.

- The Residential Retrofit Program. This program partnered with other organizations and provided funding for measures and incentives very similar to those in the Illinois Home Weatherization Assistance Program (IHWAP), which is also administered by DCEO throughout Illinois by 36 Local Administering Agencies. It includes the following electric measures.
  - Energy Star® refrigerators, window air-conditioning units, and exhaust fans
  - Central air conditioning with an Energy Star® rating
  - Furnaces with electrically efficient air handlers
  - Electric water heaters
  - CFLs

  It also includes the following gas measures.
  - High efficiency furnaces
  - Energy Star® rated water heaters
  - Attic insulation and bypass air sealing
  - Wall insulation
  - Blower door guided air leakage reduction
  - Crawl space wall insulation

- Efficient Living: Illinois Public Housing Authority Energy Efficiency Program. This program targeted residents in public housing. The target was low-income renters at or below 80 percent of AMI. The program provides upgrades for electric and/or natural gas savings for common areas and residential units including lighting, appliances, attic and wall insulation, duct insulation and sealing, and high-efficiency HVAC equipment.

- Energy Savers: This is a comprehensive retrofit program for low-income multi-family housing, delivered in conjunction with Elevate Energy. The program provides a turnkey service for building owners, including energy assessments; recommendations for insulation, air sealing, and/or other measures; bid solicitation and overview; and connection with low-cost financing, if applicable.

The most recent publically available DSM plans filed with the ICC by the utilities in preparation for the transition in January 2018 provide some information on the new programs that will be offered.

ComEd will offer the following LIEE programs.

- Lighting: Instant discounts will be provided on Energy Star® certified LED lighting at the time of sale. Additionally, LEDs will be distributed to food banks who will distribute the bulbs to ComEd customers.

- Single-Family Retrofits: Comprehensive retrofits including assessments, education, direct installation of energy-saving measures, replacement of inefficient equipment and systems, and technical assistance to resolve health and safety issues. Measures will include LED lighting, programmable and smart thermostats, advanced power strips, faucet aerators, low-flow showerheads, pipe insulation, furnaces, central air conditioners, water heaters, boiler tune-ups and replacements, ductless heat pumps, air sealing, attic and wall insulation, and air conditioning window units. The program is to be offered jointly or in coordination with Nicor Gas and Peoples Gas/ North Shore Gas.

- Multi-Family Retrofits: Comprehensive energy efficiency retrofits in common areas and tenant spaces, including assessments, direct installation of energy-saving measures, replacement of inefficient equipment and systems, and resolution of health and safety issues at no cost. Measures will include LED and energy efficient lighting retrofits, programmable thermostats, advanced power strips, faucet aerators, low-flow showerheads, pipe insulation, furnaces, water heaters, boiler tune-ups and replacements, ductless heat pumps, air sealing, attic and wall insulation, and air conditioning window units.

  ComEd will also develop an expanded residential income-eligible all-electric multi-family program that includes bulk purchase of ductless heat pumps.

- Affordable Housing New Construction: Technical assistance and incentive funding for energy-efficient construction of affordable housing. This includes major renovations. Technical experts will identify ways to save energy and lower operating expenses, provide energy modeling or whole building energy simulations, and estimate the cost-effectiveness of the project. High insulation levels, air sealing, controlled ventilation, and high-efficiency HVAC systems will be encouraged.

- Low-Income Kits: Kits will include a power strip, six LEDs, an LED night light, and aerators and a showerhead for households with electric hot water. They will be hand-delivered by 15 Community Action Agencies.

- Public Housing Retrofits: Energy efficient retrofits in Public Housing Authority facilities will include assessments and incentives to upgrade most inefficient equipment in units and common areas. Measures will include LED and energy efficient lighting retrofits, programmable thermostats, advanced power strips, faucet aerators, low-flow showerheads, pipe insulation, furnaces, water heaters, boiler tune-ups and replacements, ductless heat pumps, air sealing, attic and wall insulation, and air conditioning window units.

Ameren's Income-Qualified Initiative will provide comprehensive home weatherization services at little or no cost to low- and moderate-income customers. They will partner with local Community Action Agencies to recruit participants and provide assessments and weatherization. Services provided will be consistent with the Illinois Weatherization Assistance Program. The comprehensive home assessment will include a health and safety

evaluation, and low-cost measures including LED light bulbs, low-flow faucet aerators, low-flow showerheads, pipe wrap, programmable thermostats, and power strips will be installed at the time of this assessment. Comprehensive measures installed at no cost will include insulation, air sealing, duct sealing, furnace replacement, central air conditioner replacement, and ECM blower replacement.

Ameren will also offer public housing programs. They will collaborate with federal, state, and municipal government agencies and housing authorities to identify and weatherize eligible properties. Services will be the same as for the income-eligible weatherization program.

New Jersey

The Comfort Partners program provides no-cost home audits, education, and comprehensive weatherization services to low-income households and multi-family buildings with less than 14 units. Because the program is jointly delivered by electric and gas utilities, individuals that heat with electric or gas receive comprehensive service delivery in one program. One contractor provides gas and electric usage reduction measures, so the program is seamless from the customer's perspective.

Measures considered include efficient lighting products, hot water conservation measures, refrigerator and freezer replacement, programmable thermostats, insulation, blower-door guided air sealing, duct sealing and repair, and heating/cooling system repair and replacement. Other repairs that remediate barriers to installing energy efficiency measures may also be made.

Pennsylvania

LIURP programs typically provide whole home retrofit services including home energy audits, energy education, CFL/LED lamp replacement, refrigerator replacement, weatherization services including air sealing and insulation, and health and safety repairs. In addition to heating jobs, electric utilities provide baseload jobs that mainly address refrigerators and lighting. Details vary by utility, but services are generally available to all residential units.

With the passage of Act 129, utilities face new energy savings requirements. To supplement the existing LIURP programs, utilities commonly also offer energy reports, appliance trade-ins, appliance rebates, additional lighting, education, and home energy kits to low-income customers. A summary of programs delivered by utility is provided in Table III-3. The whole house retrofit programs are delivered as part of LIURP. LIURP jobs address gas heating, electric heating, electric water heating, or electric baseload depending on the utility providing services and the fuels used by the customer.

Table III-3
PA Act 129 Phase III Programs

	Whole House Retrofit	Multi-Family Retrofit	New Homes	Home Energy Kits	Appliance Replace / Recycle	Upstream Lighting	School Education	Home Energy Reports
Duquesne Light	X	X						X
Met-Ed	X	X	X	X	X		X	X
PECO-Electric	X	X		X	X	X		
Penelec	X	X	X	X	X		X	X
Penn Power	X	X	X	X	X		X	X
PPL	X			X				
West Penn	X	X	X	X	X		X	X

Program Administration

This section describes the administration of LIEE programs in each state.

- Colorado: EOC administers contracts with the utilities for the LIEE programs. Some of the programs are implemented by EOC, some are implemented by nonprofit organizations, and the CEO coordinates utility funding with Weatherization Assistance Program Funding. However, all of the organizations report monthly to EOC, who then provides one monthly bill to the utilities for all LIEE work that was implemented by the various organizations.

- Illinois: The LIEE programs were previously implemented by DCEO, but are transitioning to the utilities beginning in January 2018.

- New Jersey: The electric and gas utilities work together to design program parameters, procedures and guidelines. Each utility has their own contracts for service delivery with implementation contractors.

- Pennsylvania: Each utility designs and implements its own LIURP and Act 129 programs within the parameters that are set by the PUC.

Table III-4 summarizes the program administration for each state.

Table III-4
LIEE Program Administration

	Colorado	Illinois	New Jersey	Pennsylvania
Utility Role	Utilities manage individual programs through EOC	In transition to utility management of individual low-income programs	Single program jointly managed by six NJ electric and gas utilities	Utilities manage individual programs
State Role	PUC oversight and budget approval role	ICC oversight and budget approval role	BPU oversight and budget approval role	PUC oversight and budget approval role

Colorado

Each investor-owned utility that is covered by the legislation implements its own DSM program. The PUC has oversight over each program. Utilities must submit a three-year DSM plan for PUC approval as well as an annual status report.

EOC currently has contracts with all investor-owned utilities to administer some or all of the low-income components of their programs. EOC leverages the utility funds with other sources, including federal, state, local, and private funds to deliver services in Colorado. EOC facilitates rebates to the CEO and to nonprofit organizations.

Illinois

Prior to FEJA, the LIEE programs were administered by the state through DCEO. Starting on January 1, 2018, utilities will independently implement the entire portfolio of energy efficiency programs, including the LIEE and public-sector segments that were previously unified under DCEO oversight. DSM plan approval and budget approval will continue to be provided by the ICC.

New Jersey

Six New Jersey electric and gas utilities jointly administer the NJ Comfort Partners Program. The BPU provides oversight and budget approval review and must approve any changes in budget allocations. Utilities hire private contractors to provide service delivery following a request for proposal process that assesses qualifications, cost, and experience.

The New Jersey Clean Energy Program has seen changes and uncertainty in their program management, offerings, incentive levels, and implementation over time. These changes have made it difficult to effectively implement, market, and deliver program services. In addition to many changes in programs and incentives, in 2010 the NJCEP was suspended for almost three months, and in September 2015 NJCEP stopped taking new assessments for one of the programs. These stoppages created additional challenges. However, the NJ Comfort Partners program was not impacted by these changes.

Pennsylvania

LIURP programs are run separately by each utility under the oversight of the PUC's Bureau of Consumer Services (BCS). Electric distribution and natural gas companies are directed to submit a triennial Universal Service and Energy Conservation Plan (Plan) to the PUC. These plans outline the eligibility, needs, funding, and structure of each utility's program. The PUC approves or requests modifications to the plans.

Utilities also independently run additional LIEE programs dedicated to achieving the savings goals required by Act 129. Act 129 requires Energy Efficiency and Conservation plans to be submitted to and approved by the PUC.

Utilities contract with nonprofit and/or for-profit contractors to administer and implement or just to implement their programs. Each utility has their own method for selecting and retaining contractors. Many have been working with the same set of contractors for years. Some utilities prefer to work with WAP agencies because they have a set of standards provided by DOE and their state offices. Contracts between the utilities and contractors specify details related to costs and approved energy usage reduction measures.

Utility Scope

This section discusses mandated utility participation in LIEE programs. In each state only the IOUs are mandated to participate in LIEE programs. The section on Policies and Financing Mechanisms addresses the potential for additional offerings through public utilities and electric cooperatives.

- Colorado's legislation that mandates the utilities' DSM programs applies to all IOUs. The legislation specifies that each DSM program must contain a low-income component. This includes the electric utilities, Xcel Energy and Black Hills Energy, and the natural gas utilities Atmos Energy, Colorado Natural Gas, Xcel Energy, and Black Hills Energy.[12]

  Colorado's 22 rural electric cooperatives and 29 municipal electric utilities provide 43 percent of the electricity load in the state.[13] They are not for-profit corporations, so they are not regulated by the PUC and are not required to provide energy efficiency programs. While not required, some of Colorado's rural and municipal electric utilities provide energy efficiency services. Fort Collins Utilities, Colorado Springs Utilities, and Holy Cross Energy have developed comprehensive programs. While most of the residential programs are not specifically targeted to low-income households, the following utilities participate in EOC's CARE single-family weatherization program.

  - Holy Cross Energy
  - Platte River Power Authority
  - San Miguel Power Association
  - Yampa Valley Electric Association

[12] It also included SourceGas, which was purchased by Black Hills Energy in 2016.
[13] http://www.swenergy.org/programs/utilities/state/colorado#CSU

- Illinois's FEJA and the Public Utilities Act cover the two largest electric utilities in the state, ComEd and Ameren, and the large investor owned gas utilities, Nicor, North Shore, and Peoples.

- The New Jersey Comfort Partners program includes the investor-owned electric and gas utilities. The electric utilities are Atlantic City Electric (ACE), FirstEnergy (Jersey Central Power & Light), Public Service Electric & Gas (PSE&G), and Rockland Electric. The gas utilities are Elizabethtown Gas (ETG), New Jersey Natural Gas (NJNG), Public Service Electric and Gas (PSE&G), and South Jersey Gas (SJG).

- Pennsylvania's legislation applies to the large utilities. LIURP includes gas utilities with at least 60,000 customers and electric utilities with at least 100,000 customers, covering 15 electric and gas utilities in the state.

  Act 129 includes the seven largest EDCs. The same electric companies are included in both LIURP and Act 129; Duquesne Light Company, Metropolitan Edison Company, PECO Energy Company, Pennsylvania Electric Company, Pennsylvania Power Company, PPL Electric Utilities Corporation, and West Penn Power Company.

Program Funding and Investment

This section describes how programs are funded, how funding levels are determined, and recent levels of program investment.

Table III-5 summarizes the amount of LIEE spending by state. The total budget includes all 2016 spending by utilities on LIEE programs. It does not include non-utility funds, or utility funds dedicated to energy efficiency programs not specified as low-income.

The IL budget numbers are from the Illinois Energy Now 2014-2017 plan. The enactment of FEJA creates new mandated funding levels for low-income programs from the two largest electric utilities, ComEd ($25 million) and Ameren ($8.35 million). This funding will be fully in effect when utilities begin administering their own LIEE programs in January 2018. The most recently filed DSM plan proposal from ComEd had $40.3 million budgeted for its LIEE program in 2018. This exceeds the $25 million in mandated funding amounts reported from the 2015-2016 program year DCEO budget reported below.

The PA participants includes the electric LIURP participants and the Act 129 single-family participants.

Table III-5
2016 Electric Utility Investment Level in LIEE Programs

	Colorado	Illinois	New Jersey	Pennsylvania
Total LIEE Budget	$8,231,530	$18,520,000	$30,000,000	$82,605,263

	Colorado	Illinois	New Jersey	Pennsylvania
Electric LIEE Budget	$3,824,027	$13,200,000	$11,302,113	$62,952,299
LIHEAP–Eligible Households (FY 2014)	377,050	1,015,201	761,203	1,050,059
Electric Budget Per Eligible LIHEAP HH	$10	$13	$15	$60
Electric LIEE Participants	7,922	NA	4,612	34,887
Electric Budget Per Electric LIEE Participant	$483	NA	$2,451	$1,804

Sources: 2015 Report on Universal Service Programs & Collections Performance of the Pennsylvania; Electric Distribution Companies & Natural Gas Distribution Companies, p. 39 (PUC BCS); Source: PA PUC Phase III Implementation Order, Docket No. M-2014-2424864, June 11, 2015. LIHEAP Home Energy Notebook for FY 2014: Appendix B: Income Eligible Household Estimates; Energy Efficiency Trust Fund Program Report 2016, Illinois Dept. of Commerce & Economic Opportunity; Illinois Energy Now Integrated Natural Gas & Electricity Energy Efficiency Portfolio Plan 2014-2017.

Colorado

CO legislation does not specify a minimum funding requirement for electric utilities. However, the electric utilities have mandated savings goals and receive financial incentives based on those goals.

CO statute specifies minimum gas utility expenditure requirements of at least one-half of one percent of a natural gas utility's revenues from its full-service customers in the year prior to setting such targets. Rule 4 of CRS 723 states that the annual expenditure targets for a gas utility's DSM program "be, at a minimum, two percent of a natural gas utility's base rate revenues (exclusive of commodity costs), from its sales customers in the 12-month calendar year period prior to setting the targets, or one-half of one percent of total revenues from its sales customers in the 12-month calendar period prior to setting the targets, whichever is greater." This requirement is for the DSM program in its entirety and not specific to the LIEE. Gas utilities charge customers a Demand Side Management Cost Adjustment (DSMCA) factor on each Therm of gas consumed to recoup the cost of energy efficiency programs.

Table III-6A displays the approved budget and actual expenditures for the electric LIEE programs in Colorado. Xcel Energy provides the vast majority of funding. The investment level for Black Hills Energy includes funding for the school education program.

Table III-6A
LIEE Utility Investment (2016)
Colorado Electric Utilities

Utility	PUC Approved Budget	Actual Expenditure
Xcel Energy	$2,983,251	$3,086,902
Black Hills* Energy	$840,776	$451,885
Total	$3,824,027	$3,538,787

Source: PUC 2016 Report to the Colorado General Assembly on DSM
* Report combines funding for Low-Income and School Energy Education programs.

Table III-6B displays the approved budget and actual utility investment level for the low-income segments of each gas utility's DSM plan for 2015. Total actual investment from gas utilities was $4.3 million in 2015. The vast majority was from Xcel Energy.

Table III-6B
LIEE Utility Investment (2015)
Colorado Gas Utilities

Utility	PUC Approved Budget	Actual Expenditure
Atmos Energy	$292,830	$278,352
Black Hills* Energy	$434,800	$704,519
Colorado Natural Gas	$60,788	$17,445
Xcel Energy	$3,399,258	$3,174,843
SourceGas	$253,099	$205,302
Total	$4,440,775	$4,380,461

Source: PUC 2016 Report to the Colorado General Assembly on DSM.
* Report combines funding for Low-Income and School Energy Education programs.

Illinois

FEJA mandates that ComEd provide at least $25 million and Ameren at least $8.35 million annually to LIEE programs. The gas utilities will continue to provide measures for low-income households in proportion to the share of the market made up of customers at or below 150 percent of the FPL. Table III-7A provides funding levels from the final year of the most recent DCEO DSM plan, and Tables III-7B and III-7C display planned ComEd and Ameren electric LIEE investments under FEJA.[14]

Table III-7A
Illinois LIEE Utility Investment (2016)

	Electric		Gas				Total
	ComEd	Ameren	Ameren	Nicor	Peoples	North Shore	
PHA	$2 M	$0.8 M	$0.3 M	$0.3 M	$0.5 M	$0.04 M	$4 M
EEAHCP	$2.6 M	$1 M	$0.3 M	$0.5 M	$0.6 M	$0.05M	$5 M
Residential Retrofit	$3.9 M	$1.5 M	$0.5 M	$0.7 M	$.8 M	$0.07M	$ 7.5 M
Energy Savers	$1 M	$0.4 M	$0.1 M	$0.2 M	$0.2 M	$0.07M	$2 M
Total	**$9.5 M**	**$3.6 M**	**$1.3 M**	**$1.7 M**	**$2 M**	**$0.2 M**	**$18.5 M**

Source: Illinois Energy Now Integrated Natural Gas and Electricity Energy Efficiency Portfolio Plan

[14] Currently Illinois is in a six-month bridge period between the last program year of DCEO's program and the start of the utility programs.

Table III-7B
Planned ComEd LIEE Investment

Program	2018	2019	2020	2021
Income-Eligible Lighting Discounts	$4,468,130	$3,861,735	$4,062,446	$4,563,234
Income-Eligible Single-Family Retrofit	$11,649,080	$11,643,470	$11,638,436	$11,649,021
Income-Eligible Multi-Family Retrofit	$8,250,848	$8,255,223	$8,259,707	$8,264,304
Affordable Housing New Construction	$2,662,348	$2,930,445	$3,224,795	$3,553,078
Food Bank LED Distribution Program	$3,214,478	--	--	--
Low-Income Kit Program	$3,154,244	--	--	--
Total	**$33,399,128**	**$26,690,873**	**$27,185,384**	**$28,029,637**

Source: Commonwealth Edison Company's 2018-2021 Energy Efficiency and Demand Response Plan. June 2017.

Table III-7C
Planned Ameren Electric LIEE Investment

Program	2018	2019	2020	2021
Income-Qualified	$15,335,083	$15,938,362	$15,635,273	$15,635,809
Public Housing	$661,288	$660,145	$660,575	$660,605
Total	$15,996,371	$16,598,507	$16,295,848	$16,296,414

Source: Ameren Illinois Company Electric and Gas Energy Efficiency and Demand Response Plan 2018-2021, June 2017.

New Jersey

New Jersey's restructuring legislation requires that the BPU undertake a CRA every four years to inform program funding. The NJ Comfort Partners Program funding and expenditures are displayed in Tables III-8A and III-8B. Total funding in FY 2017 was budgeted at $30 Million but was reduced to $24 Million in FY 2018.

Table III-8A
LIEE Electric Utility Investment
NJ Comfort Partners

Utility	1/1/10-12/31/10	1/1/11-12/31/11	1/1/12-06/30/2013	07/01/13-06/30/14	07/01/14-06/30/15	07/01/15-06/30/16	07/01/16-06/30/17
Budgeted Amount							
ACE	$1,102,608	$1,349,717	$2,181,629	$1,378,177	$1,599,256	$1,370,791	$1,342,918
JCPL	$4,313,257	$4,218,212	$7,954,412	$5,563,888	$4,419,168	$3,247,858	$3,445,580
PSEG-Electric	$6,962,152	$6,856,226	$10,793,575	$7,227,057	$7,643,937	$6,379,146	$6,562,216
Total Electric	**$12,378,017**	**$12,424,155**	**$20,929,615**	**$14,169,122**	**$13,662,361**	**$10,997,795**	**$11,350,713**

Utility	1/1/10-12/31/10	1/1/11-12/31/11	1/1/12-06/30/2013	07/01/13-06/30/14	07/01/14-06/30/15	07/01/15-06/30/16	07/01/16-06/30/17
Program Expenditures							
ACE	$1,072,828	$1,348,100	$2,035,958	$968,074	$1,323,570	$1,353,785	$1,295,427
JCPL	$4,218,176	$3,594,075	$7,008,751	$4,411,277	$2,556,976	$3,106,378	$3,270,659
PSEG-Electric	$6,795,648	$6,307,553	$10,724,523	$6,913,566	$6,043,286	$6,292,412	$6,432,681
Total Electric	**$12,086,652**	**$11,249,728**	**$19,769,233**	**$12,292,916**	**$9,923,832**	**$10,752,575**	**$10,998,767**

Table III-8B
LIEE Gas Utility Investment
NJ Comfort Partners

Utility	1/1/10-12/31/10	1/1/11-12/31/11	1/1/12-06/30/2013	07/01/13-06/30/14	07/01/14-06/30/15	07/01/15-06/30/16	07/01/16-06/30/17
Budgeted Amount							
NJNG	$4,550,099	$3,981,984	$6,078,953	$4,561,170	$4,599,252	$4,482,216	$4,314,503
E-Town	$3,319,009	$2,569,483	$3,947,829	$3,157,043	$2,920,241	$2,395,064	$2,382,422
PSEG-Gas	$10,193,474	$10,194,340	$16,190,362	$10,840,586	$11,465,906	$9,438,618	$9,843,324
SJG	$1,870,877	$1,659,346	$3,153,241	$2,374,552	$2,352,239	$2,556,205	$2,109,038
Total Gas	**$19,933,459**	**$18,405,153**	**$29,370,385**	**$20,933,351**	**$21,337,639**	**$18,872,103**	**$18,649,287**
Program Expenditures							
NJNG	$4,183,207	$3,733,099	$5,840,598	$4,170,387	$3,827,206	$4,325,967	$4,101,812
E-Town	$3,205,468	$2,423,234	$3,627,719	$2,920,901	$2,588,749	$2,352,816	$2,227,988
PSEG-Gas	$10,193,474	$9,461,329	$16,086,785	$10,370,348	$9,064,929	$9,438,618	$9,649,022
SJG	$1,708,387	$1,538,372	$3,132,230	$1,984,983	$2,105,300	$2,396,544	$1,887,560
Total Gas	**$19,290,536**	**$17,156,034**	**$28,687,332**	**$19,446,620**	**$17,586,185**	**$18,513,945**	**$17,866,381**

Pennsylvania

Actual and projected spending for LIURP programs in Pennsylvania are shown in Table III-9A and Table III-9B. Pennsylvania utilities provided over $54 million to fund LIURP services, with over $34 million on electric jobs.

Table III-9A
LIURP Spending
PA Electric Utilities

	2016 Projected Spending*	2015 Actual Spending
Duquesne	$1,655,700	$2,244,667
Met-Ed	$4,605,000	$4,147,534
PECO-Electric	$5,600,000	$5,600,000
Penelec	$5,536,000	$4,565,730
Penn Power	$2,371,000	$1,794,913
PPL	$10,128,246	$9,371,754
West Penn	$4,573,000	$4,448,225
Total	**$34,468,946**	**$32,172,823**

Table III-9B
LIURP Spending
PA Gas Utilities

	2016 Projected Spending*	2015 Actual Spending
Columbia	$4,906,581	$4,847,387
NFG	$1,626,491	$1,002,398
Peoples	$1,250,085	$1,251,395
Peoples-Equitable	$800,000	$890,300
PECO-Gas	$2,250,000	$2,250,000
PGW	$6,151,327	$7,913,908
UGI-Gas	$1,230,341	$665,759
UGI Penn Natural	$936,007	$831,817
Total	**$19,150,832**	**$19,652,964**

Act 129 prescribed that, each EDC's EE&C Plan must include specific energy efficiency measures for households at or below 150 percent of the FPL, in proportion to that sector's share of the total energy usage in the EDC's service territory. Table III-9C provides the budgets for each EDC's Act 129 LIEE Program.

Table III-9C
Act 129 LIEE Budget
PA Electric Utilities

EDC	Program Year					Phase III Total
	2016	2017	2018	2019	2020	
Duquesne	$379,624	$615,607	$923,410	$1,056,792	$1,128,612	$4,104,045
Met-Ed	$3,848,438	$3,649,553	$3,738,821	$3,759,189	$3,048,912	$18,044,914
PECO-Electric	$7,000,000	$7,000,000	$7,100,000	$7,400,000	$7,700,000	$36,200,000
Penelec	$4,218,888	$4,032,597	$4,140,442	$4,164,242	$3,466,681	$20,022,850
Penn Power	$1,321,787	$1,220,489	$1,239,507	$1,249,746	$1,068,099	$6,099,627
PPL	$9,998,000	$9,865,000	$12,807,000	$13,073,000	$9,016,000	$54,759,000
West Penn	$4,012,739	$3,861,780	$3,935,814	$3,957,692	$3,289,777	$19,057,802
Total	**$30,779,476**	**$30,245,026**	**$33,884,994**	**$34,660,661**	**$28,718,081**	**$158,288,238**

LIEE Eligibility and Targeting

This section outlines program eligibility determination and requirements. Table III-10 summarizes program eligibility in each state.

- Income: Programs generally provide income-eligibility based on 200 percent of the FPL or 80 percent of AMI.

- Heating Type: Customers with electric or natural gas heat are eligible for the ratepayer-funded programs.

- Home Type: CO, IL and NJ have programs for all residential customers. NJ serves residential customers in multi-family buildings up to 14 units.

Table III-10
Program Eligibility

	Colorado	Illinois	New Jersey	Pennsylvania
Income Eligibility	80% AMI	80% AMI	225% FPL	150%/200%* FPL
Heating Type	Electric Natural Gas	Electric Natural Gas	Electric Natural Gas	Electric Natural gas
Home Type	All Residential	All Residential	1-14 unit building	All Residential
Notes	Customers typically must check with the service provider to confirm eligibility.	WAP requires 150% FPL for projects using state funds.	Households that receive USF, Lifeline, and/or PAAD are also eligible.	Details differ by utility.

*20% of the budget can be spent on customers between 151- 200% of the Federal poverty level.
Sources: PA: 52 Pa Code § 58.4; CO: HB07-1037, 4 CCR 723-3, 4 CCR 723-4; IL: P.A. 99-0906 / SB
NJ: New Jersey's Clean Energy Program FY 2017 Program Descriptions and Budgets

Colorado

Colorado's LIEE income eligibility is typically 80 percent of AMI for the utility programs and 200 percent of the FPL for WAP.

- Single Family Weatherization: Households with income at or below 80 percent of AMI are eligible.
- Multi-family Affordable Housing Weatherization Program: Requires facilities with more than 5 units to have 67 percent of the population below 80 percent of AMI.
- Colorado Affordable Residential Energy Program: The program is open to participants below 80 percent of the AMI.
- Nonprofit Energy Efficiency Program: 501(c)3 nonprofits who serve low-income populations, own (or have a long-term lease) and use a facility with a need for efficiency improvements, and who pay their own utility bills are eligible.[15]

Table III-11 summarizes this eligibility information.

Table III-11
Colorado LIEE Income Eligibility

Program	Income Eligibility Requirement
Single Family Weatherization	80% AMI
Affordable Housing Weatherization Program	67% of facility under 80% AMI
Affordable Housing Energy Rebate	66% of tenants below 80% AMI
Nonprofit Energy Efficiency Program	Nonprofit facilities serving low-income populations

EOC has a standard application that is similar to the WAP application, but households are not required to provide proof of citizenship, as all income-eligible utility customers are eligible. Households provide pay stubs, tax forms, or other benefit documentation to prove their income. LIHEAP qualification is accepted as income verification.

Illinois

Legislation specified that households at or below 80 percent of AMI are eligible for LIEE programs. Planning documents for the new FEJA programs suggest that low-income customers will be defined as those below 150 percent of the FPL or below 80 percent of AMI and moderate income households will be defined as those with income between 150 and 300 percent of the FPL. The utilities plan to focus marketing to moderate-income customers and to coordinate with the DCEO to serve households below 150 percent of the FPL.

[15] Churches with outreach programs serving low-income populations may also apply.

Ameren's new program plans state that they will target single-family homes and multi-family properties in communities with average household incomes at or below 300 percent of FPL.

Under the previous programs, multi-family building owners would attest to the fact that more than two-thirds of the units were affordable to households earning 80 percent of AMI. Eligibility was not strictly verified. Under the new programs, there is consideration for an approach where buildings will automatically qualify if they are in census tracts where at least 50 percent of the population is below 80 percent of AMI. There will be an additional pathway for households outside those census tracts.

New Jersey

The NJ Comfort Partners (NJCP) program's income eligibility limit is 225 percent of the FPL. Customers who receive SSI, HEAP, USF, Lifeline, PAAD, TANF, or Section 8 Housing may also be eligible. The program is targeted to participants in the Universal Service Fund (energy bill payment assistance program) who have high energy usage.

Participants must be individually metered and be the customer of record for at least one of the participating gas or electric utilities. The residence must be the primary home and be a single-family or multi-family building with up to 14 units. Customers who do not heat with gas or electricity (e.g., fuel oil) are eligible for baseload measures and will be referred to WAP for other services. Customers who heat with fuel oil and where WAP cannot provide critical services will be considered for conversion to natural gas by Comfort Partners.

Customers may enroll in the NJCP Program through various avenues.

- The utilities generate lists of USF customers with high energy usage.
- Program contractors conduct outbound telemarketing.
- Program contractors receive calls from customers who have seen program brochures.
- CAP agencies and other nonprofits refer customers.
- Customers complete information on the NJCEP website to be contacted.
- Personalized customer solicitations.
- Mass mailing campaigns.
- NJ winter moratorium mailings.
- NJCP utility bill inserts.

The main way that customers enroll in NJCP is through contractor marketing to customers on the lists that the utilities provide. It does not appear that the contractors make additional effort to direct marketing towards the highest-usage customers on the utility lists. Additionally, customers who are high users of one fuel may not be high users in the other. This is demonstrated in Tables III-12A and III-12B.

Table III-12A displays a cross tabulation of electric baseload and gas heating pre-treatment usage. The table shows that only eight percent of customers treated (highlighted in the table) are in the highest usage groups for both electric and gas usage.

Table III-12A
New Jersey Comfort Partners 2013 Evaluation Analysis of Pre-Treatment Usage

Electric Baseload Pre-Treatment Usage (kWh)	Gas Heating Pre-Treatment Usage (ccf)		
	≤800	801-1,200	>1,200
≤6,000	19%	18%	8%
6001-10,000	11%	13%	10%
>10,000	4%	9%	8%

Source: NJ Comfort Partners Usage Impact Analysis Memo. October 2014.

Table III-12B displays the percent of electric baseload participants with various levels of gas pre-treatment usage. The table shows that only 39 percent of the highest electric users (highlighted) were also the highest gas users.

Table III-12B
New Jersey Comfort Partners 2013 Evaluation
Electric Baseload Customers Usage Analysis

Electric Baseload Pre-Treatment Usage (kWh)	Gas Heating Pre-Treatment Usage (ccf)			Total
	≤800	801-1,200	>1,200	
≤6,000	42%	40%	19%	100%
6001-10,000	31%	38%	31%	100%
>10,000	20%	41%	39%	100%

Source: NJ Comfort Partners Usage Impact Analysis Memo. October 2014.

Pennsylvania

LIURP programs are required to set income eligibility at 150 percent the FPL, with up to 20 percent of the LIURP budget for special needs customers, defined in the statute as a customer having an arrearage with the covered utility and whose household income is at or below 200 percent of the FPL. Utilities may prioritize certain categories, such as seniors or those in crisis as special needs customers.

Eligibility requirements differ among the utilities. The legislation specifies that "Among eligible customers, those with the largest usage and greatest opportunities for bill reductions relative to the cost of providing program services shall receive services first. When prioritizing eligible customers by usage level, several factors shall be considered when feasible. These factors include: the size of the dwelling, the number of occupants and the end uses of the utility service. When prioritizing eligible customers by opportunities for bill reductions, utility rate factors which may tend to limit (for example, declining block rates) or facilitate, for example, time-of-day rates or heating rates, bill reductions somewhat independently of absolute usage levels should be considered."

As usage reduction is a primary goal of LIURP, high usage customers are given priority. Utilities often have minimum usage requirements and may impose additional company-specific eligibility requirements.

Utilities often have a provision limiting eligibility to individually-metered residences, have residency requirements including that services are only available at a primary residence, and home tenure requirements of six to twelve months. Typically, customers who have received program services in the past five to seven years are also ineligible. Eligibility requirements may be waived under specific circumstances, or if services are coordinated with another weatherization program whose eligibility requirements have already been met, such as another utility's program or WAP.

The PA statute mandates that renters are eligible for LIURP services, provided that the landlord has granted written permission. Furthermore, the rules state that the landlord cannot raise rents or unfairly evict the tenant for a period of 12 months following provision of LIEE services. Obtaining landlord permission has been a challenge for some programs.

PA LIURP participation is often linked with the bill payment assistance programs, known as Customer Assistance Programs (CAP). Customers are required to have income below 150 percent of the FPL to participate in CAP. Some utilities require customers to be payment-troubled to enroll, meaning that they are behind on their bills or express difficulty paying their bills. While some utilities require CAP participants to participate in LIURP, other utilities prioritize CAP participants for LIURP. As such, a large number of LIURP participants are also enrolled in CAP.

Table III-13A and Table III-13B provide examples of utility-specific LIURP eligibility requirements. Some minor caveats and exceptions are not reflected in the table. For example, PECO Electric's minimum usage requirement is 500 kWh for CAP customers but 600 kWh for non-CAP customers. Another exception is allowing services to homes in very small multi-family dwellings that are not individually metered if the landlord and all residents agree.

Table III-13A
PA Electric LIURP Program Eligibility

Electric Utility	Income Eligibility	Minimum Usage Requirement	Home Type	Residency	Lock Out Period
Duquesne	200% FPL	500 kWh (baseload) / mo.	All Residential	6 Months	-
First Energy*	200% FPL	6,500 kWh / year	All Residential	6 Months	5 Years
PECO – Electric	200% FPL	500 kWh (baseload) / mo. 1,400 kWh (heat) / mo.	All Residential	-	-
PPL	200% FPL	-	All Residential	9 Months	7 Years
UGI - Electric	200% FPL	Above Average	All Residential	12 Months	7 Years

*First Energy companies include: Met-Ed, Penelec, Penn Power, and West Penn Power.
Sources: EAP Member Utility Reference Manual; Duquesne Light Company Universal Service and Energy Conservation Three Year Plan 2014-2016; PECO Energy Company Universal Service and Energy Conservation Plan 2016-2018; First Energy Universal Service & Energy Conservation Plan Program Years 2015, 2016, 2017,

and 2018; Revised Universal Service and Energy Conservation Plan UGI 2014 – 2017; PPL Electric Utilities Corporation Proposed 2014-2016 Universal Service and Energy Conservation Plan

Table III-13B
PA Gas LIURP Program Eligibility

	Income Eligibility	Minimum Usage Requirement	Home Type	Residency
Columbia	200% FPL	170 ccf / mo. (winter)	Detached Single/Duplex	-
Peoples	200% FPL	140 Mcf / year	Detached Single/Duplex	12 Months
NFG	200% FPL	130 Mcf / year	Detached Single/Duplex	12 Months
PECO – Gas	200% FPL	50 ccf / mo.	All Residential	-
PGW	150% FPL	Top 20% of CAP	All Residential	-
UGI – PNG	200% FPL	Above Average	All Primary Residential	12 Months
UGI - CPG	200% FPL	Above Average	All Primary Residential	12 Months
UGI - Gas	200% FPL	Above Average	All Primary Residential	12 Months

Sources: EAP Member Utility Reference Manual; Columbia Gas of Pennsylvania, Inc. Universal Service and Energy Conservation Plan 2015-2018; National Fuel Gas Distribution Corporation Universal Service and Energy Conservation Plan 2014-2016; PECO Energy Company Universal Service and Energy Conservation Plan 2016-2018; Philadelphia Gas Works Universal Service and Energy Conservation Plan 2014-2016; Revised Universal Service and Energy Conservation Plan UGI Gas, UGI PNG, UGI CPG, UGI Electric 2014 – 2017; Peoples Natural Gas Company Universal Service and Energy Conservation Plan 2015-2018.

After usage-based targeting, utilities are required to target customers in the following order.

- Customers with high arrearages, and those with the largest arrearages relative to their income.
- Customers with the lowest incomes.

PA Act 129 set low-income eligibility at 150 percent of the FPL. In Phase II of Act 129 the PUC proposed to allow utilities to increase eligibility up to 250 percent of the FPL if they chose to do so to facilitate the EDCs' attainment of the Phase II required 4.5 percent reduction in consumption for the low-income sector. The PUC proposed that the provision of energy efficiency measures to 250 percent of the poverty level be voluntary and left to the determination of each EDC. However, upon consideration of the comments received, the PUC decided to maintain the 150 percent standard for the low-income carve out. They noted that there are a significant number of households in that income bracket that had not been reached and a concern that if the eligibility criteria was expanded to customers above the 150 percent standard, there would be less funding available to the poorest households in the Commonwealth. The income standard was maintained at 150 percent in Phase III.

Utilities define their methods for customers to verify income-eligibility. Because many of the LIURP participants are CAP participants, they have already verified that their income is below 150 percent of the FPL. Many of the utilities accepted LIHEAP, other utility CAP participation, or other low-income program participation as eligibility for LIURP. If

customers do not participate in another program, they must provide documentation of their income through pay stubs, tax forms, or public benefit letters.

Program Participation

This section provides recent program participation statistics. Table III-14 displays program participations numbers for 2016 and projected participation in Illinois for 2018.

Table III-14
2016 LIEE Participants

Colorado**	Illinois***	New Jersey (FY 2016)	Pennsylvania
Electric: 7,922 Gas: 8,984	Ameren: 33,938 (2018 planned) Comed: 104,931 (2018 planned)	4,612	Electric: 34,887* Gas: 6,395

*Electric includes LIURP jobs and single-family Act 129 jobs.
**Colorado participation numbers are estimated
***DCEO plans, reports, and evaluations do not include numbers of participants

Colorado

Table III-15 displays participation statistics for the LIEE programs offered by Colorado electric utilities in 2016. These statistics are based upon the annual reports filed with the PUC.

Total participation counts are complicated by many factors. First, Xcel Energy's annual report provides the number of multi-family weatherization projects undertaken, not the number of customers. Second, customers may participate in multiple programs (e.g., a multi-family project and an energy savings kit). Xcel Energy reports an estimate of the total number of unique participants for their residential and business customers, but does not provide a unique LIEE participant count.

Table III-15
LIEE Program Participation
Colorado Electric Utilities

Utility	Year	Program	Actual Participation
Xcel Energy	2016	Energy Savings Kit	4,957
		Multi-family Weatherization	25*
		Non-Profit	25
		Single-Family Weatherization	2,114
		Subtotal	**7,121**
Black Hills Energy	2016	Low-Income Assistance Program	801
Total Annual Participation Estimate			**7,992**

*Number of projects, not participants.

Utility	Year	Program	Actual Participation

Sources: DSM Annual Status Report, Xcel Energy, 2016; Black Hills Energy – Colorado Electric Utility Company, Annual Status Report 2016.

Illinois

No funding was appropriated to DCEO in 2016 and no new projects were undertaken. Planned ComEd and Ameren participation levels are shown in Tables III-16A and III-16B.

Table III-16A
Planned ComEd LIEE Participation

Program	2018	2019	2020	2021
Income-Eligible Lighting Discounts (Total Bulbs and Fixtures)	737,599	466,096	496,517	555,449
Income-Eligible Single-Family Retrofit (Total Assessments)	104,931	104,931	104,907	104,907
Income-Eligible Multi-Family Retrofit (Total Assessments)	5,694	5,694	5,694	5,694
Affordable Housing New Construction (Total Units, Some in Multi-Family)	1,012	1,114	1,226	1,351
Food Bank LED Distribution Program (Total Households)	1,003,800	210,000	180,000	--
Low-Income Kit Program (Total Kits)	35,000	--	--	--

Source: Commonwealth Edison Company's 2018-2021 Energy Efficiency and Demand Response Plan. June 2017.

Table III-16B
Planned Ameren Electric LIEE Participation

Program	2018	2019	2020	2021
Income-Qualified Units	33,938	34,866	33,770	33,770
Public Housing Units	3,131	3,131	3,131	3,131

Source: Ameren Illinois Company Electric and Gas Energy Efficiency and Demand Response Plan 2018-2021, June 2017.

New Jersey

There were 4,612 NJCP jobs completed in fiscal year 2016 (July 1, 2015 through June 30, 2016). All homes receive electric usage reduction services and customers with natural gas service would also receive energy efficiency services aimed at reducing natural gas usage. Historic participation counts from 2010 through FY 2017 are displayed in Table III-17. The table shows that participation declined in recent years. The decline in participation was due to an increase in the investment level following an evaluation that found low rates of measure installation and lower than expected savings. In response, the Utility Working Group directed the implementation contractors to provide more comprehensive service delivery.

Table III-17
New Jersey Comfort Partners Participants

	1/1/10-12/31/10	1/1/11-12/31/11	1/1/12-06/30/2013	07/01/13-06/30/14	07/01/14-06/30/15	07/01/15-06/30/16	07/01/16-06/30/17
Electric	6,814	7,054	11,877	6,054	5,403	4,612	4,373
Gas	6,140	6,704	11,082	5,550	5,081	4,285	4,131

Pennsylvania

Table III-18A and Table III-18B provide the number of participants by job type and utility company for LIURP programs in 2015, and Table III-18C provides the number of Act 129 jobs planned for 2016 in the utilities' Phase II Act 129 plans.

Table III-18A
PA Electric LIURP Participants (2015)

Utility	Heating Jobs	Water Heating Jobs	Baseload Jobs
Duquesne	499	0	2,375
Met-Ed	628	576	382
PECO-Electric	1,111	0	8,913
Penelec	433	1,302	685
Penn Power	209	300	293
PPL	1,579	519	807
West Penn	687	274	108
Total	**5,146**	**2,971**	**13,563**

Source: 2015 Report on Universal Service Programs and Collections Performance (PA PUC BCS)

Table III-18B
PA Gas LIURP Participants (2015)

Utility	Gas Heating Jobs
Columbia	608
NFG	135
Peoples	246
Peoples-Equitable	160
PECO-Gas	1,293
PGW	3,722
UGI-Gas	106
UGI Penn Natural	125
Total	**6,395**

Source: 2015 Report on Universal Service Programs and Collections Performance (PA PUC BCS).

Table III-18C
PA Act 129
2016 Phase III Participation

	Whole House Retrofit	Multi-family Retrofit	New Homes	Home Energy Kits	Appliance Replacement/ Turn-in	School Education	Home Energy Reporting
Duquesne Light	1,100	48					12,000
Met-Ed*	1,277	280	30	9,000	555 replaced per year, 1,095 turn-in per year	900	11,161
Penelec*	2,140	180	20	9,000	401 replaced per year, 727 turned- in per year	800	15,921
Penn Power*	683	40	8	2,500	117 replaced per year, 212 turned in per year	210	2,966
PPL	7,000			8,000			
West Penn*	1,007	200	30	7,500	472 replaced per year, 885 turned in	1,300	10,498

*FirstEnergy whole house includes those where full funding is from Act 129 and where only extra measures are from Act 129. Note: PECO provided participation by measure rather than by program.

Energy Savings Goals

This section discusses mandated savings targets and savings goals. Table III-19 displays the savings goals or estimated potential for each state.

Table III-19
LIEE Savings Goals or Potential Estimates

	Colorado (2016)	Illinois (2016)	New Jersey (2016)	Pennsylvania (2016)
Electric (GWh)	8	13.5	43-83	67
Gas (Therms)	763,000	840,000	607,000-942,000	-

Colorado

H.B. 1037 required the PUC to develop a rule-making proceeding to develop natural gas and electric savings targets. The legislation stated that electric saving and peak demand reduction goals must be at least five percent of the utility's retail system peak demand in the base year and at least five percent of the utility's energy sales in the base year (2006). The goals were to be met by 2018. Table III-20 displays the 2016 savings goals for the LIEE programs set by each electric utility in their DSM program plan.

Table III-20
LIEE Program Savings Goals (2016)
Colorado Electric Utilities

Utility	Program	Savings Goal (kWh)
Xcel Energy	Energy Savings Kit	1,008,759
	Multi-family Weatherization	1,917,554
	Non-Profit	1,838,130
	Single-Family Weatherization	2,379,324
	Subtotal	7,143,767
Black Hills Energy	Low-Income Assistance Program	929,409
Total		**8,073,176**

Source: Xcel Energy Demand-Side Management Annual Status Report 2016
Black Hills Energy Annual Status Report Energy-Efficiency Programs 2016

Illinois

For the 2016-2017 program year, IL's statutory targets were a two percent reduction in electric usage and a 1.2 percent reduction in gas usage for DCEO's entire portfolio (public sector, low income, and market transformation programs). DCEO established gas energy savings targets of 0.2 percent for the low-income program and 0.7 percent for the public sector program, corresponding to 4.7 million therms. For electricity energy savings they established an annual reduction of 0.3 percent for the low-income program and one percent for the public sector program, corresponding to 138 million kWh. The plan specifies a goal of 13.5 million kWh of savings and 0.84 million therms for the LIEE program.

Table III-21
Illinois LIEE Program Savings Goals (2016-2017)

	IL LIEE Goal	DCEO Target
Electric (kWh)	13,500,000	0.3%
Gas (Therms)	840,000	0.2%

New Jersey

New Jersey set goals for energy savings of 20 percent relative to predicted consumption in 2020 in the 2008 Energy Master Plan, but did not update these savings in the 2011 plan or the 2015 plan.

A feasibility study projected the LIEE savings range as 43 to 83 GWh and 607,000 to 942,000 therms. The low end of the range was based on a program funding assumption of $21.8 million, and the high end was based on a funding assumption of $39.2 million.

Pennsylvania

The PA LIURP programs do not have specific energy savings goals. However, the electric utilities face Act 129 compliance targets. Table III-22A displays the savings reductions mandated in the three phases of Act 129 for Pennsylvania electric utilities with at least 100,000 customers. As part of the Phase III order, 5.5 percent of each utility's overall reduction is required to come from LIEE programs.

Table III-22A
Act 129 Savings Requirements

Phase	Electric Savings Requirement
Phase I	Electricity savings equivalent to 3% of projected June 2009 to May 2010 electricity consumption by May 31, 2013
Phase II	Varies by utility. Electricity savings equivalent to between 1.6% and 2.9% of June 2009 to May 2010 sales by May 31, 2016
Phase III	Varies by utility, electricity savings range from 2.6% to 5%. Phase III runs from June 1, 2016 through May 31, 2021

Source: http://programs.dsireusa.org/system/program/detail/4514

LIEE savings goals for Act 129 Phase III and for one fifth of the five-year goals are shown in Table III-22B.

Table III-22B
Act 129 Phase III
LIEE Savings Goals

EDC	2016-2021 Potential Savings (MWh)	5.5% Low-Income Savings Target (MWh)	Annual Savings Goal (MWh)
Duquesne	470,609	25,884	5,177
Met-Ed	627,814	34,530	6,906
PECO	2,080,553	114,430	22,886
Penelec	598,612	32,924	6,585
Penn Power	170,182	9,360	1,872
PPL	1,590,264	87,465	17,493
West Penn Power	585,807	32,219	6,444
Total	**6,123,841**	**336,812**	**67,362**

Source: PA PUC Phase III Implementation Order, Docket No. M-2014-2424864, June 11, 2015.

C. Evaluation, Measurement, and Verification

States impose various requirements for evaluation, measurement, and verification of energy savings. This section outlines state requirements and program procedures, and presents recent evaluation results.

Requirements

This section outlines the state requirements for energy savings evaluation, measurement, and verification (EM&V). Table III-23 displays the evaluation type and frequency in each state. The Projected EM&V approach relies on use of Technical Reference Manuals (TRMs) or formulas that specify how much energy is saved based upon program inputs. These inputs may include specifics about the home condition, such as existing insulation levels or air leakage rate, or the replacement equipment, such as efficiency level for a new heating or air conditioning system. In some cases, a small number of jobs receive site verification to assess measure installation rates. Billing Analysis refers to analysis using utility billing data that is weather-normalized to assess the reduction in energy usage as a result of LIEE services. While the TRM approach provides an assessment of measures installed and energy efficiency work completed, the Billing Analysis approach provides an assessment of the outcome of the energy efficiency work that was done.

For the most part, the target states' evaluations do not provide specific information about the number of vulnerable households served, the savings among various population segments, and the impacts on the vulnerable populations. While the programs serve low-income households, the goals beyond that reach are generally to save as much energy as possible, rather than to ensure service to subgroups within the low-income population.

Table III-23
Measurement and Verification Approach

	Colorado	Illinois	New Jersey	Pennsylvania
Projected	Annual	Annual	Annual	Annual (Act 129)
Billing Analysis	--	--	2013,2017	Annual (LIURP)

Colorado

Evaluations are administered by the utilities. Each utility submits a set of technical assumptions regarding savings as part of their multi-year DSM plan filing, which are approved by the PUC. These technical assumptions are used to project savings submitted by the utilities as part of their DSM Annual Status Reports.

Pursuant to § 40-3.2-105, C.R.S. the PUC must submit an annual report to the general assembly on the progress made by IOUs in meeting their DSM goals. These reports must include the following information.

- Energy and demand savings
- Avoided annual and cumulative CO2 and SOx emissions in metric tons
- Actual expenditures
- Expenditures in terms of $/kWh over the lifetime of installed measures
- Net economic benefits achieved

Xcel Energy is also required to conduct comprehensive evaluations of three or four programs each year. These evaluations are required to assess customer satisfaction, changes that should

be made to technical assumptions, net-to-gross ratios, and program processes. Xcel Energy completed evaluations of the low-income single family program in 2011, the low-income energy savings kit in 2012, and the multi-family weatherization program in 2014.

Illinois

Legislation requires an annual independent evaluation of the performance and the cost-effectiveness of the portfolio of energy efficiency measures, as well as a full review of the three-year results of the broader net program impacts. The legislation also required that the measures be adjusted based on the results of the evaluations.

New Jersey

NJ Comfort Partners is required to project savings annually. Evaluations with weather-normalized analysis of customer billing data were conducted in 2013 and 2017.

Pennsylvania

Pennsylvania LIURP programs are required to conduct annual evaluations using customer billing data and Act 129 is required to project savings using the TRM or alternative approved approaches on an annual basis. All findings are reported to the PUC. Utilities also conduct periodic evaluations of individual Act 129 programs.

Evaluated Energy Savings

Recent evaluation findings for LIEE programs in each state are presented in this section. While some of the states provide evaluation results from a billing analysis, others provide engineering estimates.

Given the difference in programs and estimation methodologies, it is difficult to compare savings across states. Savings projections usually overstate total program savings. Table III-24 displays average savings per household for single-family weatherization programs.

- Colorado: Engineering estimates for Xcel Energy's single-family weatherization program are used to represent Colorado, as their program represents the vast majority of savings in the state.

- Illinois: The evaluation for the DCEO single-family retrofit program only reports savings for the program as a whole, not by household, and does not include participation numbers.

- New Jersey: Results from the 2013 billing impact analysis, the most recent publicly-available data, represent program year 2011.

- Pennsylvania: The results of a long-term study using billing impact analysis (conducted by Penn State) are displayed. This study includes data from every LIURP program across all utilities, from 1989 to 2005.

Table III-24
Average Annual Household Savings

	Colorado (2016)	Illinois	New Jersey (2011)	Pennsylvania (1989-2005)
Mean Electric Baseload (kWh)	918	NA	473	698
Mean Electric Heating (kWh)		NA	1,071	1,198
Mean Gas Heating (Therm)	327	NA	50	298

Colorado

Table III-25A reports the projected energy savings for the investor-owned electric utility's LIEE program as reported in the PUC's most recent annual report to the Colorado General Assembly.

Table III-25A
LIEE Program Evaluated Energy Savings
Colorado Electric Utilities (2015)

Utility	Savings (kWh)
Black Hills Energy	1,686,706
Xcel Energy	6,503,439
Total	**8,190,145**

Source: PUC 2016 Report to the Colorado General Assembly on DSM
*Goal for "Special" program. Includes Low-Income and School Energy Education.

Table III-25B reports Xcel Energy's projected savings per participant for each component of their LIEE programs.

Table III-25B
Low-Income Program Projected Savings
Xcel Energy (2016)

	Electric			Natural Gas		
	Participants	Average Cost	Average Savings kWh	Participants	Average Cost	Average Savings Therms
Energy Savings Kit	4,957	$23.49	173	6,165	$6.49	10
Multi-family Weatherization	25	$28,566	92,456	16	$55,565	8,149
Non-Profit	25	$21,406	84,879	17	$14,988	1,614
Single-Family Weatherization	2,114	$562	918	1,887	$1,081	327

Source: DSM Annual Status Report, Xcel Energy, 2016

Illinois

Table III-26A displays the savings estimates for the low-income residential retrofit program implemented by the DCEO for the electric utilities from June 2014 through May 2015. Tables III-26B and III-26C report projected savings for ComEd and Ameren electric LIEE programs planned for 2018 through 2021.

Table III-26A
IL Low Income Residential Retrofit Program
June 2014 through May 2015 Projected Savings - Electric Utilities

Program Component	Utility	Savings (kWh)	Grant Amount
Weatherization	Ameren	2,417,676	-
	ComEd	2,494,151	-
	Subtotal	4,911,828	$3,215,000
Program Grantees	Ameren	20,631	-
	ComEd	585,255	-
	Subtotal	605,886	$987,497
Energy Savers Multi-family	Ameren	1,000,742	-
	ComEd	2,058,382	-
	Subtotal	3,059,124	$2,000,000
Total		**8,576,838**	**$6,202,497**

Source: Evaluation of Low Income Retrofit Program Final Report April 2016 (EPY7)

Table III-26B
Planned ComEd LIEE First-Year Annual Savings (Gross MWh)

Program	2018	2019	2020	2021
Income-Eligible Lighting Discounts	27,783	21,365	22,767	25,547
Income-Eligible Single-Family Retrofit	6,985	6,985	6,982	6,838
Income-Eligible Multi-Family Retrofit	4,877	4,877	4,877	4,111
Affordable Housing New Construction	1,879	2,069	2,277	2,509
Food Bank LED Distribution Program	15,241	2,981	2,555	--
Low-Income Kit Program	9,012	1,085	930	

Source: Commonwealth Edison Company's 2018-2021 Energy Efficiency and Demand Response Plan. June 2017.

Table III-26C
Planned Ameren Electric LIEE Savings (Net MWh)

Program	2018	2019	2020	2021
Income-Qualified	9,209	9,630	9,441	9,441
Public Housing	618	618	618	618

Source: Ameren Illinois Company Electric and Gas Energy Efficiency and Demand Response Plan 2018-2021, June 2017.

New Jersey

Table III-27A displays average households savings and estimated total savings from the utility billing analysis conducted in 2011.

Table III-27A
NJ Comfort Partners 2011 Evaluation Results

Job Type	2011 Mean Participant-Level Savings	Estimated Total 2011 Savings
Electric Baseload (kWh)	473	3,027,673
Electric Heating (kWh)	1,071	699,363
Gas Heating (ccf)	50	335,200

Source: New Jersey Comfort Partners Final Evaluation Report, APPRISE, December 2014.
Estimated total savings is based upon the number of participants in 2011 and the percentage of electric participants that were heating and baseload program participants.

The NJ Comfort Partners submits program savings projections based on their Energy Savings Protocols to the BPU. These savings are shown in the table below.

Table III-27B
NJ Comfort Partners Projected Savings

	1/1/10-12/31/10	1/1/11-12/31/11	1/1/12-06/30/2013	07/01/13-06/30/14	07/01/14-06/30/15	07/01/15-06/30/16	07/01/16-06/30/17
Electric (MWh)	8,993	8,904	12,250	5,550	5,151	4,885	5,179
Gas (Dtherms)	65,643	62,678	90,671	64,460	50,040	39,836	33,595

Pennsylvania

Penn State published a report on energy savings measured through a billing analysis from 1989 through 2005. Results from this study are displayed in Table III-28A.

Table III-28A
PA LIURP Evaluation Results, 1989-2005

Job Type	1989-2005 Mean Participant Evaluated Savings
Electric Baseload (kWh)	698
Electric Water Heating (kWh)	443
Electric Heating (kWh)	1,198
Gas Heating (Therm)	298

Source: Long Term Study of Pennsylvania's Low-Income Usage Reduction Program: Results of Analyses and Discussion, Consumer Services Information System Project, Penn State University, January 2009.

LIURP savings for select electric utility companies with publicly available billing analysis results are displayed in Table III-28B.

Table III-28B
PA LIURP Evaluation Results
Selected Electric Utilities

Utility Company	Program Year	Mean Participant Evaluated Savings (kWh)	
		Electric Baseload	Electric Heating
Duquesne	2013	477	1,021
PECO-Electric	2014	849	1,113
PPL	2014	936	1,822

Sources: PECO Energy 2014 LIURP Evaluation Final Report
Duquesne Light Universal Service Programs Final Evaluation Report PY2014

The PA PUC requires that the PA Technical Reference Manual (TRM) be used to estimate energy and demand savings from Act 129 programs. Each utility is required to report to the statewide evaluator and the statewide evaluator conducts additional research to verify the utilities' reported results. If the utilities do not wish to use the TRM protocols, they are permitted to use a custom method as long as they also calculate the TRM savings and include both results in their reports.

The PA PUC reported that as of Program Year Six, Quarter Three, five of the EDCs had LIEE savings well in excess of the 4.5 percent Phase II compliance target. However, the majority of the LIEE savings were from the upstream lighting program, rather than the mix of low-income specific programs. The PUC was concerned with the heavy reliance on the LIEE savings generated from the upstream lighting programs and stated that it did not want to see the same reliance in Phase III. Utilities were required to increase LIEE programs that were specifically targeted to that customer segment to meet their savings goals.

The most recent Program Year 7 results (ending May 31, 2016) show that the utilities had greater savings from low-income customers than required. These results are displayed in Table III-28C.

Table III-28C
PA Act 129 LIEE Savings as a Percent of Required Level
Program Year 2016 (June 1, 2015 – May 31, 2016)

	Duquesne	Met-Ed	Penelec	Penn Power	West Penn	PECO	PPL	Total
Percent of Phase II Low-Income Goal	186%	302%	385%	296%	247%	181%	159%	218%

Source: Act 129 SWE Phase II Final Annual Report, February 28, 2017.

Cost-Effectiveness Testing

This section discusses the cost-effectiveness tests that are used in each state and how they are used for informing programs.

Table III-29
Cost-Effectiveness Testing Overview

	Colorado	Illinois	New Jersey	Pennsylvania
LIEE Included	Yes	No	No	No
Test	TRC	TRC	TRC, UCT, PCT, SCT, RIM	TRC
NEBs	25% Adder	Some societal components	Not Specified	Fossil fuels and water avoided costs
Discount Rate	Utility's weighted average cost of capital	Not Specified	Not Specified	EDC's weighted average cost of capital
LIEE Net-to-Gross	96%	Not Specified	Not Specified	Not Specified

Colorado

Colorado House Bill 07-137 specified the cost-benefit analysis to be used. Colorado's utilities submit technical assumptions with their plan filings to be approved by the PUC.

Cost-effectiveness testing is done for all of the programs in Colorado. Colorado uses the Total Resource Cost test with a 25 percent NEB adder for low-income programs. For the most part they use the tests to examine the programs overall. The low-income programs must pass the test at the portfolio level to count toward their overall savings goal. The utilities may use the test when examining the nonprofit and multi-family programs and in determining which measures to rebate for each project.

Xcel Energy's stipulation and Settlement Agreement in Docket No. 08A-366EG[16] states that as long as the portfolio of electric DSM programs have a cost-benefit ratio of at least one, there "shall be a rebuttable presumption that actual expenditures within 115% of the approved electric budget for any given plan year are reasonable and prudent." The same statement is made with respect to gas programs, except that these expenditures are permitted to be within 125 percent of the approved gas budget.

The challenge that the cost-effectiveness tests pose is in approving new measures. Utilities may not approve proposed measures for rebates if they do not pass the cost-effectiveness test.

Illinois

Illinois requires cost-effectiveness testing for portfolio level screening. The rules for these tests are specified in Public Act 95-0481.[17] The Act requires that the utilities demonstrate that their overall portfolios of energy efficiency and demand response measures are cost-effective under the TRC. However, the measures targeted to customers at or below 150 percent of the poverty level were not required to meet that test.

A recent Policy Manual describes the requirements for the new energy efficiency programs. The TRC is used at the measure-level, program-level, and portfolio level, and calculated on an annual basis. However, the statement notes that the low-income programs are not required to meet the cost-effectiveness tests.[18]

The Policy Manual also proposes that the program administrator "consider performing retrospective and/or prospective TRC calculations on an annual basis in order to inform the planning and implementation of efficiency Programs going forward, or as otherwise directed and/or approved by the Commission."

New Jersey

New Jersey uses all five cost-effectiveness tests without designating a primary one. The tests are required for program and project-level screening, and at the measure level for new technologies. The evaluation plan states that they will perform a cost-benefit analysis each year to determine if programs should be continued in the future and to assess how cost-effective proposed programs are. However, cost-effectiveness is not required for low-income programs, as the 2015 Energy Master Plan update states that the cost-benefit analysis "must demonstrate a net benefit or provide other social or policy benefits, as do the low-income EE programs."[19]

Pennsylvania

[16] http://www.dora.state.co.us/puc/docketsdecisions/decisions/2008/R08-1243A_08A-366EG.pdf
[17] Illinois Public Power Act. http://www.ilga.gov/legislation/publicacts/95/PDF/095-0481.pdf
[18] Illinois Energy Efficiency Policy Manual Version 1.1. A Manual Guiding the Operation of Illinois Energy Efficiency Programs. Effective January 1, 2018.
[19] New Jersey Energy Master Plan Update. New Jersey Board of Public Utilities, New Jersey Department of Environmental Protection. December 2015.
http://nj.gov/emp/docs/pdf/New_Jersey_Energy_Master_Plan_Update.pdf

Pennsylvania uses the Total Resource Cost Test in Act 129 programs. Act 129 requires the utilities to analyze program costs and benefits in their program plans and demonstrate that the plan is cost-effective. Utilities are also required to report the TRC test ratios for each program and the portfolio in their final annual reports. Utilities are required to report the TRC test at the program level and the Commission reserves the right to reject any program with a low TRC test ratio. The Commission limits the calculations to include a maximum of 15 years of benefits and costs, and includes electric savings as the only benefit of the program.

The Commission does not require a TRC test for the low-income sector, but they do require tests to be conducted for all low-income specific programs and for all standard residential programs.

D. Coordination

This section discusses coordination of LIEE programs between utilities, with WAP, and with other programs. All states have some degree of coordination between separate utilities and between utility programs and WAP. However, there is a great deal of variety in how coordination works and the level of coordination that is achieved.

Colorado

Utilities partner with EOC to provide weatherization and LIEE services. EOC serves as the intermediary between the utilities and the CEO and between the utilities and more than 15 other organizations that provide services to the low-income community. EOC also administers its own programs where the utilities provide rebates to cover some of the program cost.

- CEO Programs: The CEO manages the DOE WAP funds. They work with a variety of nonprofit and government agencies that deliver weatherization services. The CEO aggregates the work that these agencies perform and submits the list of utility-funded measures to EOC. WAP pays for other measures that the utilities do not fund or that go over the utility rebated amount. EOC pays the CEO for the utility-funded measures that the agencies complete each month. The CEO invests these funds back into WAP. This is a seamless process from the customer's perspective.

- EOC Programs: EOC administers a single-family weatherization program CARE, the Nonprofit Energy Efficiency Program (NEEP), and the Multi-Family Affordable Housing Program.

    - CARE: EOC provides grants to nonprofit organizations that serve single-family low-income households with restrictions that they must participate in the utility rebates. EOC covers the part of the costs that utilities will not cover. This can include health and safety repairs that are needed to do the weatherization work, or if the home exceeds the utility rebate amount. The services are perceived to be one program from the customer's perspective.

  - NEEP: EOC evaluates each building and proposes the project to the utilities. The utilities review each proposal and determine the rebate that they can offer based on the TRC. EOC aims to provide funding for the part of the project that the utilities do not fund with grants, private funding, and EOC funding. From the nonprofit's perspective, EOC handles the project design, provides the complete funding, and oversees the subcontractors who deliver services. Again, this is a seamless program from the participant's perspective.

  - Multi-Family: The Multi-Family program is similar to NEEP except that the property owners usually provide about 30 percent of the costs that the utilities do not cover.

- Other Organization Programs: Other organizations have LIEE programs that are eligible for utility rebates. They submit measures to EOC each month for utility reimbursement and fund the remaining costs in a variety of ways. Because these programs differ and are managed by a variety of nonprofits, the coordination of funding works in various ways.

Illinois

Under the previous program implementation, utilities partnered with DCEO to implement their LIEE measures. The DCEO was also responsible for administering the state's DOE WAP. DCEO provided services for low-income households using funds provided by ratepayer funded LIEE programs as well as with DOE funding sources. DCEO leveraged funds from different sources to accomplish different needs, for example, if one funding source could not be used for health and safety barriers, but another could, different funding sources could be combined to address the health and safety barriers and provide weatherization. This appeared to be one program from the customer's perspective.

The process will change when utilities begin implementing independent programs in January 2018. It is not clear how coordination will be handled when the utility funding is managed by the utilities rather than DCEO. It is likely that coordination will be reduced if there are separate programs and delivery systems. However, the utilities' plans state that they will continue to coordinate with WAP.

New Jersey

Administration for WAP is handled by the Office of Low-Income Energy Conservation within the New Jersey Department of Community Affairs. NJ Comfort Partners coordinates with WAP to share information, eligibility, and to coordinate services. For example, if a WAP agency or contractor is prevented from providing a service to a customer that is allowed under the NJ Comfort Partners program, the WAP agency may refer a customer to Comfort Partners to see if the customer is eligible for the service. Measures that WAP may refer customers to Comfort Partners for include evaluation of central air conditioning and freezer replacements. Similarly, if a Comfort Partners participant heats with fuel oil, Comfort Partners will still provide baseload measures, but refer the customer to WAP for other services. Comfort Partners continues to work with WAP to assess ways to improve coordination, address health and safety barriers, and provide comprehensive services. They are currently piloting an

increased coordination approach. Because this process is in flux, the details of delivery are still being tested.

Comfort Partners provides joint service delivery for electric and gas measures, and coordination between electric and gas services is 100 percent. Customers who have only electric and natural gas fuels will receive comprehensive energy efficiency services through the program. The utilities have determined allocation formulas to divide the costs of the comprehensive job, including measures that address both electric and gas usage. It is one program and it is seamless from the customer's perspective.

Pennsylvania

Coordination has not been required in PA and there has not been extensive efforts by many of the utilities and implementers to provide joint delivery of services. The PUC put together a Universal Service Coordination Working Group in 2009 to improve joint delivery of the numerous energy efficiency programs (LIURP, WAP, and Act 129). However, the separate utility LIURP programs and WAP are disjointed and there is much room for improvement with respect to program coordination.

Since a customer may receive gas and electric services from different utilities, the utilities may coordinate LIURP activities across their separate programs and jointly deliver services. However, because the utilities usually target services to the highest-usage customers who participate in bill payment assistance programs, there is often limited overlap and only a small percentage of jobs are coordinated in practice. A customer may participate in the payment assistance programs for both the electric and gas utilities, but they are unlikely to be considered high users by both companies, and will not be on both utility's target lists. Similarly, WAP has a different list of households that may not match up with the utility lists.

Several of the utilities continue to work to increase coordination and sometimes reduce or remove usage requirements if coordination is possible. As such, the level of coordination differs by utility.

WAP agencies may share data with utility LIURP data systems to check eligibility and coordinate services, and those LIURP data systems may be used to capture WAP information on jointly delivered jobs. In some cases, WAP agencies and a utility's LIURP services, or an electric utility's LIURP and a gas utility's LIURP may be administered by the same local contractor or CBO, facilitating coordination of services from both programs into a single jointly-delivered job.

In some cases, the coordinated jobs will have one combined audit, but in other cases, the paperwork requirements are too different and the contractors must essentially perform two audits.

Greater flexibility is needed by all parties, in terms of eligibility, paperwork, and funding to allow for increased coordination. Such coordination is important to improve efficiency and

effectiveness of program services, and to take full advantage of the vast opportunities in PA given their high level of LIEE funding.

E. Key Findings

The regulatory requirements and administrative structure for LIEE programs can have a large impact on the program design, efficiency, and effectiveness. This section of the report documented the regulatory background and program structure for Colorado, Illinois, New Jersey, and Pennsylvania, and assessed how these characteristics have affected the implementation of LIEE programs. Key findings are summarized in this section. The following sections of this report assess how these parameters have impacted barriers, opportunities, and results in the state LIEE programs.

Regulatory Background and Program Administration

The regulatory background in these states has, to a certain extent, shaped the direction of LIEE. States that have specific spending or saving requirements for their programs have generally directed more resources to that area. PA has the largest amount of resources directed to LIEE electric efficiency programs, as they have required utilities to create low-income programs focused on both affordability and usage, and other electric programs focused on reductions in usage with requirements for low-income carve-outs.

- Colorado: Legislation requires all investor-owned utilities to develop DSM programs with specific saving goals for electric utilities and spending targets based on a percentage of revenue for gas utilities. While utilities are required to include a low-income program in their offerings, there are no specific saving goals or spending requirements for these programs. Energy Outreach Colorado administers the utility LIEE programs.

- Illinois: New legislation passed in 2016 and enacted in 2017 transferred energy efficiency program administration from the state to the utilities and increased electric energy efficiency spending requirements, beginning in January 2018.

- New Jersey: Electric restructuring legislation in 1999 and a 2001 Board of Public Utilities Order made the New Jersey electric and gas utilities and representatives of the Natural Resources Defense Council (NRDC) responsible for implementing programs to reduce the amount of electricity and natural gas used in New Jersey and to reduce the summer peak demand for electricity. The Utility Residential Low-Income Program Working Group designed the Comfort Partners Program to contribute to usage reduction goals and to improve energy affordability for low-income customers. The BPU approves the programs and the budgets, and has most recently reduced the Comfort Partners budget for the 2018 fiscal year.

- Pennsylvania: PA utilities individually run energy efficiency programs that were codified into law with 1997 utility restructuring legislation. Additional legislation requiring overall electric usage reduction, measures targeted toward low-income households, and a

percentage of savings from the low-income segment significantly increased LIEE investments and savings on the electric side.

LIEE Programs

Programs and services vary by state. However, each state offers a low-income whole house energy efficiency program, as well as additional programs that provide services to low-income households.

- Colorado offers a variety of low-income programs with services including whole house weatherization in all housing types, appliance rebates, and energy savings kits.

- Illinois provides weatherization services for single family homes, multi-family housing, and public housing. IL also provides for gut rehabs and new construction. As programs transition from state administration to utility administration, program delivery and available services will change.

- The New Jersey Comfort Partners program offers whole house weatherization services for single-family homes and multi-family buildings up to 14 units.

- Pennsylvania LIURP and Act 129 programs offer low-income customers whole house weatherization services, appliance rebates, energy usage reports, energy efficiency kits, and new energy-efficient homes. Details vary by utility.

Program Administration

Programs may be administered individually by utilities, jointly by utilities, by the state, or through a nonprofit. However, all utilities and regulators play some role in each state's LIEE programs.

- Colorado's LIEE programs are implemented separately by each utility with the PUC providing state and budgetary oversight. EOC provides administration of the utility programs.

- Illinois's LIEE programs were administered by the State. Each utility will be administering separate low-income programs beginning January 2018. Under both arrangements, program and budgetary approval and oversight is provided by the Illinois Commerce Commission (ICC).

- The New Jersey Comfort Partners program is jointly administered by six utilities with the Board of Public Utilities providing oversight and budget approval.

- Pennsylvania utilities independently administer LIURP and Act 129 programs with the PUC providing oversight and budget approval.

Program Scope

In each state only the investor-owned utilities are mandated to participate in LIEE programs.

- Colorado's legislation that mandates the utilities' DSM programs applies to all investor-owned gas and electric utilities. The legislation specifies that each DSM program must contain a low-income component.

- Illinois's FEJA and the Public Utilities Act cover the two largest electric utilities in the state, ComEd and Ameren, and the large investor owned gas utilities, Nicor, North Shore, and Peoples. They specify the funding required from each EDC for LIEE.
- The New Jersey Comfort Partners program includes the investor-owned electric and gas utilities. Each utility is required to contribute to the program proportionate to its revenues.

- Pennsylvania's LIURP legislation applies to gas utilities with at least 60,000 customers and electric utilities with at least 100,000 customers, with spending negotiated individually with the BPU. Act 129 includes the seven largest electric distribution companies with total electric savings and low-income electric savings goals prescribed by the Act and PUC Orders. Electric utilities may spend a maximum of two percent of their revenue on the Act 129 programs.

Program Funding and Investment

Total LIEE electric funding in PA was far higher than the other states due to the combination of LIURP electric and Act 129 programs. While PA's electric LIEE budget for 2016 was close to $63 million, IL's budget was $13.2 million, NJ's was $11.3 million and CO's was $3.8 million.

Colorado, Illinois, and New Jersey had very similar funding levels per LIHEAP-eligible household, ranging from $10 to $15. However, PA had significantly higher levels due to having both the LIURP and Act 129 Programs. PA's funding per LIHEAP-Eligible household was $60. It is more difficult to compare the funding per LIEE participant due to differences in types of programs and services offered.

Program Eligibility

Eligibility varies by state and utility but has the following general characteristics.

- Income: Programs generally provide income-eligibility based on 200 percent of the FPL or 80 percent of AMI. NJ and PA with criteria of 150 to 225 percent of the FPL, and significantly higher funding levels than CO and IL, have begun to face challenges recruiting high-usage customers for participation and could potentially increase savings and cost-effectiveness by increasing eligibility to the higher income levels seen in CO and IL.

- Heating Type: Customers with electric or natural gas heat are eligible for the ratepayer-funded programs. Customers with other heating types are generally limited to the Weatherization Assistance Program or other non-ratepayer funded programs.

- Home Type: CO, IL and PA have programs for all residential customers. NJ serves residential customers in multi-family buildings up to 14 units.

Savings Goals or Potential

Pennsylvania had the highest savings goals for 2016 corresponding to their much higher investment levels. While PA's goals for electric savings under Act 129 (which can include LIURP savings) were 67 GWh, NJ estimated a savings opportunity between 43 and 83 GWh, IL had goals for 13.5 GWh, and CO had goals for 8 GWh of electric savings.

Evaluation, Measurement, and Verification

CO and IL provide projected savings estimates through their TRM. Therefore, it is not possible to assess the success of these programs in achieving the goals of reduced energy usage, increased affordability, and climate impacts. NJ has conducted evaluation using billing analysis in 2013 and 2017 (2017 results are not yet publicly available), and has used these findings to refine their program. PA requires utilities to conduct a billing analysis for their LIURP program each year, and utilities generally assess and improve their programs based on these results. The PA Act 129 Program uses TRM analysis.

Coordination

All of the states have some degree of coordination in the LIEE programs. Colorado has the most extensive coordination through EOC, as utility ratepayer funding is coordinated with WAP, state severance tax, and other available funds. NJ effectively coordinates between gas and electric utilities as they jointly deliver these services, and they are working to increase coordination with WAP. IL has transferred their low-income programs from the state to the utilities, which may result in reduced program coordination. PA has challenges coordinating programs due to varying usage requirements and targeting procedures, but some utilities have actively worked to increase coordination with WAP and other utilities by removing such requirements on coordinated jobs.

LIEE research presented in the following sections of this report provides information on how these characteristics relate to barriers, opportunities, and potential in these states and around the country.

IV. National Energy Costs and Burden

This section provides an analysis of national energy costs and burden for low-income households in the United States and a comparison to other income segments and all households in the United States. The first section focuses on updated data from the 2009 Residential Energy Consumption Survey. These data provide costs based on actual energy bills provided by utilities and fuel providers. The second section provides analyses based on self-reported household data from the American Community Survey. This information is based on more recently reported information, but not based on utility bills.

A. Residential Energy Consumption Survey (RECS) Analysis

The 2014 LIHEAP Home Energy Notebook provides information based on data collected in the 2009 (the most recent publicly available low-income analysis) Residential Energy Consumption Survey (RECS).[20] These data were adjusted to reflect FY 2014 weather and fuel prices.[21]

The RECS is a national household survey that provides information on residential energy use. The survey is conducted every four years. It is the best source of information on energy usage because the Energy Information Administration (EIA) obtains permission from respondents to obtain actual energy consumption and expenditure data from utility companies. Regression analysis is used to estimate the percent of fuels that are used for end uses, such as heating, cooling, and major appliances.

Table IV-1 displays the percent of residential energy expenditures by end use for low-income households with income at or below the federal maximum LIHEAP eligibility standard (i.e., the greater of 150 percent of DHHS Poverty Guidelines and 60 percent of state median income). In this table, we highlight the rows that represent electric usage. For all households, this will at least include 54 percent of usage, representing energy used by appliances, refrigeration, and cooling. For households that also use electric water heating, electricity will represent 68 percent of energy usage, and for households that use electricity for both water heating and space heating, this will represent all end uses. (There are some exceptions in the appliances category including gas stoves and dryers. However, households who use electricity for water and space heating are very likely to be all electric households.)

[20] More recent versions of the LIHEAP Home Energy Notebook have not yet been publicly released.
[21] Source: LIHEAP Home Energy Notebook for FY 2014.
https://www.acf.hhs.gov/sites/default/files/ocs/hen_final_508_compliant_fy14.pdf

Table IV-1
Percent of U.S. Residential Energy Expenditures
By Low-Income Households

End Use	Low-Income Households		
	All	Electric Water Heaters	Electric Water and Space Heaters
Appliances	38%	38%	38%
Refrigeration	8%	8%	8%
Cooling	8%	8%	8%
Water Heating	14%	14%	14%
Space Heating	32%	32%	32%
Total Opportunities	**54%**	**68%**	**100%**

Source: LIHEAP Home Energy Notebook for FY 2014.
https://www.acf.hhs.gov/sites/default/files/ocs/hen_final_508_compliant_fy14.pdf

Table IV-2 displays the main heating type in 2009. While 33.6 percent of all households heated with electricity, 36.7 percent of low-income households heated with electricity. There has been an increase in the percentage of households who use electric heat since the previous RECS survey conducted in 2005, likely due to greater growth in the south where electricity is a more common heating source.

- All Households: Electric heat increased from 30.3 percent in 2005 to 33.6 percent in 2009.
- Non-Low-Income Households: Electric heat increased from 29.2 percent in 2005 to 31.9 percent in 2009.
- Low-Income Households: Electric heat increased from 31.8 percent in 2005 to 36.7 percent in 2009.
- LIHEAP-Recipient Households: Electric heat increased from 19.0 percent in April 2005 to 29.3 percent in 2009.

Table IV-2
2009 Main Heating Type

Main Heating Fuel	All Households	Non-Low-Income	Low-Income	LIHEAP-Recipient
Natural gas	49.0%	51.4%	44.4%	49.2%
Electricity	33.6%	31.9%	36.7%	29.3%
Fuel oil	6.1%	6.1%	6.1%	11.3%
Kerosene	0.4%	0.2%	0.9%	1.1%
LPG	4.9%	5.1%	4.6%	5.0%
Other	2.9%	2.9%	3.0%	2.7%

Source: LIHEAP Home Energy Notebook for FY 2014.
https://www.acf.hhs.gov/sites/default/files/ocs/hen_final_508_compliant_fy14.pdf

Table IV-3 displays mean 2014 residential energy expenditures for electric heaters, natural gas heaters, and all households. The table shows that mean energy costs for low-income electric heaters were $1,623 and for gas heaters were $1,847.

Table IV-3
2014 Residential Energy Expenditures

Main Heating Fuel	All Households	Non-Low-Income	Low-Income	LIHEAP-Recipient
Electric	$1,917	$2,099	$1,623	$1,660
Gas	$2,095	$2,210	$1,847	$1,974
All Fuels	**$2,199**	**$2,363**	**$1,894**	**$2,137**

Source: LIHEAP Home Energy Notebook for FY 2014.
https://www.acf.hhs.gov/sites/default/files/ocs/hen_final_508_compliant_fy14.pdf

Table IV-4 displays measures of energy burden. The mean individual energy burden is the average of energy costs divided by income for each individual household. The group energy burden is the sum energy costs divided by the sum of income for all households in the group. The individual energy burden is higher because there are some customers who have reported energy costs that are close to or equal to their total income, and therefore have a burden close to 100 percent. These customers are likely to be receiving additional assistance including TANF, food stamps, housing assistance, private assistance, or help from family.

The table shows that the mean individual energy burden for low-income electric heaters was 18 percent and the mean group energy burden was nine percent. These are high compared to the means of three percent and two percent for non-low-income households.

Table IV-4
2014 Residential Energy Burden

Main Heating Fuel	All Households		Non-Low-Income		Low-Income		LIHEAP-Recipient	
	Individual	Group	Individual	Group	Individual	Group	Individual	Group
Electric	9.0%	2.6%	3.2%	2.2%	18.4%	8.6%	17.5%	10.2%
Gas	7.5%	2.9%	2.9%	2.3%	17.3%	9.8%	17.7%	12.1%
All Fuels	**8.6%**	**3.0%**	**3.3%**	**2.4%**	**18.4%**	**10.0%**	**18.8%**	**13.1%**

Source: LIHEAP Home Energy Notebook for FY 2014.
https://www.acf.hhs.gov/sites/default/files/ocs/hen_final_508_compliant_fy14.pdf

B. American Community Survey Analysis

This section provides an analysis of Low-Income Households in the United States using the 2015 American Community Survey (ACS) Data. The one-year ACS Public Use Microdata Sample (PUMS) data were downloaded from the Census website and the tables represent households in 2015.

ACS is an annual national survey that collects data on households and housing units. The data include household income, home characteristics, main heating fuel type, electricity bills, and main heating fuel bills. We use these data to describe households who are eligible for LIEE programs under various definitions of income eligibility.

To establish the number of households under different income eligibility requirements we used the State Median Income (SMI)[22] and the Federal Poverty Income Guidelines (FPIG).[23] The SMI guidelines were provided by the Department of Health and Human Services (DHHS) for mandatory use in Federal Fiscal Year (FFY) 2015, adjusted for household size. We used the FPIG for 2015 as released on January 22, 2015 in the Federal Register.

National estimates are shown using various income eligibility guidelines: 150 percent of FPL, 200 percent of the FPL, 60 percent of the SMI, and 80 percent of the SMI guidelines. Additionally, we display the information for all households.

Table IV-5 displays the number and percent of households in the United States using each type of heating fuel under the various definitions of low-income and for all households. Under each low-income definition shown, between 41 and 42 percent of low-income households use electricity as their main heating fuel. With the largest definition of low-income, up to 80 percent of state median income, over 21 million low-income households use electricity as a main heating fuel, indicating a large population of low-income households potentially with the best opportunities for whole-house energy efficiency services.

The numbers in Table IV-5 indicate that a higher percentage of households use electricity as their main heating fuel than in Table IV-2, from the 2009 RECS. This continues the trend of an increasing percentage of households using electricity as their main heating source, described above. The increase is related to higher population growth in the south where electric heating is more prevalent. While the 2005 RECS showed that 30.3 percent of all households in the United States used electricity as the main heating fuel, the 2009 RECS showed that 33.6 percent used electricity, and the 2015 RECS showed that 36.3 percent used electricity as the main heating fuel. Therefore, the 2015 ACS estimate of 38 percent who use electricity as the main heating fuel is in line with this estimate.

[22] Federal Register / Vol. 79, No. 139 / Monday, July 21, 2014 / Notices. https://www.gpo.gov/fdsys/pkg/FR-2014-07-21/pdf/2014-17063.pdf

[23] Federal Register / Vol. 80, No. 14 / Thursday, January 22, 2015 / Notices
Link: https://www.gpo.gov/fdsys/pkg/FR-2015-01-22/pdf/2015-01120.pdf

Table IV-5
Main Heating Fuel for Low-Income Households in the United States

Main Heating Fuel	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Utility Gas	10,419,211	41%	15,036,110	42%	14,468,919	41%	20,400,341	42%	48%
Electricity	11,872,238	46%	16,372,153	45%	15,894,969	46%	21,279,110	44%	38%
Other Fuels	2,822,061	11%	4,123,159	11%	3,975,683	11%	5,607,888	12%	12%
No Fuel Used	443,500	2%	590,115	2%	571,779	2%	729,394	2%	1%
All	**25,557,010**	**100%**	**36,121,537**	**100%**	**34,911,350**	**100%**	**48,016,733**	**100%**	**100%**

Table IV-6 displays the housing unit type for low-income households in the United States. The table shows that low-income households are most likely to live in single-family homes. However, a significant percentage, more than among all households in the U.S., also live in small and large multi-family buildings, indicating the need for a multi-pronged approach to LIEE service delivery.

Table IV-6
Housing Unit Type for Low-Income Households in the United States

Housing Unit Type	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Single Detached	11,144,449	44%	16,934,163	47%	16,129,290	46%	23,872,538	50%	63%
Single Attached	1,361,835	5%	1,951,803	5%	1,882,114	5%	2,635,649	5%	6%
2-9 Unit Bldg.	5,312,138	21%	6,987,507	19%	6,844,258	20%	8,686,809	18%	13%
10-19 Unit Bldg.	1,721,583	7%	2,285,466	6%	2,241,710	6%	2,911,496	6%	4%
20+ Units Bldg.	3,419,992	12%	4,423,279	12%	4,374,731	13%	5,470,703	11%	9%
Mobile Home	2,548,176	10%	3,478,800	10%	3,379,893	10%	4,368,078	9%	6%
Boat, RV, Van	48,837	<1%	60,519	<1%	59,354	<1%	71,460	<1%	<1%
All	**25,557,010**	**100%**	**36,121,537**	**100%**	**34,911,350**	**100%**	**48,016,733**	**100%**	**100%**

Table IV-7 displays the number and percent of low-income households in the U.S. who own their homes. Home owners are usually much easier to serve because they do not face the split incentive challenge that renters face. The table shows that as the guideline for inclusion increases, the percentage of owned homes also increases. While 38 percent of households under 150 percent of the poverty level own their homes, 48 percent under 80 percent of state median income own their homes. This compares to 63 percent of all households.

Table IV-7
Home Ownership for Low-Income Households in the United States

Home Ownership	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Owned	9,657,933	38%	15,203,414	42%	14,515,205	42%	22,119,555	48%	63%
Rented	14,873,714	58%	19,626,936	54%	19,129,114	55%	24,345,082	49%	35%
Other	1,025,363	4%	1,291,187	4%	1,267,031	4%	1,552,096	3%	2%
All	**25,557,010**	**100%**	**36,121,537**	**100%**	**34,911,350**	**100%**	**48,016,733**	**100%**	**100%**

Race statistics are presented at the household level and represent the reported race of the household reference person (head of household) only. These data address the issue of Environmental Justice and provide part of the information needed to ensure that all households are equitably served by LIEE. The ACS microdata race categories have been collapsed as follows.

- White: White alone
- Black: Black or African American alone
- Asian: Asian alone
- Other – Single Race: Alaska Native alone, American Indian and Alaska Native tribes specified; or American Indian or Alaska Native, not specified, Native Hawaiian and Other Pacific Islander alone, and Some Other Race alone
- Other – More Than One: Two or More Races

Table IV-8 shows that 66 to 70 percent of low-income households are characterized as white and 17 to 20 percent are characterized as Black. This compares to 77 percent of all households who are characterized as white and 12 percent who are characterized as black.

Table IV-8
Race for Low-Income Households in the United States

Race	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
White	16,876,094	66%	24,690,018	68%	23,855,366	68%	33,781,866	70%	77%
Black	5,223,458	20%	6,758,660	19%	6,592,018	19%	8,365,470	17%	12%
Asian	1,046,561	4%	1,406,775	4%	1,346,423	4%	1,804,621	4%	5%
Other – 1 Race	1,816,103	7%	2,455,551	7%	2,335,482	7%	3,034,129	6%	4%
Other – > 1 Race	594,794	2%	810,533	2%	782,061	2%	1,030,647	2%	2%
All	**25,557,010**	**100%**	**36,121,537**	**100%**	**34,911,350**	**100%**	**48,016,733**	**100%**	**100%**

Table IV-9 displays information about direct bill payment for low-income households in the U.S. The table provides the following information about households below 200 percent of the FPL.

- Direct Electric Bill Payment: 91 percent of these households are directly responsible for their electric bill payment, as opposed to having the bill included in their rent.
- Direct Electric Bill Separate from Gas: 84 percent are responsible for their electric bill and have an electric bill that is separate from the gas bill, as opposed to having a dual fuel utility that provides one bill. We can estimate annual electric costs for these households.
- Direct, Separate Electric Bill with Electric Heat: 40 percent have a separate electric bill that they are responsible for and have electric heat.

Table IV-9
Direct Payment for Electric and/or Gas Bill in the United States

Bill Payment	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Elec Bill – Direct Pay	23,051,625	90%	32,963,920	91%	31,794,865	91%	44,247,339	92%	95%
Elec Bill Sep From Gas	21,181,190	83%	30,324,708	84%	29,264,15	84%	40,695,018	85%	86%
Sep Elec Bill, Non-Elec Heat	10,865,041	43%	15,944,711	44%	15,327,878	44%	21,840,914	45%	52%
Sep Elec Bill, Elec Heat	10,316,149	40%	14,379,997	40%	13,936,276	40%	18,854,104	39%	35%
Gas Bill – Direct Pay	10,516,357	41%	15,449,053	43%	14,825,829	42%	21,123,406	44%	51%
Direct Pay & Gas Heat	7,378,695	29%	10,924,076	30%	10,478,092	30%	15,069,950	31%	37%
All	**25,557,010**	**100%**	**36,121,537**	**100%**	**34,911,350**	**100%**	**48,016,733**	**100%**	**100%**

Table IV-10 displays the number and percent of households in the U.S. who use electric heat by type of home. In this table, single family includes attached and unattached and multi-family includes buildings with 2-9, 10-19, and 20 or more units. The table shows that about two-thirds of the low-income electric heating households are renters and that about half of the low-income electric heating households are in multi-family buildings, indicating that these are important targets for reducing electric usage among low-income households.

Table IV-10
Targets for Comprehensive LIEE in the United States

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Elec Heat	11,872,238	46%	16,372,153	45%	15,894,969	46%	21,279,110	44%	38%

Single-Family	4,583,741	18%	6,776,235	19%	6,472,171	19%	9,330,176	19%	21%
Multi-Family	5,733,713	22%	7,497,575	21%	7,386,119	21%	9,332,991	19%	14%
Mobile Home	1,533,310	6%	2,071,537	6%	2,010,052	6%	2,584,310	5%	3%
Elec Heat Own	3,695,113	14%	5,677,968	16%	5,429,498	16%	8,064,041	17%	38%
Single-Family	2,540,291	10%	4,025,001	11%	3,826,011	11%	5,881,711	12%	20%
Multi-Family	248,011	1%	372,943	1%	366,24	<1%	535,055	1%	17%
Mobile Home	894,095	3%	1,264,229	3%	1,221,447	3%	1,628,314	3%	<1%
Elec Heat Rent	7,717,826	30%	10,126,714	28%	9,908,350	28%	12,549,251	26%	17%
Single-Family	1,793,001	7%	2,433,324	7%	2,335,101	7%	3,064,302	6%	5%
Multi-Family	5,381,478	21%	7,002,546	19%	6,899,213	20%	8,661,822	18%	12%
Mobile Home	536,622	2%	682,406	2%	665,777	2%	813,085	2%	<1%
All	**25,557,010**	**100%**	**36,121,537**	**100%**	**34,911,350**	**100%**	**48,016,733**	**100%**	**100%**

Table IV-11 displays the average annual electric bills for low-income electric heaters in the U.S. based on self-reported data in the ACS. The table provides the following information.

- Households in single-family homes have the highest bills, followed closely by households in mobile homes. Households in multi-family buildings have much lower bills.
- Electric owners have bills that are higher than electric renters because they are more likely to be in single-family homes.

Table IV-11
Average Annual Electric Bills for Low-Income Electric Heaters in United States

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill
Elec Heat	10,316,149	$1,782	14,379,997	$1,807	13,936,276	$1,792	18,854,104	$1,821	$1,955
Single-Family	4,255,670	$2,180	6,328,098	$2,188	6,044,739	$2,173	8,743,137	$2,189	$2,307
Multi-Family	4,569,235	$1,289	6,036,848	$1,288	5,935,581	$1,283	7,597,055	$1,283	$1,267
Mobile Home	1,475,634	$2,168	1,995,013	$2,178	1,935,918	$2,170	2,490,08	$2,172	$2,190
Elec Heat Own	3,550,687	$2,122	5,455,244	$2,135	5,218,220	$2,116	7,749,221	$2,138	$2,264
Single-Family	2,439,719	$2,191	3,868,722	$2,201	3,678,851	$2,181	5,655,715	$2,208	$2,351
Multi-Family	226,312	$1,302	338,045	$1,309	332,310	$1,297	486,384	$1,293	$1,318
Mobile Home	874,527	$2,153	1,235,372	$2,164	1,193,954	$2,155	1,591,537	$2,156	$2,188
Elect Heat Rent	6,386,249	$1,582	8,455,370	$1,585	8,257,058	$1,575	10,553,811	$1,579	$1,557
Single-Family	1,602,921	$2,167	2,187,491	$2,167	2,099,482	$2,158	2,759,077	$2,156	$2,152
Multi-Family	4,271,371	$1,288	5,616,519	$1,287	5,521,935	$1,281	7,018,388	$1,282	$1,260

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill
Mobile Home	507,769	$2,209	645,885	$2,213	630,16	$2,203	769,617	$2,213	$2,203

Note: Only households with direct and separate electric bill payments are included.

Table IV-12 displays the average annual electric bills for non-electric heaters. The table shows that these bills are significantly lower than for those who heat with electricity. While there is a fairly large difference for owners, there is a smaller difference for renters, indicating that the non-electric heating renters may be living in energy inefficient homes or rely on space heat more often if their primary heating system is not sufficient.

Table IV-12
Average Annual Electric Bills for Low-Income Non-Electric Heaters in the United States

Home Type and Ownership	Income Eligibility Requirement								All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill
Non-Elec Heat	10,865,041	$1,391	15,944,711	$1,402	15,327,878	$1,387	21,840,914	$1,406	$1,563
Single-Family	6,805,229	$1,551	10,471,377	$1,548	9,984,266	$1,532	14,898,272	$1,541	$1,679
Multi-Family	3,132,039	$1,027	4,186,259	$1,021	4,092,024	$1,015	5,312,941	$1,014	$1,040
Mobile Home	911,152	$1,454	1,266,028	$1,463	1,231,250	$1,452	1,603,775	$1,454	$1,481
Non-Elec Heat Own	5,297,097	$1,501	8,482,705	$1,505	8,096,458	$1,488	12,502,366	$1,501	$1,666
Single-Family	4,420,374	$1,525	7,200,432	$1,528	6,849,965	$1,510	10,780,018	$1,524	$1,694
Multi-Family	254,114	$1,256	393,149	$1,229	382,298	$1,223	569,928	$1,203	$1,278
Mobile Home	613,352	$1,435	876,898	$1,446	852,189	$1,434	1,136,561	$1,440	$1,481
Non-Elec Heat Rent	5,143,359	$1,274	6,914,937	$1,273	6,695,278	$1,262	8,667,318	$1,265	$1,267
Single-Family	2,070,531	$1,613	2,858,843	$1,606	2,730,244	$1,595	3,607,346	$1,597	$1,606
Multi-Family	2,821,459	$1,005	3,723,933	$998	3,641,911	$992	4,660,598	$990	$984
Mobile Home	245,897	$1,494	325,407	$1,499	316,858	$1,492	391,552	$1,485	$1,471

Note: Only households with direct and separate electric bill payments are included.

Table IV-13 displays the electric energy burden, the percent of annual income spent on electricity for electric heaters. While the average burden for electric heaters with income below 150 percent of the poverty level is 12 percent, the average for those below 80 percent of state median income is seven percent, and the average for all households is three percent. The mobile home households have the greatest electric burden, averaging 14 percent for households below 150 percent of the poverty level.

Table IV-13
Electric Energy Burden for Low-Income Electric Heaters in in the United States

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	Burden
Elec Heat	10,316,149	12%	14,379,997	9%	13,936,276	10%	18,854,104	7%	3%
Single-Family	4,255,670	13%	6,328,098	10%	6,044,739	10%	8,743,137	8%	3%
Multi-Family	4,569,235	10%	6,036,848	8%	5,935,581	8%	7,597,055	6%	3%
Mobile Home	1,475,634	14%	1,995,013	11%	1,935,918	11%	2,490,08	9%	5%
Elec Heat Own	3,550,687	13%	5,455,244	10%	5,218,220	10%	7,749,221	8%	3%
Single-Family	2,439,719	13%	3,868,722	10%	3,678,851	10%	5,655,715	8%	3%
Multi-Family	226,312	11%	338,045	8%	332,310	8%	486,384	6%	2%
Mobile Home	874,527	13%	1,235,372	10%	1,193,954	11%	1,591,537	9%	5%
Elec Heat Rent	6,386,249	11%	8,455,370	8%	8,257,058	9%	10,553,811	7%	3%
Single-Family	1,602,921	12%	2,187,491	10%	2,099,482	10%	2,759,077	8%	4%
Multi-Family	4,271,371	10%	5,616,519	8%	5,521,935	8%	7,018,388	6%	3%
Mobile Home	507,769	14%	645,885	11%	630,16	11%	769,617	9%	7%

Note: Only households with direct and separate electric bill payments are included.

Table IV-14 displays the electric energy burden, the percent of annual income spent on electricity for non-electric heaters. While the average burden for non-electric heaters with income below 150 percent of the poverty level is nine percent, the average for those below 80 percent of state median income is five percent, and the average for all households is two percent.

Table IV-14
Electric Energy Burden for Low-Income Non-Electric Heaters in in the United States

	Income Eligibility Requirement								All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	Burden
Non-Elec Heat	10,865,041	9%	15,944,711	7%	15,327,878	7%	21,840,914	5%	2%
Single-Family	6,805,229	9%	10,471,377	7%	9,984,266	7%	14,898,272	6%	2%
Multi-Family	3,132,039	7%	4,186,259	6%	4,092,024	6%	5,312,941	5%	2%
Mobile Home	911,152	9%	1,266,028	7%	1,231,250	8%	1,603,775	6%	3%
Non-Elec Heat Own	5,297,097	9%	8,482,705	7%	8,096,458	7%	12,502,366	5%	2%
Single-Family	4,420,374	9%	7,200,432	7%	6,849,965	7%	10,780,018	5%	2%
Multi-Family	254,114	9%	393,149	6%	382,298	7%	569,928	5%	1%

	Income Eligibility Requirement								All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	Burden
Mobile Home	613,352	9%	876,898	7%	852,189	7%	1,136,561	6%	3%
Non-Elec Heat Rent	5,143,359	8%	6,914,937	6%	6,695,278	7%	8,667,318	5%	2%
Single-Family	2,070,531	9%	2,858,843	7%	2,730,244	7%	3,607,346	6%	3%
Multi-Family	2,821,459	7%	3,723,933	6%	3,641,911	6%	4,660,598	5%	2%
Mobile Home	245,897	9%	325,407	7%	316,858	8%	391,552	6%	4%

Note: Only households with direct and separate electric bill payments are included.

C. Summary

This section provided an analysis of energy costs and burden for low-income households in the United States and a comparison to all households in the United States using data from the Residential Energy Consumption Survey (RECS) and the American Community Survey (ACS).

Analysis of RECS data provided in the LIHEAP Home Energy Notebook showed that 54 percent of all low-income households' energy expenditures was for electric end uses including energy used by appliances, refrigeration, and cooling. For households that also use electric water heating, electricity represented 68 percent of energy usage, and for households that use electricity for both water heating and space heating, electricity will represent all end uses.

There has been an increase in the percentage of households who use electric heat. Electric heating usage by low-income households increased from 31.8 percent in 2005 to 36.7 percent in 2009, and continued to increase as shown in the 2015 RECS and the 2015 ACS. The 2015 ACS showed that 42 percent of low-income households used electricity as their main heating fuel.

About two-thirds of the low-income electric heating households were renters and about half of the low-income electric heating households were in multi-family buildings, indicating that these are important targets for reducing electric usage among low-income households.

The analysis also demonstrated that low-income energy burden is much higher than non-low-income energy burden. While the average burden for electric heaters with income below 150 percent of the poverty level was 12 percent, the average for those below 80 percent of state median income was seven percent, and the average for all households was three percent.

V. Energy Costs and Burden in Target States

This section provides an analysis of low-income households in each of the four states using the 2015 American Community Survey (ACS) Data. The one-year ACS Public Use Microdata Sample (PUMS) data were downloaded from the Census website for Colorado, Illinois, New Jersey, and Pennsylvania. The tables represent households in 2015.

We provide estimates in the four states using the 150 percent of FPL and 200 percent of FPL, 60 percent of SMI, and 80 percent of SMI guidelines. In addition, we used 225 percent of FPL for New Jersey, the income eligibility requirement used by the NJ Comfort Partners program.

Table V-1A displays the number and percent of households at each income level in each of the four target states. In each of the four states, 17 to 20 percent were below 150 percent of the FPL, 24 to 29 percent were below 200 percent of the FPL, 27 to 33 percent were below 60 percent of SMI, and 34 to 44 percent were below 80 percent of SMI.

Table V-1A
Number and Percent of Households
At Various Income Levels

Income Level	Colorado		Illinois		New Jersey		Pennsylvania	
	#	%	#	%	#	%	#	%
<150% FPL	345,372	17%	964,552	20%	537,445	17%	988,130	20%
<200% FPL	511,231	25%	1,367,685	29%	756,946	24%	1,427,31	29%
<60% SMI	565,298	27%	1,448,792	30%	1,039,924	33%	1,513,726	31%
<80% SMI	803,528	34%	1,969,925	41%	1,398,300	44%	2,097,807	42%
All HH	**2,074,739**	**100%**	**4,794,513**	**100%**	**3,187,963**	**100%**	**4,956,033**	**100%**

Table V-1B displays the average residential retail electric rates for 2013 through 2016 in the four target states and across the U.S. The table shows that New Jersey has rates that are about 25 percent higher than the national average. Rates in Pennsylvania increased from 2013 to 2016 and are also above the national average. Rates in Colorado and Illinois are about the same as the national average.

Table V-1B
Average Residential Retail Electric Price (Cents/kWh)

Year	Colorado	Illinois	New Jersey	Pennsylvania	United States
2013	11.93	10.63	15.73	12.79	12.13
2014	12.18	11.91	15.78	13.32	12.52
2015	12.12	12.50	15.81	13.64	12.65
2016	12.02	12.23	15.75	14.03	12.55

Source: Energy Information Administration. Electricity Data Browser.
https://www.eia.gov/electricity/data/browser/

A. Colorado

Table V-2 displays the number and percent of households using each main heating fuel under various definitions of low-income. Under each definition shown, between 28 and 31 percent of these households use electricity as their main heating fuel. With the largest definition of low-income, up to 80 percent of state median income, over 224,000 low-income households use electricity as a main heating fuel, indicating a large population of low-income households potentially with the best opportunities for whole-house energy efficiency services.

Table V-2
Main Heating Fuel for Low-Income Households in Colorado

Main Heating Fuel	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Utility Gas	211,214	61%	319,737	63%	354,498	63%	511,627	64%	69%
Electricity	105,919	31%	146,950	29%	162,884	29%	224,149	28%	23%
Other Fuels	26,007	8%	41,449	8%	44,781	8%	63,154	8%	8%
No Fuel Used	2,232	1%	3,095	1%	3,135	1%	4,598	1%	<1%
All	**345,372**	**100%**	**511,231**	**100%**	**565,298**	**100%**	**803,528**	**100%**	**100%**

Table V-3 displays the housing unit type for low-income households in Colorado. These low-income households are most likely to live in single-family homes. However, a significant percentage also live in small and large multi-family buildings, indicating the need for a multi-pronged approach to LIEE service delivery.

Table V-3
Housing Unit Type for Low-Income Households in Colorado

Housing Unit Type	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Single Detached	143,014	41%	229,168	45%	255,477	45%	385,808	48%	63%
Single Attached	24,817	7%	35,648	7%	39,064	7%	56,394	7%	7%
2-9 Unit Bldg.	59,086	17%	82,889	16%	90,972	16%	121,305	15%	10%
10-19 Unit Bldg.	28,513	8%	42,417	8%	46,783	8%	66,088	8%	6%
20+ Units Bldg.	60,770	18%	78,122	15%	87,285	15%	114,595	14%	10%
Mobile Home	28,134	8%	41,791	8%	44,496	8%	58,031	7%	4%
Boat, RV, Van	1,038	<1%	1,196	<1%	1,221	<1%	1,307	<1%	<1%
All	**345,372**	**100%**	**511,231**	**100%**	**565,298**	**100%**	**803,528**	**100%**	**100%**

Table V-4 displays the number and percent of low-income households in Colorado who own their homes. The table shows that as the guideline for inclusion increases, the percentage of owned homes also increases. While 37 percent of households under 150 percent of the poverty level own their homes, 46 percent under 80 percent of state median income own their homes.

Table V-4
Home Ownership for Low-Income Households in Colorado

Home Ownership	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Owned	127,498	37%	209,688	41%	237,206	42%	368,830	46%	64%
Rented	206,327	60%	286,691	56%	312,882	55%	416,176	52%	35%
Other	11,547	3%	14,852	3%	15,210	3%	18,522	2%	1%
All	**345,372**	**100%**	**511,231**	**100%**	**565,298**	**100%**	**803,528**	**100%**	**100%**

Table V-5 shows that 80 to 83 percent of low-income households in Colorado are characterized as white and six percent are characterized as Black. This compares to 87 percent of all households who are characterized as white and four percent who are characterized as black.

Table V-5
Race of Low-Income Households in Colorado

Race	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
White	274,455	80%	415,025	81%	462,111	82%	666,600	83%	87%
Black	21,610	6%	31,641	6%	34,476	6%	46,140	6%	4%
Asian	11,644	3%	15,143	3%	16,461	3%	21,825	3%	3%
Other – 1 Race	26,243	8%	34,315	7%	36,802	7%	49,296	6%	4%
Other – > 1 Race	11,420	3%	15,107	3%	15,448	3%	19,667	2%	2%
All	**345,372**	**100%**	**511,231**	**100%**	**565,298**	**100%**	**803,528**	**100%**	**100%**

Table V-6 displays information about direct bill payment for low-income households in Colorado. The table provides the following information about households below 200 percent of the federal poverty level.

- Direct Electric Bill Payment: 89 percent of these households, or over 450,000 are directly responsible for their electric bill payment, as opposed to having the bill included in their rent.
- Direct Electric Bill Separate from Gas: 66 percent are responsible for their electric bill and have an electric bill that is separate from the gas bill, as opposed to having a dual fuel utility that provides one bill. We can estimate annual electric costs for these households.
- Direct, Separate Electric Bill with Electric Heat: 20 percent have a separate electric bill that they are responsible for and have electric heat.

Table V-6
Low-Income Households Direct Payment for Electric and/or Gas Bill in Colorado

Bill Payment	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Elec Bill – Direct Pay	300,543	87%	455,914	89%	505,443	89%	729,831	91%	95%
Elec Bill Separate From Gas	221,482	64%	335,596	66%	373,394	66%	526,981	66%	66%
Separate Elec Bill, Non-Elec Heat	149,803	43%	233,300	46%	259,779	46%	372,007	46%	50%
Separate Elec Bill, Elec Heat	71,679	21%	102,296	20%	113,615	20%	154,974	19%	16%
Gas Bill – Direct Pay	153,443	44%	239,158	47%	266,232	47%	378,399	47%	52%
Direct Pay & Gas Heat	112,819	33%	177,227	35%	197,972	35%	283,271	35%	40%
All	**345,372**	**100%**	**511,231**	**100%**	**565,298**	**100%**	**803,528**	**100%**	**100%**

Table V-7 displays the number and percent of households in Colorado who use electric heat by type of home. In this table, single family includes attached and unattached and multi-family includes buildings with 2-9, 10-19, and 20 or more units. The table shows that more than two-thirds of the electric heating households are renters and that more than half of the electric heating households are in multi-family buildings, indicating that these are important targets for reducing electric usage among low-income households.

Table V-7
Targets for Comprehensive LIEE in Colorado

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Electric Heat	105,919	31%	146,950	29%	162,884	29%	224,149	28%	23%
Single-Family	37,115	11%	53,668	10%	57,832	10%	85,309	11%	12%
Multi-Family	65,538	19%	88,074	17%	99,303	18%	131,228	16%	11%
Mobile Home	3,221	1%	5,163	1%	5,704	1%	7,567	1%	<1%
Electric Heat Owners	21,011	6%	33,534	7%	38,544	7%	59,482	7%	9%
Single-Family	14,379	4%	24,796	5%	28,030	5%	45,832	6%	8%
Multi-Family	4,309	1%	5,209	1%	6,585	1%	8,358	1%	1%
Mobile Home	2,323	1%	3,529	1%	3,929	1%	5,292	1%	<1%
Electric Heat Renters	82,688	24%	111,014	22%	121,803	22%	161,676	20%	13%
Single-Family	21,089	6%	27,144	5%	27,939	5%	37,394	5%	4%
Multi-Family	60,656	18%	82,191	16%	92,044	16%	122,004	15%	9%
Mobile Home	898	0%	1,634	0%	1,775	0%	2,233	0%	<1%

Table V-8 displays the average annual electric bills for low-income electric heaters in Colorado based on self-reported data in the ACS. The table provides the following information.

- Households in single-family and mobile homes have the highest bills. Households in multi-family buildings have much lower bills.
- Electric owners have bills that are higher than electric renters because they are more likely to live in single-family homes.

Table V-8
Average Annual Electric Bills
Low-Income Electric Heaters in Colorado

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill
Elect Heat	71,679	$1,180	102,296	$1,200	113,615	$1,189	154,974	$1,220	$1,335
Single-Family	24,512	$1,720	36,308	$1,696	39,592	$1,699	58,605	$1,733	$1,741
Multi-Family	44,773	$856	62,299	$879	69,942	$870	90,908	$866	$867
Mobile Home	2,349	$1,709	3,644	$1,734	4,036	$1,690	5,416	$1,617	$1,592
Elec Heat Own	15,518	$1,495	23,731	$1,573	27,701	$1,560	42,200	$1,627	$1,678
Single-Family	10,233	$1,704	16,944	$1,727	19,406	$1,747	31,363	$1,793	$1,799
Multi-Family	3,510	$760	4,278	$804	5,535	$796	6,777	$844	$846
Mobile Home	1,775	$1,742	2,509	$1,840	2,760	$1,778	4,060	$1,651	$1,639
Elec Heat Rent	54,793	$1,092	77,015	$1,087	84,364	$1,068	111,019	$1,067	$1,086
Single-Family	13,261	$1,761	18,265	$1,691	19,087	$1,672	26,033	$1,680	$1,620
Multi-Family	40,913	$867	57,570	$886	63,956	$879	83,627	$869	$880
Mobile Home	574	$1,609	1,135	$1,500	1,276	$1,500	1,314	$1,481	$1,370

Note: Only households with direct and separate electric bill payments are included.

Table V-9 displays the average annual electric bills for non-electric heaters. The table shows that these bills are almost as high as those who heat with electricity. While there is a fairly large difference for owners, there is a smaller difference for renters, indicating that the non-electric heating renters may be living in energy inefficient homes or rely on space heat more often if their primary heating system is not sufficient.

Table V-9
Average Annual Electric Bills
Low-Income Non-Electric Heaters in Colorado

Home Type and Ownership	Income Eligibility Requirement								All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill
Non-Elec Heat	149,803	$1,130	233,300	$1,147	259,779	$1,136	372,007	$1,146	$1,271
Single-Family	89,701	$1,278	147,520	$1,296	166,659	$1,276	247,935	$1,284	$1,378
Multi-Family	40,522	$788	57,485	$774	62,700	$768	85,752	$751	$734
Mobile Home	19,174	$1,165	27,731	$1,128	29,856	$1,137	37,756	$1,143	$1,192
Non-Elec Heat Own	79,465	$1,223	130,980	$1,241	148,304	$1,226	223,637	$1,231	$1,353

Home Type and Ownership	Income Eligibility Requirement								All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill
Single-Family	62,134	$1,269	105,616	$1,290	119,985	$1,270	185,464	$1,271	$1,388
Multi-Family	5,210	$852	7,007	$813	8,443	$815	12,335	$756	$775
Mobile Home	11,800	$1,157	17,971	$1,128	19,490	$1,143	25,452	$1,173	$1,223
Non-Elec Heat Rent	64,366	$1,006	94,270	$1,011	103,221	$1,001	138,972	$1,008	$1,011
Single-Family	23,861	$1,317	36,565	$1,329	41,163	$1,301	56,092	$1,338	$1,326
Multi-Family	34,370	$777	49,536	$768	53,315	$760	72,199	$750	$722
Mobile Home	6,050	$1,084	8,084	$1,062	8,658	$1,061	10,596	$1,021	$1,076

Note: Only households with direct and separate electric bill payments are included.

Table V-10 displays the electric energy burden, the percent of annual income spent on electricity for electric heaters. While the average burden for electric heaters with income below 150 percent of the poverty level is eight percent, the average for those below 80 percent of state median income is four percent. The single-family households have the greatest electric burden, averaging ten percent for households below 150 percent of the poverty level.

Table V-10
Electric Energy Burden
Low-Income Electric Heaters in Colorado

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	Burden
Elec Heat	71,679	8%	102,296	6%	113,615	6%	154,974	4%	2%
Single-Family	24,512	10%	36,308	7%	39,592	7%	58,605	5%	2%
Multi-Family	44,773	6%	62,299	5%	69,942	5%	90,908	4%	2%
Mobile Home	2,349	9%	3,644	7%	4,036	6%	5,416	5%	3%
Elec Heat Own	15,518	10%	23,731	7%	27,701	7%	42,200	5%	2%
Single-Family	10,233	10%	16,944	7%	19,406	7%	31,363	5%	2%
Multi-Family	3,510	9%	4,278	7%	5,535	6%	6,777	5%	1%
Mobile Home	1,775	9%	2,509	9%	2,760	8%	4,060	5%	4%
Elec Heat Rent	54,793	7%	77,015	6%	84,364	5%	111,019	4%	2%
Single-Family	13,261	10%	18,265	7%	19,087	7%	26,033	5%	3%
Multi-Family	40,913	6%	57,570	5%	63,956	5%	83,627	4%	2%
Mobile Home	574	7%	1,135	4%	1,276	4%	1,314	4%	2%

Note: Only households with direct and separate electric bill payments are included.

Table V-11 displays the electric energy burden, the percent of annual income spent on electricity for non-electric heaters. While the average burden for non-electric heaters with income below 150 percent of the poverty level is seven percent, the average for those below 80 percent of state median income is four percent. The single-family households have the greatest electric burden, averaging eight percent for households below 150 percent of the poverty level.

Table V-11
Electric Energy Burden
Low-Income Non-Electric Heaters in Colorado

Home Type and Ownership	Income Eligibility Requirement								All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	Burden
Non-Elec Heat	149,803	7%	233,300	6%	259,779	5%	372,007	4%	1%
Single-Family	89,701	8%	147,520	6%	166,659	5%	247,935	4%	1%
Multi-Family	40,522	6%	57,485	4%	62,700	4%	85,752	3%	1%
Mobile Home	19,174	7%	27,731	5%	29,856	5%	37,756	4%	3%
Non-Elec Heat Own	79,465	8%	130,980	6%	148,304	5%	223,637	4%	1%
Single-Family	62,134	8%	105,616	6%	119,985	5%	185,464	4%	1%
Multi-Family	5,210	7%	7,007	6%	8,443	5%	12,335	3%	1%
Mobile Home	11,800	7%	17,971	5%	19,490	5%	25,452	4%	3%
Non-Elec Heat Rent	64,366	7%	94,270	5%	103,221	5%	138,972	4%	2%
Single-Family	23,861	8%	36,565	6%	41,163	5%	56,092	4%	2%
Multi-Family	34,370	6%	49,536	4%	53,315	4%	72,199	3%	1%
Mobile Home	6,050	7%	8,084	5%	8,658	5%	10,596	4%	3%

Note: Only households with direct and separate electric bill payments are included.

B. Illinois

Table V-12 displays the number and percent of households in Illinois using each main heating fuel under various definitions of low-income. Under each definition shown, between 20 and 22 percent of these households use electricity as their main heating fuel. With the largest definition of low-income, up to 80 percent of state median income, nearly 400,000 low-income households use electricity as a main heating fuel, indicating a large population of low-income households potentially with the best opportunities for whole-house energy efficiency services.

Table V-12
Main Heating Fuel for Low-Income Households in Illinois

Main Heating Fuel	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Utility Gas	697,569	72%	1,002,161	73%	1,061,792	73%	1,464,878	74%	78%
Electricity	216,068	22%	289,775	21%	306,426	21%	394,489	20%	16%
Other Fuels	38,431	4%	60,274	4%	64,022	4%	91,683	5%	5%
No Fuel Used	12,484	1%	15,475	1%	16,552	1%	18,875	1%	1%
All	**964,552**	**100%**	**1,367,685**	**100%**	**1,448,792**	**100%**	**1,969,925**	**100%**	**100%**

Table V-13 displays the housing unit type for low-income households in Illinois. These low-income households are most likely to live in single-family detached homes and in two- to nine-unit buildings.

Table V-13
Housing Unit Type for Low-Income Households in Illinois

Housing Unit Type	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Single Detached	373,116	39%	586,646	43%	624,518	43%	932,441	47%	60%
Single Attached	44,283	5%	67,019	5%	71,947	5%	102,126	5%	6%
2-9 Unit Bldg.	302,218	31%	392,484	29%	410,710	28%	515,826	26%	18%
10-19 Unit Bldg.	50,321	5%	67,264	5%	71,880	5%	91,652	5%	4%
20+ Units Bldg.	151,441	16%	193,497	14%	205,166	14%	248,844	13%	10%
Mobile Home	42,837	4%	60,332	4%	64,128	4%	78,593	4%	2%
Boat, RV, Van	336	<1%	443	<1%	443	<1%	443	<1%	<1%
All	**964,552**	**100%**	**1,367,685**	**100%**	**1,448,792**	**100%**	**1,969,925**	**100%**	**100%**

Table V-14 displays the number and percent of low-income households in Illinois who own their homes. The table shows that as the guideline for inclusion increases, the percentage of owned homes also increases. While 35 percent of households under 150 percent of FPL own their homes, 47 percent under 80 percent of SMI own their homes.

Table V-14
Home Ownership for Low-Income Households in Illinois

Home Ownership	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Owned	340,550	35%	564,433	41%	609,760	42%	931,885	47%	65%
Rented	595,203	62%	766,791	56%	801,457	55%	991,588	50%	33%
Other	28,799	3%	36,461	3%	37,575	3%	46,452	2%	1%
All	**964,552**	**100%**	**1,367,685**	**100%**	**1,448,792**	**100%**	**1,969,925**	**100%**	**100%**

Table V-15 shows that 61 to 67 percent of low-income households in Colorado are characterized as white and 21 to 27 percent are characterized as Black. This compares to 76 percent of all households who are characterized as white and fourteen percent who are characterized as black.

Table V-15
Race for Low-Income Households in Illinois

Race	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
White	584,307	61%	868,337	63%	931,283	64%	1,321,872	67%	76%
Black	256,983	27%	323,106	24%	334,925	23%	411,516	21%	14%
Asian	41,915	4%	56,050	4%	57,677	4%	76,405	4%	5%
Other – 1 Race	66,049	7%	98,373	7%	100,838	7%	131,281	7%	4%
Other – > 1 Race	15,298	2%	21,819	2%	24,069	2%	28,851	1%	1%
All	**964,552**	**100%**	**1,367,685**	**100%**	**1,448,792**	**100%**	**1,969,925**	**100%**	**10%**

Table V-16 displays information about direct bill payment for low-income households in Illinois. The table provides the following information about households below 200 percent of the FPL.

- Direct Electric Bill Payment: 92 percent of these households, or over 1.25 million are directly responsible for their electric bill payment, as opposed to having the bill included in their rent.
- Direct Electric Bill Separate from Gas: 82 percent are responsible for their electric bill and have an electric bill that is separate from the gas bill, as opposed to having a dual fuel utility that provides one bill.

- Direct, Separate Electric Bill with Electric Heat: 17 percent have a separate electric bill that they are responsible for and have electric heat.

Table V-16
Low-Income Households Direct Payment for Electric and/or Gas Bill in Illinois

Bill Payment	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Electric Bill – Direct Payment	875,702	91%	1,256,328	92%	1,331,910	92%	1,833,725	93%	96%
Electric Bill Separate From Gas	787,330	82%	1,128,102	82%	1,194,362	82%	1,640,702	83%	87%
Separate Electric Bill, Non-Electric Heat	610,325	63%	889,780	65%	942,489	65%	1,311,457	67%	73%
Separate Electric Bill, Electric Heat	177,005	18%	238,322	17%	251,873	17%	329,245	17%	14%
Gas Bill – Direct Payment	540,202	56%	803,127	59%	849,417	59%	1,199,919	61%	70%
Direct Payment and Gas Heat	480,572	50%	712,370	52%	754,861	52%	1,064,100	54%	62%
All	**964,552**	**100%**	**1,367,685**	**100%**	**1,448,792**	**100%**	**1,969,925**	**100%**	**100%**

Table V-17 displays the number and percent of households in Illinois who use electric heat by type of home. In this table, single family includes attached and unattached and multi-family includes buildings with 2-9, 10-19, and 20 or more units. The table shows that about two-thirds of the electric heating households are renters and about two-thirds of the electric heating households are in multi-family buildings, indicating that these are important targets for reducing electric usage among low-income households.

Table V-17
Targets for Comprehensive LIEE in Illinois

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Elec Heat	216,068	22%	289,775	21%	306,426	21%	394,489	20%	16%
Single-Family	43,943	5%	69,072	5%	73,641	5%	106,841	5%	6%
Multi-Family	160,901	17%	204,494	15%	215,907	15%	267,478	14%	9%
Mobile Home	11,210	1%	16,195	1%	16,864	1%	20,156	1%	<1%
Elec Heat Own	40,299	4%	67,761	5%	73,236	5%	107,121	5%	7%
Single-Family	23,408	2%	40,800	3%	44,096	3%	67,128	3%	5%
Multi-Family	9,639	1%	16,093	1%	17,603	1%	26,272	1%	2%

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Mobile Home	7,238	1%	10,854	1%	11,523	1%	13,707	1%	<1%
Elec Heat Rent	169,777	18%	214,755	16%	232,912	15%	288,038	15%	9%
Single-Family	18,792	2%	26,154	2%	28,074	2%	37,544	2%	1%
Multi-Family	147,611	15%	184,035	13%	200,272	13%	244,772	12%	7%
Mobile Home	3,374	0%	4,566	0%	4,566	0%	5,722	0%	<1%

Table V-18 displays the average annual electric bills for low-income electric heaters in Illinois based on self-reported data in the ACS. The table provides the following information.

- Households in mobile homes have the highest bills, followed closely by households in single-family homes. Households in multi-family buildings have much lower bills.
- Electric owners have bills that are higher than electric renters because they are more likely to live in single-family homes and because the single-family and multi-family owners have higher costs than the renters.

Table V-18
Average Annual Electric Bills
Low-Income Electric Heaters in Illinois

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill
Elec Heat	177,005	$1,398	238,322	$1,417	261,765	$1,415	342,503	$1,443	$1,536
Single-Family	36,735	$2,024	58,349	$1,985	64,787	$2,004	95,171	$2,018	$2,122
Multi-Family	129,855	$1,164	164,709	$1,159	180,743	$1,150	227,113	$1,143	$1,111
Mobile Home	10,401	$2,102	15,250	$2,032	16,221	$2,014	20,205	$2,099	$2,229
Elec Heat Own	35,689	$1,971	59,716	$1,876	68,088	$1,845	100,214	$1,895	$1,937
Single-Family	21,284	$2,105	35,949	$2,044	41,258	$2,012	62,416	$2,091	$2,197
Multi-Family	7,830	$1,442	13,712	$1,303	15,804	$1,281	23,973	$1,264	$1,161
Mobile Home	6,561	$2,165	10,041	$2,055	11,012	$2,026	13,811	$2,106	$2,235
Elec Heat Rent	136,375	$1,250	172,661	$1,257	187,550	$1,259	234,693	$1,248	$1,218
Single-Family	14,042	$1,878	20,644	$1,871	21,739	$1,979	29,629	$1,876	$1,833
Multi-Family	119,080	$1,152	147,572	$1,147	161,366	$1,139	199,463	$1,129	$1,099
Mobile Home	3,253	$2,108	4,445	$2,065	4,445	$2,065	5,601	$2,156	$2,288

Note: Only households with direct and separate electric bill payments are included.

Table V-19 displays the average annual electric bills for non-electric heaters. The table shows that these bills are lower than for those who heat with electricity. The largest difference is for the single-family households.

Table V-19
Average Annual Electric Bills
Low-Income Non-Electric Heaters in Illinois

Home Type and Ownership	Income Eligibility Requirement								All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill
Non-Elec Heat	610,325	$1,204	889,780	$1,218	983,355	$1,209	1,368,996	$1,222	$1,305
Single-Family	310,098	$1,424	487,699	$1,417	546,501	$1,401	814,520	$1,399	$1,456
Multi-Family	276,532	$935	368,118	$931	399,870	$927	507,775	$921	$8,91
Mobile Home	23,679	$1,458	33,840	$1,464	36,861	$1,439	46,578	$1,418	$1,458
Non-Elec Heat Own	259,948	$1,344	432,113	$1,340	492,780	$1,320	754,542	$1,330	$1,407
Single-Family	208,759	$1,389	349,585	$1,384	399,129	$1,365	625,120	$1,371	$1,458
Multi-Family	35,314	$1,046	59,346	$1,049	68,081	$1,029	96,104	$1,047	$976
Mobile Home	15,859	$1,418	23,158	$1,420	25,546	$1,402	33,294	$1,377	$1,462
Non-Elec Heat Rent	333,806	$1,097	436,204	$1,099	467,739	$1,096	586,725	$1,085	$1,041
Single-Family	91,856	$1,519	125,209	$1,526	133,964	$1,524	172,521	$1,507	$1,440
Multi-Family	235,130	$918	301,823	$907	323,985	$905	402,580	$891	$856
Mobile Home	6,820	$1,574	9,073	$1,585	9,691	$1,540	11,525	$1,535	$1,453

Note: Only households with direct and separate electric bill payments are included.

Table V-20 displays the electric energy burden, the percent of annual income spent on electricity for electric heaters. While the average burden for electric heaters with income below 150 percent of the FPL is 11 percent, the average for those below 80 percent of SMI is six percent. The mobile home households have the greatest electric burden, averaging 14 percent for mobile home owners below 150 percent of the FPL and 16 percent for renters.

Table V-20
Electric Energy Burden
Low-Income Electric Heaters in Illinois

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	Burden
Elec Heat	177,005	11%	238,322	8%	261,765	8%	342,503	6%	2%
Single-Family	36,735	13%	58,349	9%	64,787	9%	95,171	7%	2%
Multi-Family	129,855	10%	164,709	8%	180,743	7%	227,113	5%	2%

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	Burden
Mobile Home	10,401	14%	15,250	10%	16,221	10%	20,205	8%	6%
Elec Heat Own	35,689	13%	59,716	9%	68,088	8%	100,214	6%	2%
Single-Family	21,284	13%	35,949	9%	41,258	8%	62,416	7%	2%
Multi-Family	7,830	11%	13,712	7%	15,804	6%	23,973	5%	1%
Mobile Home	6,561	14%	10,041	10%	11,012	9%	13,811	8%	6%
Elec Heat Rent	136,375	10%	172,661	8%	187,550	8%	234,693	6%	3%
Single-Family	14,042	13%	20,644	9%	21,739	9%	29,629	7%	3%
Multi-Family	119,080	10%	147,572	8%	161,366	7%	199,463	5%	2%
Mobile Home	3,253	16%	4,445	11%	4,445	11%	5,601	9%	7%

Note: Only households with direct and separate electric bill payments are included.

Table V-21 displays the electric energy burden, the percent of annual income spent on electricity for non-electric heaters. While the average burden for non-electric heaters with income below 150 percent of the FPL is eight percent, the average for those below 80 percent of SMI is four percent. The single-family and mobile home households have greater burden than the multi-family households, averaging nine percent for households below 150 percent of the FPL.

Table V-21
Electric Energy Burden
Low-Income Non-Electric Heaters in Illinois

Home Type and Ownership	Income Eligibility Requirement								All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	Burden
Non-Elec Heat	610,325	8%	889,780	6%	983,355	6%	1,368,996	4%	1%
Single-Family	310,098	9%	487,699	6%	546,501	6%	814,520	4%	1%
Multi-Family	276,532	6%	368,118	5%	399,870	5%	507,775	4%	1%
Mobile Home	23,679	9%	33,840	7%	36,861	7%	46,578	6%	3%
Non-Elec Heat Own	259,948	8%	432,113	6%	492,780	6%	754,542	4%	1%
Single-Family	208,759	9%	349,585	6%	399,129	6%	625,120	4%	1%
Multi-Family	35,314	7%	59,346	5%	68,081	5%	96,104	4%	1%
Mobile Home	15,859	9%	23,158	7%	25,546	7%	33,294	5%	3%
Non-Elec Heat Rent	333,806	7%	436,204	6%	467,739	5%	586,725	4%	2%
Single-Family	91,856	9%	125,209	7%	133,964	6%	172,521	5%	2%

Home Type and Ownership	Income Eligibility Requirement								All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	Burden
Multi-Family	235,130	6%	301,823	5%	323,985	5%	402,580	4%	2%
Mobile Home	6,820	9%	9,073	7%	9,691	7%	11,525	6%	4%

Note: Only households with direct and separate electric bill payments are included.

C. New Jersey

Table V-22 displays the number and percent of households in New Jersey using each main heating fuel under various definitions of low-income. Under each definition shown, between 15 and 17 percent of these households use electricity as their main heating fuel. With the largest definition of low-income, up to 80 percent of SMI, over 200,000 low-income households use electricity as a main heating fuel, indicating a large population of low-income households potentially with the best opportunities for whole-house energy efficiency services.

Table V-22
Main Heating Fuel for Low-Income Households in New Jersey

Main Heating Fuel	Income Eligibility Requirement										All HH
	< 150% FPL		< 200% FPL		< 225% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	# HH	%	%
Utility Gas	383,299	71%	541,063	71%	620,822	72%	744,651	72%	1,017,328	73%	75%
Electricity	93,171	17%	127,852	17%	143,176	16%	167,995	16%	209,162	15%	12%
Other Fuel	55,405	10%	81,798	11%	97,586	11%	119,661	12%	163,022	12%	12%
None Used	5,570	1%	6,233	1%	6,643	1%	7,617	1%	8,788	1%	<1%
All	**537,445**	**100%**	**756,946**	**100%**	**868,227**	**100%**	**1,039,924**	**100%**	**1,398,300**	**100%**	**100%**

Table V-23 displays the housing unit type for low-income households in New Jersey. Low-income households in New Jersey are most likely to live in multi-family buildings, compared to other home types. Those under 150 percent of the FPL are most likely to live in multi-family buildings. Of those households below 150 percent of the FPL, 34 percent live in multi-family buildings of two to nine units and 61 percent live in any type of multi-family building. Of those households below 80 percent of SMI, 29 percent live in multi-family buildings of two to nine units and 50 percent live in any type of multi-family building. As NJ Comfort Partners only serves multi-family buildings up to 14 units, more than 17 percent of these households below 225 percent of the FPL are not eligible for these services.

Table V-23
Housing Unit Type for Low-Income Households in New Jersey

Housing Unit Type	Income Eligibility Requirement										All HH
	< 150% FPL		< 200% FPL		< 225% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	# HH	%	%
SF Detached	147,114	27%	231,844	31%	282,539	33%	359,862	35%	545,793	39%	54%
SF Attached	50,975	9%	71,519	9%	81,308	9%	99,163	10%	130,128	9%	9%
2-9 Units	183,554	34%	247,688	33%	276,929	32%	318,567	31%	404,279	29%	20%
10-19 Units	45,161	8%	59,536	8%	66,680	8%	76,951	7%	99,735	7%	5%
20+ Units	100,994	19%	131,319	17%	143,826	17%	166,167	16%	195,881	14%	10%
Mobile Home	9,083	2%	14,476	2%	16,381	2%	18,650	2%	21,790	2%	1%
Boat, RV, Van	564	<1%	564	<1%	564	<1%	564	<1%	694	<1%	<1%
All	**537,445**	**100%**	**756,946**	**100%**	**868,227**	**100%**	**1,039,924**	**100%**	**1,398,300**	**100%**	**100%**

Table V-24 displays the number and percent of low-income households in New Jersey who own their homes. The table shows that as the guideline for inclusion increases, the percentage of owned homes also increases. While 30 percent of households under 150 percent of the FPL own their homes, 45 percent under 80 percent of SMI own their homes.

Table V-24
Home Ownership for Low-Income Households in New Jersey

Home Ownership	Income Eligibility Requirement										All HH
	< 150% FPL		< 200% FPL		< 225% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	# HH	%	%
Owned	159,837	30%	258,987	34%	318,121	37%	412,155	40%	626,977	45%	63%
Rented	361,957	67%	478,469	63%	528,827	61%	603,793	58%	741,920	53%	36%
Other	15,651	3%	19,490	3%	21,279	2%	23,976	2%	29,403	2%	1%
All	**537,445**	**100%**	**756,946**	**100%**	**868,227**	**100%**	**1,039,924**	**100%**	**1,398,300**	**100%**	**100%**

Table V-25 shows that 57 to 64 percent of low-income households in New Jersey are characterized as white and 19 to 23 percent are characterized as Black. This compares to 71 percent of all households who are characterized as white and 13 percent who are characterized as black.

Table V-25
Race of Low-Income Households in New Jersey

Race	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
White	303,679	57%	448,743	59%	643,019	62%	897,533	64%	71%

Race	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Black	121,455	23%	159,092	21%	204,341	20%	260,756	19%	13%
Asian	34,503	6%	46,520	6%	62,717	6%	81,653	6%	8%
Other – 1 Race	62,137	12%	83,504	11%	106,017	10%	129,397	9%	6%
Other – > 1 Race	15,671	3%	19,087	3%	23,830	2%	28,961	2%	2%
All	**537,445**	**100%**	**756,946**	**100%**	**1,039,924**	**100%**	**1,398,300**	**100%**	**100%**

Table V-26 displays information about direct bill payment for low-income households in New Jersey. The table provides the following information about households below 200 percent of the FPL.

- Direct Electric Bill Payment: 89 percent of these households, or over 670,000 households are directly responsible for their electric bill payment, as opposed to having the bill included in their rent.
- Direct Electric Bill Separate from Gas: 64 percent are responsible for their electric bill and have an electric bill that is separate from the gas bill, as opposed to having a dual fuel utility that provides one bill.
- Direct, Separate Electric Bill with Electric Heat: 12 percent have a separate electric bill that they are responsible for and have electric heat.

Table V-26
Low-Income Households Direct Payment for Electric and/or Gas Bill in New Jersey

Housing Unit Type	Income Eligibility Requirement										All HH
	< 150% FPL		< 200% FPL		< 225% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	# HH	%	%
Elec Bill – Direct Pay	468,056	87%	670,252	89%	775,883	89%	937,221	90%	1,282,670	92%	95%
Elec Bill Sep From Gas	333,219	62%	485,497	64%	566,581	65%	692,147	67%	956,687	68%	73%
Sep Elec Bill Non-Elec Heat	266,713	50%	391,367	52%	460,373	53%	565,038	54%	795,763	57%	63%
Sep Elec Bill Electric Heat	66,506	12%	94,130	12%	106,208	12%	127,109	12%	160,924	12%	10%
Gas Bill – Direct Pay	221,843	41%	326,612	43%	383,866	44%	471,398	45%	670,649	48%	55%
Direct Pay and Gas Heat	179,979	33%	268,079	35%	316,303	36%	391,809	38%	564,989	40%	47%
All	**537,445**	**100%**	**756,946**	**100%**	**868,227**	**100%**	**1,039,924**	**100%**	**1,398,300**	**100%**	**100%**

Table V-27 displays the number and percent of households in New Jersey who use electric heat by type of home. In this table, single family includes attached and unattached and multi-family includes buildings with 2-9, 10-19, and 20 or more units. The table shows that about two-thirds of the electric heating households are renters and about two-thirds of the electric

heating households are in multi-family buildings, indicating that these are important targets for reducing electric usage among low-income households.

Table V-27
Targets for Comprehensive LIEE in New Jersey

Home Type and Ownership	Income Eligibility Requirement										All Elec Heat
	< 150% FPL		< 200% FPL		< 225% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	# HH	%	%
Elec Heat	93,171	17%	127,852	17%	143,176	16%	167,995	16%	209,162	15%	12%
Single-Family	20,165	4%	31,449	4%	35,530	4%	43,988	4%	60,979	4%	4%
Multi-Family	72,440	13%	95,150	13%	106,371	12%	122,732	12%	146,521	10%	8%
Mobile Home	566	0%	1,253	0%	1,275	0%	1,275	0%	1,662	0%	<1%
Elec Heat Own	14,511	3%	25,416	3%	29,483	3%	38,177	4%	56,465	4%	5%
Single-Family	9,550	2%	16,048	2%	18,596	2%	24,741	2%	38,049	3%	3%
Multi-Family	4,699	1%	8,419	1%	9,916	1%	12,465	1%	17,115	1%	1%
Mobile Home	262	0%	949	0%	971	0%	971	0%	1,301	0%	<1%
Elect Heat Rent	75,486	14%	98,333	13%	109,258	13%	125,340	12%	147,792	11%	7%
Single-Family	8,859	2%	12,967	2%	14,264	2%	16,534	2%	19,969	1%	1%
Multi-Family	66,323	12%	85,062	11%	94,690	11%	108,502	10%	127,462	9%	6%
Mobile Home	304	0%	304	0%	304	0%	304	0%	361	0%	<1%

Table V-28 displays the average annual electric bills for low-income electric heaters in New Jersey based on self-reported data in the ACS. The table provides the following information.

- Households in single-family homes have the highest bills.
- Electric owners have bills that are higher than electric renters because they are more likely to be in single-family homes and because they have higher bills for single and multi-family homes.

Table V-28
Average Annual Electric Bills
Low-Income Electric Heaters in New Jersey

Home Type and Ownership	Income Eligibility Requirement										All Electric Heat
	< 150% FPL		< 200% FPL		< 225% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill
Electric Heat	66,506	$1,672	94,130	$1,738	106,208	$1,785	127,109	$1,828	160,924	$1,881	$2,028
Single-Family	16,834	$2,267	26,637	$2,395	30,502	$2,469	38,427	$2,531	53,014	$2,595	$2,769

Home Type and Ownership	Income Eligibility Requirement										All Electric Heat
	< 150% FPL		< 200% FPL		< 225% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill
Multi-Family	49,106	$1,471	66,240	$1,472	74,431	$1,503	87,407	$1,518	106,248	$1,527	$1,554
Mobile Home	566	$1,394	1,253	$1,870	1,275	$1,873	1,275	$1,873	1,662	$1,809	$1,839
Electric Heat Owners	13,309	$2,464	21,943	$2,566	25,546	$2,588	33,813	$2,637	49,086	$2,587	$2,668
Single-Family	9,242	$2,605	14,821	$2,718	17,283	$2,765	23,172	$2,837	34,900	$2,796	$2,923
Multi-Family	3,805	$2,232	6,173	$2,308	7,292	$2,266	9,670	$2,233	12,885	$2,095	$2,002
Mobile Home	262	$835	949	$1,868	971	$1,872	971	$1,872	1,301	$1,857	$1,967
Electric Heat Renters	51,025	$1,450	69,379	$1,451	77,618	$1,495	90,209	$1,504	108,460	$1,547	$1,552
Single-Family	6,154	$1,726	9,742	$1,830	10,909	$1,931	12,902	$1,934	15,649	$2,119	$2,161
Multi-Family	44,567	$1,409	59,333	$1,387	66,405	$1,422	77,003	$1,431	92,450	$1,450	$1,456
Mobile Home	304	$1,876	304	$1,876	304	$1,876	304	$1,876	361	$1,636	$1,566

Note: Only households with direct and separate electric bill payments are included.

Table V-29 displays the average annual electric bills for non-electric heaters. The table shows that these bills are lower than those who heat with electricity. The largest difference is for the single-family households.

Table V-29
Average Annual Electric Bills
Low-Income Non-Electric Heaters in New Jersey

Home Type and Ownership	Income Eligibility Requirement										All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 225% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill
Non-Elec Heat	266,713	$1,485	391,367	$1,484	460,373	$1,479	565,038	$1,478	795,763	$1,510	$1,750
Single-Family	134,287	$1,789	207,411	$1,779	253,485	$1,755	324,964	$1,736	485,227	$1,744	$1,956
Multi-Family	123,938	$1,157	170,987	$1,128	192,248	$1,118	223,283	$1,105	290,985	$1,125	$1,150
Mobile Home	8,331	$1,463	12,812	$1,473	14,483	$1,435	16,634	$1,446	19,318	$1,412	$1,451
Non-Elec Heat Own	114,468	$1,718	184,544	$1,698	227,432	$1,678	298,008	$1,670	453,209	$1,676	$1,925
Single-Family	94,816	$1,787	154,077	$1,761	192,744	$1,737	254,864	$1,722	391,613	$1,728	$1,973
Multi-Family	14,085	$1,370	21,483	$1,330	24,734	$1,307	31,638	$1,323	47,839	$1,329	$1,430
Mobile Home	5,567	$1,434	8,984	$1,501	9,954	$1,454	11,506	$1,473	13,681	$1,414	$1,470
Non-Elec Heat Rent	146,987	$1,304	199,691	$1,290	224,851	$1,280	257,261	$1,258	330,327	$1,279	$1,268
Single-Family	35,831	$1,816	48,314	$1,868	54,792	$1,849	63,007	$1,817	84,107	$1,830	$1,823
Multi-Family	108,235	$1,128	147,392	$1,096	165,373	$1,088	188,969	$1,067	240,426	$1,083	$1,067
Mobile Home	2,764	$1,520	3,828	$1,407	4,529	$1,393	5,128	$1,385	5,637	$1,408	$1,409

Home Type and Ownership	Income Eligibility Requirement										All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 225% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill

Note: Only households with direct and separate electric bill payments are included.

Table V-30 displays the electric energy burden, the percent of annual income spent on electricity for electric heaters. While the average burden for electric heaters with income below 150 percent of the FPL is 12 percent, the average for those below 80 percent of SMI is six percent. The single-family households have the greatest electric burden, averaging 17 percent for home owners below 150 percent of the FPL and 11 percent for renters.

Table V-30
Electric Energy Burden
Low-Income Electric Heaters in New Jersey

Home Type and Ownership	Income Eligibility Requirement										All Electric Heat
	< 150% FPL		< 200% FPL		< 225% FPL		< 60% SMI		< 80% SMI		
	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	Burden
Elec Heat	66,506	12%	94,130	10%	106,208	9%	127,109	8%	160,924	6%	3%
Single-Family	16,834	14%	26,637	11%	30,502	10%	38,427	9%	53,014	8%	3%
Multi-Family	49,106	12%	66,240	9%	74,431	8%	87,407	7%	106,248	6%	2%
Mobile Home	566	11%	1,253	7%	1,275	7%	1,275	7%	1,662	6%	4%
Elec Heat Own	13,309	17%	21,943	12%	25,546	11%	33,813	10%	49,086	7%	3%
Single-Family	9,242	17%	14,821	13%	17,283	11%	23,172	10%	34,900	8%	3%
Multi-Family	3,805	18%	6,173	11%	7,292	10%	9,670	8%	12,885	7%	2%
Mobile Home	262	7%	949	6%	971	6%	971	6%	1,301	5%	4%
Elec Heat Rent	51,025	11%	69,379	9%	77,618	8%	90,209	7%	108,460	6%	2%
Single-Family	6,154	11%	9,742	9%	10,909	8%	12,902	7%	15,649	7%	3%
Multi-Family	44,567	11%	59,333	9%	66,405	8%	77,003	7%	92,450	6%	2%
Mobile Home	304	13%	304	13%	304	13%	304	13%	361	9%	4%

Note: Only households with direct and separate electric bill payments are included.

Table V-31 displays the electric energy burden, the percent of annual income spent on electricity for non-electric heaters. While the average burden for non-electric heaters with income below 150 percent of the FPL is nine percent, the average for those below 80 percent of SMI is four percent. The single-family and mobile home households have greater burden than the multi-family households, averaging ten and 11 percent respectively for households below 150 percent of the FPL.

Table V-31
Electric Energy Burden
Low-Income Non-Electric Heaters in New Jersey

Home Type and Ownership	Income Eligibility Requirement										All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 225% FPL		< 60% SMI		< 80% SMI		
	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	Burden
Non-Elec Heat	266,713	9%	391,367	7%	460,373	6%	565,038	5%	795,763	4%	2%
Single-Fam	134,287	10%	207,411	8%	253,485	7%	324,964	6%	485,227	4%	2%
Multi-Fam	123,938	8%	170,987	6%	192,248	5%	223,283	5%	290,985	4%	2%
Mobile	8,331	11%	12,812	8%	14,483	7%	16,634	6%	19,318	5%	3%
Non-Elec Heat Own	114,468	11%	184,544	8%	227,432	7%	298,008	6%	453,209	4%	2%
Single-Fam	94,816	11%	154,077	8%	192,744	7%	254,864	6%	391,613	4%	2%
Multi-Fam	14,085	11%	21,483	8%	24,734	7%	31,638	6%	47,839	4%	2%
Mobile	5,567	10%	8,984	8%	9,954	7%	11,506	6%	13,681	5%	4%
Non-Elec Heat Rent	146,987	8%	199,691	6%	224,851	6%	257,261	5%	330,327	4%	2%
Single-Fam	35,831	9%	48,314	7%	54,792	7%	63,007	6%	84,107	5%	3%
Multi-Fam	108,235	8%	147,392	6%	165,373	5%	188,969	5%	240,426	4%	2%
Mobile	2,764	11%	3,828	8%	4,529	7%	5,128	6%	5,637	6%	3%

Note: Only households with direct and separate electric bill payments are included.

D. Pennsylvania

Table V-32 displays the number and percent of households in Pennsylvania using each main heating fuel under various definitions of low-income. Under each definition shown, between 24 and 27 percent of these households use electricity as their main heating fuel. With the largest definition of low-income, up to 80 percent of state median income, over 500,000 low-income households use electricity as a main heating fuel, indicating a large population of low-income households potentially with the best opportunities for whole-house energy efficiency services.

Table V-32
Main Heating Fuel for Low-Income Households in Pennsylvania

Main Heating Fuel	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Utility Gas	509,859	52%	726,938	51%	772,060	51%	1,059,190	50%	52%

Main Heating Fuel	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Electricity	263,544	27%	362,178	25%	382,171	25%	513,552	24%	22%
Other Fuels	208,486	21%	329,571	23%	350,685	23%	513,593	24%	26%
No Fuel Used	6,241	1%	8,626	1%	8,810	1%	11,472	1%	<1%
All	**988,130**	**100%**	**1,427,313**	**100%**	**1,513,726**	**100%**	**2,097,807**	**100%**	**100%**

Table V-33 displays the housing unit type for low-income households in Pennsylvania. These low-income households are most likely to live in single-family homes. While 57 percent of those below 150 percent of the FPL live in single-family homes, 65 percent of those below 80 percent of SMI live in single-family homes.

Table V-33
Housing Unit Type for Low-Income Households in Pennsylvania

Housing Unit Type	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Single Detached	349,942	35%	560,410	39%	602,176	40%	922,578	44%	58%
Single Attached	220,996	22%	312,033	22%	328,221	22%	445,583	21%	19%
2-9 Unit Bldg.	198,000	20%	261,809	18%	273,851	18%	348,001	17%	11%
10-19 Unit Bldg.	39,228	4%	50,685	4%	54,274	4%	68,412	3%	2%
20+ Units Bldg.	121,120	12%	156,139	11%	162,662	11%	191,556	9%	6%
Mobile Home	57,822	6%	85,106	6%	91,411	6%	120,546	6%	4%
Boat, RV, Van	1,022	<1%	1,131	<1%	1,131	<1%	1,131	<1%	<1%

Table V-34 displays the number and percent of low-income households in Pennsylvania who own their homes. The table shows that as the guideline for inclusion increases, the percentage of owned homes also increases. While 41 percent of households under 150 percent of the FPL own their homes, 53 percent under 80 percent of SMI own their homes.

Table V-34
Home Ownership for Low-Income Households in Pennsylvania

Home Ownership	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Owned	403,836	41%	658,653	46%	710,543	47%	1,103,963	53%	69%
Rented	551,398	56%	723,461	51%	755,404	50%	934,681	45%	30%

Other	32,896	3%	45,199	3%	47,779	3%	59,163	3%	2%
All	**988,130**	**100%**	**1,427,313**	**100%**	**1,513,726**	**100%**	**2,097,807**	**100%**	**100%**

Table V-35 shows that 72 to 78 percent of low-income households in Pennsylvania are characterized as white and 15 to 20 percent are characterized as Black. This compares to 85 percent of all households who are characterized as white and ten percent who are characterized as black.

Table V-35
Race of Low-Income Households in Pennsylvania

Race	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
White	708,956	72%	1,071,036	75%	1,147,164	76%	1,642,762	78%	85%
Black	192,945	20%	241,860	17%	249,424	16%	311,683	15%	10%
Asian	31,064	3%	41,611	3%	42,342	3%	53,863	3%	3%
Other – 1 Race	35,475	4%	45,031	3%	46,503	3%	53,947	3%	2%
Other – > 1 Race	19,690	2%	27,775	2%	28,293	2%	35,552	2%	1%
All	**988,130**	**100%**	**1,427,313**	**100%**	**1,513,726**	**100%**	**2,097,807**	**100%**	**100%**

Table V-36 displays information about direct bill payment for low-income households in Pennsylvania. The table provides the following information about households below 200 percent of the FPL.

- Direct Electric Bill Payment: 88 percent of these households, or over 1.26 million households are directly responsible for their electric bill payment, as opposed to having the bill included in their rent.
- Direct Electric Bill Separate from Gas: 85 percent are responsible for their electric bill and have an electric bill that is separate from the gas bill, as opposed to having a dual fuel utility that provides one bill.
- Direct, Separate Electric Bill with Electric Heat: 20 percent have a separate electric bill that they are responsible for and have electric heat.

Table V-36
Low-Income Households Direct Payment for Electric and/or Gas Bill in Pennsylvania

Bill Payment	Income Eligibility Requirement								All HH
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Elec Bill – Direct Pay	857,353	87%	1,262,216	88%	1,343,269	89%	1,899,605	91%	95%
Elec Bill Separate From Gas	822,876	83%	1,214,648	85%	1,292,788	85%	1,825,504	87%	89%

Separate Elec Bill, Non-Electric Heat	619,106	63%	926,716	65%	988,489	65%	1,404,533	67%	69%
Separate Elec Bill, Electric Heat	203,770	21%	287,932	20%	304,299	20%	420,971	20%	20%
Gas Bill – Direct Pay	479,581	49%	705,193	49%	751,111	50%	1,056,843	50%	53%
Direct Pay, Gas Heat	387,102	39%	566,372	40%	603,764	40%	849,505	40%	42%
All	**988,130**	**100%**	**1,427,313**	**100%**	**1,513,726**	**100%**	**2,097,807**	**100%**	**100%**

Table V-37 displays the number and percent of households in Pennsylvania who use electric heat by type of home. In this table, single family includes attached and unattached and multi-family includes buildings with 2-9, 10-19, and 20 or more units. The table shows that about two-thirds of the electric heating households are renters and over half of the electric heating households are in multi-family buildings, indicating that these are important targets for reducing electric usage among low-income households.

Table V-37
Targets for Comprehensive LIEE in Pennsylvania

Home Type and Ownership	Income Eligibility Requirement								All Electric Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	%	# HH	%	# HH	%	# HH	%	%
Electric Heat	263,544	27%	362,178	25%	382,171	25%	513,552	24%	22%
Single-Family	94,275	10%	142,698	10%	152,320	10%	223,849	11%	13%
Multi-Family	159,525	16%	205,571	14%	215,507	14%	268,902	13%	9%
Mobile Home	9,615	1%	13,758	1%	14,193	1%	20,650	1%	<1%
Electric Heat Owners	61,239	6%	101,132	7%	107,703	7%	171,914	8%	12%
Single-Family	50,453	5%	84,486	6%	90,223	6%	144,115	7%	10%
Multi-Family	4,228	0%	7,288	1%	7,779	1%	12,365	1%	1%
Mobile Home	6,429	1%	9,207	1%	9,550	1%	15,283	1%	<1%
Electric Heat Renters	195,104	20%	252,620	18%	272,811	18%	339,595	16%	10%
Single-Family	38,689	4%	52,513	4%	57,826	4%	73,152	3%	2%
Multi-Family	153,879	16%	196,461	14%	211,091	14%	261,581	12%	8%
Mobile Home	2,536	0%	3,646	0%	3,894	0%	4,595	0%	<1%

Table V-38 displays the average annual electric bills for low-income electric heaters in Pennsylvania based on self-reported data in the ACS. The table provides the following information.

- Households in single-family homes have the highest bills.

- Electric owners have bills that are higher than electric renters because they are more likely to be in single-family homes and because they have higher bills for single and multi-family homes.

Table V-38
Average Annual Electric Bills
Low-Income Electric Heaters in Pennsylvania

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill
Elec Heat	203,770	$1,844	287,932	$1,911	317,134	$1,923	439,843	$1,982	$2,216
Single-Family	86,139	$2,495	132,930	$2,489	150,380	$2,484	221,937	$2,491	$2,647
Multi-Family	108,063	$1,328	141,361	$1,366	151,841	$1,364	196,389	$1,407	$1,397
Mobile Home	9,439	$1,824	13,490	$1,937	14,762	$1,973	21,099	$1,977	$2,169
Elec Heat Own	58,575	$2,493	97,054	$2,484	110,841	$2,493	175,523	$2,501	$2,652
Single-Family	48,506	$2,660	81,875	$2,586	93,935	$2,595	149,101	$2,593	$2,726
Multi-Family	3,542	$1,740	5,911	$2,093	6,631	$2,003	10,511	$2,084	$1,708
Mobile Home	6,398	$1,659	9,117	$1,832	10,124	$1,879	15,760	$1,916	$2,097
Elec Heat Rent	138,923	$1,558	183,867	$1,598	198,341	$1,591	253,703	$1,604	$1,630
Single-Family	32,920	$2,280	45,891	$2,325	50,880	$2,282	64,798	$2,235	$2,294
Multi-Family	103,535	$1,311	134,398	$1,333	143,635	$1,329	184,111	$1,365	$1,368
Mobile Home	2,468	$2,291	3,578	$2,249	3,826	$2,263	4,527	$2,224	$2,502

Note: Only households with direct and separate electric bill payments are included.

Table V-39 displays the average annual electric bills for non-electric heaters. The table shows that these bills are lower than those who heat with electricity. The largest difference is for the single-family households.

Table V-39
Average Annual Electric Bills
Low-Income Non-Electric Heaters in Pennsylvania

Home Type and Ownership	Income Eligibility Requirement								All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill
Non-Elec Heat	619,106	$1,292	926,716	$1,301	1,044,216	$1,293	1,475,898	$1,316	$1,483
Single-Family	433,691	$1,406	669,181	$1,400	761,131	$1,386	1,117,526	$1,401	$1,565
Multi-Family	138,288	$908	188,698	$905	205,039	$903	258,876	$910	$932
Mobile Home	46,778	$1,379	68,488	$1,433	77,697	$1,413	99,147	$1,422	$1,448

Home Type and Ownership	Income Eligibility Requirement								All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Bill	# HH	Bill	# HH	Bill	# HH	Bill	Bill
Non-Elec Heat Own	321,906	$1,374	525,439	$1,383	609,325	$1,361	935,254	$1,382	$1,569
Single-Family	279,914	$1,381	462,514	$1,386	537,045	$1,365	839,693	$1,385	$1,583
Multi-Family	8,309	$1,195	12,351	$1,068	14,113	$1,040	20,039	$1,093	$1,139
Mobile Home	33,683	$1,356	50,574	$1,430	58,167	$1,407	75,522	$1,417	$1,453
Non-Electric Heat Rent	276,614	$1,198	371,210	$1,189	402,224	$1,190	500,478	$1,196	$1,210
Single-Family	137,292	$1,479	182,779	$1,458	198,063	$1,460	245,861	$1,470	$1,485
Multi-Family	127,542	$877	172,903	$884	187,137	$885	233,896	$887	$898
Mobile Home	11,471	$1,419	15,219	$1,444	16,715	$1,431	20,412	$1,449	$1,453

Note: Only households with direct and separate electric bill payments are included.

Table V-40 displays the electric energy burden, the percent of annual income spent on electricity for electric heaters. While the average burden for electric heaters with income below 150 percent of the FPL is 14 percent, the average for those below 80 percent SMI is eight percent. The single-family home households have the greatest electric burden, averaging 16 percent for home owners below 150 percent of the FPL and 15 percent for renters.

Table V-40
Electric Energy Burden
Low-Income Electric Heaters in Pennsylvania

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	Burden
Elec Heat	203,770	14%	287,932	10%	317,134	10%	439,843	8%	3%
Single-Fam	86,139	16%	132,930	12%	150,380	11%	221,937	8%	3%
Multi-Fam	108,063	11%	141,361	9%	151,841	8%	196,389	7%	3%
Mobile	9,439	12%	13,490	10%	14,762	10%	21,099	8%	5%
Elec Heat Own	58,575	15%	97,054	11%	110,841	11%	175,523	8%	3%
Single-Fam	48,506	16%	81,875	11%	93,935	11%	149,101	8%	3%
Multi-Fam	3,542	16%	5,911	12%	6,631	11%	10,511	8%	2%
Mobile	6,398	12%	9,117	10%	10,124	9%	15,760	7%	5%
Elec Heat Rent	138,923	12%	183,867	10%	198,341	9%	253,703	7%	3%
Single-Fam	32,920	15%	45,891	11%	50,880	11%	64,798	8%	4%
Multi-Fam	103,535	11%	134,398	9%	143,635	8%	184,111	7%	3%

Home Type and Ownership	Income Eligibility Requirement								All Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	Burden
Mobile	2,468	14%	3,578	11%	3,826	11%	4,527	9%	7%

Note: Only households with direct and separate electric bill payments are included.

Table V-41 displays the electric energy burden, the percent of annual income spent on electricity for non-electric heaters. While the average burden for non-electric heaters with income below 150 percent of the FPL is nine percent, the average for those below 80 percent of SMI is five percent. The single-family and mobile home households have greater burden than the multi-family households, averaging nine percent for households below 150 percent of the FPL.

Table V-41
Electric Energy Burden
Low-Income Non-Electric Heaters in Pennsylvania

Home Type and Ownership	Income Eligibility Requirement								All Non-Elec Heat
	< 150% FPL		< 200% FPL		< 60% SMI		< 80% SMI		
	# HH	Burden	# HH	Burden	# HH	Burden	# HH	Burden	Burden
Non-Elec Heat	619,106	9%	926,716	6%	1,044,216	6%	1,475,898	5%	2%
Single-Family	433,691	9%	669,181	7%	761,131	6%	1,117,526	5%	2%
Multi-Family	138,288	7%	188,698	5%	205,039	5%	258,876	4%	2%
Mobile Home	46,778	9%	68,488	7%	77,697	7%	99,147	5%	3%
Non-Elec Heat Own	321,906	9%	525,439	7%	609,325	6%	935,254	5%	2%
Single-Family	279,914	9%	462,514	6%	537,045	6%	839,693	4%	2%
Multi-Family	8,309	9%	12,351	6%	14,113	6%	20,039	4%	2%
Mobile Home	33,683	9%	50,574	7%	58,167	7%	75,522	5%	3%
Non-Elec Heat Rent	276,614	8%	371,210	6%	402,224	6%	500,478	5%	3%
Single-Family	137,292	9%	182,779	7%	198,063	7%	245,861	5%	3%
Multi-Family	127,542	7%	172,903	5%	187,137	5%	233,896	4%	2%
Mobile Home	11,471	9%	15,219	7%	16,715	7%	20,412	6%	4%

Note: Only households with direct and separate electric bill payments are included.

E. Summary

This section provided an analysis of the characteristics and energy costs and burden for low-income households in Colorado, Illinois, Pennsylvania, and New Jersey using American Community Survey data that represent 2015.

We provided estimates in the four states using the 150 percent of FPL and 200 percent of FPL, 60 percent of SMI, and 80 percent of SMI guidelines. In addition, we used 225 percent of FPL for New Jersey, the income eligibility requirement used by the NJ Comfort Partners program. In each of the four states, 17 to 20 percent were below 150 percent of the FPL, 24 to 29 percent were below 200 percent of the FPL, 27 to 33 percent were below 60 percent of SMI, and 34 to 44 percent were below 80 percent of SMI.

Electric heating usage by low-income households varied in the four target states.

- Colorado: 31 percent below 150 percent of FPL used electric heat and 28 percent below 80 percent of SMI used electric heat.
- Illinois: 22 percent below 150 percent of FPL used electric heat and 20 percent below 80 percent of SMI used electric heat.
- New Jersey: 17 percent below 150 percent of FPL used electric heat and 15 percent below 80 percent of SMI used electric heat.
- Pennsylvania: 27 percent below 150 percent of FPL used electric heat and 24 percent below 80 percent of SMI used electric heat.

Electric bills varied significantly in the four target states. Part of the difference relates to the percent who own their homes and who live in multi-family buildings. New Jersey and Pennsylvania also had electric rates that were 12 to 25 percent higher than the other target states and the U.S. average.

- Colorado: Mean electric bills for electric heaters below 150 percent of FPL were $1,180 and were $1,220 for households below 80 percent of SMI.
- Illinois: Mean electric bills for electric heaters below 150 percent of FPL were $1,398 and were $1,443 for households below 80 percent of SMI.
- New Jersey: Mean electric bills for electric heaters below 150 percent of FPL were $1,672 and were $1,881 for households below 80 percent of SMI.
- Pennsylvania: Mean electric bills for electric heaters below 150 percent of FPL were $1,844 and were $1,982 for households below 80 percent of SMI.

We analyzed energy burden in the four target states.

- Colorado: Mean burden was eight percent for electric heating households below 150 percent of FPL and four percent for those below 80 percent of SMI. This compares to two percent for all electric heating households.
- Illinois: Mean burden was 11 percent for electric heating households below 150 percent of FPL and six percent for those below 80 percent of SMI. This compares to two percent for all electric heating households.
- New Jersey: Mean burden was 12 percent for electric heating households below 150 percent of FPL and six percent for those below 80 percent of SMI. This compares to three percent for all electric heating households.

- Pennsylvania: Mean burden was 14 percent for electric heating households below 150 percent of FPL and eight percent for those below 80 percent of SMI. This compares to three percent for all electric heating households.

VI. Energy Efficiency Funding and Opportunities

This section provides an analysis of current funding available for LIEE and potential opportunities to increase the amount of cost-effective investment in LIEE in the four target states.

A. Low-Income Energy Efficiency Funding

The National Association for State Community Services Programs' (NASCSP) Weatherization Assistance Program (WAP) Funding Survey provides data on WAP funding each year. There are three main funding sources for WAP.[24]

- Department of Energy WAP Funds (DOE): WAP provides funding to all states, the District of Columbia, three tribes, and five U.S. territories to improve the energy-efficiency of low-income homes. Congress provides annual DOE appropriations for WAP.

- Low-Income Home Energy Assistance Program (LIHEAP): LIHEAP offices can use up to 15 percent of their block grants to fund WAP, or up to 25 percent with a waiver. Forty-eight states transferred LIHEAP funds into WAP in 2015. All four target states allocated 15 percent of their LIHEAP funds for WAP in 2015.

- Other Sources: This includes any other source of funding other than DOE and LIHEAP. This funding is usually derived from utilities, state general funds, and state public benefit funds. The primary source is utility funds, followed by state public benefit funds and other state funds.

Table VI-1 displays the funding from each of these sources, the total funding, the number of homes treated, and the average cost per home. There is an error in the data provided for Pennsylvania, as shown by the computed average cost. The same error was present in the 2014 data.

Table VI-1
2015 WAP Funding
By Source

State	DOE Funding		LIHEAP Funding		Other Funding		Total Funding	Homes	$/Home
	$	%	$	%	$	%			
CO	$4,590,704	24%	$6,611,666	34%	$8,300,000	43%	$19,502,370	2,935	$6,645
IL	$3,462,275	30%	$7,181,815	62%	$1,008,370	9%	$11,652,460	1,988	$5,861
NJ	$4,308,921	26%	$12,260,374	74%	$0	0%	$16,569,295	2,094	$7,913
PA	$12,320,702	29%	$30,371,473	71%	$0	0%	$42,692,175	386	$110,601

[24] NASCSP Weatherization Assistance Program Funding Survey, PY 2015.
http://www.waptac.org/data/files/website_docs/Reports/Funding_Survey/NASCSP-2015-WAP-Funding-Survey-FINAL.pdf

Table VI-1 showed that CO and IL had other sources of funds that contributed to WAP delivery. Table VI-2 shows the sources of these funds. CO funding was provided by state severance taxes and utility contributions. IL funding was provided through state funds that were not further identified.

Table VI-2
2015 WAP Other Funding Sources

State	Source 1		Source 2	
	Source	Amount	Source	Amount
CO	State Severance Taxes	$6,500,000	Utility Funds	$1,800,000
IL	State Funds	$1,008,370		

Table VI-3 displays the historical levels of WAP funding from all sources. The table shows that Colorado funding significantly increased in 2011 and remained at that higher level. IL's funding has fluctuated up and down with American Recovery and Reinvestment Act (ARRA) funding in 2009, high levels again in 2012 and 2013, and much lower levels in 2014 and 2015 when the WAP budget declined. New Jersey's funding also increased significantly in 2009, and stayed at a higher level until 2013. Pennsylvania's has fluctuated over the years shown.

Table VI-3
Total WAP Funding in Target States

	2008	2009	2010	2011	2012	2013	2014	2015
CO	$12,051,593	$11,416,305	$11,634,451	$20,918,861	$17,738,473	$19,669,969	$19,169,732	$19,502,370
IL	$52,300,069	$60,443,286	$38,732,251	$45,214,734	$60,639,222	$66,136,695	$21,322,503	$11,652,460
NJ	$11,358,338	$28,044,562	$24,744,240	$29,869,812	$24,196,759	$17,787,690	$11,589,596	$16,569,295
PA	$49,233,884	$41,100,552	$30,177,169	$36,144,041	$44,578,644	$32,689,516	$42,777,445	$42,692,175

Table VI-4 displays the total LIEE expenditures in 2015 including electric and gas utility funding, and all sources of WAP funding. Colorado's utility WAP funding is included in the utility columns rather than the other WAP funding column.

Table VI-4
Total Low-Income Energy Efficiency Expenditures in 2015

State	Electric Utility	Gas Utility	WAP Funding			Total
			DOE	LIHEAP	Other	
CO	$3,538,787	$4,380,461	$4,590,704	$6,611,666	$6,500,000	$25,621,618
IL	$13,100,000	$5,200,000	$3,462,275	$7,181,815	$1,008,370	$29,952,460
NJ	$11,302,113	$18,697,887	$4,308,921	$12,260,374	$0	$46,569,295
PA	$62,952,299	$19,652,964	$12,320,702	$30,371,473	$0	$125,297,438

Table VI-5 displays the LIEE expenditures per LIHEAP-eligible household, per household below 150 percent of the federal poverty level, and per household below 80 percent of state median income. While LIEE spending in IL was the lowest, 2018 plans provided by Com-Ed and Ameren show significant increases are planned.

Table VI-5
Low-Income Energy Efficiency Expenditures per Household in 2015

State	Total Spending	LIHEAP-Eligible		Under 150% FPL		Under 80% SMI	
		#	$ Per	#	$ Per	#	$ Per
CO	$25,621,618	377,050	$68	345,372	$74	803,528	$32
IL	$29,952,460	1,015,201	$30	964,552	$31	1,969,925	$15
NJ	$46,569,295	761,203	$61	537,445	$87	1,398,300	$33
PA	$125,297,438	1,050,059	$119	988,130	$127	2,097,807	$60

Table VI-6 displays total electric LIEE expenditures in 2015. We estimate that approximately 30 percent of WAP was spent on electric reduction because approximately 30 percent of LIHEAP recipients used electric heat.

Table VI-6
Electric Low-Income Energy Efficiency Expenditures in 2015

State	Electric Utility	30% WAP Total	Total Electric Spending
CO	$3,538,787	$5,310,711	$8,849,498
IL	$13,100,000	$3,495,738	$16,595,738
NJ	$11,302,113	$4,970,789	$16,272,902
PA	$62,952,299	$12,807,653	$75,759,952

Table VI-7 displays the electric expenditures per electric heating household below 150 percent of the FPL and below 80 percent of SMI.

Table VI-7
Electric Low-Income Energy Efficiency Expenditures per Electric Heating Household

State	Total Electric Spending	Electric Heaters			
		Under 150% FPL		Under 80% SMI	
		#	$ Per	#	$ Per
CO	$8,849,498	105,919	$84	224,149	$39
IL	$16,595,738	216,068	$77	394,489	$42
NJ	$16,272,902	93,171	$175	209,162	$78
PA	$75,759,952	263,544	$287	513,552	$148

B. Low-Income Energy Efficiency Opportunities

Table VI-8 displays potential savings for electric heating households and the amount that could be cost-effectively spent under various assumptions.

- Pre-Treatment Usage: The 2010 national WAP evaluation found that 44 percent of electric heating participants had more than 20,000 kWh pre-treatment electric usage and 20 percent had more than 25,000 kWh pre-treatment electric usage. We estimate that 30 percent of electric heating households have usage of at least 20,000 kWh, 22,000 kWh, or 25,000 kWh.

- Avoided Cost: Lazard provides an estimate of the levelized cost of energy.[25] Based on his analysis of various sources of electricity generation, we use an avoided cost of $0.08 per kWh.

- Measure Life: Various estimates are used in practice. We use values of 15 and 20 years to represent the mean life expectancy of common electric energy efficiency measures.

- Discount Rate: While the costs of energy efficiency are born when the measures are installed, the benefits accrue over the life of the measure. Because benefits that occur in the future are worth less than those that occur today, the value of those benefits must be discounted to calculate the present value of the stream of benefits. Future benefits are worth less than those received today because of inflation, time preference for benefits today, and risk or uncertainty in future benefits. Lawrence Berkeley National Labs proposes a discount rate of five percent as the societal discount rate. We use this rate in our analysis.[26] Note that a lower rate, often three percent is used, would result in higher total benefits from the energy efficiency.

- Electric Reduction: A high-performing energy efficiency program can achieve 20 percent savings with high-quality installations that address cost-effective opportunities. (Based on experience with LIEE evaluations.)

- Non-Energy Benefits Adder: Most jurisdictions do not include a value for non-energy benefits. We model cost-effectiveness using no adder, and also using a 25 percent adder, as is done in Colorado's LIEE programs. Vermont uses a 15 percent adder plus 15 percent for low-income, and also includes 10 percent for the reduced risk from energy efficiency compared to generation.

The table below shows the amount that could be cost-effectively spent on an electric heating energy efficiency project based on the various assumptions described above. Under the most

[25] Lazard's Levelized Cost of Energy Analysis, Version 10.0. December 2016. https://www.lazard.com/media/438038/levelized-cost-of-energy-v100.pdf

[26] Better Buildings Residential Energy Efficiency Cost-Effectiveness Tool Version 2.0. April 4, 2017. https://emp.lbl.gov/sites/default/files/bbrp_ee_ce_tool_presentation_final_040417.pdf

conservative approach, we estimate that $3,321 could be cost-effectively spent and under the most aggressive approach, we estimate that $6,231 could be cost-effectively spent.

Table VI-8
Potential Savings and Cost-Effective Spending
On High-Use Electric Heating Homes

	Scenario								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Assumptions									
Pre-Treatment Usage (kWh)	20,000	20,000	20,000	22,000	22,000	22,000	25,000	25,000	25,000
Avoided Cost	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Measure Life	15	20	20	15	20	20	15	20	20
Discount Rate	5%	5%	5%	5%	5%	5%	5%	5%	5%
Savings	20%	20%	20%	20%	20%	20%	20%	20%	20%
Non-Energy Benefit Adder	0	0	25%	0	0	25%	0	0	25%
Calculations									
Annual Savings (kWh)	4,000	4,000	4,000	4,400	4,400	4,400	5,000	5,000	5,000
PDV savings (kWh)	41519	49849	49849	45670	54834	54834	51898	62311	62311
Max spending	$3,321	$3,988	$4,985	$3,654	$4,387	$5,483	$4,152	$4,985	$6,231

Table VI-9 displays the number of electric heating jobs that could be completed given a cost of $5,000 and the current total electric efficiency budget. The table shows that under these assumptions, Colorado could serve a total of 1,770 households and PA could serve a total of 15,152 households. The table also displays the budget needed to serve ten percent of the high users classified in the top 30 percent of electric heating low-income households, and the percent of the current budget that would be needed to do so. PA and NJ currently have large enough electric efficiency budgets to accomplish this for all households under 150 percent of the FPL and still provide electric energy efficiency services to non-electric heaters. To service ten percent of the top 30 percent of electric heating households under 80 percent of SMI, CO would need 380 percent of their current budget, and PA would have just about enough budgeted to serve these households (if no other homes were served).

Table VI-9
Annual Number of Electric Heated Energy Efficiency Jobs
With Average Spending of $5,000

State	Total Electric Spending	Potential Jobs with Current Budget	Budget Needed to Serve 10% of High-Use Electric Heaters			
			150% FPL		80% SMI	
			Budget Needed	% of Current	Budget Needed	% of Current
CO	$8,849,498	1,770	$15,887,850	180%	$33,622,350	380%
IL	$16,595,738	3,319	$32,410,200	195%	$59,173,350	357%

NJ	$16,272,902	3,255	$13,975,650	86%	$31,374,300	193%
PA	$75,759,952	15,152	$39,531,600	52%	$77,032,800	102%

C. Summary and Recommendations

Electric energy efficiency opportunities in all households include at least 54 percent of usage, representing energy used by appliances, refrigerators, and cooling. For households that also use electric water heating, electricity will represent 68 percent of energy usage, and for households that use electricity for both water heating and space heating, electricity will represent all end uses. These all electric homes are the targets for comprehensive electric efficiency services.

Approximately 36.7 percent of low-income households heat with electricity and represent this comprehensive opportunity for electric usage reduction. Mean 2014 national energy costs for low-income electric heaters were $1,623. The mean energy burden for electric heaters was 18 percent and the mean for non-low-income households was three percent.

We conducted an analysis to estimate the amount that could be cost-effectively spent on an electric heating energy efficiency project based on various assumptions. Under the most conservative approach, we estimated that $3,321 could be cost-effectively spent and under the most aggressive approach, we estimated that $6,231 could be cost-effectively spent.

Given an average cost of $5,000 per home and the current total electric efficiency budget, Colorado could serve a total of 1,770 households and PA could serve a total of 15,152 households. PA and NJ currently have large enough electric efficiency budgets to serve ten percent of the top 30 percent of electric heating energy users under 150 percent of the FPL and still provide electric energy efficiency services to non-electric heaters. To serve ten percent of the top 30 percent of electric heating households under 80 percent of AMI, CO would need 380 percent of their current annual budget, and PA would have just about enough budgeted annually to serve these households.

VII. Barriers to Investment in Low-Income Energy Efficiency

Many barriers are encountered when attempting to provide energy efficiency services to low-income communities. These barriers and the existing avenues to address energy-saving opportunities differ substantially from one state to another. This section provides an overview of key barriers and later sections of the report present opportunities for overcoming the barriers.

Economic barriers, technical barriers, social barriers, and informational barriers are explored. The barriers that have the greatest detrimental impact on LIEE are summarized below.

- Economic: Energy efficiency services are expensive and require a large up-front investment before cost savings are realized, often over a period of ten to 15 years. As a result, low-income households are unlikely to participate in LIEE programs that require a monetary contribution. Low-income households are dependent on ratepayer-funded programs and raided energy efficiency funds may present a large barrier to LIEE service provision. Additional economic barriers to LIEE discussed in this section include the landlord/tenant split incentive, use of asymmetric cost-effectiveness tests, high fixed costs in utility rates, and utility disincentives.

- Social and Transactions Costs: There are many significant barriers to no-cost LIEE participation as well. While LIEE programs usually do not require a participant to make a monetary contribution, the transactions costs of application, obtaining landlord permission, readying the home for services, and being at home for service delivery are large. Additionally, households may not be aware of available options or understand the potential benefits of energy efficiency. There can be challenges in gaining acceptance and participation in no-cost LIEE programs, which may be related to language barriers, literacy, or immigration status.

- Health and Safety Barriers: Home issues including mold, asbestos, knob and tube wiring, pests, clutter, and structural issues can prevent installation of important energy efficiency measures. The prevalence of these issues in low-income homes can be high, reducing the savings that can be achieved.

- Data and Information: A fundamental challenge with analyzing programs and providing an assessment of who is served and who is not served, the services that are provided, and the results that are achieved, is a lack of data and information. Two key areas where program information is missing are participant and program statistics and evaluation results.

A. Economic Barriers

Many of the barriers to LIEE are related to economic issues. These include affordability of energy efficiency services, credit worthiness, the landlord/tenant split incentive, cost-effectiveness tests that do not take non-energy benefits (NEBs) into account, low-income baselines, administrative burdens, rate design, utility disincentives, and energy-efficiency funds that have been raided to balance state budgets.

Affordability

The lowest income customers face challenges meeting their basic needs and often do not have the capital to invest in energy efficiency even when the services are cost-effective on a pure energy-savings basis.

While few research studies were found that documented participation in general residential energy efficiency programs by income level, there were some studies that corroborate the perception that low-income households are unlikely to participate in programs that only provide a partial subsidy for energy efficiency work.

Honeywell undertook an Energy Efficiency Program Survey for the New Jersey Clean Energy Program in 2015.[27] Table VII-1 shows that the lower-income respondents were less likely to state that they heard of the New Jersey Home Performance with Energy Star Program (HPwES), less likely to state that they had participated in a New Jersey Clean Energy Program (NJCEP), and were less likely to state that they would consider participating in a NJCEP if they had not already done so.

Table VII-1
Knowledge, Participation, and Interest in NJCEP, By Income

Annual Income	Heard of the HPwES Program	Participated in a NJCEP	Would Consider Participating in NJCEP Program if Have Not
<$35,000	22%	6%	58%
$35,000-$49,000	19%	11%	63%
$50,000-$74,999	21%	16%	66%
$75,000-$99,999	41%	14%	76%
$100,000 or more	37%	23%	80%
All (including income not provided)	**28%**	**16%**	**60%**

Another study in Wisconsin surveyed participants in the income-qualified and the standard HPwES.[28] The income-qualified track is only open to households with income at or below 80 percent of SMI. The income-qualified track provides a free energy assessment, but does not require a blower door test unless the customer moves forward with the project. The standard track assessment is more comprehensive and the customer pays the full cost which usually ranges from $200 to $400. Both programs require a minimum of ten percent energy savings and both provide a set of direct install measures at no cost. The income-qualified track provides 75 percent of the major measure cost up to $2,000 (Xcel Energy provided an additional $2,000 with combined incentives not to exceed $4,000 or 90 percent of the installation cost) and the standard track provides 33 percent up to $1,250 with a $250 bonus if energy savings of 25 percent are achieved (Xcel Energy provided an additional 33 percent

[27] New Jersey Clean Energy Program Energy Efficiency Program Survey, February 13, 2015, Honeywell.
[28] Focus on Energy Calendar Year 2015 Evaluation Report, Volume II, May 20, 2016, Cadmus. Public Service Commission of Wisconsin.

of the project price not to exceed a total of $2,750). (Note that only 162 participants were surveyed in total.)

Table VII-2 shows that less than twenty percent of participants in even the income-qualified program had household income below $20,000, and that the majority of participants in the standard track who completed the retrofit had income over $75,000.

Table VII-2
Wisconsin Home Performance 2015 Participation by Income

Income	Income-Qualified Program		Standard Track	
	Assessment Only	Retrofit	Assessment Only	Retrofit
<$20,000	19%	18%	4%	2%
$20,000-$50,000	69%	75%	22%	20%
$50,000-$75,000	13%	4%	29%	24%
$75,000-$100,000	0%	0%	18%	24%
$100,000-$150,000	0%	4%	11%	16%
$150,000 or More	0%	0%	15%	16%
Total Participants	116	474	228	1,309
	20%	80%	15%	85%

Another study in Massachusetts examined the demographic characteristics of 2013 residential program participants based on American Community Survey Data in areas of higher and lower program participation and energy savings.[29] Table VII-3 shows that the census block groups with greater participation rates had higher median incomes, lower poverty rates, a lower percentage of renters, a lower percentage of older homes, and a lower percentage who do not speak English well.

Table VII-3
Residential Whole House Electric Program
Demographics by Participation Level

	Average Participation	Median HH Income	<200% FPL	Renter	Built Pre-1970	Do Not Speak English Well
Quintile 1	11.6%	$88,972	14%	18%	57%	3%
Quintile 2	4.6%	$80,796	16%	18%	59%	3%
Quintile 3	3.2%	$67,962	22%	27%	62%	4%
Quintile 4	2.0%	$58,672	29%	40%	66%	7%
Quintile 5	0.8%	$48,085	40%	56%	71%	11%

[29] Residential Customer Profile Study – Final Report, October 2, 2015, Cadmus. Prepared for the Electric and Gas Program Administrators of Massachusetts.

Table VII-4 displays characteristics by quintile of modeled energy savings which represents the comprehensiveness of energy efficiency upgrades that were undertaken. The table shows that the census block groups with higher electric savings had higher median incomes, lower poverty rates, a lower percentage of renters, a lower percentage of older homes, and a lower percentage who do not speak English well. These data show that households who live in lower income areas are not only less likely to participate in whole house electric programs, they are also less likely to install comprehensive measures when they do participate.

Table VII-4
Residential Whole House Electric Program
Demographics by Modelled Electric Savings

	Average Savings (kWh)	Median HH Income	<200% FPL	Renter	Built Pre-1970	Do Not Speak English Well
Quintile 1	107.8	$91,514	14%	18%	52%	3%
Quintile 2	36.4	$79,445	16%	19%	58%	3%
Quintile 3	22.6	$67,936	22%	27%	63%	4%
Quintile 4	12.4	$58,126	29%	41%	70%	7%
Quintile 5	3.9	$47,676	40%	56%	73%	12%

Participant costs for whole-house energy efficiency can be high, even with generous program subsidies. Table VII-5 displays the mean project cost for South Jersey Gas Home Performance with Energy Star (HPwES) projects from 2010 through 2015. Average total job costs each year were about $16,000 to $17,000.[30] Costs vary from program to program, but data on average costs across the country are not available. Given that this is a very comprehensive program with high incentive levels, it is expected that these investment levels are on the high end. A 2011 Environmental Protection Agency (EPA) HPwES fact sheet reported average New York HPwES costs ranged from $5,600 to $8,500.[31]

Table VII-5
South Jersey Gas HPwES Loan Program
Total Project Cost

Year	2010	2011	2012	2013	2014	2015	Total
Participants	585	321	390	267	640	1,168	3,371
Mean Project Cost	$16,973	$16,691	$16,446	$16,311	$16,082	$15,871	$16,282
<$10,000	4%	1%	2%	3%	2%	2%	2%
$10,000 - $14,999	24%	36%	24%	27%	20%	37%	29%
$15,000- $19,999	56%	50%	62%	57%	68%	50%	57%

[30] http://www.appriseinc.org/wp-content/uploads/2016/10/Final-2016-SJG-Energy-Efficiency-Evaluation-Report-8-30-16.pdf
[31] https://www.energystar.gov/ia/home_improvement/HPwES_Utility_Intro_FactSheet.pdf

Year	2010	2011	2012	2013	2014	2015	Total
≥$20,000	16%	13%	12%	12%	10%	11%	12%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

The SJG projects were comprehensive, as shown in Table VII-6. The table shows that in 2015, 91 percent had the furnace replaced, 100 percent had air sealing, 83 percent had a hot water heater replaced, 83 percent had attic insulation, and 71 percent had a central air conditioning unit replaced.

Table VII-6
South Jersey Gas HPwES Measure Penetration

Year	2010	2011	2012	2013	2014	2015	Total
Number of Jobs	585	321	390	267	640	1,168	3,371
Gas Furnace	89%	90%	92%	81%	91%	91%	90%
Air Sealing	17%	89%	99%	99%	100%	100%	84%
Gas Domestic Hot Water Heater	76%	85%	87%	78%	85%	83%	82%
Miscellaneous Measure	44%	84%	91%	87%	90%	89%	81%
Attic/Floor Insulation	58%	75%	76%	70%	85%	83%	76%
Central A/C Unit	62%	69%	77%	68%	70%	71%	69%
Custom Safety Measure	17%	28%	27%	37%	64%	58%	44%
Sub Total HVAC	45%	36%	20%	16%	20%	18%	25%
Custom HVAC	26%	24%	21%	27%	24%	10%	19%
Heat Pump	26%	20%	16%	12%	19%	17%	19%
Attic/Wall Insulation	14%	21%	19%	27%	20%	16%	18%
Air Sealing Subtotal	95%	13%	1%	0%	0%	0%	18%
Remove A/C	23%	19%	15%	12%	18%	16%	18%
Sub Total Comfort & Safety	5%	30%	36%	19%	2%	1%	10%
Gas Boiler	8%	7%	6%	13%	6%	7%	7%
Basement/Wall Insulation	6%	5%	6%	9%	7%	4%	6%
Ceiling Insulation	2%	2%	1%	1%	6%	11%	6%
Custom Insulation	7%	3%	5%	4%	3%	6%	5%

The New Jersey Clean Energy Program (NJCEP) provides generous rebates for the HPwES. However, these rebates have declined in fiscal year 2016 to a maximum of $4,000 (from a maximum of $5,000 in FY 2015). With an average cost of almost $16,000 and an average rebate of almost $5,000 in 2015, customers still had $11,000 in energy efficiency costs remaining after the NJCEP incentive.

Table VII-7
South Jersey Gas NJCEP HPwES Rebate

Year	2010	2011	2012	2013	2014	2015	Total
Participants	585	321	390	267	640	1,168	3,371
Mean Rebate	$8,084	$4,269	$4,644	$4,742	$4,780	$4,572	$5,214
<$3,000	<1%	<1%	0%	1%	0%	0%	<1%
$3,000 - $4,999	7%	87%	34%	24%	22%	41%	34%
$5,000 - $6,999	17%	3%	66%	75%	78%	59%	52%
$7,000 - $9,999	61%	8%	<1%	0%	0%	0%	11%
$10,000 +	15%	2%	<1%	0%	0%	0%	3%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

However, in addition to the rebate provided by the NJCEP, SJG customers were eligible for a zero percent interest loan of up to $10,000 over a ten-year period for customers who participate in an audit and install energy efficiency measures that are projected to achieve at least 20 percent energy savings. (The loan terms have changed since 2015.) Table VII-8 shows that that on average 91 percent of the costs were covered by the loan and rebate combined, leaving about $1,600 out of pocket costs for the participant. This is still a significant burden for low-income customers, who also may not be approved for the loan or may be wary of taking on additional debt.

Table VII-8
SJG HPwES Percent of Project Cost Covered by Loan and NJCEP Rebate

Year	2010	2011	2012	2013	2014	2015	Total
Participants	585	321	390	267	640	1,168	3,371
Mean % Covered by Loan & Rebate	91%	86%	90%	89%	92%	92%	91%
<30%	0%	0%	0%	<1%	0%	<1%	<1%
30-49%	1%	2%	1%	1%	0%	1%	1%
50-69%	16%	11%	8%	7%	8%	8%	10%
≥70%	83%	87%	91%	91%	92%	91%	89%
Missing	0%	<1%	0%	0%	0%	0%	<1%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

While recent data on HPwES costs for other states was not available, Table VII-9 displays information on the types of incentives available in other states.[32] Alaska (with a maximum rebate of $10,000) and Texas (Entergy) offered the program at no cost to the participants.

[32] Home Performance with Energy Star Work Group Discussion in Compliance with Order No. 87285, Maryland Commission Staff, September 1, 2016.

Other states offered incentives based on measures installed, based on a percentage of costs with a maximum incentive, or based on tiers of energy savings achieved. In most cases the maximum rebate is significantly lower than the total cost of a comprehensive energy efficiency job, often maxing out at a few thousand dollars.

Table VII-9
Home Performance Incentives around the Country

State	Program Implementer	Incentive Structure	Financing Available	Discounted /No Cost Audit	Max Rebate
Alaska	Alaska Housing Finance Corporation	Tiers	Yes	No	$10,000
Arizona	APS	Incentives by Measure	Yes	Yes	$1,395
Arizona	SRP	Incentives by Measure	No	Yes	$1,850
Arkansas	SWEPCO	No Cost	No	Yes	N/A
California	SMUD	Incentives by Measure	Yes	No	$8,000
California	Energy Upgrade California	Tiers	Yes	No	$6,500
Colorado	Xcel Energy	Incentives by Measure	Yes	No	$3,125
Connecticut	Energize Connecticut	Incentives by Measure	Yes	Yes	$2,100
Delaware	Energize Delaware	Incentives by Measure	Yes	Yes	$7,825
DC	DC Sustainable Energy Utility	Incentives by Measure	No	No	$450
Georgia	Jackson Electric Membership Corporation	Incentives by Measure	Yes	Yes	$2,200
Louisiana	Energy Smart	Incentives by Measure	No	No	$200+
Massachusetts	MassSave	% of Total Cost	Yes	Yes	$2,000
Michigan	Xcel Energy	Incentives by Measure	No	Yes	$4,750
Michigan	CE	Incentives by Measure	No	Yes	$3,500
Minnesota	Xcel Energy	Incentives by Measure	No	Yes	$2,000
Missouri	City Utilities	Incentives by Measure	No	Yes	$600
Missouri	City of Columbia	Incentives by Measure	Yes	No	$2,800
New Hampshire	NHSaves	% of Total Cost	Yes	Yes	$4,000
New Jersey	Clean Energy Program	Tiers	Yes	No	$4,000
New York	NYSERDA	% of Total Cost	Yes	Yes	$3,000
Ohio	Dominion	Incentives by Measure	No	Yes	$1,250
Oklahoma	Public Service Company of Oklahoma	Incentives by Measure	No	No	$6,000
Oregon	Energy Trust	Incentives by Measure	Yes	No	$1,850+
Texas	Austin Energy	Incentives by Measure	Yes	No	$1,500+
Texas	Entergy	No Cost	No	Yes	N/A

State	Program Implementer	Incentive Structure	Financing Available	Discounted /No Cost Audit	Max Rebate
Vermont	Efficiency Vermont	Incentives by Measure	Yes	No	$2,500
Washington	Energy Trust	Incentives by Measure	Yes	No	$700+
Wisconsin	Xcel Energy	Tiers	No	Yes	$2,250

Eligibility for LIEE programs is limited to 150 percent of the FPL in some states, but reaches up to 80 percent of AMI in others. The data in this section showed that HPwES services are expensive and even the most generous programs usually leave a significant cost for customers to bear. While low- or no-cost financing may be available, it can be difficult for low-income participants to qualify (see next section). Therefore, low-income customers need access to free or very low-cost programs to participate.

When examining affordability, an important issue is the standard that is used for eligibility in the low-income programs. While some states use 60 or 80 percent of AMI or SMI, many use only 150 or 200 percent of the FPL. In NJ, the maximum standard is 225 percent of the FPL and in PA it is 150 to 200 percent. This can make it very difficult for households between 200 and 400 percent of the FPL to implement energy efficiency in their homes, yet these are the households who also face energy costs that comprise a high percentage of their income.

Utilities may be wary of increasing eligibility for energy efficiency programs in PA (and in other states) because they are concerned that the eligibility limit will also be increased for the energy bill payment assistance programs, known as Customer Assistance Programs (CAP) in PA. Currently, the CAP eligibility limit in PA is 150 percent of the FPL. However, it is important to note that the energy efficiency program and bill payment assistance program eligibility criteria do not need to be set at the same level, and are not set at the same level in NJ, CO, or IL. While bill payment assistance programs primarily help customers without enough income to pay their bills, energy efficiency programs provide a one-time benefit to reduce energy usage and make bills more affordable. Energy efficiency programs are more likely to achieve energy affordability for customers whose incomes are somewhat higher.

Credit Worthiness

Customers who have good payment histories and credit scores may be eligible for no-cost/low-cost financing or on-bill financing, but many low-income customers do not have good payment histories or credit ratings.

A report on the economic well-being of U.S. Households in 2017 using data from the 2016 Federal Reserve Board's Survey of Household Economics and Decision Making[33] found that lower-income households are much more likely to be denied credit or to be offered less credit than requested.

[33] Report on the Economic Well-Being of U.S. Households in 2016, Board of Governors of the Federal Reserve System, May 2017.

Table VII-10
Credit Applicants who were Denied or Offered Less Credit than Requested
2016 Survey of Household Economics and Decision-making

Family Income	Denied Credit	Approved for Less Than Requested	Denied or Approved for Less
<$40,000	37%	10%	47%
$40,000-$100,000	21%	8%	29%
>$100,000	9%	6%	16%
All	23%	8%	31%

The Board of Governors of the Federal Reserve System also conducts the Survey of Consumer Finances (SCF) every three years. A 2007 report based on the 2004 SCF[34] found that lower-income households were more likely to either have been denied credit or not to have applied for fear of being turned down.

Table VII-11
Credit Constraints by Income
2004 Survey of Consumer Finance

Income Quintile	Applied, Denied, and Could Not Get Full Amount Elsewhere	Did Not Apply Because of Fear of Being Turned Down	Household is Credit Constrained
Bottom Quintile	13%	12%	25%
Second Quintile	19%	10%	30%
Middle Quintile	16%	7%	22%
Fourth Quintile	13%	3%	15%
Top Quintile	5%	3%	7%
Total	**13%**	**7%**	**20%**

Another study found that from 2009 through 2011 approximately 10,000 households applied for financing through Pennsylvania's Keystone Home Energy Loan Program (HELP). About 40 percent had income at 80 percent of AMI or less. While 31 percent of households earning more than 80 percent of AMI did not meet the program's underwriting standards, 57 percent of those earning less than 80 percent AMI did not meet the standards. Additionally, fewer of the lower income households moved forward with the financing even if they were approved (the reason they did not move forward was not reported).[35]

[34] Access Denied. Low-income and Minority Families Face More Credit Constraints and Higher Borrowing Costs, Center for American Progress, August 2007.
[35] Zimring, Hoffman, and Todd. Delivering Energy Efficiency to Middle Income Single Family Households. LBNL-5244E. December 2011.

Table VII-12
Keystone HELP Applications and Approvals, 2009-2011

Income	# Applications	Applications Approved	Loans Funded	Average Loan Size
<80% AMI	~4,000	~1,720 (43%)	~1,000 (58%)	~$7,500
≥80%AMI	~6,000	~4,140 (69%)	~3,000 (73%)	~$9,500

Landlord/Tenant Split Incentive

Energy efficiency poses challenges for tenants because the landlord bears the cost of improvements but the tenant receives the benefit in terms of reduced energy bills (this would not be the case if the landlord was responsible for the utility bills). The lowest-income households are most likely to be renters and to face this issue. The following studies have documented the impacts of this issue.

- A 2011 study in the Journal of Economic Literature found that households who pay for their energy use are 20 percent more likely to have their homes insulated.[36]

- A 2010 paper compared appliance ownership rates between homeowners and renters using data from the RECS and found that controlling for household income and other characteristics, renters were significantly less likely to have energy-efficient refrigerators, clothes washers, and dishwashers.[37] They were seven percentage points less likely to have energy-efficient refrigerators, ten percentage points less likely to have energy-efficient dishwashers, and five percentage points less likely to have efficient lighting.

- A 2006 study from the Lawrence Berkeley National Laboratory estimated that about 46.1 million households in the United States, or 44 percent had inefficient space heating in 2003 due to split incentives.[38]

Another aspect of the split incentive is that low-income programs require tenants to obtain permission from their landlord to participate in energy-efficiency programs and sometimes require that the landlord contributes to the cost of services or agrees not to raise the rent of the tenant for a certain period of time after services are delivered. As a result, it can be difficult for tenants to participate in free energy efficiency programs. The landlords do not have an incentive to provide permission if the tenant is responsible for the energy costs. While the work can improve the value of the home or building, the landlord may be concerned that deficiencies in the space may be identified during service delivery and the landlord will then be required to undertake expensive improvements.

[36] Gillingham, Harding, and Rapson. Split Incentives in Residential Energy Consumptions. Journal of Economic Literature. 2011.
[37] Evaluating the Slow Adoption of Energy Efficient Investments: Are Renters Less Likely to Have Energy Efficient Appliances? Davis. National Bureau of Economic Research. 2010.
[38] Sathaye and Murtishaw. *Quantifying the Effect of the Principal-Agent Problem on US Residential Energy Use.* 2006.

An additional problem for renters is when the building is master-metered and the tenant has an allocated portion of the bill. In this case, the tenant receives no feedback on how the unit's energy usage varies or how potential actions or measures impact energy usage.

Cost-Effectiveness Tests

A detailed review of cost-effectiveness testing is provided in the evaluation section of this report. In this section, we discuss how cost-effectiveness testing can be a barrier to LIEE programs.

Cost-effectiveness tests that factor in all of the costs, but do not factor in all benefits of energy efficiency can make it difficult for energy efficiency investments to be approved. This problem is faced in both general energy efficiency programs and LIEE programs, but non-energy benefits (NEBs) can be greater in LIEE, so it is even more important to account for NEBs in LIEE.

The American Council for an Energy-Efficient Economy (ACEEE) conducted a study in 2012 to assess states' use of cost-effectiveness screening.[39] They found that 44 states and the District of Columbia had formally approved ratepayer-funded energy efficiency programs, and conducted a survey with these entities. ACEEE found that while 29 states used the Total Resource Cost test that is defined as including all costs and benefits from the utility and participant perspective, only 12 states included the participant NEBs in their calculation and none quantified comfort, health, safety or improved productivity, as shown in Table VII-13.

Table VII-13
Benefits included in Cost-Effectiveness Testing

Benefits	Include Benefit Category	
	# of States	% of States
Utility System Avoided Costs	40	100%
Environmental Benefits	14	35%
Customer Non-Energy Benefits	12	30%
Other Societal Benefits	5	12%

Customer Benefits	Include Customer Non-Energy Benefit	
	# of States	% of States
None	29	71%
Water & Other Fuel	7	17%
Reduced Maintenance	2	5%
General Adder	1	2%
Other	1	2%
Health	0	0%
Comfort	0	0%
Not Specified	5	12%

This use of cost-effectiveness testing, where all costs but not all benefits are included in the analysis, makes it difficult for programs to pass the test or to include as many measures as

[39] Kushler, Nowak and Witte. *A National Survey of State Policies and Practices for the Evaluation of Ratepayer-Funded Energy Efficiency Programs.* 2012.

would otherwise be included with a test that took account of more benefits. However, additional study is needed to provide better estimates of NEBs and the value of these impacts.

States have used various methods to account for NEBs. These have included using "adders" that select a percentage or dollar amount to be added to the savings value to represent the NEBs; including readily-measured NEBs; including a broader range of NEBs; or a hybrid approach that includes an adder plus the easily measured NEBs.[40]

Table VII-14 displays NEB adders that are used in different states.[41] The NEB adder was included in Colorado based on actions from interveners and research conducted both in Colorado and on other states' methodologies. Some states view the adders as a conservative estimate of the value of NEBs, and assert that the use of such an adder is better than assuming a value of zero. Several states utilize a higher adder for LIEE than for other energy efficiency programs.

Table VII-14
Non-Energy Benefit Adders

State	Adder	Notes
CA	$30/ton	
CO	10% electric, 25% low-income, 5% gas	
DC	30%	
IL-Ameren	Ameren: 10% electric, 7.5% gas	
IL-DCEO	10%	
IA	10% electric, 7.5% gas	
MD	1.115¢ per kWh	Environmental
NM	15%, 25% low-income	
NY	$15/ton for carbon	
OR	$15/ton for carbon, 10%	
UT	10% for low-income	Environmental
VT	15%, 30% low-income	Plus 10% cost reduction for reduced risk
WA	10%	
WI	$30/ton for carbon	
WY	10%	

Additional research needs to be conducted to develop justifiable estimates of the range of NEBs to be expected from various types of programs and measures and a reasonable range of adders to use when specific estimates for these benefits are not developed. Because NEBs

[40] Skumatz. None-Energy Benefits / NEBs – Winning at Cost-Effectiveness Dominos: State Progress and TRMs. 2016 ACEEE Summer Study on Energy Efficiency in Buildings.
[41] Non-Energy Impacts Approaches and Values: an Examination of the Northeast, Mid-Atlantic, and Beyond. Northeast Energy Efficiency Partnerships, Inc. June 2017.

will vary based on the specific program and the measure penetration rates, as well as the way that the measures are implemented, and because it is time-consuming and expensive to conduct a thorough assessment of NEBs for each program and implementation cycle, the use of adders is a reasonable method to account for benefits that accrue in addition to energy savings.

Low-Income Baseline

The amount of energy saved through energy efficiency measures, when calculated through a Technical Reference Manual or engineering estimate, is computed as the difference between the energy use of the new installed measure and the energy use of the baseline. The baseline that is used can have a large impact on the amount of savings that is estimated. Some argue that the baseline for low-income households should be the equipment that is present in the home, as these households are constrained and are unlikely to replace that equipment until it fails. However, others contend that the replacement measure should be compared to current code requirements or current standard equipment, as this would be the minimum efficiency level if the equipment was replaced. An intermediate approach is to use the current equipment as the baseline for the estimated remaining life in the current system and the standard equipment as the baseline for savings during the rest of the life of the new measure.[42] However, low-income households may continue to utilize equipment well past the expected life of the equipment.

As current codes have created increased requirements for energy efficiency, the potential savings using the current code approach has declined, and it is more difficult to pass the cost-effectiveness test.

Of the four target states studies, only Colorado requires cost-effectiveness testing for LIEE. Details were not available on the baseline used for this testing, but review of other states has rarely found that a different baseline is used for LIEE.

Administrative Burden

Also related to the cost-effectiveness tests are the administrative requirements that may be placed on programs, imposing costs that make it even more difficult to pass the cost-effectiveness testing requirements. While a certain level of requirements is needed to ensure program integrity, safety, and effectiveness, it is important to assess each requirement, understand why it is in place and the contribution it makes to the program, and evaluate whether there is a more efficient approach. Some examples of administrative barriers are provided below.

- Eligibility Documentation: Customers must document their eligibility to participate in energy efficiency programs. In the case of programs that serve income-eligible households, potential participants must document their income to prove they are eligible for the program. Administrators can reduce the burden of such requirements by accepting

[42] But a percentage of low-income systems will already have outlived their expected life.

participation in other low-income programs as proof of eligibility for the energy efficiency program and providing flexibility in the types of verification accepted.

- Contractor Certifications: Over the past decade, the number and types of energy efficiency professional certifications and requirements have increased. Such credentialing can help to ensure that providers have the necessary training, knowledge, and experience to provide high-quality and effective services to participating households. However, these certifications can become burdensome because of the expense of the testing and the time required to complete the tests. Programs should assess the level of knowledge and skills required for each position and require certification that is commensurate with such need.

- Reporting: Reporting requirements can be onerous for program administrators. Reporting methods should be designed to facilitate program review, management, and evaluation. They should include only that information that is needed to manage, assess, and improve programs. The reporting should be developed in accordance with data management systems to allow for smooth delivery of required data fields.

Fixed and Variable Rates

Customers' decisions to participate in a program that is not no-cost will be affected by the impact that the program can have on their energy bills. Rate design, and the part of the bill that is fixed and variable, can be important in affecting this impact.

According to one study, while fixed costs represent 40 to 65 percent of a customer's bill, the highest fixed charge in the United States is about $25 per month and the average charge is about $10 per month, representing a much lower percentage. Most of the fixed costs are collected through the variable usage charges. However, others note that while utilities consider distribution system infrastructure costs as fixed, these costs may depend on changes in customer demand, and that these costs should not provide a basis of support for increasing the amount of fixed customer charges.

Utilities prefer to shift costs to fixed charges because it reduces their risk from changes in sales volume that may occur with energy efficiency, weather, or economic downturns.[43] Many utilities have increased, or proposed to increase, the fixed costs of service delivery and reduce the variable costs or the rate paid per kWh consumed. Some of these proposals would increase the fixed charge by 100 percent or more. Proposals have been approved in some states and rejected in others.[44]

When costs of energy service are charged in this way, with a greater portion of costs in the fixed part of the bill, the return to participants from energy efficiency is reduced, as a smaller portion of their bill is related to the amount of energy that they consume. This lengthens the payback period for any energy efficiency project. Additionally, customers who have made

[43] Fixed Charges and Utility Customers. Prepared for Consumers Union by Synapse Energy Economics. www.synapse-energy.com/fixed_charges_factsheet.

[44] Wood, Howat, Cavanagh, and Borenstein. Recovery of Utility Fixed costs: Utility, Consumer, Environmental and Economist Perspectives. Future Electric Utility Regulation. LBNL-1005742, Report No. 5. June 2016.

decisions to install energy efficiency measures based on previous rate structures will have their payback calculations invalidated if the rate structure is altered to rely more on fixed charges. These designs also negatively impact low-income customers who tend to use less energy. The National Association of State Utility Consumer Advocates adopted a resolution opposing increases in electric and natural gas utility fixed charges.[45]

Some recent PUC Decisions regarding rate structure included the following, but there are other areas around the country where utilities are beginning to work towards higher fixed rates.[46]

- "The Commission must also consider the public policy implications of changing the existing customer charges. There are strong public policy considerations in favor of not increasing the customer charges. Residential customers should have as much control over the amount of their bills as possible so that they can reduce their monthly expenses by using less power, either for economic reasons or because of a general desire to conserve energy. Leaving the monthly charge where it is gives the customer more control." *Missouri Public Service Commission Report & Order, File No. Er-2014-025, April 29, 2015.*

- "The Commission concludes that raising the [fixed charge] would give too much weight to the… cost of service study and not enough weight to affordability and energy conservation…[This] highlights the need for caution in making any decision that would further burden low-income, low-usage customers, who are unable to absorb or avoid the increased cost." *Minnesota Public Utilities Commission, Findings of Fact, Conclusions, and Order; Docket No. E-002/GR-13-868, May 8, 2015.*

- "The Commission is not prepared to move away from the long-accepted principle that basic charges should reflect only "direct customer costs" such as meter reading and billing. Including distribution costs in the basic charge and increasing it 81 percent, as the company proposes in this case, does not promote, and may be antithetical to, the realization of conservation goals." Washington Utilities and Transportation Commission, Final Order; Docket UE-140762, March 25, 2015.

Additionally, customers' ability to understand their energy usage and cost of using energy are critical to encouraging energy efficiency.[47]

Utility Disincentives

Unless specific mechanisms are put in place, utility revenues will be related to the amount of energy sold. Additionally, because most distribution and customer service costs are recovered with a charge for each kWh consumed, a reduction in usage and sales results in a greater

[45] Wood, Howat, Cavanagh, and Borenstein. Recovery of Utility Fixed costs: Utility, Consumer, Environmental and Economist Perspectives. Future Electric Utility Regulation. LBNL-1005742, Report No. 5. June 2016.
[46] Fixed Charges and Utility Customers. Prepared for Consumers Union by Synapse Energy Economics. www.synapse-energy.com/fixed_charges_factsheet.
[47] Customer Incentives for Energy Efficiency through Electric and Natural Gas Rate Design. A Resource of the National Action Plan for Energy Efficiency, 2009.

reduction in revenues than in costs.[48] Therefore, the utility has a disincentive to encourage and incentivize customers to participate in energy efficiency programs.

Raided Funds

Statewide ratepayer-funded energy-efficiency programs are typically funded by a surcharge on energy consumed that is directed to an energy efficiency trust fund. As such, these funds are the property of ratepayers rather than the state's budget. However, some states have drawn upon these funds during times when state budgets face shortfalls. This reduces the potential funding available for energy efficiency programs.

Such transfers have been made in New Jersey each year since 2008. In 2017 the governor proposed to take $154.7 million from the Clean Energy Fund and reallocate it to the general fund to make up for shortfall in other areas of the state budget.

The 2010 NJ transfer was challenged in court on the grounds that it violated the NJ law that stipulated how funds through the SBC could be used. However, the Superior Court of NJ in March 2011 upheld the transfer, stated that the legislature authorized the collection and purposes of the SBC funds and therefore retains authority to change the purposes of the use.[49]

Table VII-15 summarizes these transfers that occurred in New Jersey from 2008 through estimated transfers in 2016.[50]

Table VII-15
New Jersey Clean Energy Fund Transfers

Fiscal Year	Resources	Clean Energy Program Expenditures	General Fund Transfers	Year-End Fund Balance
2008	$378,224,000	$147,063,000	$15,305,000	$215,856,000
2009	$463,600,000	$154,658,000	$10,932,000	$298,010,000
2010	$595,641,000	$202,974,000	$198,830,000	$193,837,000
2011	$497,330,000	$226,174,000	$53,689,000	$217,467,000
2012	$633,735,000	$266,086,000	$255,097,000	$112,552,000
2013	$493,244,000	$193,908,000	$133,441,000	$165,895,000
2014	$543,750,000	$167,193,000	$273,660,000	$102,896,000
2015 (estimated)	$447,716,000	$184,900,000	$139,576,000	$123,240,000
2016 (estimated)	$468,060,000	$212,450,000	$120,594,000	$135,016,000

Some of the other states where such actions have been proposed or taken are described below.

[48] The Effect of Energy Efficiency Programs on Electric Utility Revenue Requirements. American Public Power Association. http://www.publicpower.org/files/PDFs/EffectofEnergyEfficiency.pdf
[49] Societal Benefits Charge. Energy.gov. https://energy.gov/savings/societal-benefits-charge
[50] http://www.njleg.state.nj.us/legislativepub/budget_2016/BPU_response.pdf

- Connecticut: The state senate proposed to take $236 million over two fiscal years from the ratepayer-funded Connecticut Energy Efficiency Fund and transfer it to the state's General Fund to address the state budget crisis.[51]

- Rhode Island: There has been a movement to take $12.5 million from the energy efficiency fund (ratepayer funding) and transfer it to the state's general fund. This is proposed to replace funds that were lost when the car tax was removed from state income.[52]

- Wisconsin: Funds collected for energy efficiency programs were used for municipal aid payments, the general fund, and the Wisconsin Works or W-2 Program. A total of $110.9 million was transferred from 2002 to 2007. From 2007 to 2011 the state transferred $36.7 million in funds from a low-income weatherization program to the W-2 Program. Following that transfer, the Legislature enacted a special charge on utility bills that collected $18.3 million that was transferred to pay for the salaries and benefits of prosecutors in district attorney's offices in the state.[53]

In some cases, states have tried to remove this possibility by requiring that utilities collect the funds and run the programs or that the state remit the funds to third-party program administrators so that the funds never appear in state budgets and are not part of the state appropriation process.[54]

B. Technical Barriers

Key technical issues include safety barriers to measures and customer understanding and acceptance of energy efficiency.

Health and Safety

Health and safety issues in low-income homes can prevent the implementation of energy efficiency measures. Key barriers include mold, asbestos, knob and tube wiring and other wiring issues, pests, and clutter. Structural issues also fall under this umbrella. Some homes have significant roof leaks, foundation issues, grading issues, or other structural issues that prevent efficiency work. The prevalence of these issues in low-income homes can be high, reducing the savings that can be achieved.

- The National Center for Healthy Housing estimates that the number of homes that are deferred from weatherization is roughly ten to 15 percent.[55]

[51] https://ctviewpoints.org/2017/06/28/why-raiding-connecticuts-energy-efficiency-fund-is-a-bad-idea/
[52] http://www.rifuture.org/energy-efficiency-fund/
[53] State May Spend Focus on Energy Fees on Broadband. Milwaukee Journal Sentinel. October 18, 2016. http://www.jsonline.com/story/money/business/energy/2016/10/18/state-may-spend-focus-energy-fees-broadband/92368470/
[54] Brown, Matthew. Funding Mechanisms for Energy Efficiency. Alliance to Save Energy. September, 2008.
[55] Wilson and Tohn. Healthy Housing Opportunities During Weatherization Work. 2011.

- A report published by the National Renewable Energy Laboratory estimated that 11 percent of the housing units nationwide occupied by households under the poverty line have "moderate to severe" structural problems, based on data from the 2007 American Housing Survey.[56]

Table VII-16 displays the results from a recent study conducted for Columbia Gas of Pennsylvania's LIEE program. APPRISE conducted a review of job files that included audit forms, work scopes, and measure invoices to determine whether there was a health and safety issue that prevented energy efficiency work from being completed and the type of health and safety issue that was present. The table shows that 12 percent of the jobs had one or more health and safety issues that prevented all or some energy efficiency measures from being implemented. The most common issue was mold and/or moisture which prevented eight percent of jobs from being completed and comprised 68 percent of the health and safety issues. The other most common issues were knob and tube wiring and roof leaks.[57]

Table VII-16
2015 Frequency of Specific Health and Safety Issues
Columbia Gas of Pennsylvania LIEE Program

H&S Issue	Jobs with Health & Safety Issues that Prevented Work		
	Number	Percent of All Jobs	Percent of H&S Issues
Mold or Moisture	83	8%	68%
Knob and Tube Wiring	41	4%	34%
Roof Leak	38	4%	31%
Asbestos/Vermiculate	18	2%	15%
Sewage Leak	13	1%	11%
Infestation	12	1%	10%
Structural Issues	12	1%	10%
Holes in Attic Floor	10	1%	8%
Clutter	8	1%	7%
Other	21	2%	17%
Any Issue	122	12%	100%
All Jobs	**997**	**100%**	**100%**

The Minnesota Department of Commerce conducted a study of health and safety problems found in their Weatherization Assistance Program. They analyzed data from 238 units completed in 2015 and 2016 and found an average health and safety cost of $2,461 per unit. The largest expenditures were required to comply with ASHRAE 62.2 (ventilation standards

[56] Wilson and Tohn. Healthy Housing Opportunities During Weatherization Work. 2011.
[57] APPRISE research, not yet publicly available.

to ensure safe air quality) and water heater replacement due to back drafting concerns.[58] (Note that these water heater issues would not apply to electric water heaters.)

Other research on health and safety barriers preventing weatherization found the following.

- A 2016 Sustainable Resources Center study found that 30 percent of Minneapolis homes were deferred for low-income weatherization.[59]
  - Inaccessible crawl spaces comprised 26 percent of deferrals.
  - Vermiculite and/or asbestos comprised 21 percent of deferrals.
  - Excessive mold or moisture comprised 14 percent of deferrals.
  - Other deferral causes included structural defects, pests, and hoarding.

- A 2010 report from the Green & Healthy Homes Initiative[60] examined the impact of health and safety issues in nine urban low-income weatherization programs and one rural weatherization program in the United States. The average percentage of homes that were deemed ineligible during the audit based solely on health and safety issues was 13 percent, and this excludes the homes that were deferred due to health and safety issues prior to the audit taking place. The percentage of homes found ineligible due to health and safety issues ranged from none in New Haven to 64 percent in Atlanta.

Table VII-17
Frequency of Homes Ineligible for Weatherization due to Health and Safety Issues Identified in GHHI Study

Atlanta	Baltimore	Denver	Cleveland	Cowlitz Tribe	San Antonio	Flint	Chicago	New Haven	Average
64%	42%	27%	11%	10%	10%	8%	5%	0%	13%

The report identified fire and safety hazards in 61 percent of the audited homes, clutter in 36 percent, structural issues in 30 percent, and moisture and mold in 28 percent of the audited homes.

Table VII-18
Frequency of Specific Health and Safety Issues Identified in GHHI Study

[58] Minnesota 2017 Weatherization Assistance Program Plan. http://mn.gov/commerce-stat/pdfs/py17-doe-state-plan.pdf
[59] Norgaarden. Low Income Energy Efficiency Challenges and Opportunities. Sustainable Resources Center. September 2016. https://mplscleanenergypartnership.org/wp-content/uploads/2016/09/src-mcepsept2016ff1.pdf
[60] Green and Healthy Homes Initiative. *Identified Barriers and Opportunities to Make Housing Green and Healthy Through Weatherization.* 2010.

Fire and Safety Hazards	Ventilation	Clutter	Structural Defects	Moisture Mold Mildew	Pests	Asbestos	Lead Paint	Electrical
61%	37%	36%	31%	28%	26%	19%	17%	11%

The average cost of addressing health and safety hazards in these cities was $2,172. The lowest average cost for any site was $1,200, for San Antonio. These costs were usually higher than the allowable ten to 15 percent that can be used to address health and safety according to DOE WAP rules. Given the average cost of DOE WAP jobs of $5,000 to $6,500, the allowable health and safety costs range from $500 to $975.

One of the recommendations of this report was to develop a comprehensive assessment tool to collect information on all health and safety issues in the home so that there is better documentation of the prevalence of these issues.

Requirements for High-Efficiency Equipment Installation

This topic is an issue for homes with combustion appliances. High-efficiency natural gas equipment requires knowledge and expertise for safe and correct installation. Installation of high-efficiency heating systems may require replacement of water heaters as well to prevent orphaned hot water heaters that may backdraft and cause dangerous carbon monoxide issues. Venting requirements can also be difficult and/or expensive. Contractors need to be trained on these issues to ensure that installations are safe and effective.

Key issues with respect to the natural gas high-efficiency units are as follows.

- Heating capacity (sizing)
- Duct distribution systems
- Gas piping
- Vent systems
- Provision for combustion air
- Flue gas condensate disposal
- Electrical connection requirements
- Provision for forced-air cooling
- Air filtering equipment
- Humidification requirements

One example where the utility has taken the lead to address this barrier is in New Jersey. The New Jersey Natural Gas SAVEGREEN Project provides incentives that are complimentary to the New Jersey Clean Energy Programs (NJCEP). The residential programs provide grants and/or on-bill repayment plans to assist with the purchase and installation of furnaces/boilers and water heaters and other whole house home performance work.

NJNG introduced additional program incentives for customers who install a high-efficiency heating and water heating system at the same time. The program provides no-interest on bill financing for five years for up to $6,500 for customers who install a furnace or boiler and a water heater that qualify for the NJ Clean Energy Program. This $6,500 On Bill Repayment

option was introduced to reduce the problem of orphaned hot water heaters. When only the furnace is replaced with a high efficiency furnace and the chimney that had previously vented the gases from the furnace and water heater is now only venting the gases from the hot water heater, this creates unsafe water heater venting. The focus on replacing both systems simultaneously was also intended to eliminate a potential barrier to further seal-up and insulation in the HPwES program. NJNG also requires the Manual J and Manual S so they know that the equipment is sized properly and that the home is ready for HPwES following these replacements.

NJNG has provided education and outreach to help contractors understand the requirements for installing high-efficiency equipment because technological innovations in equipment have made it difficult for the contractors to keep up with changing installation requirements. They trained hundreds of contractors on SAVEGREEN and on the technical skills needed for energy efficiency work.

NJNG's free training classes for contractors offer BPI and NATE CEUs. Over the years classes offered have included the following.

- Manual J
- Manual S
- Residential Duct Design & Sealing with ACCA Manual D
- Airflow and System Charging
- Gas Furnace Troubleshooting
- ECM Motors
- Heat Pump Troubleshooting
- Residential Airflow and System Charging
- Energy Efficiency – Beyond the Installation (This class that was designed to address the orphaned hot water heater issues their auditors were seeing in the field.)

The NJNG inspections of these completed jobs found that the education and outreach had an effect, as the number of orphaned water heaters and the number of incorrect one-pipe installations, where the intake requirements draw inside house air, have declined.

Additionally, the NJCEP began requiring Manual J Load Calculations and Manual S sizing requirements in January 2017.

Returning to Previously Treated Homes

Another barrier to LIEE is a limitation on when a program can return to the home after it has previously received energy efficiency services. The National Weatherization Assistance Program (WAP) does not permit service delivery if the home has been served since 1994, currently 23 years. LIEE utility programs generally have less stringent requirements, often ranging from five to seven years in Pennsylvania and New Jersey.

This requirement can prevent homes with good opportunities for weatherization from being treated. Because technology is evolving, there may be many high-use homes with additional opportunities to be addressed over 20 years after previous treatments. Additionally, some

opportunities may have been missed in the first delivery, some households may have addressed health and safety issues that prevented measure installation, and some measures may no longer be effective.

Permitting

Township permitting requirements can be difficult and/or expensive. Contractors must be familiar with the requirements in all municipalities in which they work. Customers may have their installation decisions impacted if these additional costs are more than what they expected. Jobs may be delayed when waiting for the inspection necessary to obtain the permit and contractors may bear additional costs that they pass on to the participant. Additionally, participants are inconvenienced when they must be at home for the inspection associated with the permitting process. Coordination between the local municipality and the LIEE may help to resolve this barrier.

A New Jersey Department of Community Affairs newsletter from Spring 2007 discussed some of the challenges in obtaining permits needed for HVAC replacement. The newsletter stated, "The Department receives many calls complaining about the high cost of permit fees for a replacement because municipalities have set a minimum fee for each required technical section. Some municipal fees accumulate to over $200 for a furnace replacement. It is hard for a homeowner to comprehend such an excessive permit fee for such a simple job." The newsletter also noted that "In order to avoid discouraging individuals from obtaining permits for projects involving the simple replacement of equipment due to the high cost of the permit fees, the Department encourages municipalities that do not employ a mechanical inspector to assign to the plumbing inspector enforcement responsibility for the Mechanical Sub-code for direct replacement heating or cooling equipment. Also, the municipality needs to set a flat fee for mechanical inspections. In addition to establishing a reasonable cost for the work performed, this would eliminate the need for a homeowner to have to stay home for multiple inspections that may occur on different days."[61]

Knowledge and Acceptance

Customers may not be aware of available options or understand the potential benefits of energy efficiency. There can be challenges in gaining acceptance and participation in both no-cost low-income programs and highly subsidized market rate programs.

A 2011 survey asked home performance professionals why more homeowners do not complete an energy audit. Key barriers were as follows.

- 63% identified that homeowners "know about audits but don't know what they are and the information that they provide".
- 50% stated that homeowners were "unaware that energy audits exist".

[61] Construction Code Communicator. State of New Jersey, Department of Community Affairs. Spring 2007.

- The only issue that auditors identified as a major or critical issue with higher frequency than these was that homeowners "can't afford upgrades and retrofits that the auditor might recommend". [62]

One method that has been used to overcome this barrier is neighborhood outreach. Community leaders and/or existing social infrastructure and peer-to-peer outreach is used to sign up households for energy efficiency services. The intermediaries provide education about the benefits of the program and create an increased level of awareness and acceptance in the community. Many who work in the energy efficiency field are strong proponents of the community-level approach to both educate customers about the available programs and to gain the trust needed for participation.

C. Social Barriers

Social barriers on the participant side include uncertainty about length of time planned in the current home, trust of programs and service providers, and scheduling issues. Social barriers on the provider side include recruiting and training employees, language barriers, and unsafe neighborhoods.

Home Tenure

Customers may not be willing to invest in energy efficiency services if they do not plan to remain in their home for an extended time period. While LIEE programs usually do not require a monetary contribution from the participant, the transactions costs of application, readying the home for services, and being at home for service delivery are large. No-cost utility programs for low-income households often ask customers if they are planning to move in the next year and disqualify them for services if they are planning on moving. Or they may require customers to have been in their homes for a certain period of time to assess their level of usage and whether they are a good candidate for service-delivery or how much to spend on energy efficiency measures. Some programs will use the consumption of the previous resident or a default usage level to determine service delivery expenditure levels if the potential participant does not have a long enough usage history in the home.

PACE and On Bill Financing programs can be structured to transfer to the new owner if the borrower moves prior to the repayment of the loan.[63] This can increase acceptance of energy efficiency by households who are uncertain as to how long they will remain in their home.

Trust

Customers may not trust contractors or programs that provide subsidies or free services. Even when program services are provided at no cost, it can be difficult to get some customers to accept services.

[62] Palmer, Walls, Gordon and Gerarden, *Assessing the Energy-Efficiency information Gap: Results from a Survey of Home Energy Auditors.* 2011

[63] Leventis, Martin Fadrhonc, Kramer and Goldman. *Current Practices in Energy Efficiency Financing: An Overview for State and Local Governments.* 2016

One reason that customers may not trust the program is their immigration status. Especially in the current climate, customers fear being asked for documentation of their status.

As noted above, community outreach and intake can be key to developing trust in low-income communities. The Lawrence Berkeley National Laboratory recommends the use of "trusted messengers" to promote energy efficiency programs, to increase participation through personal contact. Some methods described in their report include selecting "program ambassadors" among prominent members of the community, and promoting the program through neighbor-to-neighbor or door-to-door conversations.[64]

Scheduling

Energy efficiency services can involve up to five or more visits to the home depending on the comprehensiveness of services and the number of subcontractors involved in the installation work. Customers may not be able to take off work to have the energy efficiency work completed. Some programs provide the audit in the evening hours to improve accessibility and work to deliver services in the smallest number of visits possible. Coordination and joint delivery of programs can also reduce the number of visits that are required.

Language Barriers/Literacy

Language barriers and literacy issues can pose challenges in the application process and during service delivery. Applications can be long and complicated and ask for detailed documentation. Low-income households may not have the time to visit agencies to obtain assistance with these forms.

Many agencies, and even for-profit contractors have staff that can communicate in Spanish if they work in neighborhoods with high concentrations of these languages, but they are unlikely to be able to communicate in less common languages.

Neighborhoods

Some low-income neighborhoods have high crime rates and/or can be perceived as dangerous and some contractors are hesitant to provide services in these locations. These are often the neighborhoods with the poorest housing stock that is most in need of services. As the housing market has recovered, there are additional opportunities for contractors to take on other work, and the opportunities in the low-income neighborhoods are less attractive than they were previously.

Recruiting and Training Employees

Related to overcoming language barriers and delivering services in low-income neighborhoods is the challenge of recruiting and training staff to provide these services. One key to overcome service delivery challenges may be to develop a more diverse workforce that is from these communities and has ongoing ties to these neighborhoods. These individuals may help overcome the social barriers that are encountered.

[64] Merrian, F. *Driving Demand for Home Energy Improvements: Motivating residential customers to invest in comprehensive upgrades that eliminate energy waste, avoid high utility bills, and spur the economy*. 2011.

Illinois' FEJA requires utilities to implement job training programs for underserved communities. The Energy Coordinating Agency in Philadelphia and Isles in Trenton, New Jersey have also implemented job training programs for underserved communities. These programs need to be researched to provide information on the most effective approaches for LIEE workforce development.

D. Incomplete Data and Information

A fundamental challenge with analyzing programs and providing an assessment of who is served, the services that are provided, and the results that are achieved, is a lack of data and information. Two key areas where program information is missing are participant and program statistics and evaluation results. In this section we provide a description of the data and information that are needed to provide a comprehensive review and assessment of programs and develop a better understanding of best practices.

Participant and Program Statistics

Many programs do not have databases that provide comprehensive information or develop comprehensive program statistics that are available as part of program reports and/or documentation. The following information would provide a broad understanding of program design and delivery.

- Participant Characteristics: Comprehensive information on LIEE participants should include income and poverty level; number of household members; presence of young children, elderly, and disabled; race and ethnicity; and location type including rural, suburban, or urban.

- Home Characteristics: Data should include detailed home type, home ownership, home age, home size, type of foundation, and level of insulation.

- Energy Usage Characteristics: Information should include main heating fuel, use of supplemental heat, type of supplemental heat, water heating fuel, and whether a multi-family building is individually or master metered.

- Health and Safety Barriers: It is important to understand whether there were health and safety barriers that prevented installation of some measures, what the barriers were, the barriers that were and were not addressed by the program, and the work and the costs of the work to address the health and safety issues.

- Pre-treatment Usage: Data should include how much energy participants used prior to treatment, and the disaggregation of that usage into baseload, heating, and cooling contributions.

- Testing Results: Blower door pre- and post-treatment testing results, refrigerator metering results, and combustion safety testing (if applicable) should be included.

- Measures Installed: A comprehensive list of treatments should be databased for each job.

- Spending per Measure: The cost per installed measure should be documented.

Evaluation Results

Energy savings data are often not available, and when they are available they are often based on engineering estimates without provision of the specific methodology that was used. Evaluation results should include the following information.

- Projected: Expected savings based on the Technical Reference Manual or program software analysis, and the formulas and assumptions used to develop those results.

- Billing Analysis: Weather-normalized, comparison group adjusted estimates of energy savings based on analysis of utility energy usage data. Information should include data on the percent of program participants who were included in the analysis, and analysis of bias caused by participant attrition.

- Subgroups: Analysis of usage impacts by home type, pre-treatment usage, contractor, dollars spent in the home, and measures installed.

E. Summary and Recommendations

Economic barriers include affordability of energy efficiency services, credit worthiness, the landlord/tenant split incentive, cost-effectiveness tests that do not take NEBs into account, low-income baselines, administrative burdens, rate design, utility disincentives, and energy-efficiency funds that have been raided to balance state budgets.

Technical barriers include health and safety issues that prevent the installation of energy-efficiency measures, requirements for high-efficiency equipment installation, and customer understanding and acceptance of energy efficiency.

Social barriers include home tenure, scheduling, language and literacy, and dangerous neighborhoods.

Promising solutions to many of these issues have been developed and implemented. We identify these solutions briefly below and will elaborate on these issues and provide model approaches in the following sections of this report.

- Affordability: No-cost energy efficiency services can be extended to households with income up to 80 percent of AMI to improve accessibility.
- Credit-worthiness: PACE and on-bill financing (or other credit enhancements) may provide access to credit without use of FICO scores.
- Split incentives: Green leases can increase incentives for landlords. Additionally, required disclosure of the past year's utility bills provide important information to potential tenants and increase the incentive for landlords to make energy-efficiency upgrades.
- Cost-effectiveness tests: Including a NEB adder can improve the ability of energy efficiency measures to pass the cost-effectiveness test.

- Low-income baselines: Use of current equipment as the baseline for low-income participants can accurately take account of energy savings.
- Fixed and variable rates: Structures that include a large percent of the bill in the variable charges can increase incentives for energy efficiency.
- Utility disincentives: Decoupling and EERS can create incentives or requirements for utilities to implement energy efficiency programs.
- Raided energy efficiency funds: Transferring funds to utilities or independent energy efficiency boards after they are collected can prevent the funds from being appropriated for other uses.
- Health and safety issues: Program coordination and innovative delivery models can provide higher funding to resolve the issues that prevent implementation of energy efficiency measures.
- High-efficiency equipment installation: Contractor training and quality control can ensure that the work is done correctly.
- Customer understanding and acceptance: Community engagement and outreach can increase program acceptance.
- Home tenure: PACE and on-bill financing can be structured to transfer loans to the new owner.
- Trust: Community-based outreach can help overcome skepticism.
- Scheduling: Evening schedules and efforts to reduce the number of required visits can be helpful.
- Language Barriers and Literacy: Multi-lingual service providers can be important.

Some of the other issues require policy changes or other innovative approaches.

VIII. Policies and Financing Mechanisms

Given the barriers that were documented, additional policies and financing mechanisms are needed to increase investment in LIEE and to ensure that the low-income population is adequately served. Stakeholders need to understand what policies have been tried and have been successful, under what situations have these approaches made the most impact, and how to develop these additional approaches. This section develops information on the policies and financing mechanisms that can increase investments in LIEE based on literature review and interviews with key actors in the four pilot states.

A. Additional Program Offerings or Delivery Models

The most common delivery models are in-home audits and installation of energy efficiency measures, completed in single-family homes or in multi-family building common areas and individual apartments, usually implemented or funded only by investor-owned utilities for their customers. However, other types of investments have potential for overcoming some of the barriers to energy efficiency or providing services on a broader scale or in a more targeted fashion. These other approaches include additional offerings by public utilities or electric cooperatives, heat island reduction programs, community solar, and school-based energy efficiency.

Public Utility and Electric Cooperative Programs

Public utilities and electric cooperatives together provide 25 percent of the total electric consumption in the U.S., and are therefore an important target for LIEE. SMUD and Austin Energy are public utility leaders in the energy efficiency field due to local interest in these issues. The National Rural Electric Cooperative Association developed energy efficiency programs to help rural electric utilities overcome barriers to energy efficiency. Some of the barriers to energy efficiency that public and rural utilities face include the following.[65]

- Lack of financial or political impetus.
- No regulatory or statutory requirements. Because energy efficiency programs are usually regulated by the state PUCs who often do not oversee municipal and rural utilities, it may be challenging to develop LIEE programs through these utilities.
- Lack of capacity to design and implement programs due to their size. They may not serve enough low-income households to develop an effective and cost-effective program.
- Long-term contracts with power plants that removes the incentive for efficiency due to low rates.

However, there may be some opportunities.

- Some of these utilities have invested in energy efficiency to delay investments in power plants.

[65] McKibbin, Evens, Nadel, and Mackres. Engaging as Partners in Energy Efficiency: Multi-family Housing and Utilities. CNT Energy, ACEEE. January 2012.

- Some public power utilities in CA, FL, IA, NE, NY, SC, TX, VT, and WA have adopted their own energy efficiency goals.[66]
- These utilities usually do have relationships with local governments that may provide opportunities for developing energy efficiency programs and coordination.
- The Environmental and Energy Study (EESI) developed an On-Bill Financing Project and has developed an initiative to improve efficiency of homes served by rural electric cooperatives and public power utilities by developing residential on-bill financing programs. They note that these programs are offered by 60 cooperatives and public utilities across the country.
- Iowa's 2008 Senate Bill 2386 did require natural gas and electric municipal and rural electric utilities to establish energy efficiency goals, but there were no specific LIEE requirements.

Rural Electric Utilities

The USDA's Rural Utilities Service (RUS) provides low-cost loan funding for efficiency lending by rural electric utilities. The loans are made to the rural utilities, who can then re-lend funds to their customers for energy efficiency upgrades. These are important programs for customers of rural electric utilities, because while these customers are eligible for WAP, they are generally not served by the ratepayer-funded programs.

The Rural Energy Savings Program (RESP) was signed into law in 2014 and offered for the first time in 2016. The purpose of RESP is to "help rural families and small businesses achieve (energy) cost savings by providing loans to qualified consumers to implement durable cost-effective energy measures." It is intended to provide funding for On-Bill energy efficiency loan or tariff programs. At full funding, it could provide $75 million for low-income, higher-energy cost communities. The RESP requires annual congressional appropriations.[67]

The RESP provides 20-year zero percent interest loans to the rural utilities. The funds are lent to customers who repay the loans at three percent interest rates for up to ten years through their utility bills. Eligible measures are "structural improvements and investments in cost-effective, commercial technologies to increase energy efficiency." The cost savings must have a payback period of ten years or less. Energy audits and measurement and verification are required.[68]

In 2017, the RESP announced the first two zero-interest loans to rural energy providers to help businesses and residential customers lower energy use and costs.[69]

[66] American Public Power Association. August 2011. http://www.publicpower.org/files/pdfs/stateenergyefficiencyaugust2011.pdf
[67] http://appvoices.org/energysavings/usda/
[68] http://appvoices.org/energysavings/usda/
[69] https://www.usda.gov/media/press-releases/2016/06/21/usda-announces-new-assistance-help-rural-utility-customers-conserve

- South Carolina's KW Savings Co. received a $13 million loan. They will use the loan to fund seven rural electric cooperatives for SC's Help My House Program which supports behind-the-meter technologies and energy efficiency improvements.
- Northeast Ohio Public Energy Council (NOPEC) received a $1 million loan. This nonprofit regional council of governments will provide energy improvement loans to small businesses through the Savings Through Efficiency Program (STEP).

The Energy Efficiency and Conservation Loan Program (EECLP) is a loan guarantee program provided by the Rural Utilities Service (RUS). The program supports utility energy efficiency programs. In Fiscal Year 2014, the first year of the program, $250 million was made available. EECLP goals are as follows.[70]

- Increase customers' energy efficiency.
- Reduce overall system demand.
- Improve the efficiency of electric distribution, transmission, and generating facilities.
- Provide for economic development in rural communities through energy efficiency investments.
- Encourage the use of renewable energy fuels.

The EECLP provides loan guarantees to electric cooperatives and other rural electricity providers. The provider can undertake energy efficiency improvements or can re-lend funds to residential and commercial customers for energy efficiency improvements. The funding can allow for approval for customers with a good bill payment history in lieu of a credit check. Eligible activities include the following.

- Energy audits.
- Energy efficiency measures.
- Customer outreach and education.
- On- and off-grid renewable energy systems.

Recipients of the EECLP include the following.[71]

- Roanoke Electric Cooperative: They borrowed $6 million from EECLP at a 3.5 percent interest rate to lend for home energy retrofits. They aim to have 1,000 whole house retrofits completed in five years.
- North Arkansas Electric Cooperative: They borrowed $4.5 million from EECP at a 3.5 percent interest rate. They will provide loans for building retrofits across all sectors.

[70] http://appvoices.org/energysavings/usda/

[71] Cross. Opportunities through the USDA Energy Efficiency and conservation Loan Program. Environmental and Energy Study Institute. April 2015. http://www.eesi.org/files/EESI-CEA-webinar-April-2015.pdf

Heat Island Reduction Programs

A Heat Island Reduction Program is one example of a community-level investment that can reduce energy usage and energy costs, reduce greenhouse gas emissions and storm water runoff, improve public health and quality of life, increase resiliency to climate change impacts, and increase local economic development. Strategies include use of cool roofs, cool pavements, pervious pavements, and tree planting.[72]

Heat Island Reduction Programs can help low-income households and vulnerable residents because they target urban communities where these households are concentrated and are most impacted by heat islands. In some cases there may be opportunities to partner neighborhood level Heat Island Reduction Programs with neighborhood targeted LIEE. The ECA programs that combine LIEE with cool roofs is one example.

Programs and initiatives implemented in Colorado include the following.

- The Mile High Million Denver Tree Planting Map: This initiative aims to plant one million trees in the Denver metropolitan area by 2025. Programs under this initiative include DOE's Trees for Energy Savings that will plant 4,600 trees to reduce energy use and lower bills for residents. Expected benefits include mitigation of the urban heat island effect, reduced storm water runoff, and improved air quality.[73]

- Urban Drainage and Flood Control District Manual: Fort Collins' storm water management policy requires at least 25 percent of new pavement to implement permeable technologies.

Programs and initiatives implemented in Illinois include the following.

- Chicago Energy Conservation Code: The Urban Heat Island Provisions of Chicago's energy code require that contractors use roofing products that qualify for an Energy Star® label. The requirements relate to solar reflectance and emissivity.[74]

- Chicago Green Alleys Initiative: This initiative uses permeable pavement any time the city needs to repave an alley. These pavements allow storm water to filter and drain into the ground rather than collecting on hard surfaces or draining into the sewer system. Other characteristics include catch basins to capture water and funnel it into the ground, proper grading and pitch to facilitate drainage, light-colored surfaces to reflect sunlight, and recycled materials. Since 2010, more than 100 Green Alleys have been installed.[75]

[72] Heat Islands Community Actions Database.
https://www.epa.gov/heat-islands/heat-island-community-actions-database
[73] http://milehighmillion.org/
[74] https://www.cityofchicago.org/city/en/depts/bldgs/supp_info/chicago-energy-conservation-code.html
[75] https://www.cityofchicago.org/city/en/depts/cdot/provdrs/street/svcs/green_alleys.html

- Chicago Green Roof & Cool Roof Grants Program: Chicago started this program for residential and commercial buildings in 2005. They supported green roof installation projects in 2005 through 2007.

Chicago has many other programs including the City Hall Rooftop Garden that installed a green roof on city hall in 2000; the Sustainable Backyards Program that provides rebates for the cost of installing trees, plants, compost bins, or rain barrels; the Sustainable Development Policy which provided for construction of green roofs on public buildings, estimating the impacts from the green roofs, providing grants to encourage green roof installations, and educating the public about green roofs; the Landscape Ordinance that requires planting trees or shrubs on parkways and landscaping parking lots, loading docks, and other areas; and the Landscaped Medians program that plants trees and other vegetation in medians to reduce the urban heat island effect.

Programs and initiatives implemented in New Jersey include the following.

- Cool Cities: The Department of Environmental Protection and the Board of Public Utilities created this program to plant trees to reduce electricity demand. The BPU provided $2 million in funding and planted 3,000 trees in Paterson and Trenton.

- Groundwork Elizabeth: Neighborhood residents are involved in community revitalization projects including tree planting at schools and parks.[76]

Programs and initiatives implemented in Pennsylvania include the following.

- Energy Coordinating Agency Cool Roofs Program: ECA has implemented cool roof programs that address the urban heat island. As part of their EnergyFIT Philly program, they targeted a very low-income neighborhood in West Philadelphia, provided comprehensive repairs and energy efficiency services, and applied reflective roof coatings.

- City of Philadelphia Cool Roof Ordinance: This ordinance was enacted in 2010 and requires all new construction in Philadelphia to use white roof coverings or those rated as highly reflective by Energy Star®. Vegetative roofs and rooftops with photovoltaics are exempted from the requirement.[77]

- Energy Harvest Program: Pennsylvania's Department of Environmental Protection provides grants for energy-saving projects including green roof projects across the state.[78]

[76] http://groundworkelizabeth.org/
[77] http://legislation.phila.gov/attachments/10096.pdf
[78] http://www.prnewswire.com/news-releases/pa-governor-rendells-energy-harvest-program-investing-6-million-in-pas-future-55693877.html

- TreeVitalize: Pennsylvania's Department of Conservation and Natural Resources collaborates with county and local governments, foundations, trade associations, and industry to restore tree cover in southeastern PA.[79]

Some examples of initiatives in this area in other states include the following.[80]

- NYSERDA's Environmental Justice Interagency Taskforce Action Agenda included "Greening the Bronx", where they worked with horticulture students to plant trees throughout the borough.[81]

- NYSERDA led research to identify species and sites to maximize the reduction in electricity usage. They aimed to reduce the public health impacts of the urban heat island on the elderly and poor urban residents. Elderly and vulnerable populations are especially at risk for mortality and morbidity during summer heat waves. Elevated ozone conditions increase hospital admissions and mortality for asthma and cardiovascular issues.[82]

- Los Angeles Roofs Building Code: The 2014 Los Angeles Green Building Code requires cool roofs for all new and refurbished homes. The roofing materials must meet standards for solar reflectance, or ability to reflect the sun's energy back into the atmosphere, and thermal emittance, or the material's ability to release heat. Incentives for single-family and multi-family residential customers cover the additional costs of these roofs.

  Benefits of the cool roofs are expected to include reduced smog formation, reduced heat-related illness, increased energy savings, increased home comfort, and increased life expectancy for the new roof.[83]

- Cool Communities: This nonprofit program in Atlanta aims to improve urban environments and conserve energy. They advocate for reflective roof coatings and paving and planting trees.[84]

- NeighborWoods: Baton Rouge Green, a nonprofit urban forestry program, developed this program that provides shade trees for medians, parks, and schools in environmentally underserved neighborhoods. They select four neighborhoods each year.[85]

[79] http://www.dcnr.pa.gov/Communities/CommunityTreeManagement/Pages/default.aspx
[80] Energy Efficiency and Renewable Energy in Low-Income Communities. A Guide to EPA Programs. https://www.epa.gov/sites/production/files/2016-03/documents/epa_low_income_program_guide_508_2-29-16.pdf
[81] NYSERDA Greening the Bronx: Urban Heat Island Mitigation Project Request for Proposals No. 2960.
[82] Urban Heat Island Mitigation Can Improve New York City's Environment: Research on the Impacts of Mitigation Strategies. Sustainable South Bronx. October 2008.
[83] Cool Roofs: What You Need to Know about LADWP Rebates and Building Code Requirements. Los Angeles Department of Water and Power. March 2015.
[84] http://www.coolcommunities.org/
[85] http://batonrougegreen.com/what-we-do/neighborwoods/

Community Solar

Community Solar projects provide access to solar energy that is located somewhere in the community rather than on the participant's roof. There are multiple subscribers who purchase a portion of the power produced and receive a credit on their electric bill.

Low-income households should be treated with all cost-effective energy efficiency in addition to having access to the community solar gardens, as energy efficiency is the least expensive path. GRID Alternatives is one organization that pairs energy efficiency and solar through the California LIEE program. However, most of the community solar models do not pair these services, as the LIEE program is provided at the household level and the community solar program is disconnected from the low-income home.

Community solar programs have many advantages for low-income households.[86]

- Customers do not need to own their homes.
- The roof condition is not material.
- Customers can participate in smaller levels than what may be financially viable for an independent installation.
- Financing is more accessible.
- Subscriptions can be transferred.

The following challenges have been found.[87]

- Explicit policy is needed to ensure that these resources serve low-income customers at scale, such as targets for low-income participation.
- Support and incentives may be needed to achieve those targets.
- Low-credit customers may also need underwriting support.

Additionally, the following marketing and communication challenges have been faced.[88]

- Trust is a key barrier and many interactions are needed to become a trusted partner with the low-income household.
- There are cultural and language barriers.
- Email and phone calls are not always effective for low-income households.
- Households question the value of the solar garden when the subscription is given away for free, but this is necessary to get low-income participation.
- Environmental benefits do not always resonate with the low-income subscribers who must focus on their economic needs.
- The paperwork requirements can be burdensome.
- There is a long lag between completion of paperwork and benefit receipt.
- Organizations are wary of sharing lists of low-income households with solar developers.

[86] http://www.lowincomesolar.org/toolbox/community-shared-solar/
[87] http://www.lowincomesolar.org/toolbox/community-shared-solar/
[88] Analysis of the Fulfillment of the Low-Income Carve-Out for Community Solar Subscriber Organizations. November 2015. Prepared for the Colorado Energy Office by Lotus Engineering and sustainability LLC. https://www.colorado.gov/pacific/sites/default/files/atoms/files/Low-Income%20Community%20Solar%20Report-CEO.pdf

Demographic challenges are also faced.

- Low-income tenants often move every few years and the gardens may fall out of compliance with low-income requirements.
- In low-income, multi-family housing there is often one meter for the entire building and these households do not qualify.

At least 15 states and DC have some sort of community solar. Colorado is one of four states that have low-income carve-outs as part of their community solar requirements. (The other states are California, New York, and Oregon.)[89]

Colorado is a leader in Community Solar, with 53 projects generating approximately 30 MW.[90] The Community Solar Gardens Act requires that solar garden developers allocate at least five percent of each garden to low-income subscribers if there is such demand. The PUC ruled that the utilities must determine the low-income customer definition. Xcel Energy determined that customers who participated in Energy Outreach Colorado, The Atmosphere Conservancy, Colorado LEAP, or a Municipal Housing Authority would be eligible.[91]

While the law only applies to Xcel Energy and Black Hills Energy, there are other community solar gardens in CO that have low-income subscribers that were implemented by municipal utilities and cooperative utilities. Xcel Energy is the only investor-owned utility that had active community solar at the time of the report. They stated that 349 of their 1,010 subscribers qualified as low-income.[92]

The Colorado Energy Office launched the Low-Income Community Shared Solar Demonstration Project with GRID Alternatives in 2015 to provide affordable solar to low-income households. The portfolio will include five to 12 shared solar systems, and will provide solar power to at least 300 low-income subscribers. The project will be developed in partnership with Rural Electric Cooperative associations, municipal utility providers, or investor-owned utility providers.

The process for low-income participation is described as follows.

- The developer partners with a nonprofit organization or public housing authority.
- The nonprofit identifies participants.
- The developer and/or nonprofit market the project through email blasts, phone calls, mailers, community meetings, and/or door-to-door sales.

[89] https://www.nrel.gov/technical-assistance/lmi-solar.html
[90] https://www.colorado.gov/pacific/energyoffice/community-solar
[91] Analysis of the Fulfillment of the Low-Income Carve-Out for Community Solar Subscriber Organizations. November 2015. Prepared for the Colorado Energy Office by Lotus Engineering and sustainability LLC. https://www.colorado.gov/pacific/sites/default/files/atoms/files/Low-Income%20Community%20Solar%20Report-CEO.pdf
[92] Analysis of the Fulfillment of the Low-Income Carve-Out for Community Solar Subscriber Organizations. November 2015. Prepared for the Colorado Energy Office by Lotus Engineering and sustainability LLC. https://www.colorado.gov/pacific/sites/default/files/atoms/files/Low-Income%20Community%20Solar%20Report-CEO.pdf

- The developer, nonprofit, and subscriber complete the application. Many or all of the low-income subscribers do not qualify for financing so the developers must give away the panels for free to obtain the five percent low-income carve-out.
- The subscriber receives solar energy and utility incentives. The solar could cover from 40 to 100 percent of the subscriber's bill. Incentives may be in the form of a utility bill credit, a Renewable Energy Credit, or a lump sum payment.
- The developer manages the subscription.

Minnesota unveiled a new solar array in August 2017 that will power 100 low-income homes. The Rural Renewable Energy Alliance (RREAL) developed this first 100 percent low-income shared solar array in Minnesota, the first in the country to be integrated with LIHEAP, and the first in the country on tribal land.[93]

School-Based Energy Education Programs

School-Based Energy Education Programs are a common element in utility energy efficiency portfolios. These programs may target energy savings in the schools or in the homes of the students who attend the schools. They take many different forms, but some of the common programs include the following.

- Workshops and/or curriculum for teachers.
- Kits for students to take home and implement. These kits may include CFLs or LEDs, showerheads, and faucet aerators. The kits enable the utilities to claim energy savings from the program.
- Student assemblies.
- Student energy efficiency activities.
- Intensive energy education and conservation as part of the STEM curriculum.

One principle behind these efforts is that it is easier to educate children than to educate adults, and that children can learn energy efficiency lessons that they carry with them throughout their lifetimes. The programs can encourage behavior change in the students and their families, and the students can become advocates for energy efficiency.[94]

Illume's 2015 review found active school-based energy efficiency programs in 21 states. The programs provide education, encourage energy efficiency, attempt to reach other household members, and generate savings. While the programs are most often targeted to students in fifth and sixth grades, some extend from pre-kindergarten through 12th grade.[95]
These programs have the advantage that they can reach customers who otherwise would not or could not participate in energy efficiency, including lower-income households who cannot

[93] https://www.cleanenergyresourceteams.org/blog/leech-lake-community-solar-garden-first-mn-be-100-dedicated-to-low-income-residents?mc_cid=3a0c71593d&mc_eid=85a56f1b5bl

[94] Harrigan. Energy Efficiency Education as a Cost-Effective Resource Program. Behavior, Energy and Climate Change Conference. 2011. http://web.stanford.edu/group/peec/cgi-bin/docs/events/2011/becc/presentations/4%20-%207F%20Energy%20Education%20as%20a%20Cost-%20Merrilee%20Harrigan.pdf

[95] Dougherty and Hannigan, School-Based Energy Education Programs: Goals, Challenges, and Opportunities. October 2015.

afford energy efficiency measures, and customers who live in multi-family buildings and/or who rent their homes.

School-based programs in Colorado include the following.

- Black Hills Energy in Colorado offers a School-Based Energy Education Program to enhance student education and awareness of energy efficiency, educate students about energy efficiency benefits and opportunities, increase awareness of the utility's energy efficiency programs, and expand the school curricula to include information on energy efficiency. The program provides lesson plans, classroom posters, videos, supplemental activities, and energy savings kits. The program is targeted to middle and high school children, teachers, principals, and parents.[96]

- ReNew Our Schools partners with school districts and implements a month-long competition to create changes in how energy is used in schools, homes, and communities. The program received foundation support as well as support from the Colorado Energy Office. Students form environmental clubs that work with local energy professionals as mentors. Winning schools receive funding for energy efficiency improvements to their schools. Over 40,000 students have participated since 2007 and the program is ongoing.[97]

- The Denver Public Schools Energy Challenge was a collaboration between Denver Public Schools, Xcel Energy, the City and County of Denver, the Colorado Renewable Energy Society, and the Alliance for Climate Education in 2011-2012. The program aimed to promote energy efficiency and renewable energy in the high schools and empower students to take actions to reduce energy usage. The students designed and completed conservation actions to win points. Program support included workbooks and measurement devices, seed funding, colloquiums, and speakers.[98]

School-based programs in Illinois include the following.

- Com-Ed's 2018-2021 Energy Efficiency Plan included a Residential Elementary Energy Education Kits Program to target fifth grade students. The program includes an energy efficiency educational curriculum and take-home kits with low-cost measures that may include LEDs, a high-efficiency showerhead, and high-efficiency faucet aerators. The program aims to reduce residential energy usage for water heating and lighting. Com-Ed plans to offer this program jointly with Nicor Gas and Peoples Gas/ North Shore Gas. An implementation contractor will be responsible for school recruitment; curriculum development; kit assembly, distribution, and tracking; marketing, outreach, and public relations; and data tracking and reporting.

[96] Black Hills Energy Colorado 2016-2018 DSM Plan.
https://www.blackhillsenergy.com/sites/default/files/bhe-coe_attachment-med-1_bhcoe%202016-2018-dsm-plan.pdf
[97] https://conservationcenter.org/renew-our-schools/
[98] http://static.dpsk12.org/gems/sustainability/DECprogoverviewschools082311.pdf

Com-Ed's plan also included a one-year National Theatre for Children (NTC) Energy Education Kits Program. In this program, the NTC delivers kits to 6th through 8th grade students when requested by their parents. The program includes educational theater performances for all school students.[99]

In New Jersey, Sustainable Jersey had a School-Based Energy Conservation Initiative that was retired in January 2017. Under this program municipal teams could earn points for working with their schools. The communities were permitted to work with programs that are connected with the NJ Core Curriculum Content Standards. The programs educate students about the importance of energy conservation.

The FirstEnergy companies in Pennsylvania and Pennsylvania Power & Light (PPL) included school-based education in their Act 129 Phase III plans.

- FirstEnergy's School Education programs provide energy education to elementary school students and teachers. The programs provide handout materials, homework assignments, and presentations that educate students on energy efficiency measures. The programs also provide energy efficiency kits with low-cost measures including CFLs, LEDs, faucet aerators, and showerheads for the students to work on at home with their parents. As part of their low-income program, they target some of their School Education programs to schools with low-income students. They also provide this program for the general population.

- Pennsylvania Power and Light has a Student Energy Efficiency Education Program that provides energy efficiency kits and education to students and teachers. The program includes interactive classroom presentations in grades two to three, five to seven, and nine to 12. The presentations educate students about energy efficiency using hands-on activities. In their Phase II program they also aimed to drive students and their families to their Customer Engagement Hub for follow-up education activities including an online home energy audit.

Other school-based initiatives include the following.

- The Alliance to Save Energy introduced their PowerSave Schools Program in 1996 to teach students about energy efficiency, identify energy problems, develop solutions, and save energy in their schools, their homes, and their communities. They have implemented these programs in schools across the country.
- Con Edison developed a school-based energy education program in New York City and Westchester County in January 2017. The program targets fifth grade students and their families and aims to impact 300,000 households. The program was designed to meet New York's state education standards. Methods include education about activities the students can undertake at home and hands-on activities. Students receive a Smart Kids Energy Efficiency kit with three LED Lightbulbs, a high-efficiency three-way showerhead, a

[99] Commonweath Edicson Company's 2018-2021 Energy Efficiency and Demand Response Plan. June 2017.

kitchen faucet aerator, a bathroom faucet aerator, a digital thermometer, a student guide, and a workbook.[100]

Other energy education programs focus on training students and increasing the flow of new workers into the energy conservation field. The Massachusetts Clean Energy Council (MassCEC) and Commonwealth Corporation awarded six grants totaling one million dollars in 2009 to develop comprehensive workforce development programs for the clean energy industry. They developed training programs for high school and college students, at-risk youth and low-income populations, building and trade professionals, and clean energy employers. The following high school curriculums were developed.[101]

- Energy Efficiency Weatherization & Green Roofs
- Energy Efficiency Science Course
- ESL for Renewable Energy Technology
- Photovoltaic Training Curriculum
- Freshman HVAC Solar Thermal Curriculum
- Senior HVAC Solar Thermal Curriculum

The Energy Tech Early College and Career High School opened in 2013 in Long Island City, Queens and serves students in grades nine to 14. The school provides students with a high school diploma and an associate's degree, as well as career readiness experiences during the six-year program. They partner with Con Edison and National Grid for field visits, job shadowing, mentoring, and internships.[102]

New York provided grants for STEM-based training in high schools. Some of the grants are described below.[103]

- New York City Department of Education, Office of Post-Secondary Readiness: They received a grant for training approximately 480 students in grades nine through 12 in four New York City high schools. The funding included support for career development to establish connections to local clean-energy employers, school sustainability projects aiming to create energy awareness and behavior change in school and at home, and incorporation of energy curricula into the school's programming.
- Ballston Spa Central School District Capital Region: The school district received funding to train 110 students through the existing Clean Technologies and Sustainable Industries Program. Juniors and seniors earn college credit. The grant also funded participation of 60 students in grades nine and ten in STEM-related fields.

[100] Resource Action Programs Wins Con Edison Smart Kids Energy Efficiency Program. March 2017. https://www.resourceaction.com/assets/con-edison-smart-kids-energy-efficiency-program.pdf
[101] http://www.masscec.com/clean-energy-workforce-training-capacity-building-curricula
[102] http://www.energytechschool.org/
[103]https://www.governor.ny.gov/news/governor-cuomo-announces-funding-high-school-clean-energy-training-programs

- Buffalo City School District: The District received funding to train 126 high school students in Green Technology and HVAC. The funding also provided for training of middle school students on clean-energy education and career opportunities and training for teachers in energy efficiency, renewable energy, and advanced technology.

Most of these programs do not have evaluations available, and those that do claim energy savings estimate these savings through engineering estimates. Therefore, it is difficult to determine the success of these programs in achieving energy savings. If these programs do spur households to undertake energy efficiency or participate in LIEE programs as a result of the increased knowledge, they may provide an effective addition to a portfolio of LIEE offerings. And they may provide additional benefits including occupational training. Additional research is needed in this area.

B. Program Funding

In addition to ratepayer and WAP funding, funding for LIEE may be provided through LIHEAP; rate case and merger settlements; and other models that combine donations, volunteer labor, and other leveraged grants. Additional funding may include Cap and Trade revenue and investments in climate resilience.

Ratepayer and WAP Funding

Most LIEE funding is provider through IOU ratepayers and WAP.

- Ratepayer Funding: Many electric and natural gas utilities have ratepayer-funded LIEE programs that invest in no-cost services to reduce energy usage and increase energy affordability. According to CEE, the amount of ratepayer funds spent on electric LIEE in 2015 was $353 million, and the amount spent on natural gas LIEE was $340 million.[104]

- DOE WAP: This program provides funding to all states, the District of Columbia, three tribes, and five U.S. territories to improve the energy-efficiency of low-income homes. Congress provides annual DOE appropriations for WAP.

Table VIII-1A displays 2015 ratepayer and WAP LIEE funding in the four target states.

Table VIII-1A
Ratepayer and WAP Low-Income Energy Efficiency Expenditures in 2015

State	Electric Utility	Gas Utility	DOE WAP	Total
CO	$3,538,787	$4,380,461	$4,590,704	$12,509,952
IL	$13,100,000	$5,200,000	$3,462,275	$21,762,275
NJ	$11,302,113	$18,697,887	$4,308,921	$34,308,921

[104] 2016 State of the Efficiency Program Industry. Budgets, Expenditures, and Impacts. Consortium for Energy Efficiency. March 2017.

State	Electric Utility	Gas Utility	DOE WAP	Total
PA	$62,952,299	$19,652,964	$12,320,702	$94,925,965

LIHEAP Funding

The U.S. Department of Health and Human Services, Administration for Children and Families, Office of Community Services administers the Low-Income Home Energy Assistance Program (LIHEAP). LIHEAP is a federal block grant program that assists low-income households with home energy bills, energy crises, and weatherization and energy-related home repairs. Because LIHEAP is a block grant program, each state establishes its own policies and procedures, within the requirements of the LIHEAP Statute.[105]

States must cap LIHEAP income-eligibility at no more than the greater of 150 percent of the Federal Poverty Guidelines (FPG) or 60 percent of the State Median Income, and no less than 100 percent of the FPG.

The U.S. Department of Health and Human Services provides broad flexibility for states to use LIHEAP funds for energy efficiency services. There are four key ways that the funds can be used. They must give higher benefits to households with higher energy burden and target benefits to households with elderly members, disabled members, and/or households with young children.

1. Crisis Programs: Energy Crisis programs pay for replacement of unsafe heating and cooling equipment. That usually has a big impact on energy usage because unsafe equipment usually is operating very inefficiently. In some cases these programs are delivered in conjunction with WAP or by WAP agencies, and in some cases they are delivered by Emergency Assistance Program (EAP) agencies. One effective model is for LIHEAP/WAP to collaborate with the ratepayer-funded program to jointly deliver the highest-efficiency equipment.

   In FY 2014, 27 states had emergency furnace or air conditioner repair/replacement programs

2. Assurance 16 Programs: These programs can pay for identifying high-usage households, conducting needs assessments, offering energy education, and advocating on behalf of the client for energy efficiency services (WAP or ratepayer-funded). States can use up to five percent of LIHEAP funds to "provide services that encourage and enable households to reduce their home energy needs and thereby the need for energy assistance, including needs assessments, counseling, and assistance with energy vendors…"

   In FY 2014, 24 states had Assurance 16 programs. IL was the only target state to implement this program. Illinois used these funds for client education and counseling; and for outreach and coordination with other related programs targeted to the elderly and

[105] https://www.acf.hhs.gov/ocs/programs/liheap

persons with disabilities. All LIHEAP applicants received energy conservation education and clients received energy conservation pamphlets or watched an energy conservation video in intake waiting areas. This program has not been comprehensively evaluated.

One best practice that has been implemented through Assurance 16 is providing agencies with the resources to learn about ratepayer-funded LIEE so that they can more effectively target and refer high-burden, high-usage clients to these programs. Minnesota allocates up to 75 percent of its Assurance 16 funding for such activities. Connecticut has also used Assurance 16 funding for these purposes.

Another potential use of Assurance 16 is to provide funding for agency staff to work with utility LIEE staff to help shape the utility ratepayer-funded LIEE programs to better serve their clients.

3. Transfer of Funds to WAP: Transfer of funds for weatherization can be used to increase the number of low-income housing units served or to enhance the WAP services delivered to clients. States can transfer up to 15 percent of LIHEAP funds to WAP, and up to 25 percent if they receive a waiver. States can determine whether to use the transferred funds to deviate from WAP rules in ways that meet the needs of their clients. For example, they can use the LIHEAP funding to exceed the WAP health and safety limit and/or to exceed the average spending limit.

   In FY 2014, 42 states used LIHEAP funds for weatherization. The percent of funds allocated to WAP in FY 2014 were the following.

   - 9 states provided no LIHEAP funding to WAP.
   - 23 states provided funding, but less than 15 percent of LIHEAP funding to WAP.
   - 3 states provided 15 percent of LIHEAP funding to WAP.
   - 16 states provided more than 15 percent of LIHEAP funding to WAP.

   Table VIII-1B displays how the four target states use LIHEAP funding for LIEE. The four target states each transferred significantly less than 15 percent of LIHEAP to WAP. Percentages ranged from 6.5 percent to 9.4 percent.

Table VIII-1B
Target States Use of LIHEAP Funds

	Colorado	Illinois	New Jersey	Pennsylvania
2016 LIHEAP Funding	$49,002,284	$166,270,241	$127,094,199	$203,405,185
2014 Program				
Equipment Program	Yes	Yes	Yes	Yes
Assurance 16 Program	No	Yes	No	No
WAP Transfer	Yes	Yes	Yes	Yes

	Colorado	Illinois	New Jersey	Pennsylvania
WAP % Transferred	9.38%	6.53%	6.90%	6.86%
WAP $ Transferred	$4,037,408	$9,400,000	$8,000,000	$12,797,500

4. Heating Assistance: Because LIHEAP is a Block Grant program, states have the flexibility to use LIHEAP Heating Assistance funding to pay for energy efficiency. This is an opportunity for additional LIEE funding, as the approach has not been used, and there is no limit on the amount of LIHEAP funding that can be used for this purpose.

Rate Case and Merger Settlements

Utilities' rates of return and revenue requirements are determined by the Public Utility Commission during a rate case. Low-income advocacy groups are often permitted to intervene and become parties to the case, provide testimony, and offer comments on proposed changes. Therefore, rate cases are an opportunity for low-income advocates to obtain additional funding for low-income programs including LIEE programs. Merger settlements are an additional opportunity for advocates to intervene, obtain LIEE funding, and be involved in how those funds are deployed.

- In Colorado, Xcel Energy's 2016 rate settlement agreement included provisions for low-income solar programs. The low-income rooftop solar program will be administered by the CEO in partnership with Xcel Energy. Customers will receive both solar and weatherization measures. DOE WAP funds will contribute to the cost of solar installation. The program will scale up over three years to install up to 300 systems in total.

  Additionally, the settlement included a provision to improve low-income customer access to Community Solar Gardens (CSG). While previous rules required five percent low-income subscription to the CSGs, the method had not worked efficiently. Therefore, the settlement provided for Xcel Energy ownership of dedicated low-income CSGs to achieve the five percent requirement. Xcel Energy will also solicit up to 4 MW of CSGs annually that commit to provide all of their output to qualified low-income customers.

  The settlement also provides for a Low-Income Standard Offer where .5 MW is set aside annually. Participants will receive the average annual awarded REC for the low-income CSG plus $0.01/kWh. [106]

- In Pennsylvania, as part of a settlement, PECO increased its Low-Income Usage Reduction Program by $700,000 per year for three years to provide additional energy efficiency measures for De Facto gas or bulk fuel heating customers who use electricity for heat because their primary heating source is inoperable or unaffordable. They also will provide an additional $1 million per year for three years to provide energy efficiency

[106] Non-Unanimous Comprehensive Settlement Agreement. Colorado PUC E-Filings System. August 2016.

services to reduce the energy burden of Customer Assistance Program participants whose energy burden exceeds the PUC's energy burden targets.[107]

- In Pennsylvania, as part of its 2013 rate case agreement, Duquesne Light increased the Low-Income Usage Reduction Program enrollment for 2014 through 2016 from 2,555 customers per year to 3,100 customers per year.

- Arizona Public Service filed a rate case with the Arizona Corporation Commission in June 2016. Under the agreement, APS will invest $10 to $15 million annually in a program for utility-owned rooftop solar on customers' homes to benefit low- and moderate-income residents.[108]

- A proposed September 2017 settlement in the Puget Sound Energy (PSE) rate case (still to be approved by the Washington Utilities and Transportation Commission) would provide a $2 million investment in weatherization for low-income customers.

Merger settlements are another opportunity for advocates to obtain funding for energy efficiency and for LIEE programs.[109]

- The 2016 Merger Agreement between Exelon corporations and Pepco created additional funding for energy efficiency and funding directed to low-income households in Delaware, Maryland, New Jersey, and Washington D.C.

- The 2012 Merger between Exelon and the Constellation Energy Group resulted in $113.5 million in funding for energy efficiency with specific assistance for low-income customers.

- The 2012 merger between Central Vermont Public Service Corporation and Green Mountain Power resulted in a $21 million investment in energy efficiency.

- The 2016 merger between Duke Energy and Piedmont Natural Gas resulted in $7.5 million in funding for LIEE and job training programs in the year following the acquisition.[110]

GRID Alternatives' Model

GRID Alternatives developed a model to provide solar PV technology to low-income communities. They began working with the California Public Utilities Commission to manage the statewide Single-Family Affordable Solar Homes (SASH) program in 2008. They also install solar as part of the Low-Income Weatherization Program. They currently serve California, Colorado, New York, New Jersey, Connecticut, Washington D.C., Virginia, Maryland, and Delaware.

[107] PECO Energy Company Universal Service and energy Conservation Plan for 2016-2018. Pennsylvania Public Utility Commission Final Order. August 2016.
[108] https://solarindustrymag.com/solar-advocates-aps-reach-major-settlement-agreement-arizona
[109] http://www.neep.org/blog/utility-mergers-where-does-energy-efficiency-fit
[110] http://www.charlotteobserver.com/news/business/article83057132.html

GRID Alternatives is able to provide no-cost or very-low-cost solar to low-income households on a large scale because they have funding from low-income programs such as SASH or WAP, they work with volunteers and job trainees, they receive equipment donations from solar manufacturers, and they identify other available grants to help households cover the remaining installation costs. Recipients are required to participate in energy efficiency training provided by GRID Alternatives' staff and enroll in California's ratepayer funded LIEE program called the Energy Savings Assistance Program (ESAP).

In addition to providing no-cost to very-low-cost solar to low-income families, GRID Alternatives provide installation experience for job seekers and community volunteers. They partner with over 100 job training organizations and community colleges to provide solar job training. Their training is focused on underserved communities and provides hands-on training, skill certificates, experience towards the PV Installer Exam, and access to potential employment opportunities.

C. Financing

Most low-income households will require no-cost energy efficiency programs to participate given their limited resources. However, where such programming is not available or does not provide complete energy efficiency services, there may be financing available that will be utilized by a small subgroup of low-income households who understand the benefits and opportunities for energy efficiency.

Many different types of financing are available, but education and outreach are needed to inform households that these funds are available and encourage and assist them in undertaking these investments. Additionally, it is important to ensure that sufficient safeguards in place. Safeguards for low- and moderate-income households should include the following.

- Positive Cash Flow: Projected monthly energy savings should exceed the monthly loan repayment, energy savings should be forecasted conservatively, quality control should ensure that the work is implemented properly, and customers should participate in utility budget billing to equalize their monthly bills.

- Guaranteed Savings: When the providers offer guaranteed savings, the households can ensure that their monthly utility payments will not increase, as long as the investment level is properly restricted.

- Assistance: Reduced energy efficiency costs or low- or no-cost financing can increase the likelihood of a positive cash flow.

- Customer Protection: Customer payments should be credited to their monthly energy usage charges first, and they should not be disconnected for failure to pay the monthly loan installment.

On-Bill Lending

Energy efficiency improvements can be financed on the utility bill and this can overcome the barrier of the high initial cost of the work.

Legislation in at least 12 states provide requirements for On-Bill Lending. These requirements include waivers on utilities' ability to lend, requirements for utilities to provide these programs, and measures that are eligible for the programs.[111]

ACEEE classifies On-Bill programs into three main types.[112]

1. On-Bill Financing (OBF): The utility provides the capital for the improvements usually through ratepayer funds. Shareholder funds may also be used. Utilities can provide these programs in-house.

2. On-Bill Repayment (OBR): A third party provides the capital for the project and the utility facilitates the repayment on the bill. Funding is usually provided by banks, community development financing institutions, or private investors. Therefore, a higher level of funding may be available than when the utility must have ratepayer funding allocated to financing. Utilities may improve the value of these programs by providing interest rate buy downs or loan loss reserves.

3. Tariffed On-Bill (TOB): The utility provides an additional tariff where the charge is attached to the meter where the upgrades are installed. We describe this method in the following section described as Pay as You Save (PAYS).

Under On-Bill Financing and On-Bill Repayment, the loan typically must be paid off when the customer sells the home, as it is not transferrable to the new home owner.

There are several advantages to On-Bill programs.

- Upfront Cost: The upfront cost of energy efficiency upgrades is reduced, increasing the potential for measure uptake.

- Health and Safety Improvements: Programs may allow for health and safety improvements to be undertaken as part of the package.

- Creditworthiness: The utility may use the history of utility bill payment rather than a credit score, and this may open up to the program to lower-income households who may not qualify if a credit score is used. This type of "alternative underwriting" has been shown to result in lower financing rejection rates but similar default rates. However, the utility

[111] Deason, Leventis, Goldman, and Carvallo. Energy Efficiency Program Financing. Where it comes from, where it goes, and how it gets there. Lawrence Berkeley National Laboratory. June 2016.
[112] http://aceee.org/sector/state-policy/toolkit/on-bill-financing

may need to provide credit enhancement, such as a loan loss reserve or guarantee to obtain private capital.[113]

- Rebates: The On-Bill programs may be combined with rebates, further increasing the affordability of repayment and reducing the customer's transaction costs.

- Repayment: On-Bill programs tend to have low default rates, as customers often place a priority on utility bill payment, or may be concerned about disconnection if they do not repay the loan. With lower default rates, more attractive financing can be offered, and loans may be available to a broader pool of customers. However, there is a concern that the low default rates may relate to the fact that many of the participants are new, and that default rates will rise as participants extend into the later part of their loan terms.[114]

- Bill Neutrality or Bill Reduction: The programs may require that the loan repayment is lower than the energy efficiency savings. Customers may see immediate savings if the savings exceed the loan repayment amount.

- Market Transformation: These programs may demonstrate the potential for energy efficiency lending from more traditional financial institutions.[115]

However, there are concerns about the following issues.

- Realized Bill Neutrality: Expected bill neutrality may not come to fruition if projections of energy savings are not achieved. Even when the program achieves the average projected level of savings, savings will vary for any individual household.

- Disconnection: The household may be disconnected for nonpayment if they do not pay the portion of the bill that relates to energy efficiency improvements. Most of the programs that SEE Action reviewed did provide for disconnection if the On-Bill amount was not paid.

- Electric and Gas: There can be challenges in determining how to structure the loan arrangement when different utilities provide gas and electric service and savings accrue to both fuels.

- Transfer: If the household moves prior to realizing the energy savings, they will have to pay off the portion of the loan that they have not realized. However, they may be able to benefit in terms of the value of the home.

[113] Financing Energy Improvements on Utility Bills: Market Updates and Key Program Design considerations for Policymakers and Administrators. State and Local Energy Efficiency Action Network. Financing Solutions Working Group. May 2014.
[114] Kramer. Disconnection and On-Bill Repayment. An Analysis of Risks and Benefits. Connecticut Energy Efficiency Board. May 2014.
[115] Henderson. On-Bill Financing. Overview and Key Considerations for Program Design. NRDC Issue Brief. July 2013.

- Renters: These customers are not typically eligible for the programs.

- Administration: Utilities may need to make expensive adjustments to their billing systems and credit systems to accommodate On-Bill programs.

On-Bill Programs appear to be a potential solution for low- and moderate-income households due to the lower up-front cost, reduced credit requirements, potential for bill neutrality, and ability for other utility incentives or risk reduction to further improve terms. However, there has been little or no research on participation by low-income households in this financing structure. The research on program implementation and experience to date has largely addressed the residential market or commercial and industrial market as a whole, or the overall performance of a particular program without disaggregation by income or other vulnerable household characteristics.

SEE Action conducted a survey of On-Bill programs in 2014. They found that at least 25 states had On-Bill programs that were operating or preparing for implementation. Table VIII-2 provides a summary of the 27 programs with data out of the 30 programs that were reviewed. Single family home loans ranged from $525 to $16,810 and residential financing averaged $5,787. Some of the programs included in SEE's review were On-Bill Tariffs that are described in more detail in the next section.[116]

Two-thirds of the reviewed programs were OBF, where the utility shareholder, ratepayer, or public funds are used to provide capital. More recently, there has been a shift toward OBR, where outside capital is used.

Table VIII-2
On-Bill Programs Existing in 2014

Sector	# Programs	Total Participants	Loan Volume	Average Amount	Default Rate Range[117]
Residential	20	182,324	$1,050 million	$5,787	0% to 3%
Non-Residential	7	50,339	$775 million	$15,400	0.6% to 2.9%

Table VIII-3 displays a summary of the On-Bill Programs in the target states. There has been no action in Pennsylvania.[118]

[116] Financing Energy Improvements on Utility Bills: Market Updates and Key Program Design considerations for Policymakers and Administrators. State and Local Energy Efficiency Action Network. Financing Solutions Working Group. May 2014.
[117] Based on 16 residential programs and seven nonresidential programs.
[118] http://www.ncsl.org/research/energy/on-bill-financing-cost-free-energy-efficiency-improvements.aspx#chart

Table VIII-3
On-Bill Programs in Target States

	Colorado			Illinois	New Jersey	
Program	Fort Collins Home Energy Loan Program	EnergySmart Boulder County	Denver Energy Challenge	Illinois Energy Efficiency Loan Program	New Jersey Natural Gas SAVEGREEN Project	PSE&G
Status	Implemented or In Development			Legislation Enacted	Implemented	
Bill(s)	NA			Senate Bill 1918(2009); Senate Bill 2350(2013)	NA	
Jurisdiction	Residential energy efficiency, solar photovoltaic, and water conservation. Only owners can apply.	Residents and Businesses	Residents and Businesses	Residential; multi-family residential; commercial (depending on utility)	Residential, C&I	Multi-family Residential
Loan Size	$500-$25,000 Up to 100% of cost			$500 to $20,000	Up to $15,000	
Interest Rate	2.75%			4.99%	0% or 4.99%	0%
Term	15 years			3, 5, or 10 years	7 or 10 years	3 years
Administering Entity	Elevations Credit Union			AFC First Financial	NJNG	National Housing Trust
Funding	Elevations Credit Union	Boulder County	Denver County	National Penn Bank; utility ratepayer funds	Shareholders	PSE&G
Details	Participants must follow the Efficiency Works' Home Efficiency Program.			The 2009 legislation requires utilities to provide residential on-bill financing if they server more than 100,000 customers. The 2013 legislation expands On-Bill to multi-family and master-metered buildings. Programs vary by utility. Traditional underwriting methods are used.	Different specifications for C&I On-Bill	

Pay as You Save

Under the Pay as You Save (PAYS) model, energy efficiency measure costs are paid back through a utility tariff assigned to the location of the meter where the measure was installed. The model provides billing and payment through a charge on the distribution utility bill. The charges remain with the meter until they are paid off.

The benefits of this model are as follows.

- There is independent certification of the installation and that the estimated savings will exceed payments.
- Customers are not responsible for costs if the measure fails.
- The payment responsibility stays with the meter, so the customers do not pay for the costs of the energy savings after they move.
- Tenants have an incentive to implement this type of investment because they are not responsible for the cost after they move. (If the customer is a landlord, both the customer and the landlord must sign a purchase agreement.)

The disadvantages of this model are as follows.

- The customer is at risk for termination of utility service if they do not pay this charge.
- When electric and non-electric measures are combined on the electric bill, the electric bill may increase. This may create some dissatisfaction among participants. However, the total utility bills will be lower.
- The question as to whether or how LIHEAP benefits can be applied to the monthly payment has not been answered.
- If the customer sells the home, the new occupant may not value the energy efficiency at the same rate, due to different usage characteristics or understanding of energy efficiency.
- The landlord will face greater risk and more expenses if they cannot replace a tenant who moves with a new tenant.
- Regulator approval is required (for investor-owned utilities), so this mechanism can only be used for a state-mandated efficiency program.[119]

For the most part, this model has been implemented by small rural cooperatives. The Roanoke Electric Cooperative reported that they have been implementing about 200 home efficiency projects each year using the PAYS approach. Their "Upgrade to $ave" program is funded through the U.S. Department of Agriculture's Rural Utility Service. They worked with the Energy Efficiency Institute who had a proprietary system they could use.

The Ouachita Electric Cooperative, serving a high-poverty area in southern Arkansas, began using PAYS in early 2016, and had about 200 participants in the first six months. Participation in energy efficiency improved as compared to the previous loan model they used. Additionally, one third of the participants were renters. They use smart meters to track savings and have reported savings of two to three kW per home off peak demand and bill

[119]The Pay-As-You-Save™ (PAYS®) System. Presentation to Electricity & Consumer Affairs Committees. Denver, CO. July 2003.

reductions of 40 to 50 percent.[120] However, these savings reports have not been independently verified.

Pilot PAYS programs have been implemented by Public Service of New Hampshire (PSNH) with municipal customers and by the New Hampshire Electric Coop (NHEC). In both of these cases, the utilities advance the funding, certify measures, and oversee installations.

- Both programs are permitted to use up to ten percent of the System Benefit Charge (SBC) funding.
- PSNH developed a revolving loan fund with their SBC funds.
- NHEC uses their SBC funds as a guarantee fund to leverage capital. They can then borrow ten times the SBC amount set aside for PAYS. Guaranteeing the repayment stream will lower the cost of capital and more projects will calculate as cost-effective.
- The NHEC pilot allows participants to choose between subsidies that range from 30 to 85 percent and PAYS financing, so few participants will choose PAYS.[121]

Property Assessed Clean Energy

Property Assessed Clean Energy (PACE) is a method of funding energy efficiency and renewable energy projects with low-cost, long-term financing. PACE provides payback of energy efficiency investments through an assessment on the property owner's tax bill. PACE financing can be provided directly by private third party lenders or revenues from municipal bond sales.

Legislation is typically required to enact PACE, and municipalities must develop an assessment district for this purpose. The legislation develops procedures for establishing special assessment districts, authorizes local governments to issue and sell bonds or to finance projects with private capital, and sometimes outlines program characteristics including property eligibility, loan and underwriting terms, and measure eligibility.[122]

PACE-enabling legislation has been passed by 33 states and the District of Columbia, 19 of which have active programs (i.e., launched and operating).[123] PACE programs have been implemented for residential property owners (referred to as Residential PACE, or R-PACE) and commercial property owners (referred to as Commercial PACE, or C-PACE). Commercial properties include multi-family (generally, 5+ unit) residential buildings and buildings housing non-profit organizations. These types of commercial properties are relevant to the low-income sector since low-income households may reside in multi-family residential

[120]Walton. Pay as You Save: Co-ops are reaching new customers with a novel way to pay for efficiency. UtilityDIVE. August 2016. http://www.utilitydive.com/news/pay-as-you-save-co-ops-are-reaching-new-customers-with-a-novel-way-to-pay/424234/

[121]The Pay-As-You-Save™ (PAYS®) System. Presentation to Electricity & Consumer Affairs Committees. Denver, CO. July 2003.

[122]Deason, Leventis, Goldman, and Carvallo. Energy Efficiency Program Financing. Where it comes from, where it goes, and how it gets there. Lawrence Berkeley National Laboratory. June 2016.

[123] PACE Nation (2017). *PACE Programs*. http://pacenation.us/pace-programs/

buildings and non-profit organizations such as foodbanks may directly serve the needs of low-income households.

In PACE-enabled states, local jurisdictions generally decide whether to allow R-PACE and/or C-PACE, however, the enabling legislation of some states explicitly prohibits R-PACE (e.g., Illinois).

Currently, only three states, California, Florida, and Missouri, have R-PACE programs. The slow development of R-PACE programs compared to C-PACE programs is due in part to regulatory issues and guidance letters by the Federal Housing Finance Agency regarding the first-lien status of home loans that are secured by Fannie Mae or Freddie Mac, which has led many R-PACE programs to suspend development or operations.[124] Despite the slow implementation of R-PACE programs available to homeowners nationwide, since 2009, the cumulative financing provided by R-PACE programs ($3.67 billion to 158,000 homeowners) has been much greater than C-PACE programs ($482 million to 1,097 projects).[125]

Regardless of model, the following are common attributes for PACE programs.[126]

- PACE is voluntary for all parties involved.
- PACE can cover 100% of project costs (both hard and soft costs).
- Long-term financing (up to 30 years) can be provided.
- Projects receiving PACE financing can also receive other incentives from utility, state, and federal programs.
- The debt is tied to the property, not the owner. PACE assessments are filed with the local government as a lien on the property.

Advantages of PACE financing include the following.[127]

- The tax assessment offers security, which can lead to lower interest rates for the property owner. (While this is a claim made by proponents of PACE, it has not been verified to have that impact.)

- Repayment is spread over many years and matched to the expected lifetime of the clean energy upgrades.

[124] Federal Housing Finance Agency (FHFA) (2014). *Statement of the Federal Housing Finance Agency on Certain Super-Priority Liens.* https://www.fhfa.gov/Media/PublicAffairs/Pages/Statement-of-the-Federal-Housing-Finance-Agency-on-Certain-Super-Priority-Liens.aspx; and U.S. Department of Energy (DOE) (2017). *Property Assess Clean Energy Programs*. https://energy.gov/eere/slsc/property-assessed-clean-energy-programs
[125] PACE Nation (2017). *PACE Market Data.* http://pacenation.us/pace-market-data
[126] PACE Nation (2016). *PACE Basics.* http://pacenation.us/wp-content/uploads/2016/10/PACEBasics_2016_10_7.pdf
[127] American Council for an Energy-Efficient Economy (ACEEE) (2017). *What the Wall Street Journal Got Wrong about PACE*. http://aceee.org/blog/2017/03/what-wall-street-journal-got-wrong; U.S. Department of Energy (DOE) (2017). *Updated Guidelines for Residential PACE Financing Programs* https://energy.gov/eere/slsc/downloads/updated-guidelines-residential-pace-financing-programs; and PACE Nation (2016). *PACE Basics.* http://pacenation.us/wp-content/uploads/2016/10/PACEBasics_2016_10_7.pdf.

- Secure financing over a longer term allows for comprehensive, deep retrofits and upgrades.

- Debt is tied to the property, not the owner, allowing the PACE loan to be transferred if the property is sold.

- Annual energy savings driven by the project should exceed the annual assessment payment, allowing for positive cash flows and freeing up capital to be used for other purposes by the property owner.

- For municipalities, PACE offers a way to encourage clean energy upgrades without risking general funds.

- For owners of multi-family residential buildings, the costs of PACE loans can be passed forward to tenants (within limits of rent control regulations of a jurisdiction).

Disadvantages of PACE financing include the following.[128]

- PACE programs are only available to property owners. Renters can benefit from improvements made through PACE financing, if landlords participate, but renters do not participate directly in PACE programs.

- Acceptance appears to be limited. Implementation has generally been seen on properties with simple financing and few subsidy restrictions. PACE has not yet been approved on HUD-mortgaged properties.

- Some energy efficiency measures are ineligible, i.e. portable items that are not attached to the property, such as refrigerators.

- For energy efficiency measures, there is no guarantee that annual energy savings will exceed the costs of the improvements, and there is little oversight of projected savings calculations. While programs encourage energy efficiency improvements with an expected savings-to-investment ratio (SIR) of 1.0 or greater, property owners can often proceed with improvements with a SIR of less than 1.0. Some eligible measures, such as windows, might result in energy savings, but not cost-effective energy savings.

- There can be high program administration costs, such as legal and administrative setup and local government staff requirements.

[128]U.S. Department of Energy (DOE) (2017). *Updated Guidelines for Residential PACE Financing Programs* https://energy.gov/eere/slsc/downloads/updated-guidelines-residential-pace-financing-programs; and Wall Street Journal (WSJ) (2017). *America's Fastest-Growing Loans Has Echoes of Subprime Crisis*. https://www.wsj.com/articles/americas-fastest-growing-loan-category-has-eerie-echoes-of-subprime-crisis-1484060984?mg=id-wsj.

- Defaulting on PACE loans can lead to foreclosure on the property.

- There has been resistance by lenders and mortgage-holders. As PACE assessments are part of property taxes, PACE loans have raised concerns because property taxes are paid before mortgages in the event of foreclosure. To address these concerns, the PACE industry has voluntarily agreed to subordinate PACE assessments to primary mortgage loans so that mortgages are paid first in a foreclosure.

- PACE loans are not mortgages and not subject to the lending requirements of that industry. Because PACE loans are based on the value of the property, credit scores are not a major concern for lenders. However, the ability of homeowners to afford PACE loans, on top of other obligations, can be overlooked.

- PACE financing is often pitched and arranged by contractors, with little oversight. Contractors may receive referral fees from PACE lenders, a potential conflict for the consumer's best interest.

PACE financing can provide an opportunity for lower-income households to make energy efficiency improvements. However, PACE assessments create an additional financial burden on the property, and certain advantages and disadvantages of PACE financing are magnified when viewed through the lens of LIEE.

- PACE loans can address barriers to entry for low-income homeowners by making low-cost capital available, and PACE loans can be used to augment funding received from utility, state, and federal programs for energy efficiency. However, PACE loans are not available to low-income renters, who represent a sizeable portion of the low-income population. In addition, multi-family building owners may participate in C-PACE programs and pass the costs on to low-income renters. In some cases, this may make the housing burden unaffordable to low-income renters. However, if renters directly pay their energy bills, the improved energy efficiency should offset some of the increase in rent.

- If a PACE-financed improvement was projected to be cash flow positive and annual energy savings are not realized, the PACE assessment will place more burden on the homeowner than anticipated. This is a greater concern for low-income homeowners.

- PACE programs that do not emphasize owner income or credit worthiness may place a new assessment on a property which the owner cannot afford. This is also a greater concern for low-income homeowners.

- PACE loans generally are not recommended for small investments ($2,500 or less).[129] This may limit opportunities for LIEE if low-income homeowners have small investments that they are willing to make.

[129]U.S. Department of Energy (DOE) (2017). *Property Assess Clean Energy Programs*. https://energy.gov/eere/slsc/property-assessed-clean-energy-programs.

For the target states of Colorado, Illinois, New Jersey, and Pennsylvania, Table VIII-4 provides information on whether PACE programs are allowed and implemented.

Table VIII-4
PACE Programs in Target States[130]

State	Allowed		Implemented	
	R-PACE	C-PACE	R-PACE	C-PACE
Colorado	Yes	Yes	No	Yes
Illinois	No	Yes	No	No
New Jersey	Yes	Yes	No	Yes
Pennsylvania	No	No	No	No

Colorado passed PACE-enabling legislation in 2010, and a series of amendments in 2013 and 2014. The enabling legislation defines "Eligible Real Property" as residential or commercial buildings, and therefore allows for both R-PACE and C-PACE programs. However, Colorado has only implemented a PACE program in the commercial sector. The enabling legislation also establishes the Colorado New Energy Improvement District (NEID) to oversee the development of and implementation of PACE programs in the state. The NEID is governed by board members representing the Colorado Energy Office, real estate development industry, banking, energy efficiency and renewable energy industries, and public utilities.

Illinois passed PACE-enabling legislation in 2017. The enabling legislation allows for PACE programs targeted to the commercial sector, defined as privately-owned commercial, industrial, non-residential agricultural, or multi-family (5+ unit) residential buildings, but does not allow PACE programs targeted to the residential sector.

New Jersey passed PACE-enabling legislation in 2012, and amending legislation in 2015, but the legislation but was conditionally vetoed by the governor. The enabling legislation does not differentiate between commercial and residential properties, allowing for both R-PACE and C-PACE programs. However, New Jersey has only implemented PACE programs in the commercial sector.

No PACE-enabling legislation has been passed by Pennsylvania.

For the target states that have implemented PACE programs (Colorado and New Jersey), Table VIII-5 provides the status of those programs, whether the programs have funded projects, launched but have not funded projects yet, or are still being developed.

[130] PACE Nation (2017). *PACE Programs*. http://pacenation.us/pace-programs/

Table VIII-5
C-PACE Program Status in Target States[131]

State	Program Status		
	Funded	Launched	In-Development
Colorado	CO C-PACE	None	None
New Jersey	None	Alliance NRG	NJ PACE

The CO C-PACE has been implemented and projects have been funded. CO C-PACE is a statewide program, but each county must opt in to participate. Once a county opts into the CO C-PACE program, commercial property owners in the county may participate in the program. CO C-PACE targets property owners in the commercial sector, including multi-family (5+ unit) building owners and nonprofit organizations, with PACE financing for qualifying energy efficiency, renewable energy, water conservation, and other energy improvements on existing and newly constructed properties. Capital is provided by third party lenders. Building owners can request that the Program Administrator facilitate financing terms from participating Qualified Capital Providers (QCPs), local and national banks and financers approved by the NEID to provide C-PACE financing. Alternatively, building owners can use their own lenders to provide financing for projects.[132]

New Jersey has implemented two C-PACE programs, but neither has funded projects yet. One program has been launched (Alliance NRG) and one program is in development (NJ PACE). Both programs target the commercial sector. The Alliance NRG program has been approved in select counties. The program targets the commercial sector, including multi-family (5+ unit) building owners, for projects that range from $100,000 to $50 million.[133]

Table VIII-6 provides information on the CO and NJ PACE programs.

[131] PACE Nation (2017). *PACE Programs*. http://pacenation.us/pace-programs/
[132] PACE Nation (2017). *PACE Programs*. http://pacenation.us/pace-programs/; Colorado Commercial Property Assessed Clean Energy (CO C-PACE) (2017). https://copace.com/; and CO C-PACE (2017). *C-PACE Program Guide, Colorado New Energy Improvement District (NEID), Version 3*. https://copace.com/wp-content/uploads/CO_C-PACE_Program_Guide.pdf.
[133] PACE Nation (2017). *PACE Programs*. http://pacenation.us/pace-programs/; and Alliance NRG (2017). https://www.alliancenrg.com/retail/

Table VIII-6
C-PACE Programs in CO and NJ[134]

Program	Colorado (CO C-PACE)	New Jersey (Alliance NRG)
Program Status	Projects Funded	Program Launched
Target Market	Commercial	Commercial*
Coverage Area	Approved in Adams, Arapahoe, Boulder, Broomfield, Delta, Denver, Eagle, Fremont, Garfield, Jefferson, Lake, Montezuma, Montrose, Pitkin, Pueblo, Routt, and San Miguel Counties	Approved in Passaic, Union, Hudson, and Middlesex Counties
Program Administrator(s)	Sustainable Real Estate Solutions	Leidos Engineering / Counterpointe Energy Solutions
Costs Covered	100% of costs, including project implementation costs (permits, audit expenses, closing fees, capitalized interest)	100% of costs
Loan Repayment Terms	Up to 20 years	Up to 30 years
Qualifying Measures	Automated building controls; Boilers, chillers, and furnaces; Building envelope; High efficiency lighting; Hot water heating systems; HVAC updates; roof replacement; Variable speed drives on motors, pumps, and fans; Combined heat and power (CHP) systems; Fuel cells; Geothermal systems; Hydroelectric systems; Small wind systems; Solar PV; Solar thermal; Irrigation systems; Low-flow fixtures (faucets, toilets, etc.)	HVAC, roofing, solar, windows, lighting, and other energy efficiency updates

*The Alliance NRG program is a national residential and commercial PACE program that has been launched in New Jersey targeting the commercial sector.

Since 2009, R-PACE programs have provided about $3.67 billion in financing to 158,000 homeowners. About 58 percent of this funding was for energy efficiency, 37 percent for renewable energy, and four percent for other upgrades to their homes. An additional $21.4 million in PACE financing funded improvements to multi-family residential buildings and $59.3 to improvements for non-profit organizations, which may benefit the low-income population.[135]

There are several R-PACE programs currently funding projects in California, Florida, and Missouri. Table VIII-7 identifies these programs and the locations they serve. Many of these programs are partnered with nationwide PACE organizations such as Renovate America, Ygrene, Renew Financial, and Alliance NRG.

[134] PACE Nation (2017). *PACE Programs*. http://pacenation.us/pace-programs/; Database of State Incentives for Renewables & Efficiency (DSIRE Database) (2017). http://www.dsireusa.org/; Colorado Commercial Property Assessed Clean Energy (CO C-PACE) (2017). https://copace.com/; and Alliance NRG (2017). https://www.alliancenrg.com/retail/

[135] PACE Nation (2017). *PACE Market Data.* http://pacenation.us/pace-market-data

Table VIII-7
R-PACE Programs in CA, FL, and MO [136]

State	Program Name	Coverage
California	CaliforniaFIRST	Many cities and counties
	Clean Energy Works	Many cities and counties
	mPower	Placer County and Folsom City
	PACE Funding	Many cities and counties
	Sonoma County Energy Independence Program	Sonoma County
Florida	Clean Energy Works	Many cities and counties
	FL PACE Funding Agency	Any municipality in FL
Missouri	MO Clean Energy District / HERO Program	Many cities and counties

These R-PACE programs share many common features identified as best practices, such as flexible loan terms (e.g., repayment periods of 5 years, 10 years, 20 years, etc., to match the expected lifetime of the clean energy upgrades), required use of qualified contractors, and eligible measures that are intended to meet the public purpose goals of the program. One feature that does not appear to be required by most existing R-PACE programs is for homeowners to obtain a home energy audit prior to program application. The Sonoma County program indicates that this is optional but highly recommended for residential properties (but required for commercial properties), but other program websites do not explicitly address this topic. The process typically involves the following steps.

- Homeowner completes the program application and applies for financing.
- Homeowner selects improvements from eligible measures and savings and repayment terms are estimated.
- PACE financing is approved and arranged.
- Homeowner selects a registered/certified contractor; improvements are made to the home. Contractors may further discuss the desired improvements and make recommendations to the homeowner based on the projected value of energy savings or other features for non-energy measures, but this does not appear to be a requirement.
- PACE assessment is repaid over time through property tax collections.

The DOE has published updated best practices for R-PACE programs to provide guidance on how to structure R-PACE programs to address industry concerns.[137] The updated best practices address the following topics.

[136] PACE Nation (2017). *PACE Programs*. http://pacenation.us/pace-programs/
[137] U.S. Department of Energy (DOE) (2016). *Best Practice Guidelines for Residential PACE Financing Programs.* https://energy.gov/sites/prod/files/2016/11/f34/best-practice-guidelines-RPACE.pdf

- Defining program scope and eligible improvements, including cost-effectiveness of improvements.
- Establishing eligibility criteria, including verifying property ownership and reviewing income and existing debt obligations and credit score.
- Establishing both consumer and lender protections, including property owner education, setting appropriate minimum equity requirements and maximum assessments, and additional protections for low-income households.
- Quality assurance and anti-fraud measures, including contractor qualifications, work standards and dispute resolution procedures.
- Data collection and evaluation.

Additional protections recommended by DOE for low-income households include the following.[138]

- A screening process to ensure proper disclosure of information has been provided to and understood by low-income homeowners.
- Coordination with other organizations (utility, state agencies, etc.) to provide low-income homeowners with information on accessing other resources for energy efficiency, including free or reduced cost programs.
- Contractor registration as an authorized PACE program supplier.
- Methods to adjust PACE assessments for other incentives low-income homeowners might receive (e.g., rebates, tax credits, and grants).
- Limits on PACE financing to measures that pay for themselves over the course of the measure life.
- Limits on PACE assessments to a percentage of the property value (DOE recommends 10 percent; the CaliforniaFIRST R-PACE program has set 15 percent as its limit).
- Additional incentives to further reduce costs.

The DOE notes that following these updated best practices, in combination with guidance issued by the Federal Housing Administration[139] and U.S. Department of Veterans Affairs,[140] will enable greater uptake of R-PACE programs by states and municipalities.[141]

Several C-PACE programs have funded improvements in multi-family residential buildings. Highlights from some of those projects are included below.

[138] A complete list of recommended protections for low-income households is available in U.S. Department of Energy (DOE) (2016). *Best Practice Guidelines for Residential PACE Financing Programs.* https://energy.gov/sites/prod/files/2016/11/f34/best-practice-guidelines-RPACE.pdf

[139] U.S. Department of Housing and Urban Development (HUD) (2016). *PACE Guidance Letter.* https://portal.hud.gov/hudportal/documents/huddoc?id=16-11ml.pdf

[140] U.S. Department of Veterans Affairs (VA) (2016). *PACE Loan Processing Guidance Letter.* https://www.benefits.va.gov/HOMELOANS/documents/circulars/26_16_18.pdf

[141] U.S. Department of Energy (DOE) (2017). *Updated Guidelines for Residential PACE Financing Programs* https://energy.gov/eere/slsc/downloads/updated-guidelines-residential-pace-financing-programs

Table VIII-8
C-PACE Programs

Program	Project Name	PACE Financing	New or Existing Construction	Project Details	Impact on Low-Income
CO C-PACE	Sloan Lake Apartments (Denver, CO)	$2.8 million (16% of total project cost)	New	Estimated 56% energy savings over local code; improvements include HVAC, lighting, building envelope, domestic hot water, and solar PV	Unknown
DC PACE	Phyllis Wheatley YWCA (Washington, DC)	$700,000; combined with resources from low-income housing programs	Existing	Estimated 24% energy use reduction and 47% water use reduction; operating cost reduction of $6,000/year; improvements include HVAC, heat recovery system, lighting, Energy Star appliances, low-flow water fixtures, and solar PV; first project to use PACE financing for HUD-assisted mixed-finance public housing property	Yes; Multi-family Affordable Housing
DC PACE	400 M St SE (Washington, DC)	$340,000; combined with resources from low-income housing programs	Existing	Estimated $41,000 in benefits each year; improvements include control systems, lighting, water conservation, and solar PV; part of the HOPE VI program administered by HUD	Yes; Multi-family Affordable Housing
KY PACE	Ivy Knoll Senior Living Community (Covington, KY)	$750,000	Existing	Improvements include control systems, cooling, heating, lighting, and solar PV	Yes; Senior Living Community
Lean and Green MI	Cambridge Court Apartments (Greenville, MI)	$115,000; combined with resources from low-income housing programs	Existing	Estimated 40% reduction in electric and gas usage and 29% reduction in water usage; improvements include heating and cooling upgrades, lighting, high efficiency appliances, low-flow water fixtures, and solar PV; received USDA approval for PACE financing with Rural Energy for America (REAP) grant funding	Yes; Multi-family Affordable Housing
Lean and Green MI	New Amadore Apartments (Saginaw, MI)	$298,295	Existing	Improvements include high efficiency windows	Unknown

Program	Project Name	PACE Financing	New or Existing Construction	Project Details	Impact on Low-Income
Energize NY	Natlew Corporation (Mt. Vernon, NY)	$238,078; combined with incentives from NYSERDA's Multi-family Program	Existing	Estimated $19,140/year average savings compared to $20,700/year financing cost (6.08%, 20 years); improvements include indirect-fired hot water heater, conversion of oil heater to HE gas-fired unit, addition of HE lighting, and pipe insulation; 29,787 kWh electric use offset / 46.8 MMBtu offset	Yes; Multi-family Affordable Housing
Energize NY	Lengyel House (Lewisboro, NY)	$77,200	Existing	Estimated $5,150/year average savings compared to $5,100/year financing costs (2.84%, 20 years); Qualified Energy Conservation Bond (QECB)-enhanced interest rate; improvements include building envelope, heating, and windows	Yes; Multi-family Affordable Housing for adults with disabilities
Energize NY	Drum Hill Independent Senior Living (Peekskill, NY)	$429,000; combined with incentives from Con Edison	Existing	Estimated 14% electric use offset and 10% natural gas savings; Qualified Energy Conservation Bond (QECB)-enhanced interest rate (3.14%, 20 years); improvements include replacing boiler with HE condensing units, installation of HE chillers, lighting, and variable frequency drive-pumping technology	Yes; Senior Living Community

Energy Saving Performance Contracts

In Energy Savings Performance Contracts (ESPCs) or Energy Performance Contracts (EPCs), the Energy Service Companies (ESCOs) take on the risk that the predicted savings are not achieved. The ESCO coordinates the installation and maintenance of efficiency equipment and is paid from the energy savings. ESPCs are typically financed by a third-party financing provider and backed by the ESCO's savings guarantee.[142] This financing mechanism is suited toward larger, more complex projects. Most of these investments have been in the institutional sector, in state and local governments, schools, colleges, hospitals, and federal government agencies, because the projects are large, the risk is low, and the customer will be in the building for a long time. ESCOs have not been used in the residential sector, but have been used by large public housing authorities.[143]

[142] Energy Efficiency Financing for Low- and Moderate-Income Households: Current State of the Market, Issues, and Opportunities. State and Local Energy Efficiency Action Network, Financing Solutions Working Group. August 2017.

[143] Deason, Leventis, Goldman, and Carvallo. Energy Efficiency Program Financing. Where it comes from, where it goes, and how it gets there. Lawrence Berkeley National Laboratory. June 2016.

The steps of the ESPC are as follows.[144]

- The customer partners with the ESCO.
- The ESCO conducts an audit and determines which measures are cost-effective.
- The ESCO identifies efficiency incentives or rebates.
- The performance contract specifies that the ESCO agrees to implement and manage the upgrades. Services often include operations, maintenance, repair, service upgrades, and measurement and verification.
- The customer makes regular service payments to the ESCO, and repayments to the lender if the project was financed.
- The customer's payments are designed to be lower than the post-retrofit energy costs plus the financing costs.
- If the ESCO provides a guarantee of savings to the customer, the ESCO will pay the difference between actual savings and the guaranteed amount to the customer.
- When the ESCO term ends, the customer stops making service payments, takes responsibility for maintaining the equipment, and keeps future energy savings.

There are several advantages of the ESPC.

- Energy savings are guaranteed.
- Project management is outsourced.
- ESCO maintenance provides for long-term reliability and performance of the equipment.
- ESCOs have standardized processes because the market is well-established.
- ESPCs can be used on a large scale and for portfolio-level initiatives.

The disadvantages of ESPCs are as follows.

- ESPCs have long close times because of their complexity and can have high transactions costs.
- Leases can provide challenges for this mechanism, especially if the lease term is shorter than the ESPC contract term.
- ESPCs need larger project sizes, usually over one million dollars, and often over five million, because of the size of the transactions costs.
- Savings with an ESCO are lower than from in-house implementation because of the ESPC costs that are paid to the ESCO.
- Engineering costs may be higher than necessary to reduce the risks to the ESCO.
- Low-income housing generally requires approval from subsidy sources, which can add time and cost to the project. HUD has an approval path, but the process can take many months.

[144] https://betterbuildingssolutioncenter.energy.gov/financing-navigator/option/epc-financing

The financing for the project is typically separate from the ESPC. The customer can pay out of pocket or obtain financing from a third-party lender. Most ESPCs are financed by a loan, capital lease, or bond.

As mentioned above, ESPCs have been used in public sector affordable housing, most often by large public housing authorities. Some examples are as follows.

- The Denver Housing Authority provides affordable housing to more than 10,000 very-low-, low-, and middle-income households. Their mission is to "serve the residents of Denver by developing, owning, and operating safe, decent, and affordable housing in a manner that promotes thriving communities.[145]

    - The Denver Housing Authority (DHA) completed a traditional ESPC administered by an ESCO in 2007. Due to the success of this project, they implemented a second phase that was a self-managed variation of the traditional ESPC.[146]

    - DHA partnered with engineering consultants, financing consultants, and a general contractor in the second phase. They implemented $14 million in capital improvements and Energy Conservation Measures (ECMs) in 2,800 housing units across 14 properties. The measures included new roofs, attic insulation, window replacement, efficient furnaces and water heaters, central plant upgrades, common and unit-level lighting retrofits, efficient appliances, ceiling fans, and thermostats. The measures have a 15-year payback from ECM-related utility savings. They estimated 17 percent electric savings, 35 percent natural gas savings, and 45 percent water and sewer savings.
        - The Professional Engineering (PE) firm and EPC Consultant analyzed utility billing data, conducted an audit, and identified potential ECMs. They developed bid specifications for all selected ECMs.
        - The Architectural and Engineering Firm reviewed the audit, commissioned the ECM implementation, and provided M&V services and reporting.
        - The General Contractor (GC) developed the budget and schedule, and managed the work.
        - DHA managed the PE, EPC, and GC contractors and worked with the lender.

    - DHA's project included a focus on resident impact and education.
        - DHA gathered feedback from residents during the design process to understand behavioral impacts and installed ceiling fans, HVAC replacements, and building envelope improvements that improved climate control and had high resident satisfaction.
        - DHA educated high-energy users during the audits and partnered with energy consulting firms to further educate residents on energy usage. They will test

[145] http://www.denverhousing.org/aboutus/Pages/default.aspx
[146] https://betterbuildingssolutioncenter.energy.gov/implementation-models/self-managed-energy-performance-contracting

strategies to incentivize energy conservation and expand the most successful strategies.

- The Rockford Housing Authority (RHA) in Rockford, IL has a mission to partner with the community and guide families into self-sufficiency. HUD funding was not covering maintenance costs, so they implemented an ESPC and realized reduced energy costs and improved housing quality for their low-income tenants. The ESPC implemented improvements in eight buildings and achieved a projected 13 percent utility cost savings.[147]

    - RHA signed a $7.5 million ESPC with an ESCO. The ESCO performed an audit, determined the most effective measures, estimated project costs, and identified funding, financing, and grant needs.

    - The ESCO educated local lenders on the ability of RHA to enter into long-term debt.

Energy Service Agreements (ESAs)

Under Energy Service Agreements, customers pay for energy savings instead of paying for energy efficiency measures and the service providers take on the risk for achieving the projected energy savings. The ESA supplier provides the capital for the project, coordinates measure installation, and shares in the savings. In some cases payments depend on realized energy savings and in other cases there are fixed payment levels that are backed by a guarantee for the amount of energy saved.

This model has not been used very often in the residential sector, but it has been used in the residential market by Sealed in New York and PosiGen in Louisiana, Connecticut, and New York. PosiGen has completed over 8,400 energy efficiency projects since 2011 and 75 percent have been for households with income at or below 100 percent of AMI. Their general product is a solar lease with an optional ESA for energy efficiency measures, and about 90 percent of participants take up the energy efficiency measures.

PosiGen undertakes practices which help them to provide the guaranteed savings.[148]

- Pre-Treatment Usage: They use at least 12 months of pre-treatment utility data to estimate potential energy savings.
- Contractor Risk: The contractors agree to the savings and are not paid if the savings are not achieved.
- Education: They provide energy education to support energy savings.
- Smart Thermostat: They install a communicating thermostat, monitor energy consumption, and arrange for a follow-up visit if savings are not being achieved.

[147] https://betterbuildingssolutioncenter.energy.gov/implementation-models/use-energy-performance-contract-allows-continuous-provision-quality-affordable

[148] Energy Efficiency Financing for Low- and Moderate-Income Households: Current State of the Market, Issues, and Opportunities. State and Local Energy Efficiency Action Network, Financing Solutions Working Group. August 2017.

PosiGen does not use the customer's credit profile and has had an approval rate of 75 to 85 percent. When customers have difficulty making payments, they work out payment plans with the customers. Their overall default rate is 0.5 percent and they have not found a higher default rate for lower-income customers.

PosiGen engages in community-based marketing to overcome issues of trust. Their approaches include hiring within the communities they are serving, obtaining referrals from local organizations, and using a system of referrals.

This model appears to be a good opportunity for lower-income households because the customer does not take on the risk and the home is not at risk. However, health and safety work may not be included if it cannot be factored into a positive cash flow project, and this may provide a barrier for many of the potential low-income participants.

Community Reinvestment Act (CRA)

The Community Reinvestment Act was enacted in 1977 to help meet the credit needs in the communities where the financial institutions operate, including low- and moderate-income neighborhoods. The CRA requires that the financial institution's record in helping meet the credit needs of the community is evaluated and taken into account when considering its application for deposit facilities, including mergers and acquisitions. The banks often meet these obligations by investing in loans and grants for economic development projects, low-income housing projects, and community centers. The benefits from these investments must remain in the low-income communities. One way that banks can comply with the CRA requirements is to lend to Community Development Financial Institutions (CDFIs).

CDFIs are private institutions that are dedicated to lending to help low-income and other disadvantaged households. They aim to expand economic opportunity in low-income communities through access to capital and services for local residents and businesses. CDFIs can be banks, credit unions, loan funds, microloan funds, or venture capital providers.

The Solar and Energy Loan Fund (SELF) is a CDFI that serves 58 cities and 23 counties in Florida. They make unsecured loans for energy efficiency and renewable energy projects. SELF underwrites the financing based on the borrower's expenses, income, and ability to repay, and does not rely solely on FICO scores.[149] SELF received CDFI accreditation in 2012 and has financed $2.4 million in residential energy improvements in Florida, including low-income rooftop solar systems.[150]

[149] Asset-building for Low-Income Homeowners: Leveraging Financing Solutions for Energy-Efficiency Home Improvements. https://prosperitynow.org/files/resources/White%20Paper%20-%20Citi.Ford_.PN_.pdf

[150] Bovarnick and Banks. State Policies to Increase Low-Income Communities' Access to Solar Power. Center for American Progress. September 2014.
https://www.americanprogress.org/issues/green/reports/2014/09/23/97632/state-policies-to-increase-low-income-communities-access-to-solar-power/

An energy efficiency or solar project can both provide funding for important home energy improvements and assist the low- to moderate-income household build credit. A credit-building loan could be provided prior to the efficiency or solar loan to raise the household's credit scores enough to obtain a loan. Virtual net metering provides energy cost-savings benefits to low-income households. As a result, banks can claim Community Reinvestment Act credit.[151]

Louisiana does not have support or financing for low-income solar, but PosiGen, a solar leasing company developed a low-income solar leasing model using tax credits, the Residential Renewable Energy Tax Credit, and financing on community redevelopment terms, more favorable than standard agreements. CDFIs could replicate this approach in low-income neighborhoods in other parts of the country. There are 896 CDFIs around the country, and many could support investments in LIEE and in low-income solar.[152]

Bank of America invested $55 million in CDFI energy efficiency projects in 2011. They held a competitive process and selected nine CDFIs for the program. Two examples are as follows.[153]

- Enterprise Cascadia used the funds to scale up an On-Bill utility energy efficiency program for homeowners.
- NeighborWorks Capital provides loans for purchasing or installing renewable energy systems.

D. Utility Cost Recovery and Incentives

Legislation and Public Utility Commission regulations can provide incentives for utilities to implement energy efficiency programs. These mechanisms include cost recovery, decoupling, Energy Efficiency Resource Standards (EERS) or spending requirements, and performance incentives.

Cost Recovery

Program Cost Recovery allows for the cost of energy efficiency programs to be recouped in the utility's rates. This is a common practice where the costs may be recovered through rate increases or through a return earned on the funds invested in energy efficiency.[154]

Three methods are typically used for cost recovery.

[151] Asset-building for Low-Income Homeowners: Leveraging Financing Solutions for Energy-Efficiency Home Improvements. https://prosperitynow.org/files/resources/White%20Paper%20-%20Citi.Ford_.PN_.pdf

[152] Bovarnick and Banks. State Policies to Increase Low-Income Communities' Access to Solar Power. Center for American Progress. September 2014. https://www.americanprogress.org/issues/green/reports/2014/09/23/97632/state-policies-to-increase-low-income-communities-access-to-solar-power/

[153] https://financere.nrel.gov/finance/content/community-development-financial-institutions-providing-clean-energy-capital

[154]Nowak, Baatz, Gilleo, Kushler, Molina, and York. Beyond Carrots for Utilities: A National Review of Performance Incentives for Energy Efficiency. American Council for an Energy-Efficient Economy. May 2015.

- Rate Case Recovery: Program costs are recouped through general rate cases. The utility estimates and seeks approval for the program costs, adds the costs to the revenue requirement, and recovers the costs through the customers' rates. A balancing mechanism (surcharge) may be needed to ensure that recovery is in line with actual expenditures.

  Because existing regulatory rules and procedures are followed, utilities can achieve timely recovery, especially if there is a frequent balancing mechanism in place between rate cases. However, prohibitions on single-issue ratemaking could preclude recovery outside of general rate cases.

  Additionally, utilities may not be permitted to recoup costs that were not included in the base rate, and thus may be wary of additional energy efficiency costs. Utilities may be concerned that they will not receive full cost recovery because of the impact on rates or because the programs did not perform at the expected level.[155]

- Tariff Rider/Surcharge: This is a charge that is a fee on the bill in addition to the base rate charge for utility service. Concerns about these charges include increased costs for customers and reduced incentives for utilities to control costs, as they are assured of full recovery and the review may be less rigorous than in rate cases. These charges shift risk from the utility to the customer, and may be considered single-issue ratemaking.

  In some cases, the full cost of the energy efficiency programs is collected through the surcharge, and in other cases only the difference between what is included in base rates and the full program cost is recovered. These additional costs are sometimes called a balancing account, or a tracker if they are recorded in a specified account that is later reviewed by the regulators.[156]

- System Benefits Charge (SBC): The SBC is a specific type of surcharge that adds a cost per unit of energy consumed and/or per unit of demand to each customer's bill for the specific purpose of providing public benefits. These differ from tariff rider/surcharges as they are within a specific category for public benefits, are often delineated on the customer bill, and were usually introduced at the time of deregulation.

  System Benefit Charges are usually collected across all rate classes, but some states have excluded or capped the amount that can be collected from large customers. Some states specify that the SBC will be in place for a set number of years and some leave the duration open-ended.[157]

[155] State and Regional Policies that Promote Energy Efficiency Programs Carried Out by Electric and Gas Utilities. A Report to the United States Congress. March 2007.
[156] Increasing Use of Surcharges on Consumer Utility Bills. Prepared by Larkin & Associates, PLLC for AARP. May 2012.
[157] State and Regional Policies that Promote Energy Efficiency Programs Carried Out by Electric and Gas Utilities. A Report to the United States Congress. March 2007.

An advantage of an SBC is that the mechanism creates a consistent source of funding and can reduce utilities' perceived risk of not being reimbursed for investments in energy efficiency.

Revenue from SBCs may be deposited into a trust fund. One issue with this method is that dollars deposited into such a trust fund are vulnerable to raids by state agencies.

Table VIII-9 displays the number of states using the three most common program cost recovery options.[158]

Table VIII-9
Program Cost Recovery

	Cost Recovery Mechanism			
	Rate Case Recovery	**Systems Benefit Charge**	**Tariff Rider / Surcharge**	**Combination**
Number of States	18	16	32	17

Note: Categories are not mutually exclusive and Combination includes states counted in two or more of the other listed program cost recovery mechanisms.
Source: State Electric Efficiency Regulatory Frameworks, IEE Report, July 2012.

Table VIII-10 displays the cost recovery mechanism used by each target state.

Table VIII-10
Program Cost Recovery in Target States

	Colorado	**Illinois**	**New Jersey**	**Pennsylvania**
Rate Case Recovery	Yes		Yes	Yes
Systems Benefit Charge			Yes	
Tariff Rider / Surcharge	Yes	Yes	Yes	Yes
Notes	Xcel Energy's programs are funded by a demand-side management Cost Adjustment Mechanism rate rider.	IL utilities are allowed to recover administrative, start-up, and program evaluation costs.		PA utilities are permitted to recover program costs through a reconcilable adjustment clause. These costs do not include those associated with decreased revenue, but these may be addressed in future utility rate-making procedures. PA program costs may not exceed two percent of total annual revenue as of December 31, 2006.

[158] Source: State Electric Efficiency Regulatory Frameworks, IEE Report, July 2012.

Source: State Electric Efficiency Regulatory Frameworks, IEE Report, July 2012

Decoupling

Decoupling is a regulatory mechanism that removes the connection between utilities' revenue and their sales volume. Under decoupling, the regulatory commission uses a test year to determine the revenue requirements for a utility. The utility is then permitted to collect that amount of required revenue irrespective of actual sales. Rates can change with consumption to meet the required revenue target. There are many variations in the way that decoupling has been implemented around the country.

Decoupling can remove the incentive for utilities to increase sales in order to increase revenue and profit (the Throughput Incentive) and reduce the disincentive for utilities to promote energy efficiency programs.[159] Under decoupling, regulators usually adjust rates much more frequently than under traditional ratemaking practices to ensure the utilities a fair return.[160] As long as the cost of saving energy is less than the cost of additional supply, decoupling should result in lower rates for customers and profit for the utilities.[161]

The simplest description of the decoupling design is that under the traditional system:

- Revenue = Fixed Price * Sales

But under the decoupled system:

- Price = Fixed Revenue / Sales[162]

Decoupling policies have been criticized when they adjust rates regardless of the reason for the variation in revenue and therefore insulate the utilities from business risks that are unrelated to energy efficiency. Therefore, some of the other adjustment methods eliminate these other factors from protection. Some of the variants on the structure of pricing and adjustments under decoupling are as follows.[163]

- Revenue-Cap Decoupling: The Public Utilities Commission sets the utility's allowed revenue and over or under collections are refunded or recovered through rate adjustments.

- Revenue-per Customer or Fixed Customer Charge: There is a fixed level of revenue that is collected for each customer and the revenue requirement is automatically adjusted with a change in the number of customers.

[159] Decoupling Policies: Options to Encourage Energy Efficiency Policies for Utilities. National Renewable Energy Laboratory.
[160] Utility Rate Decoupling. Alliance to Save Energy. October 2013.
http://www.ase.org/resources/utility-rate-decoupling-0
[161] Cook. The Case for Decoupling: A Policy to Promote Energy Efficiency. January 2007.
[162] Utility Rate Decoupling. Alliance to Save Energy. October 2013.
http://www.ase.org/resources/utility-rate-decoupling-0
[163] Center for Climate and Energy Solutions. Decoupling in Detail.
https://www.c2es.org/us-states-regions/policy-maps/decoupling/detail

This method addresses a utility argument that they should benefit from revenue increases that result from an increase in customers because this encourages the utilities to promote economic development in their territory. In this method, the allowable revenue is divided by the number of customers at the time of the rate case and the per-customer amount is multiplied by the actual number of customers at a particular time to obtain the updated revenue requirement.

- Fixed Cost Adjustments: Similar to Revenue-Cap Decoupling, but the rate adjustment is made on the part of sales that represents the utility's fixed costs.

- Flat Distribution: The utility's fixed costs are divided equally across all customers through a fixed cost charge. Only variable costs including billing, meter reading, and customer service are charged based on the amount of electricity used.

- A Lost Revenue Adjustment Mechanism (LRAM) only allows the utility to recover revenues that are reduced as a result of the energy efficiency programs. Therefore, the LRAM requires the utility to estimate savings from the energy efficiency programs. Because the LRAM is tied to measured energy savings, the evaluation of savings is very important.

  The LRAM allows for recovery of lost revenues from efficiency programs, but does not make adjustments if the utility sells more energy than predicted (as is done in Decoupling). Additionally, the LRAM can result in the utility discouraging customers from implementing non-utility energy efficiency efforts, including improvements in codes and standards, because the utility is not compensated for these lost revenues.

  ACEEE does not find that states with LRAMs have higher spending on energy efficiency or higher energy savings than states without LRAMs. They conclude that recovery of energy efficiency program costs, performance incentives, and a mechanism to oppose the throughput incentive, best accomplished with decoupling, are needed.[164] Others also argue that LRAMs do not remove the disincentive to sell more electricity and that they are easier to game because of the difficulty in measuring the effect of any DSM policy on a utility.[165]

Research has shown that decoupling has resulted in only small adjustments to rates, but no specific studies examining the impact on low-income households was found. A study of 1,269 mechanism adjustments from 2005 through 2011 found that 64 percent of the adjustments were within two percent of retail rates and 80 percent were within three percent of retail rates. While 63 percent were surcharges, 37 percent were refunds. However, more research is needed to understand whether decoupling has a significant impact on LIEE offerings. Because

[164] Gillei, Kushler, Molina, and York. Valuing Efficiency: A Review of Lost Revenue Adjustment Mechanisms. June 2015.
[165] Cook. The Case for Decoupling: A Policy to Promote Energy Efficiency. January 2007.

there are so many factors that are related to the level of LIEE investment, it is difficult to draw a connection between the policy and the investment level.

Public power utilities are significantly different from investor-owned utilities and may not require this mechanism because they do not have shareholders and the same profit motive. Additionally, they usually have their rates regulated by a city council or independent utility board which allows for more flexibility in rate adjustments on an as-needed basis.[166]

According to the Center for Climate and Energy Solutions, 23 states and the District of Columbia had decoupling policies in place in 2016 for at least one utility. Of these, 14 states had decoupling for both electric and gas utilities, five and the District of Columbia had decoupling only for electric utilities, and four had decoupling only for gas utilities.[167]

Table VIII-11 summarizes decoupling that has been implemented in the four target states. Illinois adopted decoupling in the electricity market. Colorado recently, in June 2017, approved a test of decoupling in the electricity market. They approved the "Tucson Model" which applies credits to low-usage rate tiers and charges to high-usage rate tiers with the goal of maximizing benefits for low-usage and low-income customers. Colorado is the first state to implement this model for decoupling.[168]

Table VIII-11
Decoupling in Target States

	Colorado	Illinois	New Jersey	Pennsylvania
Electric	Recently Approved	Adopted	None	Pending
Gas	None	Adopted	Adopted	None

Source: Gas and Electric Decoupling Fact Sheet: January 2017.
https://www.nrdc.org/resources/gas-and-electric-decoupling.

Two of New Jersey's four natural gas utilities have Conservation Improvement Programs (CIPs) where shareholders pay for programs that reduce natural gas usage. If the company shows that it reduced gas supply costs due to the reduced usage, they are allowed to impose a surcharge to recover their lost revenues up to the amount of savings.

The American Recovery and Reinvestment Act of 2009 required states to create policy to align utility incentives with energy efficiency implementation in order to receive Energy Efficiency Program funds. All electric utilities in California, Massachusetts, and Connecticut are required to implement decoupling in their next rate case.

- Connecticut assigns decoupling on a utility-by-utility basis.

[166] The Effect of Energy Efficiency Programs on Electric Utility Revenue Requirements. American Public Power Association. http://www.publicpower.org/files/pdfs/effectofenergyefficiency.pdf
[167] Center for Climate and Energy Solutions. *Decoupling Policies.*
https://www.c2es.org/us-states-regions/policy-maps/decoupling
[168] https://www.ecowatch.com/colorado-renewable-energy-2460778489.html

- Massachusetts determines the target revenues on a utility-wide basis that can be adjusted for inflation and capital spending requirements.
- Wisconsin, Vermont, Oregon, New York, Maryland, and Idaho have approved decoupling programs and are beginning to implement them.

However, there are various opinions with respect to whether decoupling benefits customers in general and low-income customers in particular.

- Several years ago, New Jersey introduced legislation to allow for decoupling for NJ's electric and gas utilities, but the bill was opposed by the BPU and by business and consumer representatives, and the bill was not passed. More recently, in 2014, the NJ Ratepayer Advocate argued that decoupling could reduce the incentive for energy efficiency because it lessens reductions in bills that result from energy efficiency. They expressed concern that the utilities may be compensated for decreases in sales that are not related to energy efficiency programs. They argued that decoupling would not be more effective than paying utilities to invest in energy efficiency and the mechanism used in NJ to do so is more transparent than decoupling would be.[169]

- Several other states have rejected decoupling, even in some cases where legislation permitted decoupling.[170]
  - Connecticut: Connecticut Light & Power (2010)
  - Connecticut: Connecticut Natural Gas (2009)
  - Indiana: Southern Indiana Gas (2011)
  - Montana: Northwestern Energy (2011)
  - Tennessee: Piedmont Natural Gas (2010)
  - Rhode Island: Narragansett Electric (2009)

Energy Efficiency Resource Standards (EERS)

While decoupling can reduce the utility "throughput incentive", it does not encourage energy efficiency. An Energy Efficiency Resource Standard (EERS) requires utilities to reduce energy consumption by a certain amount, typically a percentage of usual sales and sometimes a reduction in peak demand.[171] This additional policy can provide the utility with incentive by requiring that the utility meet a specified energy usage reduction target within a designated timeframe. An EERS can be created through legislation or regulation.[172]

[169]Decoupling Work Group. State of New Jersey, Division of Rate Counsel. June 2014. http://mseia.net/site/wp-content/uploads/2014/08/Rate-Counsels-Decoupling-Comments.pdf

[170] Increasing Use of Surcharges on Consumer Utility Bills. Prepared by Larkin & Associates, PLLC for AARP. May 2012.

[171] Energy Efficiency Resource Standard Policy Fact Sheet, Alliance to Save Energy. September 2013. http://www.ase.org/sites/ase.org/files/resources/Media%20browser/eers_fact_sheet_9-13.pdf

[172] Energy Efficiency Resource Standard. ACEEE. http://aceee.org/topics/energy-efficiency-resource-standard-eers

As of January 2017, 26 states had an EERS in place.[173] Various approaches to these standards include the following.

- Legislation that requires the reductions.
- Utility commissions setting targets for each utility.
- Allowing energy efficiency as a resource in renewable portfolio standards (RPS).

Information on the EERS in target states is shown in Table VIII-12. New Jersey does not have an EERS. While there is a goal for 20 percent savings by 2020, there are no consequences for failure to meet the goal, and it is not considered an EERS.

Table VIII-12
Energy Efficiency Resource Standards in Target States

	Colorado	Illinois	Pennsylvania
Year Enacted	2007, 2017	2007, 2016	2004, 2008
Method	Legislation	Legislation	Legislation
Included Entities	Investor-Owned Utilities	Utilities with over 100,000 customers	Utilities with over 100,000 customers
% of Sales Impacted	57%	88%	93%
Electric Reduction	0.8% of sales in 2011, increasing to 1.35% in 2015. For Xcel Energy, at least 400 GWh per year from 2015-2020.	Varies by utility. Averages 1.77% of sales from 2018-2021, 2.08% from 2022-2025, and 2.05% from 2026-2030.	Statewide annual savings of 0.8% for 2016-2020.

Source: State Energy Efficiency Resource Standard (EERS) Activity. ACEEE Policy Brief. January 2017. http://aceee.org/sites/default/files/state-eers-0117.pdf

Table VIII-13 provides more detail on the savings goals by electric utility in Colorado. While the statutory goals end in 2018, the Colorado Public Utilities Commission extended electricity sales reduction goals through 2020. Other key information about CO's targets are as follows.[174]

- The legislation required the PUC to develop expenditure and savings goals, determine cost recovery, and create a financial bonus structure through a rule-making procedure.
- Natural gas utilities do not have required savings targets.
- The investor-owned utilities administer the energy efficiency and DSM programs to meet the standards.
- They use a modified TRC to measure the cost-effectiveness of their programs. The test includes a ten percent adder for non-energy benefits for electric programs, and 25 percent for low-income programs.
- Electric utilities collect a fixed disincentive offset payment and a performance incentive.

[173]State Energy Efficiency Resource Standard (EERS) Activity. ACEEE Policy Brief. January 2017. http://aceee.org/sites/default/files/state-eers-0117.pdf

[174]Energy Efficiency Resource Standard. Energy.gov. https://energy.gov/savings/energy-efficiency-resource-standard

- There are no specific targets for the low-income sector.

Table VIII-13
Colorado EERS Savings Targets

Savings Targets (GWH)	2012	2013	2014	2015	2016	2017	2018	2019	2020
Xcel Energy	330	356	384	400	400	400	400	400	400
Black Hills Energy	30.9	30.9	22.3	25.0	18.0	19.8	20.6	TBD	TBD

Source: Energy Efficiency Resource Standard. Energy.gov. https://energy.gov/savings/energy-efficiency-resource-standard

Table VIII-14 provides more detail on the demand reduction targets by electric utility in Colorado.

Table VIII-14
Colorado EERS Demand Reduction Targets

Demand Targets (GW)	2012	2013	2014	2015	2016	2017	2018	2019	2020
Xcel Energy	96	88	371	593	602	620	640	663	688
Black Hills Energy	8.2	8.2	6.3	7.0	5.2	5.6	5.8	TBD	TBD

Source: Energy Efficiency Resource Standard. Energy.gov. https://energy.gov/savings/energy-efficiency-resource-standard

Table VIII-15 provides more detail on the electric savings goals in Illinois. The Illinois Power Agency Act (IPAA) of 2007 created energy efficiency and demand response programs in IL. Other key information about IL's targets is as follows.

- Electric reduction goals apply to utilities with 100,000 or more customers on December 31, 2005.
- Each Energy Year's benchmark is based on the previous year's sales.
- The sales reduction percentage remains at two percent for each year after 2016.
- Electric utilities are also required to implement cost-effective demand response to reduce peak demand by 0.1 percent over the prior year, beginning on June 1, 2008 and continuing for ten years.
- Utilities are responsible for implementing the programs.
- Cost-effectiveness is measured through the TRC, although the legislation allows "other quantifiable societal benefits".
- Utility charges were limited based on the previous year's rates from 2008 through 2011. Beginning in 2012, utilities were allowed small increases based on the cost of the energy efficiency measures.
- There are no specific targets for the low-income sector.

Table VIII-15
Illinois EERS Savings Targets

Electric Sales Reduction	2009	2010	2011	2012	2013	2014	2015	2016
Energy Year	0.2%	0.4%	0.6%	0.8%	1.0%	1.4%	1.8%	2.0%

Source: Energy Efficiency Resource Standard. Energy.gov.
https://energy.gov/savings/energy-efficiency-resource-standard

Pennsylvania adopted Act 129 in October 2008. This Act required the PA PUC to develop energy efficiency and conservation programs for electric utilities with at least 100,000 customers.

- Phase I of the Act provided conservation and demand reduction targets until 2013, required the PUC to evaluate cost-effectiveness every five years, and set additional targets if the benefits exceeded the costs.
  - Phase I extended from June 1, 2010 through May 31, 2013. This phase required savings of one percent by May 31, 2011 and of three percent by May 31, 2013 compared to projected electricity consumption from June 2009 through May 2010.
  - Phase I also required peak demand reduction of 4.5 percent compared to actual peak demand from June 2007 through May 2008.

- Phase II extended from June 1, 2013 through May 31, 2016. Targets are shown in Table VIII-16.
  - Required energy savings varied by utility from 1.6 percent to 2.9 percent.
  - Specific measures were required for households at or below 150 percent of the poverty level and the PUC had a goal that 4.5 percent of each utility's target was met with low-income sector savings.
  - Phase II kept demand savings the same as in Phase I.

- Phase III extends from June 1, 2016 through May 31, 2021.
  - Ten percent of the efficiency budget was to be allocated to peak demand and 90 percent to energy efficiency.
  - EDC's were required to obtain 5.5 percent of reductions from low-income programs.

- The EDC's are responsible for program administration.

- The TRC test is used to evaluate cost-effectiveness.

Table VIII-16
Pennsylvania Act 129 Savings Targets

EDC	PHASE II		PHASE III			
	Phase II Cumulative Sales Reduction Requirement (MWh)	% of Baseline	EE Potential Savings	% of 2010 Forecast	Average Annual Potential Savings (MW)	% Reduction Relative to 2007 Peak Demand
Duquesne	276,722	2.00%	440,916	3.10%	42	1.70%
Met-Ed	337,753	2.30%	599,352	4.00%	49	1.80%
PECO	1,125,851	2.90%	1,962,659	5.00%	161	2.00%
Penelec	318,813	2.20%	566,168	3.90%	0	0.00%
Penn Power	95,502	2.00%	157,371	3.30%	17	1.70%
PPL	821,072	2.10%	1,443,035	3.80%	92	1.40%
West Penn Power	337,533	1.60%	540,986	2.60%	64	1.80%

Energy Efficiency and Conservation Requirements for Utilities. June 12, 2015.
http://programs.dsireusa.org/system/program/detail/4514

Some other examples of these standards are as follows.[175]

- Texas has increased their requirement for avoiding 20 percent of the forecasted increase in peak electric demand with energy efficiency to 30 percent of the forecasted increase.
- Illinois mandated new electric savings that will increase to two percent of sales each year.
- Michigan requires one percent of new savings from electricity and .75 percent from gas each year.
- North Carolina has a Renewable Energy Standard (RES) and allows 25 percent of that required reduction to be met with energy efficiency. This will increase to 40 percent.
- California has multi-year targets for their electric and gas utilities.
- Vermont is mandated to set its SBC at a level needed to achieve all cost-effective energy efficiency. Rates are established annually by the PUC.
- Ohio (2008) set standards to require investor-owned utilities to achieve 22 percent energy savings by 2025.

The U.S. Senate introduced a bill in 2009 that would create a national EERS that required savings to rise to 15 percent of electricity and ten percent of natural gas by 2020.

Energy Efficiency Spending Requirements

Some states also, or alternatively, specify a set amount of spending for energy efficiency and for LIEE.

[175] Energy Efficiency Resource Standard Policy Fact Sheet, Alliance to Save Energy. September 2013.
http://www.ase.org/sites/ase.org/files/resources/Media%20browser/eers_fact_sheet_9-13.pdf

Table VIII-17
Electric LIEE Spending Requirements in Target States

	Colorado	Illinois	New Jersey	Pennsylvania
Overall Requirement	None	None	Set annually by BPU	None
Low-Income Requirement	None	ComEd: $25 million Ameren: $8.35 million	$24 Million (FY 2018)	LIURP: Specified for each utility Act 129: Provide for low-income equivalent to their share of usage

Performance Incentives

Along with decoupling, efficiency incentives are often included to incentivize energy efficiency and reduce demand. Performance Incentives provide financial rewards or earnings opportunities for measured energy savings. Utilities may implement energy efficiency if the incentives result in returns from energy efficiency that are equal to returns from investments in new generating capacity.[176]

Performance Incentives have the following advantages.

- Provide for equal or greater returns from efficiency, as compared to supply-side investments.[177]
- Make the goals and incentives explicit.[178]
- Offset or mitigate current financial incentives that are not beneficial.
- Provide method to improve utility performance.
- Put focus on desired outcomes.
- Can be applied incrementally.

However, Performance Incentives have the following potential disadvantages.

- Energy savings may not be accurately measured. Utilities may receive high incentives for over-estimated energy savings based upon inaccurate Technical Reference Manuals.
- Incentives may be too high relative to achievements.

ACEEE reports that 25 states were implementing a program where utilities or program implementers receive incentives for cost-effective achievement of energy-saving targets. All

[176]Nowak, Baatz, Gilleo, Kushler, Molina, and York. Beyond Carrots for Utilities: A National Review of Performance Incentives for Energy Efficiency. American Council for an Energy-Efficient Economy. May 2015.
[177]Nowak, Baatz, Gilleo, Kushler, Molina, and York. Beyond Carrots for Utilities: A National Review of Performance Incentives for Energy Efficiency. American Council for an Energy-Efficient Economy. May 2015.
[178] Whited, Woolf, and Napoleon. Utility Performance Incentive Mechanisms: A Handbook for Regulators. March 2015.

states and administrators who reported data stated that utilities and administrators had received the specified incentives. ACEEE found a positive relationship between the state energy efficiency budget and the existence of a performance incentive.[179]

Various models have been implemented.

- Shared Net Benefits: Utilities share the net benefits of energy efficiency with the ratepayers in 13 states.

- Energy-Saving Based: Utilities receive an incentive, typically a percentage of the program expenditures or a tiered budget, if they meet the energy savings targets in six states. Penalties are also sometimes used.

- Multifactor Incentives: Utilities receive an incentive based on multiple metrics in five states. The metrics go beyond energy savings and may include factors such as demand savings, job creation, or customer service quality assessments.

- Rate of Return Incentives: Utilities earn a rate of return that is roughly equivalent to the return on supply-side investments in one state.

Following its review, ACEEE concluded that Performance Incentives contribute toward effective energy efficiency program performance.
Most Performance Incentives do not relate to low-income delivery apart from the energy efficiency program performance as a whole. However, there are a few examples where there are specific low-income targets or requirements that must be met with respect to the low-income sector.[180]

- Michigan includes a minimum number of low-income customers served in their Performance Incentive mechanism.

- DC includes a requirement for improving energy efficiency in low-income housing. The most recent contract includes both a spending and a savings requirement.

- Texas previously allowed the utilities to receive a bonus if they achieve at least 120 percent of their demand reduction goal with at least ten percent of savings met with residential customers with annual household income at or below 200 percent of the federal poverty guidelines. However, this provision was eliminated in 2011 when other changes were made.

[179]Nowak, Baatz, Gilleo, Kushler, Molina, and York. Beyond Carrots for Utilities: A National Review of Performance Incentives for Energy Efficiency. American Council for an Energy-Efficient Economy. May 2015.
[180]Nowak, Baatz, Gilleo, Kushler, Molina, and York. Beyond Carrots for Utilities: A National Review of Performance Incentives for Energy Efficiency. American Council for an Energy-Efficient Economy. May 2015.

- The Vermont Energy Investment Corporation (VEIC), which operates Efficiency Vermont, can lose the opportunity to earn Performance Incentives if they do not meet specific targets including at least $10.5 million spent on the low-income sector.

Performance Incentives in the four target states are summarized in Table VIII-18.

- Colorado: Legislation required the PUC to develop expenditure and savings goals, determine cost recovery, and create a financial bonus structure through a rule-making procedure. Electric utilities collect a fixed disincentive offset payment and a performance incentive.

- Illinois: Utilities are not permitted to collect performance incentives related to energy efficiency goals. However, program plans are due every three years and utilities receive a fine of $100,000 for each day until the plan is filed if it is not submitted on time. Additionally, utilities with more than two million customers on December 31, 2005 must contribute $665,000 to LIHEAP if they do not comply with their plans within two years and utilities with 100,000 to two million customers must contribute $335,000 to LIHEAP. The utilities must make these contributions again if they don't meet their plans again in the third year. After three years of non-compliance the Illinois Power Agency (IPA) takes control over the energy efficiency programs.

- Pennsylvania: Utilities that do not meet targeted reductions can receive fines from $1 million to $20 million, and utilities can be charged $100,000 per day if they do not file a plan with the PUC.

Table VIII-18
Performance Incentives in Target States[181]

	Colorado	Illinois	New Jersey	Pennsylvania
Type	Shared Net Benefits	Penalty	None	Penalty
Threshold Requirements	80% of net energy savings goal	NA	NA	NA
Incentive Structure	1% to 15% of net benefits	NA	NA	NA
Disincentive Offset	$3.2 million to $5 million	NA	NA	NA
Maximum Incentive	$30 Million	NA	NA	NA

Tables VIII-19 and VIII-20 display the disincentive offsets and performance incentives that are in place for Xcel Energy and Black Hills Energy in Colorado.

[181]Nowak, Baatz, Gilleo, Kushler, Molina, and York. Beyond Carrots for Utilities: A National Review of Performance Incentives for Energy Efficiency. American Council for an Energy-Efficient Economy. May 2015.

Table VIII-19
Xcel Energy Disincentive Offset and Performance Incentive

Annual Efficiency and DSM Achievement Level	"Disincentive Offset" (Pre-Tax)	Performance Incentive (% of Net Economic Benefit)
<100%	$0	0%
100%	$5M	Lesser of 5% or $25M
105%	$5M	Lesser of 6% or $25M
110%	$5M	Lesser of 7% or $25M
115%	$5M	Lesser of 8% or $25M
120%	$5M	Lesser of 9% or $25M
125% and Above	$5M	Lesser of 10% (and Above) or $25M

Source: Energy Efficiency Resource Standard. Energy.gov. https://energy.gov/savings/energy-efficiency-resource-standard

Table VIII-20
Black Hills Energy Disincentive Offset and Performance Incentive

Annual Efficiency and DSM Achievement Level	Amount Exceeding 80% Performance	"Disincentive Offset" (Pre-Tax)	Performance Incentive (Capped at 20% of DSM Budget)
<80%	<0%	$0	0%
80%	0%	$150,000	0%
85%	5%	$150,000	1% of Net Economic Benefit
90%	10%	$150,000	2% of Net Economic Benefit
95%	15%	$150,000	3% of Net Economic Benefit
100%+	20%	$150,000	4%+ of Net Economic Benefit

Source: Energy Efficiency Resource Standard. Energy.gov.
https://energy.gov/savings/energy-efficiency-resource-standard

E. Other Models

Other models for increasing investment in energy efficiency include Building Codes, Green Leases, and Green Banks.

Building Codes

New construction standards are critical for employing energy efficiency practices in newly built structures and preventing the need for immediate improvements to reduce energy usage. Implementing energy efficient protocols during the construction process is more cost-effective than providing retrofits at a later date. Inspection during construction and enforcement of current code is required to ensure that builders adhere to existing regulations. Ongoing efforts to upgrade building codes can further increase the efficiency of new structures. Two groups that have been active in this effort are described below.

- Building Codes Assistance Project (BCAP): BCAP is a nonprofit advocacy organization that promotes the adoption, implementation, and advancement of building energy codes on the state, local, and international levels to reduce energy consumption in building construction and operation. They have conducted research to identify states' compliance with their energy codes, developed road maps to help states work toward compliance, estimated the incremental costs of construction and resulting energy savings, and they provide training and information sharing. [182]

- ACEEE Outreach: ACEEE works with states to identify opportunities and improve building codes.

Table VIII-21A and Table VIII-21B displays the status of all states and the four target states in their residential energy codes with reference to the International Energy Conservation Code (IECC). The table shows that only 10 states meet or exceed the 2015 IECC or equivalent and 12 states have no statewide code or a code that predates the 2006 IECC. The target states are at varying levels in their implementation of building codes.

Table VIII-21
States' Residential Energy Codes
With Reference to the International Energy Conservation Code

Meets or Exceeds IECC Year or Equivalent				No Statewide Code or Predates the 2006 IECC
2015	2012	2009	2006	
10 states	10 states	22 states	2 states	12 states

Table VIII-21
Target States' Residential Energy Codes
With Reference to the International Energy Conservation Code

Colorado	Illinois	New Jersey	Pennsylvania
No statewide code or predates the 2006 IECC	2015	2015	2009

Green Leases

Landlords often do not have sufficient incentive to invest in the energy efficiency of their buildings if the tenants are responsible for the energy costs. While energy efficiency improvements will add to the value of the property and may enable landlords to increase rents in certain situations, these factors may not provide enough incentive for the upgrades. Additionally, there may be restrictions on the amount by which landlords may increase rents. Tenants may not be permitted to make the upgrades and may not be willing to do so even if

[182] http://bcapcodes.org/

permitted, as their tenure in the home may be too limited to provide a payback on their investment.

A Green Lease may help to overcome the split incentive problem by including environmental aspects in the rental contract. The lease will specify the responsibilities of the landlord and the tenant with respect to environmental issues.

The Green Lease includes language that determines how the costs and savings of energy efficiency improvements will be divided between the tenant and the landlord. For example, it may state that the energy savings will be shared between the landlord and the tenant until the investment is paid off. [183]

The Green Lease has more commonly been used in commercial buildings where the tenants have long-term leases and higher energy bills. Where it has been used in the residential sector, it has generally been used in rent controlled apartments where the landlord must have a vehicle to recoup the energy efficiency investment.[184]

Some of the challenges with residential Green Leases include the following.[185]

- Landlords need to be able to recoup their investment in a reasonable amount of time. Splitting savings with the tenants increases the payback time.
- A good estimate of energy savings is needed to assess whether the investment and shared saving is beneficial.
- Energy savings may differ from what was estimated.
- The lease arrangements are complicated.

Green Banks

Green banks have been created by state and local governments to finance energy efficiency and other forms of clean energy investments. Most green banks work with utility programs to achieve deeper energy savings. Some of the green banks that have been established are described below.

- Connecticut Green Bank: This was the first green bank in the country, established by the Connecticut General Assembly in 2011. Since that time, over $1 billion in energy investments has been funded.

  Smart E-Loans provide low-interest loans with no down payment for energy efficiency improvements in individually metered owner-occupied one to four-unit residential buildings in Connecticut.

[183] http://pecpa.org/wp-content/uploads/Green-Leasing-Fact-Sheet.pdf
[184]https://stuff.mit.edu/afs/athena/dept/cron/project/EESP-Cambridge/Final%20ToR/MIT%20Community%20Energy%20Innovation%20Cambridge%20TOR%20Feb%206%202013.5.pdf
[185] http://www.sightline.org/2009/04/27/split-incentive-stalls-energy-efficiency-in-rental-housing/

The PosiGen Solar + Efficiency for Low-to-Moderate Income Homeowners provides homeowners with a solar lease and energy efficiency measures. Customers are not evaluated based on a credit profile.[186] PosiGen is the installer and manages the process including outreach, marketing, sales, applications, installations, and financing. The Green Bank connects PosiGen to community groups, helps organize events, and provided $5 million in low-cost debt capital to PosiGen and a tiered solar incentive for limited-income households.[187]

One example of a community partnership with PosiGen and the Connecticut Green Bank is with the Faith Restoration Empowerment Economic Development Outreach Ministries, Inc. (FREEDOM) network of churches. They provide outreach and education about affordable solar and energy efficiency available through this program.[188]

- New York Green Bank: The bank is administered by NYSERDA and is a state-sponsored fund designed to provide financial support to address market barriers that prevent implementation of renewable energy and energy efficiency. They have explored opportunities to serve low- and moderate-income (LMI) households, including working with local lenders, CDFIs, and regional banks to provide credit enhancements to the LMI market.[189] The New York Green Bank provided an $11 million short-term loan to the New York City Housing Authority to finance the installation of LED lighting retrofits in up to 18 buildings with low-to-moderate income tenants. [190]

  The New York Green Bank is planning to raise $1 billion to finance clean energy projects outside of New York State.

Green banks also have been established in Pennsylvania, Kentucky, Iowa, and Massachusetts.[191]

F. Summary and Best Practices

This section provides a summary of the information on policies and financing options that can increase investments in energy efficiency for low-income households.

- **Additional Program Offerings or Delivery Models**
  Beyond the most common types of LIEE, other investments have potential for overcoming some of the barriers to energy efficiency or providing services on a broader scale or in a more targeted fashion. These approaches include additional public utility offerings, heat island reduction programs, community solar, and school-based energy efficiency. New

[186] http://www.ctgreenbank.com/programs/homeowners/
[187] http://www.hartfordbusiness.com/article/20160418/PRINTEDITION/304149940/narrowing-the-clean-energy-affordability-gap
[188] http://www.bridgeportct.gov/feed-news/?FeedID=2369
[189] Report on Alternative Approaches to Providing Low and Moderate Income (LMI) Clean Energy Services. Clean Energy Advisory Council, LMI Clean Energy Initiatives Working Group. February 2017.
[190] Financing for Building Retrofits in Low-to-Moderate Income Housing Developments. New York City Housing Authority. May 2017.
[191] https://www.utilitydive.com/news/ny-green-bank-seeks-1b-in-private-sector-investment-for-clean-energy-proje/508549/

models should continue to be piloted and evaluated to develop rigorous data and information on innovative program models that can increase energy savings for low-income households and vulnerable communities.

- Public Utilities and Electric Cooperatives: Public utilities and electric cooperatives together provide 25 percent of the total electric consumption in the U.S., and are therefore an important target for LIEE. SMUD and Austin Energy are public utility leaders in the energy efficiency field due to local interest in these issues. The National Rural Electric Cooperative Association developed energy efficiency programs to help rural electric utilities overcome barriers to energy efficiency.

- Heat Island Reduction Programs: A Heat Island Reduction Program is one example of a community-level investment that can reduce energy usage and energy costs, reduce greenhouse gas emissions and storm water runoff, improve public health and quality of life, increase resiliency to climate change impacts, and increase local economic development. Strategies include use of cool roofs, cool pavements, pervious pavements, and tree planting.

  These programs can help low-income households and vulnerable residents because they target urban communities where these households are concentrated and are most impacted by the heat island effect and by climate change. Programs have been implemented in states around the country, including in the four target states. Research should be conducted to document the success of these programs and the program designs with the greatest impact.

- Community Solar: Community Solar projects provide access to solar energy that is located somewhere in the community rather than on the customer's roof. There are multiple subscribers who purchase a portion of the power produced and receive a credit on their electric bill.

  Colorado is one of four states that have low-income carve-outs as part of their community solar requirements. (The other states are California, New York, and Oregon.) Additional work should be done to ensure that low-income households have the opportunity to participate in community solar in other states.

- School-Based Energy Education: School-Based Energy Education Programs are a common element in utility energy efficiency portfolios. These programs may target energy savings in the schools or in the homes of the students who attend the schools.

  One principle behind these efforts is that it is easier to educate children than to educate adults, and that children can learn energy efficiency lessons that they carry with them throughout their lifetimes. The programs can encourage behavior change in the students and their families, and the students can become advocates for energy efficiency.

School-Based Energy Education programs have the advantage that they can reach customers who otherwise would not or could not participate in energy efficiency, including lower-income households who cannot afford energy efficiency measures, and customers who live in multi-family buildings and/or who rent their homes. Programs have been implemented in states around the country, including in the four target states. Research should be conducted to assess the models that are most effective in terms of involving low-income households, achieving energy savings, and training the energy efficiency workforce.

- **Additional Program Funding**
  In addition to ratepayer and WAP funding, funding for LIEE may be provided through LIHEAP; rate case and merger settlements; and other models that combine donations, volunteer labor, and other leveraged grants.

  - Ratepayer Funding: The total amount of annual funding that should be allocated for the LIEE program depends on the following factors.
    - Number of participants to be targeted for service delivery.
    - Comprehensiveness and cost of measures installed.
    - Percent of eligible customers to be reached each year.

    Program funding may be held in a state account, by the utilities, or in an independent energy efficiency trust fund. A serious risk for energy efficiency funding is that the account is raided for use in the general state budget. State accounts, utility-held accounts, and nonprofit administrator accounts have all been raided for use in the state budget. However, the risk of a raid may be reduced if funds are not segregated into an efficiency-specific account, but the utility is still required to fund programs based on an EERS or a funding requirement.[192]

  - LIHEAP Funding: The U.S. Department of Health and Human Services, Administration for Children and Families, Office of Community Services administers the Low-Income Home Energy Assistance Program (LIHEAP). LIHEAP is a federal block grant program that assists low-income households with home energy bills, energy crises, and weatherization and energy-related home repairs. Because LIHEAP is a block grant program, each state establishes its own policies and procedures, within the requirements of the LIHEAP Statute.

    The U.S. Department of Health and Human Services provides broad flexibility for states to use LIHEAP funds for energy efficiency services. There are three key ways that the funds can be used: crisis replacement of unsafe heating and cooling equipment, Assurance 16 services that encourage and enable households to reduce their need for energy assistance, and transfer of funds to the Weatherization Assistance Program (WAP). Given potential funding allocations, LIEE investments could be greatly

[192] Harrington and Murray. The Regulatory Assistance Project. Who Should Deliver Ratepayer Funded Energy Efficiency? May 2003.

enhanced with additional LIHEAP-funded investments or additional LIHEAP transfers to WAP.

- Rate Case Settlements and Merger Settlements: Utilities' rates of return and revenue requirements are determined by the Public Utility Commission during a rate case. Low-income advocacy groups are often permitted to intervene and become parties to the case, provide testimony, and offer comments on proposed changes. Therefore, rate cases are an important opportunity for low-income advocates to obtain additional funding for low-income programs including LIEE programs. Merger settlements are an additional opportunity for advocates to intervene and obtain LIEE funding.

- Grid Alternatives Model: GRID Alternatives is able to provide no-cost or very-low-cost solar to low-income households because they have funding from low-income programs, they work with volunteers and job trainees, they receive equipment donations from solar manufacturers, and they identify other available grants to help households cover the remaining installation costs. They have successfully used this model to greatly increase the penetration of solar photovoltaics among low-income households, especially in California.

- **Financing**

  Programs are unlikely to serve the lowest-income households when participants are required to contribute to the costs of energy efficiency measures. No-cost energy efficiency programs were introduced to ensure participation in energy efficiency by the lowest-income households.

  When programs do have a participant contribution for low-income households, on-bill lending may be an opportunity to generate participation, at least for households in the more moderate-income categories. In New York, the Center for Working families lobbied for New York's Green Jobs Green New York (GJGNY) program to include on-bill financing because of an expectation that low- and moderate-income households would be more likely to participate in on-bill financing than in interest rate buy-downs or programs that relied on participants to obtain their own financing. The GJGNY legislation provides Tier 1 on-bill loans funded through capital markets to customers with high credit scores and Tier 2 loans through a revolving loan fund with less stringent requirements.[193]

  On-bill lending programs can work best for the lower-income groups when they follow these approaches.
  - Reduced reliance on standard measures of credit-worthiness for loan approval.
  - Loan terms that are at least as long as the payback period for the efficiency measures, to provide for reduced energy bills.
  - Increased incentives to reduce the loan amount required.
  - Risks for energy savings shared with implementers or contractors.

[193] Bell, Nadel, and Hayes. On-Bill Financing for Energy Efficiency Improvements. A Review of Current Program Challenges, Opportunities, and Best Practices. American Council for an Energy-Efficient Economy. December 2011.

- Education through community-based organizations.

- **Utility Cost Recovery and Incentives**
  Legislation and Public Utility Commission regulations can provide incentives for utilities to implement energy efficiency programs. These mechanisms include rate designs with higher variable costs, utility cost recovery, decoupling, Energy Efficiency Resource Standards (EERS), and performance incentives.

  - Fixed and Variable Rates: Customers' decisions to participate in energy efficiency will be affected by the potential the program has to impact energy bills. Rate design, and the parts of the bill that are fixed and variable, can be important determinants of this impact.

    When charges for energy service are shifted to fixed costs, the return to participants from energy efficiency is reduced, as a smaller portion of the bill is related to the amount of energy that is consumed. This shift lengthens the payback period for any energy efficiency project. The National Association of State Utility Consumer Advocates adopted a resolution opposing increases in electric and natural gas utility fixed charges.[194]

  - Cost Recovery: Program Cost Recovery allows for the cost of energy efficiency programs to be recouped in the utility's rates. This is a common practice where the costs may be recovered through rate increases or through a return earned on the funds invested in energy efficiency.

    To encourage energy efficiency, cost recovery for programs should be equivalent to cost recovery for supply-side investments. However, if the programs are treated as expenses, utilities are reimbursed but do not receive a profit, as they do with supply-side investments. In this case, utilities will need other cost reimbursement or Performance Incentives to ensure that energy efficiency programs are treated as positively as supply-side investments.

    Included in equivalent treatment of LIEE investments is equivalent levels of risk. In some cases, utilities do not invest in energy efficiency because they have concerns that they will not be reimbursed for energy efficiency if projected savings or cost-effectiveness targets are not realized.

  - Decoupling: Decoupling is a regulatory mechanism that removes the connection between utilities' revenue and their sales volume. Decoupling can remove the incentive for utilities to increase sales in order to increase revenue and profit (the Throughput Incentive) and reduce the disincentive for utilities to promote energy efficiency programs.

[194] Wood, Howat, Cavanagh, and Borenstein. Recovery of Utility Fixed costs: Utility, Consumer, Environmental and Economist Perspectives. Future Electric Utility Regulation. LBNL-1005742, Report No. 5. June 2016.

Decoupling policies do a good job when they accurately reflect the cost of electricity production and delivery. They can provide lower prices for the fixed components of the bill and higher prices for volumetric charges to encourage energy efficiency, but still ensure stable revenue for the utility. Decoupling can also encourage the development of renewable energy generation if they accurately reimburse the utility for fixed costs and infrastructure and promote the least cost options.

Many decisions must be made with respect to how decoupling will be accomplished.

- Mechanism: revenue per customer, annual revenue requirement, or some other method.
- Comprehensiveness: full or partial (which will determine the impact on the throughput incentive).
- Adjustment: reconciliation calculation.
- Timing: monthly, quarterly, semi-annual, or annual adjustments.
- Distribution: equally among classes or weighted.
- Implementation: when there is a deviation or deferred for later collection.
- Term: end of program and timing of review, renewal, or termination.[195]

Specific factors in the region, economic conditions, and political issues may determine which type of decoupling will work best.[196]

- Energy Efficiency Resource Standards (EERS): While decoupling can be an effective mechanism for reducing disincentives to energy efficiency, additional policies are needed to explicitly encourage utilities to implement energy efficiency. An additional policy such as an EERS can provide that incentive by requiring that the utility meet a specified energy usage reduction target within a designated timeframe. The EERS should include explicit LIEE targets to ensure that this population is served.

  The advantage of the EERS is that it sets a requirement for the outcome, the amount that usage is reduced, rather than the input into the program. Therefore, utilities are held accountable for what they achieve through their efforts. However, measurement of the actual energy savings is usually done through deemed savings or TRMs that use formulas to estimate the amount of energy saved based on the number of measures or projects completed. Therefore, the measurement does not take account of the quality of installation or the level of use of the measure (for example, the hours per day that lighting is actually used) except sometimes in a small number of cases where metering is completed. The EERS should require use of utility billing analysis or other extensive confirmation of engineering estimates.

  States often provide performance incentives and sometimes impose penalties if utilities do not meet the EERS requirements. However, even without explicit

[195] Decoupling Policies: Options to Encourage Energy Efficiency Policies for Utilities. National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy10osti/46606.pdf

[196] Cook. The Case for Decoupling: A Policy to Promote Energy Efficiency. January 2007.

incentives, utilities are motivated to comply with the EERS because of their continued reliance on the regulatory bodies to provide favorable responses to other regulatory decisions.[197]

- Performance Incentives: Specific incentives should be provided for LIEE to encourage investment in programs targeted to these households. Incentives should be awarded based on evaluations of energy usage reductions using utility billing data, weather normalization, and comparison groups.

- **Other Models**
  Other models for encouraging investment in energy efficiency include building code, green leases, and green banks.

  - Building Code: New construction standards are critical for applying energy efficiency practices in newly built structures and preventing the need for immediate improvements to reduce energy usage. Implementing energy efficient protocols during the construction process is more cost-effective than providing retrofits at a later date. Efforts should continue to increase implementation of the latest and most energy efficient code.

  - Green Leases: A Green Lease may help to overcome the split incentive problem by including environmental aspects in the rental contract. The lease will specify the responsibilities of the landlord and the tenant with respect to environmental issues.

  - Green Banks: Green banks have been created by state and local governments to finance energy efficiency and other forms of clean energy investments. Most green banks work with utility programs to achieve deeper energy savings.

[197] Theel and Westgaard, Moving Toward Energy Efficiency: A Results-Driven Analysis of Utility-Based Energy Efficiency Policies. March 2017.

IX. Evaluation of LIEE Programs

Evaluation should be conducted to ensure that LIEE programs are implemented efficiently and effectively, and that expected results are achieved. This section provides an overview of how LIEE programs can be evaluated to provide information on what they achieve and how they can be made more effective.

A. Evaluation Purpose

The following needs can be met with a comprehensive evaluation.

- Measure Program Impacts: The evaluation can provide information to assess the impacts of the program on important performance indicators. Some of the key indicators to be examined include the following.
  - Energy usage
  - Energy bill affordability
  - Economic impacts
  - Environmental impacts
  - Health, safety, and comfort
  - Cost-benefit analysis

- Assess Potential Improvements: Process and Impact Evaluation can identify areas for program improvements. The evaluation can help program managers understand how to refine the program to improve the following.
  - Goal achievement
  - Efficiency
  - Effectiveness
  - Equity
  - Targeting
  - Participant satisfaction

- Meet Regulatory Requirements: Evaluations are also often conducted to meet regulatory reporting requirements imposed by various entities.

B. Process Evaluation

The key questions answered by the Process Evaluation are as follows.

- How is the program designed?
- How is the program implemented?
- Why is the program achieving its goals or not achieving its goals?
- How can the program be improved?

Research activities that should be included in the process evaluation are described below.

- Background Research: This activity should provide a comprehensive understanding of program details, including the program's goals, performance measures, design, eligibility, targeting, measures and services, energy education, service delivery contractors, service delivery procedures, challenges and barriers, quality control, data sources, and data availability. The following tasks should be undertaken.

  - Document Review: Analysis of program plans, rules, applications, statistics, training materials, budgets, contracts, outreach and marketing materials, data collection forms, and internal monitoring and reviews.

  - Interviews: Discussions with program managers, staff, contractors, subcontractors, and quality control inspectors to fill in gaps and assess challenges and barriers.

  The output from this research activity is documentation of all aspects of the program, a refined understanding of the evaluation focus, and initial program recommendations. The documentation can be useful for program managers and staff, as programs often do not have one concise document that provides information on all aspects of the program.

- Participant Survey: The purpose of the survey is to obtain feedback from program participants and understand several aspects of the program that cannot otherwise be understood. These aspects include the following.

  - How the participant learned about the program
  - Participants' understanding of the program
  - Motivation to participate
  - Barriers to participation
  - Energy education provided
  - Changes in energy usage behavior
  - Impacts on home comfort
  - Impacts on health
  - Program satisfaction

  A sufficient number of surveys should be conducted to provide an assessment of key subpopulations. This may include contractors, utilities, job types, or other factors. Any subgroup to be analyzed should have a minimum of 75 to 100 surveys completed.

- Nonparticipant Survey: The participant survey cannot fully explore barriers to participation, as it only includes individuals who overcame those barriers. An additional survey with recruited participants who refused services or did not participate for some other reason can provide important information on the key participation barriers and how they may be overcome.

- On-Site Research: This assessment provides an understanding of service delivery challenges, adherence to program procedures, and quality of work performed.

- On-site observation of service delivery provides direct assessment of how program protocols are implemented, the effectiveness and usability of those protocols, contractor's use of equipment, appropriateness of testing procedures, provider adaptability, comprehensiveness of service delivery, work quality, client education, and client interaction.

- Inspections of completed jobs can provide a statistically reliable analysis of the quality and comprehensiveness of work performed.

  - Sample: The sample of inspected jobs needs to be representative of all program jobs completed during the analysis year. Statistics that characterize the population of jobs, including geographic distribution, housing unit characteristics, demographic characteristics, contractor completions, spending levels, and installed measures should be developed to stratify the sample on the most important of those factors and identify various population segments. A target number of completed inspections should be determined for each sample stratum and a sample of jobs should be selected that is sufficient to achieve the sample quota.

  - Recruiting: Participants must be contacted, screened, and recruited for an on-site inspection that may last as long as four hours to complete all necessary testing and assessments. Night and weekend appointments should be available to ensure that a representative sample of participants is recruited. Participants should be offered a monetary incentive in recognition of the time and effort required to keep the inspection appointment.

  - Visit Protocol: The inspection protocol should include the following elements.

    Data Retrieval – Extract all relevant service delivery data for each sampled home, including pre- and post-diagnostics, installed measures, and costs.

    On-Site Inspection – BPI-certified and experienced technicians should conduct a four-hour inspection that includes diagnostic testing relevant to the home including blower door testing, duct testing, equipment efficiency and safety testing, IR inspection, and appliance metering.

    Measures – All installed measures should be inspected for final quality and completeness using appropriate diagnostic procedures.

    Missed Opportunities – Any measures that could have been installed, but were not should be identified.

    Client Interview – The visit should include a discussion of health, comfort, and safety issues, as well as any client-related factors that may have led to exclusion of certain measures.

- Post-Inspection Analysis: The data for each home should be analyzed in terms of: Measure Selection, Installation Quality, and Health and Safety Issues. The report should be provided to the contractor who performed the work so that the contractor has the opportunity to comment on the findings and possibly explain decisions made in the field.

- Reporting: The final report should assess the quality and comprehensiveness of the work done in the program, furnish information on the effectiveness of the program in addressing the needs of each system in the home (e.g., space heating, water heating, air conditioning, refrigeration, lighting, and appliances), and provide an overall assessment of installed measures. Key indicators may include the following.

  - Percent of Spending Appropriate (i.e., consistent with program guidelines) and Good Quality
  - Percent of Spending Appropriate but Poor Quality
  - Percent of Spending Inappropriate
  - Cost of Measures Appropriate but not Installed

On-site research should be conducted in a quantitative manner if the budget allows. A few visits can provide anecdotal information about the work, but cannot provide direction for changing protocols or specific areas where training is most needed. The quantitative assessment should proceed in the following manner.

- Develop check lists and rating scales to consistently record job information.
- Train experts to consistently implement the data collection procedures.
- Quantify findings across all observations and inspections.
- Enrich the data with descriptive information.
- Make recommendations based on prevalent issues.

C. Impact Evaluation

Research activities that should be included in the impact evaluation are described below.

Program Data Analysis

Analysis of the program database can provide important information about the program. If the tracking system contains comprehensive data, this analysis can provide essential information about targeting, participant characteristics, home characteristics, penetration of key energy efficiency measures, measure costs, health and safety repairs and costs, total job costs, and inspection rates.

Usage Impact Analysis

Various types of analysis have been implemented to assess the impacts of energy efficiency programs on energy usage. These include deemed savings, Technical Resource Manual (TRM) estimates, and analysis of pre- and post-treatment energy usage data. Tables IX-1 and IX-2 compare the data requirements and accuracy of these methods. While the billing analysis

has the greatest data requirements, it is the only analysis that can provide an accurate estimate of the program's success in saving energy.

Table IX-1
Estimation of Energy Savings
Tradeoffs of Various Approaches

Factor	Deemed Savings	Technical Reference Manual	Billing Analysis
Accuracy	Lowest	Middle	Highest
Cost	Lowest	Middle	Highest
Data Needs	Lowest	Middle	Highest

Table IX-2
Data Needs for Various Approaches to Energy Savings

Data Element	Is the Data Element Needed for Each Approach		
	Deemed Savings	Technical Reference Manual	Billing Analysis
Installed Measures	No	Yes	Yes
Pre-Treatment Usage	No	Sometimes	Yes
Post-Treatment Usage	No	No	Yes
Weather Data	No	No	Yes
Comparison Group	No	No	Yes

Below we provide more detailed information about each approach.

- Deemed Savings: The deemed savings analysis assumes a particular amount of energy saved for each measure installed, a penetration rate for each measure, a retention rate for each measure, pre-treatment usage, measure effectiveness, and a resulting level of average participant savings and total savings for the program. This is the simplest and least accurate method for estimating energy savings. No program or utility data are required, but it is unlikely that this method will provide a reasonable estimate of the amount of energy saved, even on an aggregate basis.

- Technical Reference Manual (TRM): A technical reference manual provides a formula for calculating savings from each installed measure. While some measures may have a set value for energy savings, many take into account the conditions of the baseline equipment, the replacement equipment, or the level of work undertaken. Additionally, savings are usually only claimed for the number of jobs that actually installed the measure rather than on a predicted measure penetration rate.

  Comparisons of these estimates with the billing analysis show that the TRM estimates usually over-predict the amount of energy saved, and often by a great amount. For some

measures, the TRM should do a good job of estimating savings. For example, the amount of energy saved by a new refrigerator should be equal to the metered electric usage of the existing refrigerator minus the manufacturer-reported energy usage of the replacement refrigerator. However, recent comparisons of these projected savings to those from a billing analysis found that the TRM refrigerator savings were greater than the total energy savings from the participants who received refrigerators and other measures, and significantly greater than the billing analysis savings for the refrigerators based on measure-specific regression analysis. Problems with the TRM analysis can include incorrect or inaccurate refrigerator metering or data entry and different set points used than what the manufacturer used to test the equipment.

- Billing Analysis: A billing analysis uses monthly (sometimes bimonthly or sometimes more frequent than monthly) energy usage data from the utility company for the year prior to service delivery and the year following service delivery, weather normalizes the pre- and post-treatment usage data, assesses how that compares to the change in usage for a comparison group that did not receive program services, and calculates the net impact of program services.

  - Energy Usage Data: Monthly energy usage data are needed for close to a full year before and after the home received services. The pre-treatment data should end before any services are delivered, even the audit, because energy education may be provided and minor measures may be installed during the audit. The post-treatment data should start after all measures are installed.

    A certain percentage of participants will be removed from the analysis because the energy usage data are not available or appear to be inaccurate. The following groups of participants are typically excluded.

    - No usage data provided, potentially because of errors in account numbers or the participant has moved or had the account closed following service delivery.
    - Less than nine months of pre-treatment usage data.
    - Less than nine months of post-treatment usage data.
    - Extreme outliers in energy usage.
    - Change in usage that is greater than 65 percent.

    Typically, 50 to 80 percent of the participants can be included in the analysis following these removals. It is important to compare the observable characteristics that are available in the program data to assess how the full population of treated homes compares to those with sufficient data to be included in the impact analysis. In some cases, the usage impact results must be weighted if there are differential attrition rates and the groups have significantly different energy savings.

  - Weather Normalization: It is critical to weather-normalize the data because changes in weather from the pre- to the post-treatment period will impact measured savings.

If there are large differences in pre- and post-treatment summers or winters, the weather normalization can have a large impact on estimated energy savings.

Billing data weather-normalization analysis methods can be broadly grouped into two categories – house-by-house savings analysis and pooled analysis.

- House-by-house analysis: PRISM is an example of the house-by-house analysis, where energy usage for each home is analyzed. Gross savings is calculated for each home as the difference between pre- and post-treatment weather-adjusted usage. Savings is also calculated for the comparison group. The net change is the difference between the savings for the treatment group and the comparison group.

  In addition to PRISM, proprietary degree day analysis methods often allow for a greater percentage of treated households to be included in the analysis.

- Pooled analysis is conducted using a regression model, where the model directly estimates the comparison group-adjusted savings as a parameter of the regression model.

There are several strengths of the house-by-house analysis approach.
- Savings estimates for each house can be analyzed using a range of statistical techniques.
- Characteristics of high- and low-saving homes can be assessed.
- Savings for groups of interest can be calculated.
- Regression models can be fit to estimate savings by measure.
- Relationships between usage and a wide range of characteristics can be explored.

However, the house-by-house approach has drawbacks.
- It is less robust where energy usage is idiosyncratic (i.e., does not follow the same pattern month-to-month and year-to-year).
- If there are limited or poor-quality meter reads, substantial attrition can bias the analysis.

The pooled analysis also has several advantages.
- All of the billing data that are available for treatment and comparison homes can be utilized.
- Exogenous factors that are expected to have an impact on usage patterns for both types of households (e.g., economic factors, energy price changes) can be taken into account.
- A direct estimate of program savings for the targeted analysis period is furnished.

There are two important weaknesses of the pooled analysis model.

- Since there are multiple sources of variation in savings, a fully-specified model requires the estimation of a large number of parameters that can make the final results difficult to interpret.
- There is limited ability to furnish information on the distribution of savings and to facilitate exploratory analysis of the determinants of program performance.

A good practice is to conduct both types of analyses, compare results, and assess whether differences are caused by differences in the included participants or differences in the analysis methods.

- Comparison Group: While the process described above controls for changes in energy usage that result from differences in weather rather than the impact of the program, there are other factors that can impact energy usage in addition to energy efficiency measures. These factors can include the economy, energy prices, and general energy conservation messages. The goal for a comparison group is to select a group of homes who are as similar as possible to the treatment group but who did not receive program services. There are usually at least two good candidates.

  - Later Program Participants: These are program participants who received program services one year later than the treatment group. These homes are a good comparison group because these customers also participated in the program. However, they may be different than the treatment group in some unobservable ways because they participated one year later. We examine their usage in the two years prior to participating to control for changes in usage that are not related to program participation during the same time period when we are looking at the treatment group.

Table IX-3
Treatment and Later Participant Comparison Group

	Pre	Post	Change	Measured
Treatment Group	Year Before Services	Year After Services	After - Before	Program Impact and Other Factors
Comparison Group	2 Years Before	1 Year Before	2 Years Before – 1 Year Before	Other Factors
Treatment - Comparison	**2014-2016**	**2015-2017**		**Program Impact**

  - Matched Comparison: A large number of comparable residential customers' usage must be requested from the utility to construct a matched comparison group. We typically request a sample of 100,000 customers. Their usage is then analyzed to select customers whose 12-month usage patterns are most similar to those in the treatment group prior to services. This is a good comparison group because the usage patterns are very similar to those who participated in the year before installation, and are likely to be a good representation of what the participants' usage would have been the following year if they had not participated in the

program. However, these customers may be different than the participants in unobservable ways because they did not participate.

The usage match is conducted in the following steps.

1. Average daily usage is calculated for each billing month, where average daily usage is equal to the total usage in the bill cycle divided by the number of days in the billing cycle.
2. The Sum of Squared Differences (SSD) in average daily usage between the participants and the nonparticipants for the 12-month period prior to participation is calculated.
3. We select nonparticipants for the comparison group with the minimum SSD for the 12-month period. One nonparticipant match is selected to serve as a comparison for each participant.

- Energy Usage Impacts: Once the usage impact analysis is conducted, the energy savings should be assessed for various seasons, population subgroups, and installed measures.

  - Seasonal Impacts: Energy savings can be disaggregated into heating impacts, cooling impacts, and baseload impacts. This analysis can provide some information about where the most effective usage reduction is achieved.

  - Subgroup Analysis: Analysis of which characteristics are associated with higher and lower savings can provide information to help improve program targeting and energy savings. These factors should be examined if data are available.

    1. Utility
    2. Heating fuel
    3. Program delivery contractor
    4. Customer characteristics
    5. Housing characteristics
    6. Home type – single family detached, single family attached, and mobile homes
    7. Pre-treatment energy usage
    8. Spending tiers
    9. Measures installed
    10. Health and safety measures installed
    11. Bill payment assistance program participation

  - Measure-Specific Analysis: Regression analysis should be conducted to estimate the impacts of specific measures. This will only be possible for measures that are installed in a significant percentage of homes, and where the level of implementation (such as dollars spent on air sealing or insulation) varies if the measure is installed in most home.

Payment Impact Analysis

This analysis examines the impact of the energy efficiency services on energy bills, ratepayer subsidy, affordability, and customer payments. Because these data cannot be weather-normalized like the usage data, it is even more important to include as close to a full year of data and utilize a comparison group. The full year of data is also critical because energy assistance such as LIHEAP can vary over the time of the year.

The following areas should be addressed in the payment impact analysis.

- Energy bills
- Energy burden
- Ratepayer energy assistance subsidy
- Ratepayer assistance program participation
- Bill payments
- Coverage rates (percent of bill paid)
- Shortfall (difference between bill and customer payment)
- Arrears (amount owed to the utility)

The analysis of the program's impact on the customer's bill and the ratepayer subsidy is complicated. The benefit may accrue to the ratepayers, to the customer, or be split between the ratepayer and the customer. Examples of various scenarios for the New Jersey Universal Service Fund (USF) program are shown in the table below. Whether the benefit goes to the ratepayer, the customer, or is split depends on whether the customer exceeds the maximum USF subsidy before and after the energy efficiency treatments.

Table IX-4
Impact on Customer Bill and Ratepayer Subsidy
NJ Comfort Partners and Universal Service Program Example

	Customer 1	Customer 2	Customer 3	Customer 4
Pre-Treatment				
Income	$10,000	$10,000	$10,000	$10,000
Bill	$1,000	$650	$3,000	$2,400
Burden	10.0%	6.5%	30.0%	24.0%
USF Subsidy	$400	$50	$1,800	$1,800
Customer Payment	$600	$600	$1,200	$600
Post-Treatment				
Bill	$850.00	$552.50	$2,550.00	$2,040.00
Burden	8.5%	5.5%	25.5%	20.4%
Subsidy	$250	$0	$1,800	$1,440
Customer Payment	$600	$552.50	$750	$600

	Customer 1	Customer 2	Customer 3	Customer 4
Customer Savings	$0	$48	$450	$0.00
Subsidy Reduction	$150	$50	$0.00	$360
	Pre burden>6% (before USF)	Pre burden>6% (before USF)	Pre burden>6% (before USF)	Pre burden>6% (before USF)
	Pre burden=6% (after USF)	Pre burden=6% (after USF)	Pre burden>6% (after USF)	Pre burden=6% (after USF)
	Pre USF < max subsidy	Pre USF<max subsidy	Pre USF=max subsidy	Pre USF=max subsidy
	Post burden>6% (before USF)	Post burden<6% (before USF)	Post burden>6% (before USF)	Post burden>6% (before USF)
	Post burden=6% (after USF)	Post - No USF needed	USF = max subsidy	Post burden=6% (after USF)
Benefit to:	**Ratepayers**	**Customer and Ratepayers**	**Customer**	**Ratepayers**

The short-term impact of the program may accrue to the customer more than in the longer term, if the estimate of the customer's usage that is utilized for the USF benefit determination does not take into account the full reduction in usage that results from the program.

Realization Rate Analysis

Energy savings that are projected through the TRM should be compared to savings from the billing analysis. A realization rate is the percent of projected savings that are achieved, and is calculated as the billing analysis savings divided by the TRM savings. The realization rate can be calculated for the program as a whole and for individual measures. Based on differences in these estimates, recommendations should be made for revisions to the TRM.

Performance Measurement

Performance measurement is required to achieve and document improvement in implementation over time and to confirm that program refinements lead to greater energy savings. Programs should take the following steps to measure baseline performance, improve design and implementation, conduct quality control, and assess results over time.

1. Develop Baseline Statistics: Document current statistics on pre-treatment usage, major measure installation rates, and energy savings measured through billing analysis.

2. Refine: Review and refine the program procedures. Train the contractors on areas of key weakness. Program weaknesses may result from both a lack of clear program guidance and a lack of understanding and follow through among implementation contractors.

3. Pilot Program Changes: Pilot test innovative strategies to achieve greater success if it appears that barriers cannot be fixed with incremental changes. For example, programs may test a new process for compensating contractors to achieve results, or pilot new procedures for treating different types of homes, including homes with low usage, high baseload usage, health and safety problems, and homes previously treated by the program.

4. Conduct Quality Control: Observe work in the field and conduct inspections of completed jobs on a frequent and intense (including diagnostic testing) enough basis to verify that procedures are correctly and comprehensively implemented. Review all aspects of the work, including audits, documentation of the work scope, and installation. Require contractors to return to any homes that do not meet the program standards, and ensure that all parties agree to program specifications and procedures.

5. Hold Contractors Accountable: Periodically review work at the contractor level. Remove contractors that do not meet standards or require remedial training and improved results for continued participation in the program.

6. Assess Inputs and Outputs: Conduct analysis of the program inputs and outputs on a regular basis. Review the pre-treatment usage of program participants and the measure penetration rates for major measures. Assess whether these statistics are improving enough to lead to better results.

7. Assess Inspection Results: Review rates of comprehensive and high-quality installations. Review rates of missed opportunities and poor-quality work. These statistics, in coordination with the input and output statistics, will provide an early indicator of what to expect in terms of program savings.

8. Assess Results: Conduct billing impact analysis and review results on an annual basis. One evaluation every several years is not sufficient to ensure that the program is achieving the expected results. If done on a regular basis, program managers can develop procedures to more easily extract usage data and the impact evaluation could be completed at much lower cost. Compare results over time, assess what is working, and refine the program again.

This rigorous and continuous program improvement process requires measurement, refined program design and implementation, quality control, and continued assessment.

D. Cost-Effectiveness Testing

The cost-effectiveness analysis is conducted in the following steps.

- Calculate the present discounted value of energy savings.
- Calculate the present discounted value of non-energy impacts.
- Calculate the costs of energy services.
- Calculate the ratio of benefits to costs. If the ratio is greater than one, it is considered to be cost-effective.

Tests Used in Energy Efficiency Program Evaluation

The following five cost-effectiveness tests are most commonly referred to in the energy efficiency literature.[198]

1. Participant Cost Test (PCT): This test compares the costs and benefits of an energy efficiency investment from the perspective of the energy efficiency participant. The test can be useful in helping program administrators to determine what level of energy efficiency incentive should be provided to potential program participants.

2. Ratepayer Impact Measure (RIM): This test examines all program costs and the lost utility revenues compared to the benefits of avoided energy and capacity costs. The test assesses whether an energy efficiency resource will increase or decrease the rates for electricity or natural gas.

3. Utility Cost Test (UCT): This test compares the costs and benefits of an energy efficiency investment from the perspective of the utility. The test includes all costs and benefits that impact the utility's operations and the provision of service to customers.

4. Total Resource Cost Test (TRC): This test includes the perspectives of the utility and the energy efficiency program participants. The test includes the impacts of the Utility Cost Test and the impacts on participants. As such, it includes the impacts on fuels other than those provided by the utility administering the program and it includes participants' non-energy impacts.

5. Societal Cost Test (SCT): This test assesses whether the benefits of energy efficiency exceed the cost from the perspective of society. The test includes all impacts of the TRC as well as those that impact society such as low-income community benefits, environmental benefits, and economic benefits.

Table IX-5 provides an overview of the cost-benefit tests, the perspective, the question they address, and the included costs and benefits.

Table IX-5
Cost-Effectiveness Test Overview[199]

Test		Perspective	Question	Benefits	Costs
Participant Cost Test	PCT	Participant	Will participants benefit over the life of the measures?	• Bill Reduction • Tax Credits • Participant Non-Energy Benefits	• Incremental Measure Costs (net of incentive)

[198] National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources. National Efficiency Screening Project. Edition 1. Spring 2017.
[199] Cooney, Kevin. Energy-Efficiency Cost-Effectiveness Screening: An Overview of Tests, Key Inputs, and Practics from Across the Country, Tuscon Electric Power cost-Effectiveness Workshop, Navigant, 2012.

Test		Perspective	Question	Benefits	Costs
Ratepayer Impact Test	RIM	Ratepayer	Will utility rates decline?	• Avoided Energy Costs • Avoided Capacity Costs • Avoided Investment Costs	• Incentives • Other Program Costs • Lost Revenues
Utility/ Program Admin Cost Test	UCT PAC	Utility	Are the utility's revenue requirements lowered?	• Avoided Energy Costs • Avoided Capacity Costs • Avoided Investment Costs	• Incentives • Other Program Costs
Total Resource Cost Test	TRC	Utility & Participants	Will the total costs of energy decline?	• Avoided Energy Costs • Avoided Capacity Costs • Avoided Investment Costs • Non-Energy Benefits (utility & participant) • Participant Tax Credits	• Incentives • Participant Cost • Other Utility Program Costs
Societal Cost Test	SCT	Society	Is society better off?	• Avoided Energy Costs • Avoided Capacity Costs • Avoided Investment Costs • Non-Energy Benefits (utility, participant, & society) • Participant Tax Credits	• Incentives • Participant Cost • Other Utility Program Costs

Implementation of Cost-Effectiveness Testing

ACEEE conducted a study in 2012 to assess states' use of cost-effectiveness screening.[200] They found that 44 states and the District of Columbia had formally approved ratepayer-funded energy efficiency programs, and conducted a survey with these entities. ACEEE found that the TRC test was the most common test, used by 29 states or 71 percent of the respondents.

Table IX-6
States' Use of Cost-Benefit Tests

Test		Primary Test*		Tests Used	
		# of States	% of States	# of States	% of States
Participant Cost Test	PCT	0	0%	23	53%
Ratepayer Impact Test	RIM	1	2%	22	51%
Utility Cost Test/ Program Admin Cost Test	UCT PAC	5	12%	28	65%
Total Resource Cost Test	TRC	29	71%	36	84%
Societal Cost Test	SCT	6	15%	17	40%

*Two of the states did not have a primary test and 41 states did.

[200] Kushler, Nowak and Witte. *A National Survey of State Policies and Practices for the Evaluation of Ratepayer-Funded Energy Efficiency Programs.* 2012.

Use of Cost-Effectiveness Tests

Cost-Effectiveness testing is most often framed as a way to assess the efficacy of the investment following program implementation and evaluation. However, there are several other ways that cost-effectiveness testing is used.

- Program Design (measure, program, or portfolio level): When designing a program, cost-effectiveness testing is used with projected savings, costs, and benefits to assess whether a measure, program, or portfolio of programs should be implemented. Based on the results of testing, programs may be refined, replaced, or rejected.

- Home Assessment: Testing can be used as part of a home audit to determine which measures to install, to fund through the program, and/or to recommend to the participant to select.

- Utility Performance Incentives: Testing is used to assess the performance of a program. In some cases, utilities may not be reimbursed for the full program costs if the program or portfolio does not meet a cost-effectiveness standard.

- Program Refinement: Post-implementation testing can also be used to assess which measures are cost-effective, when they are cost-effective, and in what cases measures should be installed, not installed, or completely eliminated from the program.

How the Cost-Effectiveness Test May be Impacted by a CEIP Type Incentive

The Environmental Protection Agency (EPA) developed the Clean Power Plan (CPP) which would have placed an enforceable limit on CO2 emissions from existing power plants, resulting in an overall 30 percent reduction in power plant emissions by 2030. The proposed Clean Energy Incentive Program (CEIP) provided states with an incentive to design a compliance strategy with earlier deployment of LIEE and renewable energy resources. The program contemplated a two-for-one credit for energy efficiency deployed in low-income communities. Half of the credit would come from the state and half would come from a central EPA pool.

While the federal context has changed to make it unlikely that the CEIP will be implemented in the context of the CPP, there are opportunities to learn from the concept underpinning the program — setting aside credits or allowances to create additional value for near-term investments in LIEE. There are many potential methods that could be used to take advantage of a CEIP-type program. States participating in an emission trading system could set aside allowances to provide to administrators of LIEE programs, or others investing in LIEE programs, and those allowances could then be sold to those needing them for compliance. Or, states could auction allowances to power plants and then provide the revenues to LIEE administrators to create or expand programs.[201] Such an approach could help ensure that revenues are reinvested in a way that drives down total electricity bills for consumers.

[201] Shoemaker. Best Practices in Developing Energy Efficiency Programs for Low-Income Communities and Considerations for Clean Power Plan Compliance. ACEEE. April 2016.

A CEIP-type program could impact the cost-effectiveness testing by adding external funding to the program that would not be included in the calculated costs. The impact of the program would depend on the future value of the incentives provided by the CEIP. The Center for Climate and Energy Solutions estimated a maximum value of the CEIP of $7.4 billion.

E. Summary and Recommendations

LIEE program evaluation should be conducted by an independent third-party evaluator on a regular basis to ensure that the expected savings are achieved and to assess how the program can be improved.

Whenever possible, energy savings should be estimated based on analysis of pre- and post-treatment weather-normalized utility data. A comparison group should be used to control for other changes in usage outside of program influences. Use of TRMs or engineering estimates does not provide an assessment of the true impact of energy efficiency services on energy savings, and therefore does not ensure that the expected environmental and affordability benefits of LIEEs are realized.

Process evaluation should be conducted to assess why programs are performing to their current level and how performance can be improved.

Performance measurement is required to achieve and document improvement in implementation over time and to confirm that program refinements lead to greater energy savings.

Several different cost-effectiveness tests are used to evaluate the costs and benefits of energy efficiency programs. The test that is most commonly used is the Total Resource Cost Test that takes the utility and participant perspectives into account and assesses whether the total costs of energy will decline as a result of the program. While this test theoretically takes all benefits that impact the utility and the participants into account, jurisdictions generally do not factor the non-energy benefits into the assessment, including other fuels, reduced maintenance costs, health, safety, and comfort. As such, the test that is implemented is unbalanced, as all costs but not all benefits are included. A test that accurately estimates the net benefits of the program would provide a balanced approach that does factor in these benefits or that includes an adder to account for these additional non-energy benefits. However, it is important to accurately assess which benefits are related to electric usage reduction benefits and which are related to natural gas usage reduction investments. For example, reductions in carbon monoxide-related illnesses would only be related to the natural gas investments.

Another issue with respect to cost-effectiveness testing is the baseline, or the level to which the reduced energy usage is compared. The baseline that is used can have a large impact on the amount of savings that is estimated. The baseline for low-income households should be the equipment that is present in the home, as these households are constrained and are unlikely to replace that equipment until it fails. Using the current code as the baseline for LIEE would place a high bar on the level of energy savings needed for the measure to be considered cost-effective.

Free-ridership is not a factor in when calculating the benefits of LIEE. Low-income households do not have the resources to undertake the energy efficiency investments without the program subsidy, or more often without full cost coverage through the program. Therefore, free-ridership should be calculated as zero.

X. Best Practices for LIEE Design and Implementation

LIEE programs have been implemented and evaluated around the country for many years. Various aspects of the longest-standing programs have been tested and improved upon through numerous program cycles. The wealth of knowledge from this experience should be used to help inform new programs and policies and to refine existing programs. Based on research on LIEE programs, literature review, and interviews with key actors, we provide a summary of the best practices for these programs and an assessment of whether and how these best practices are implemented in the four target states.

A. Program Goals

This report described various goals for LIEE programs and how evaluation research can assess whether and to what extent the goals are achieved. Best practices with respect to goal setting include the following.

- Goals should relate to the program's mission.

- The goal should be **concrete** and specific. For example, rather than stating that the goal is to increase energy efficiency, the goal should be to reduce energy usage by 15 percent.

- The goals should include an outcome measure, an assessment of what the program is actually **achieving**, rather than an input or an output. Examples of each of these measurement levels are as follows.
  - Inputs: Amount of dollars spent.
  - Outputs: Number of homes treated or number of measures installed.
  - Outcomes: Number of kWh saved per home, percent of pre-treatment energy usage that is saved, or the benefit-cost ratio.

- The program should have a plan for how they will measure whether the goal is reached or the extent to which the goal is reached. Necessary data should be included in the program database or available for retrieval from the utility companies.

- The goal should be challenging, but achievable, based on past results or some other benchmark. If the program **saved** an average of 850 kWh per electric heating participant in the last evaluation, one might set a goal to achieve average savings of 1,000 kWh in the next year.

B. Program Management and Coordination

Energy efficiency programs can be managed by the state regulatory agency, an energy office, an independent organization such as Efficiency Vermont, by a utility collaborative, or by individual utilities. The program management decision will have implications for flexibility, coordination, and program refinement.

Whichever entity is responsible for program management, it is important that the entity provides for consistent policy over time. Additionally, it is important that the program has approval for a long enough period to ensure program consistency and acceptance.

One model that is not used in any of the target states is the independent organization model, as in Efficiency Vermont. This model has the advantage of a separation between business objectives and the energy efficiency goals. Other advantages include statewide program application which reduces market confusion, multi-fuel efficiency, and targeted economic development.[202]

Each method has advantages and disadvantages which must be weighed depending on the specific goals for the program.

- Coordination: Ability to coordinate between electric and gas utilities and with WAP will be heavily impacted by this decision. Coordination has clear advantages for the participant because it reduces the participant's transactions costs and provides more comprehensive service delivery. When the ratepayer funds are managed or can be directly accessed by the WAP administrator, coordination with WAP is more likely. When the gas and electric ratepayer funds are jointly administered, coordination between electric and gas is facilitated.

- Customer Data: Utilities have important data on energy usage, low-income program participation, and bill payment problems that can be used in targeting LIEE. These data may not be available or up-to-date when programs are delivered by non-utility entities.

- Community Focus: Low-income households are sometimes reluctant to participate in energy efficiency programs even when the services are provided at no cost to the household. The issue can stem from a lack of trust or skepticism that the services are really provided at no cost to the participant. When delivered by a local community organization, households may be more likely to accept services. Models are more conducive to community-level education and/or delivery when local agencies can directly access utility funds, as in Colorado.

Colorado's model allows for integrated delivery of program services across various funding streams. When a household receives services through the Weatherization Assistance Program (WAP), they will receive measures that are funded by the utilities and measures that are funded by WAP, and the process is seamless from the participant's perspective. The same is true when the household participates in a program that is managed by EOC or by another nonprofit organization. The household can apply to the organization that it knows and trusts. Many of the nonprofits are community-based and may be more accepted by the low-income community.

[202] Harrington and Murray. Who should Deliver Ratepayer funded Energy Efficiency? The Regulatory Assistance Project. May 2003.

In Illinois, when the individual programs are run by the utilities, they will have the data to target services to high users and/or payment-troubled customers as desired. However, it may be more challenging to coordinate electric and gas measures and to coordinate with WAP. The same is true in Pennsylvania where the utilities do not have external incentives to coordinate with WAP or other utilities and little coordination is achieved.

New Jersey provides coordination between electric and gas utilities because the program is jointly delivered, and the process is seamless from the customer's perspective. However, the utilities have faced challenges in coordinating services with WAP. The utilities have the data to target their high-usage customers who receive bill payment assistance from the New Jersey Universal Service Fund, but the same customers are unlikely to be high users from both the electric and gas perspective. Therefore, the overall savings for one fuel will not be as high as for a utility who can individually target their highest users.

C. Eligibility and Targeting

While the key eligibility criteria for LIEE is typically the household's annual income as related to the Federal Poverty Level (FPL) or Area Median Income (AMI), many other factors are sometimes considered for eligibility and/or for targeting. There are advantages and disadvantages to the various approaches.

- Income: More restrictive income guidelines mean that a greater percentage of the lowest-income households can be served. This may be important when funding for LIEE programs is more limited or is relatively new. In these cases, there may be a large percentage of the lowest-income households who have need for energy efficiency services, depending on the local weather. However, if the program has been implemented for many years and there has been difficulty locating a sufficient number of high energy users to target for energy services, then increasing the income eligibility limit will expand the number of households who can be served, and may allow the program to treat higher users and achieve greater savings. Households with income between 200 and 400 percent of the FPL are unlikely to participate in energy efficiency if there is not a specific program that provides no-cost or highly subsidized services. A broader income eligibility limit, with discretion to target the lowest-income subgroups if warranted, may be the best approach that maximizes the advantages of higher- and lower-income participation.

- Heating Fuel: Ratepayer-funded programs often limit services to customers who heat with electricity or natural gas. However, electric reduction programs often have program elements that deliver services focused on electric baseload and/or electric water heating, and may serve customers regardless of their heating fuel.

- Energy Usage: Many utility LIEE programs limit eligibility to customers who use a minimum amount either in an average winter month or on an annual basis. Research has shown that households who use more energy have greater savings due to their greater potential for cost-effective energy efficiency measures. Focusing on high users can help programs achieve EERS goals and cost-effectiveness goals. Low-income customers with

high energy usage will often have difficulty paying for their energy usage, so this method can also have a greater impact on improving energy affordability.

- Home Type: Some programs treat all home types and some limit services to single-family homes or small multi-family buildings. Programs should aim to treat all homes with potential for energy savings, but treating different types of multi-family buildings may require technical expertise that contractors serving the majority of participants do not have.

- Home Tenure: Some programs require that customers have been in their homes for a certain period of time prior to being evaluated for program services. This requirement is in place when programs are targeting customers based on energy usage and aim to serve customers who have high usage. Other programs require that customers sign a statement that they plan to remain in their home for at least a year to avoid serving homes where there will soon be a change of occupants that will impact the level of usage and opportunities.

- Environmental Justice and Climate Vulnerability: Environmental Justice includes communities across a variety of demographic indicators not limited to income, race, immigration, and age; as well as exposure to pollution risk, especially from power plants. Programs that have specific goals to address these issues should design the programs to ensure they are served. This could include targeting low-income households who live in areas prone to flooding, heat waves, and wild fires.

D. Outreach

Various methods are used for informing low-income households about program availability and recruiting them for program participation. The methods that are used are related to the type of program administration and the organizations that provide service delivery.

- Utility Program Administration: Utilities often provide contractors with lists of their high-usage bill payment assistance program participants to target for program services. The contractors have call centers that phone potential participants to recruit them for LIEE participation. Utilities may also have their call center representatives refer customers to LIEE programs if customers call in with concerns about their bill or requests for assistance.

  Because utilities are sending the targeted customers to contractors, this approach has the potential to treat households who best meet the program goals. However, in practice, the utilities send large lists of customers to the contractors, the contractors are under pressure to produce a certain number of jobs, and the contractors churn through the list without an emphasis on the best targets within the list (for example, the highest usage customers). Contractors may not make use of other outreach methods such as attending community events and educating customers at the door when they are in the neighborhood.

- WAP: The program often targets customers who have received assistance from the Low-Income Home Energy Assistance Program (LIHEAP). This is especially the case when the same agencies are delivering WAP and LIHEAP. Because customers who apply for LIHEAP are facing challenges with their energy needs, this outreach can accomplish the goal of improving energy affordability for those customers who have high usage and large potential for savings. However, this method of outreach does not usually target those customers who have the highest energy bills.

- Nonprofit Organizations: Nonprofit organizations that deliver LIEE will often provide outreach to households who come to the organization for other types of assistance. These organizations are more likely to attend energy fairs and other low-income assistance events in the community and create trust and acceptance for the energy efficiency programs.

LIEE programs often face challenges recruiting customers for service because of a lack of awareness, understanding, or trust. Outreach within the community by organizations that are known and trusted can be the most effective means of overcoming these barriers. Additionally, some customers understand that their energy bills will not be affected by participation in LIEE programs because they receive bill payment assistance for costs above a certain level or because they pay a percentage of their income for energy services. Therefore, it is important for program outreach to promote the other benefits of energy efficiency including improved comfort, health, and safety, as well as long-term energy affordability if their income increases and they are no longer eligible for bill payment assistance.

E. Types of Services

Service delivery can range from the least expensive energy efficiency kits, to direct install of minor measures, to comprehensive weatherization with air sealing, insulation, and appliance and HVAC replacement. If programs are targeted to the highest usage customers, efforts should be made to provide the most comprehensive services possible to provide high energy savings, achieve the most cost-effective delivery, and impact energy affordability. A larger number of major measures will result in higher energy savings. Additionally, administrative expenses will be reduced as a percentage of total costs, and will not be duplicated if there is no remaining need for another program to return to provide additional energy efficiency services.

Some programs have a cost threshold. While this limit will ensure that a minimum number of households are served, it does not take individual household circumstances into account, and may spend too little in some homes and more than what is cost-effective in some homes. For these reasons, a targeted average job cost may be a better method for ensuring that a minimum number of homes are served. This allows for more flexibility in treating the individual needs of the home. However, in practice, contractors or agencies can have a difficult time targeting an average and often treat this goal as a limit rather than an average. If an average cost method is used, quality control should focus particular attention on insuring

that energy efficiency investments are matched to the level of cost-effective opportunities in the home.

If the program is going beyond the highest usage households, energy services should be targeted based on the level of usage and the level of opportunities for savings.

- Kits: Energy efficiency kits that may include CFLs or LEDs, power strips, aerators, showerheads, and caulking material should be provided to the lowest energy users. Research has found that providing a postage-paid card for customers to send back to request a kit provides higher savings than distributing the kits to all households within the targeted usage profile. When the kits are provided without a request, the measures are less likely to be installed and savings will be reduced.

- Direct Install: A one-visit direct install service will be most effective for mid-usage customers. These customers are likely to have more opportunities for lighting, other minor measures, and energy education.

F. Health and Safety Improvements

A key barrier faced in LIEE is the inability to address health and safety issues that prevent comprehensive home weatherization services. Because of these barriers, many programs have found reduced opportunities for treating low-income households.

Where possible, spending should be undertaken to overcome health and safety barriers to allow for comprehensive service delivery. Depending on program regulations, this may be done by conducting an assessment of the maximum level of health and safety spending that will still allow for cost-effective service delivery or by locating other sources of funding that can cover these repair costs.

Some programs have been established to coordinate funding and overcome health and safety barriers. Some examples of programs that have brought in coordinated funding to effectively address health and safety issues and provide comprehensive services are as follows.

- EOC is implementing a new pilot program with the Colorado Department of Transportation to provide comprehensive health and safety and energy efficiency services to 300 homes in a targeted neighborhood. The goal is to use the existing organizational structure to preserve affordable housing; improve housing stability, energy and water affordability, and health and safety; and provide improved coordination of services and stronger outcomes for program participants. The project will identify past program participation, determine the appropriate level and types of services for the participant, and coordinate with program partners.

- ECA implemented their Energy FIT Philly project that aimed to prevent homelessness by preserving and stabilizing affordable housing that could not receive energy efficiency services due to home repair needs. ECA analyzed neighborhoods with the greatest density of rejections for weatherization to determine which neighborhoods to target. Many homes

had health and safety hazards, including high carbon monoxide levels, gas leaks, high relative humidity, mold, mildew, and pests. The program provided repairs to all 67 treated homes including new roofs, masonry repair, electrical, plumbing, carpentry, and dry wall. The program then provided air sealing, insulation, heating system repair or replacement, conversion from oil heating to high-efficiency gas heating, duct sealing, white roof coating, programmable thermostats, and energy education. The program was funded by foundations to leverage available WAP and utility funding.

- ECA proposed a pilot program to use LIHEAP WAP dollars to address health and safety barriers to weatherization. Currently the funding does not address the need for a new roof, treat homes without a central heating system, undertake pest remediation costing over $100, or provide moisture and mold remediation. ECA proposed that the PA DCED develop a statewide pilot to test a Weatherization plus Health approach that could overcome these barriers. The program would utilize a portion of the funding transferred from LIHEAP to DCED to run the pilot and make some necessary changes to LIHEAP WAP guidelines. The changes would include increasing the percent of costs allocated to health and safety, increasing the average expenditure per home, and removing some of the restrictions noted. DCED has asked DHS to amend their LIHEAP state plan to permit this pilot.

G. Measure Selection

Contractors should be provided with a list of standard approved measures and preferred materials, but should have flexibility to perform custom measures or use alternate materials depending on the unique situations in the home. The program should provide guidelines for determining when to install measures. A spending guideline that is based on the household's pre-treatment usage can do a good job of targeting measures to cost-effective opportunities, such as the amount to be spent on air sealing and insulation. However, there should be room for flexibility and spending overrides if the auditor assesses that there are particularly good opportunities in a home. Specific guidelines should be provided for some measures, such as metered refrigerator usage or occupant-reported hours of lighting usage.

Measures can be selected through the use of a computerized audit or a priority list, but extensive time should not be taken to record precise measurements of every aspect of the home because that will reduce time for more important efforts and has not been shown to increase savings. An educated and experienced auditor can do a better job by using the blower door and other diagnostic equipment to pinpoint the best opportunities and provide specific information on priorities in a detailed work order for the installer. Research has shown that photos as part of the audit report can be helpful, as can the visit of the auditor to the home while the installation work is beginning.

Research has shown that programs can maximize the savings achieved by installing as many cost-effective major measures as possible. These measures include blower-door guided air sealing, especially at the top and bottom of the envelope, attic insulation, wall insulation, basement insulation, heating system replacement, and refrigerator replacement.

H. Service Delivery

Service delivery organizations include private, for-profit contractors, weatherization agencies, and other nonprofit organizations. Private contractors can be more effective at managing cash flow, have the ability to more quickly hire additional staff if needed, and have more sophisticated data management tools and capabilities. However, these contractors may have less knowledge or experience with other public programs and low-income housing, less ability to coordinate programs or refer participants to other needed services, and reduced interest in serving low-income neighborhoods when other contracting opportunities are available. Also, for-profit contractors may be too focused on profit at the expense of service quality.

Weatherization agencies often provide ratepayer-funded LIEE service delivery for multiple utilities, as well as WAP service delivery. The WAP agencies' involvement in multiple programs can create a greater ability to provide joint service delivery of electric and gas utility programs and/or WAP. Because WAP has an extensive set of policies, procedures, and training, these agencies can reduce administrative costs for utility managers who often choose to conform to these technical and administrative procedures in their own programs.

The WAP agencies' experience can be a large benefit for a small utility program that does not have the level of expertise within their LIEE staff. However, the utilities should still be sure to provide adequate supervision and quality control to make sure that their priorities are followed and their goals are met.

Nonprofit organizations may be similar to WAP agencies, with an increased focus on clients, and with delivery of other low-income assistance programs that they can provide to LIEE participants in a holistic fashion. However, nonprofit agencies are more diverse in terms of their experience with LIEE and the types of other program offerings they have available. Where these nonprofits have the skills and experience to expertly deliver LIEE, and where they provide other benefits and services that are most complimentary to LIEE, they will be most effective in LIEE service delivery.

Job training programs are critical to ensure that there is a flow of qualified and motivated workers to provide LIEE services. Where such training can develop staff who are from the vulnerable communities they will serve, there may be additional benefits including familiarity, comfort, readiness, and commitment.

Home energy efficiency auditors and inspectors should have proper training and certification to provide high-quality and effective service delivery. Building Performance Institute Building Analyst (BPI BA) certification or Home Energy Professional (HEP) certification are recommended for auditors and inspectors.

I. Data Systems

The data tracking system is a critical aspect of any energy efficiency program, as it plays a role in efficient and effective program management, operations, evaluation, and improvement. The system should facilitate the following activities.

- Management and Reporting: The LIEE administrator needs program data to ensure that the program meets performance requirements, verify the program's fiscal integrity, potentially coordinate with other programs, and provide required reports to regulatory bodies and/or stakeholders.

- Operations: The administrator, service delivery contractors, and quality assurance contractors need information to make sure the program operates efficiently and effectively. Data are needed for the following purposes.
  - Targeting high-usage customers and appropriate measure delivery.
  - Reporting on job status.
  - Tracking jobs that have and have not been completed.
  - Reviewing information about specific jobs.
  - Invoicing for measures installed and administrative costs.
  - Communicating with partners about job issues.
  - Determining inspection results and required actions.

- Evaluation: Researchers need data to assess participation, targeting, home characteristics, comprehensiveness, inspection results, projected impacts, and measured impacts.

Ideally, one database will be used for the entire program, rather than one for each utility, contractor, or agency. Therefore, the system may be most efficient and effective when one party takes responsibility for creating, maintaining, and improving the central program database. This is done in the NJ Comfort Partnership program, with one database that is shared by the six utilities, but is rarely seen in other programs.

When there is a central program database, contractors often have their own internal database that is used for tracking and/or invoicing. It is more efficient if the contractor can also make use of the program database for these purposes, but that is not always possible. Additionally, the contractor may have to enter data into multiple systems when the internal system is needed. Data entry time and potential mistakes can be reduced if there is data syncing rather than multiple data entry points.

Many contractors have moved to computerized data collection where a tablet with pre-loaded participant data is used in the field to enter participant, home, and audit data while the technician is in the field. Data can then be uploaded or automatically synced with the data management system. This system has the following advantages.

- The auditor can have customer data (including usage) available on site.
- Data validation checks can be run while the data are entered and errors can be corrected when the auditor is still in the home.
- Data entry is not necessary following the visit.
- The software can calculate cost-effectiveness based on participant energy usage and home characteristics.
- The auditor can print a report for the participant while on site.

Programs sometimes have many forms attached to a job within the data system. This can be very useful for providing detailed analysis of a specific job or researching new issues that arise. However, it is extremely important that key fields are databased so that they can be analyzed, relationships can be explored, and summary statistics can be reviewed. At a minimum, the following fields should be included.

- Customer Contact Information
  - Name
  - Address
  - County
  - Phone number
  - Email address
  - Program job number
- Demographics
  - Annual household income
  - Poverty level
  - Income source (employment, pension/retirement, public assistance, disability, unemployment)
  - Number of household members
  - Vulnerable characteristics (children, elderly, disabled)
  - Health issues (asthma, heart-related, other)
  - Primary language spoken at home
  - Urban/rural location
- Utility Data
  - Electric utility name
  - Electric utility account number
  - Type of meter (master metered or individually metered)
  - Natural gas utility (if applicable)
  - Natural gas utility account number
  - Pre-treatment energy usage
- Energy Usage Data
  - Heating type
  - Primary heating fuel
  - Use of supplemental heating
  - Secondary heating fuel
  - Water heating fuel
  - Type of air conditioning (none, central, window, wall, heat pump)
- Home Data
  - Home type (single family, mobile home, small multi-family, large multi-family, low- or high-rise building)
  - Home age (year built)
  - Square feet
  - Home ownership
  - Home tenure
  - Health and safety barriers

  - Heating system not working
- Service Delivery Data
  - Auditor
  - Service delivery contractor
  - Audit date
  - Measures installed
  - Whether measure was health and safety related
  - Measure installation dates
  - Measure-level costs
  - Total job costs
  - Job coordination (programs, costs, measures)
- Audit Testing Data
  - Refrigerator testing results
  - Refrigerator size
  - Blower door testing results (pre- and post-treatment)
- Inspection Data
  - Inspection results (passed or failed)
  - Inspection failure reason (invoice, health and safety, missed opportunity, installation quality)

Some programs' measure-level data provide thousands of detailed product codes that are difficult to characterize into specific measures. These data may be based on materials installed rather than measure type. More streamlined codes can provide for more accurate data entry and simplified analysis. Even if more detailed codes must be retained for program management, an additional measure variable should be created that limits the number of measures to key areas for analysis. An example of such coding is provided in Table X-1.

Table X-1
Key Energy Efficiency Measure Categories

Misc.	Lighting & Appliances	Air Sealing & Insulation	Heating & Water Heating
Audit	CFL	Air Sealing	Programmable Thermostat
Blower Door Test	LED	Attic Insulation	Line Voltage Thermostat
Education	LED Nightlight	Attic Ventilation	Heating System Repair
Health & Safety	Smart Power Strip	Perimeter/Wall Insulation	Heating System Replaced
Kitchen Ventilation	Refrigerator Test	Basement Insulation	Duct Sealing/Insulation
Bath Ventilation	Refrigerator Replaced	Garage Insulation	Water Heater Repair
Mechanical Ventilation	AC Replaced	Other Insulation	Water Heater Replaced
Misc. Repair	Dehumidifier Replaced	Vapor Barrier	Pipe Insulation
	Clothes Line	Attic Access Cover	Aerator
	Mattress Replaced (waterbed)	Window Seal/Repair	Showerhead
		Door Seal/Repair	Plumbing Repair

More data is not always better. The system should be streamlined to include only those fields that have an identified purpose with respect to program management, operations, reporting, or evaluation. The database should be cleaned so that inactive fields are archived or removed.

J. Energy Education

Energy education is an important component of LIEE service delivery. The education serves the following purposes.

- Measures Installed: The participant may need education on how to effectively use the installed measures.
- Energy-Saving Behaviors: The participant can learn how to make adjustments to energy usage behavior that can result in energy savings.
- Energy Bills: An understanding of energy bills allows the participant to make decisions about energy usage based on the costs of those uses. If the participant understands how to read the energy bill and determine when usage is decreasing, it provides positive re-enforcement for energy-saving actions.

Research has shown that education can be effective when a partnership is formed between the program/educator and the participant. The partnership model explains the program's role in providing energy efficiency services, the provider's role in discussing usage with the participant and identifying potential energy-saving actions, and the participant's role to take those actions to reduce energy usage. If successful, the participant has more motivation to take steps to reduce energy usage. However, it can take a skilled and dedicated auditor to develop an effective partnership.

During the visit, the auditor should work with the participant to identify potential energy-saving opportunities and assess which are feasible and the participant is willing to undertake. The output from the education should be a usage-reduction goal for the participant and an action plan. The action plan provides motivation and direction for customers to reduce energy usage.

It is important to follow-up with the participant to assess any issues with implementing the action plan, provide adjustments if usage increases, and commend the participant if usage declines. PECO provides a monthly letter to the customer for the year following service delivery. The letter is customized based on the change in usage and additional tips depending on the season. Participants with large increases in usage may receive a follow-up phone call.

K. Quality Control

Quality control is critical to ensure that procedures are followed and high-quality, effective services are delivered. A third-party inspector can provide an independent assessment of these issues. These assessments should go well beyond determining whether invoiced measures are present in the home and whether the home is left in a safe condition. The quality control reviews should assess the comprehensiveness of the installed measures, whether there were any important missed opportunities, and the effectiveness of the implemented services.

Diagnostic testing should be included, at least on a sample of the inspected jobs to review safety and quality of installations. Interviews with program participants will furnish important information on energy education provided as part of service delivery, and the extent to which the contractor communicated with the client to assess the circumstances in the home and provide the most effective service delivery.

The administrator should define a minimum number of jobs to be inspected. For a new contractor or program, or a program that is having performance issues, this percentage should be higher. When the program matures, the contractor has sufficient experience with the procedures, and the quality has improved, the percent inspected can be reduced.

Quality control should focus on the following issues.

- Were any health and safety problems caused by the program?
- Were any critical health and safety problems left unresolved by the program?
- Are the program procedures followed?
- Are the measures installed effectively?
- Are opportunities comprehensively addressed?
- Are there opportunities for improvement?
- Was the participant educated?
- Is the participant satisfied?

If there are serious issues found in the home relating to health and safety, poor work quality, or missed opportunities, the contractor should return to the home to correct the deficiencies. If only minor issues are found, the inspector should address these while in the home.

The inspection is an opportunity to follow-up with the participant regarding any questions about the installed measures and to provide additional education. The inspector should review the action plan with the participant, assess whether the participant was able to take actions, and provide additional education or goals if needed.

L. Summary

Table X-2 provides an assessment of which best practices are employed in the four target states and an analysis of best practices followed. Some of the best practices depend on the specific goals of the program, and in these cases, the items are not included in the table. The table highlights the best practices that are employed in green. In some cases we were not able to classify IL as the new programs will be implemented beginning in January 2018. Recommendations for LIEE best practices are provided in the final section of this report.

Table X-2
Energy Efficiency Policies in Target States

	CO	IL	NJ	PA
Electric Decoupling	Approved	Adopted	None	Pending

	CO	IL	NJ	PA
EERS	Adopted	Adopted	None	Adopted
Management	Nonprofit	Utilities	Utility Collaborative	Individual Utilities
Coordination	Yes	No	Yes	No
Community Focus	Yes	No	No	No
Utility Data	No	Yes	Yes	Yes
Income Eligibility	80% AMI	80% AMI	225% FPL	150%/200%* FPL
Community-Based Outreach	Yes	Yes	No	Sometimes
Data System				
Detailed System	In Development	?	Yes	Yes
Centralized System	In Development	?	Yes	No
Energy Education	Yes	Yes	Yes	Yes
3rd Party Quality Control	Yes	No	Yes	Yes
3rd Party Evaluation	No	No	Yes	Yes
Billing Analysis	No	No	Yes	Yes

XI. Findings and Recommendations

Low-Income Energy Efficiency (LIEE) programs have been implemented and evaluated around the country for many years. Various aspects of the longest-standing programs have been tested and improved upon through numerous program cycles. The wealth of knowledge from this experience should be used to help inform new programs and policies and to refine existing programs. Based on the research in this study, we provide a summary of key findings and recommendations to inform future LIEE implementation.

A. Program Administration and Regulatory Structure

Program goals, design, management and coordination, and utility rate design and incentives are discussed below.

- LIEE Design Framework: Goals are needed for the LIEE programs to direct, assess, and improve the program. The program should be designed with a focus on the goals and opportunities.
    - LIEE Goal Design: LIEE goals should relate to the program's mission, be concrete and specific, include an outcome measure and measurement plan, and provide an achievable challenge.
    - Program Environment: The unique characteristics of the jurisdiction are critical in LIEE program design. LIEE programs must assess the environment in which they are operating to determine best practices. Factors which will impact the design that is most successful include geography/weather, political and social factors, and available resources.
- Program Management and Coordination: Energy efficiency programs can be managed by the state regulatory agency, an energy office, an independent organization, a utility collaborative, or by individual utilities. The entity chosen for program management will have implications for flexibility, coordination, and program refinement. Program designers should assess these advantages of the various models and choose the one that best aligns with its goals. Whichever model is chosen, the designer should use other mechanisms to overcome the disadvantages of the particular approach.
    - Coordination: The ability to coordinate between electric and gas utilities and with WAP will be heavily impacted by the management decision. Coordination has clear advantages for the participant because it reduces the participant's transactions costs and provides more comprehensive service delivery. When the ratepayer funds are managed or can be directly accessed by the WAP administrator, coordination with WAP is more likely. When the gas and electric ratepayer funds are jointly administered, or administered through a centralized organization, coordination between electric and gas services is facilitated.

- Customer Data: Utilities have important data on energy usage, low-income program participation, and bill payment problems that can be used in targeting LIEE. These data may not be available or up-to-date when programs are delivered by non-utility entities. However, well-designed systems and procedures can provide external access to utility data.

- Community Focus: When delivered by a local community organization, households may be more likely to accept services. Models are more conducive to community-level education and/or delivery when local agencies can directly access utility funds, as in Colorado, or are used to deliver ratepayer-funded services, as is the case for some utilities in Pennsylvania and is planned in Illinois.

- Rate Design, Cost Recovery, and Utility Incentives: The regulatory structure and legislation relating to rates, program costs, and other mechanisms can have a large impact on incentives for LIEE.

  - Fixed and Variable Rates: Rate designs that minimize the percent of bill that is fixed, as opposed to the percent that varies with energy usage, will best encourage energy efficiency.

  - Cost Recovery: Cost recovery for LIEE should be equivalent to cost recovery for supply-side investments, both in terms of the monetary return and the level of risk.

  - Utility Incentive: Decoupling, Energy Efficiency Resource Standards (EERS), and Performance Incentives may be used to reduce the utility's "throughput incentive" and increase incentives for LIEE investments. An EERS can provide an incentive for energy efficiency by requiring that the utility meet a specified energy usage reduction target within a designated timeframe. To provide for low-income participation, specific targets must be set with respect to income-eligible households.

  - Measurement: The EERS and Performance Incentives should include specific LIEE targets and require use of utility billing analysis or other extensive confirmation of engineering estimates for energy savings.

B. Funding, Participant Costs, and Financing

Findings and recommendations in this area include LIEE funding, participant costs, and financing.

- LIEE Funding: The total amount of annual funding needed for the LIEE program depends on the comprehensiveness and cost of measures installed, and the percent of eligible customers to be reached each year.

- Raided Funds: LIEE resources may be less likely to be raided for other purposes if they are not segregated into an efficiency-specific account and the utility is required to fund programs based on an EERS or a funding requirement.

- Participant Costs: Programs are unlikely to serve the lowest-income households when participants are required to contribute to the costs of energy efficiency measures. No-cost energy efficiency programs are critical to ensure participation in energy efficiency by the lowest-income households.

- Financing: When programs have a participant contribution for low-income households, on-bill repayment may be an opportunity to generate participation, at least for households in the more moderate income categories. However, additional research is needed to understand the income levels where such an approach can be successful.

  On-bill programs for the lower-income groups should utilize appropriate measures of credit-worthiness for loan approval, provide credit enhancements, provide loan terms that are at least as long as the payback period for the efficiency measures, increase incentives to reduce the loan amount required, share risk for energy savings with implementers or contractors, and provide education through community-based organizations (CBOs).

C. Eligibility, Targeting, and Outreach

Program design issues include income eligibility and targeting, energy usage eligibility and targeting, and outreach.

- Income Eligibility and Targeting: More restrictive income guidelines mean that a greater percentage of the lowest-income households can be served. This may be important when funding for LIEE programs is more limited or the programs are relatively new. If the program has been implemented for many years and there has been difficulty locating a sufficient number of high energy users to target for energy services, then increasing the income eligibility limit will expand the number of households who can be served, and may allow the program to treat higher users and achieve greater savings. Households with income between 200 and 400 percent of the FPL are unlikely to participate in energy efficiency if there is not a specific program that provides no-cost or highly subsidized services.

  A broader income-eligibility limit, with discretion to target the lowest-income subgroups if warranted, may be the best approach that maximizes the advantages of higher and lower income eligibility requirements.

- Energy Usage Eligibility and Targeting: Households who use more energy achieve greater savings due to their potential for cost-effective energy efficiency measures. Focusing on high users can help programs achieve EERS goals and cost-effectiveness goals. Low-income, high users will often have difficulty paying for their energy usage, so this method can also have a greater impact on improving energy affordability.

- Home Type: Programs should aim to treat all homes with potential for energy savings, but treating certain types of multi-family buildings may require technical expertise that

contractors serving the majority of participants do not have. Specialists should be recruited when needed to ensure that energy saving opportunities are realized.

- Outreach: LIEE programs often face challenges recruiting customers for service because of a lack of awareness, understanding, or trust. Outreach within the community by organizations that are known and trusted can be the most effective means of overcoming these barriers. Program outreach should promote the non-energy benefits of energy efficiency including improved comfort, health, and safety, as well as long-term energy affordability.

D. LIEE Services

Service considerations include level of service, measure selection, health and safety improvements, and energy education.

- Comprehensiveness: If programs are targeted to the highest usage customers, efforts should be made to provide the most comprehensive services possible to provide high energy savings, achieve the most cost-effective delivery, and impact energy affordability. Spending should be undertaken to overcome health and safety barriers. If the program is going beyond the highest-usage households, energy services should be targeted based on the level of usage and the level of opportunities for savings.

- Measure Selection: Contractors need detailed program guidelines to effectively implement LIEE services. Programs can maximize the savings achieved by installing as many cost-effective major measures as possible.

    - Measure Selection Guideline: Contractors should be provided with a list of standard approved measures and preferred materials, but should have flexibility to perform custom measures or use alternate materials depending on the unique situations in the home.

    - Spending Guideline: The program should provide guidelines for determining when to install measures. A spending guideline that is based on the household's pre-treatment usage can do a good job of targeting measures to cost-effective opportunities, such as the amount to be spent on air sealing and insulation. However, there should be room for flexibility and spending overrides if the auditor assesses that there are particularly good opportunities in a home. Specific guidelines should be provided for some measures, such as metered refrigerator usage or occupant-reported hours of lighting usage.

    - Diagnostic Testing and Work Orders: An educated and experienced auditor should use the blower door and other diagnostic equipment to pinpoint the best opportunities and provide specific information on priorities in a detailed work order for the installer. .

    - Major Measures: Major measures including blower-door guided air sealing, especially at the top and bottom of the envelope, attic insulation, wall insulation, basement

insulation, heating system replacement, and refrigerator replacement should be installed when cost-effective opportunities are available.

- Cost Threshold: Expenditures per household should not be set based on a cost threshold, as such thresholds do not take individual household circumstances into account, and spend too little in some homes and more than what is cost-effective in some homes.

- Health and Safety Improvements: A key barrier faced in LIEE is the inability to address health and safety issues that prevent comprehensive home weatherization services. Because of these barriers, many programs have found reduced opportunities for treating low-income households.

  - Health and Safety Investment: Where possible, spending should be undertaken to overcome health and safety barriers to allow for comprehensive service delivery. Depending on program regulations, this may be done by conducting an assessment of the maximum level of health and safety spending that will still allow for cost-effective service delivery or by locating other sources of funding that can cover these repair costs.

  - Funding Coordination: Additional investment is needed to coordinate funding, overcome health and safety barriers, and provide comprehensive LIEE services.

- Energy Education: Energy education is an important component of LIEE service delivery. The education serves the following purposes.

  1. Measures Installed: The participant may need education on how to effectively use the installed measures.
  2. Energy-Saving Behaviors: The participant can learn how to make adjustments to energy usage behavior that can result in energy savings.
  3. Energy Bills: An understanding of energy bills allows the participant to make decisions about energy usage based on the costs of those uses. If the participant understands how to read the energy bill and determine when usage is decreasing, it provides positive re-enforcement for energy-saving actions.

  - Education Partnership: A partnership approach should be considered. The partnership model explains the program's role in providing energy efficiency services, the provider's role in discussing usage with the participant and identifying potential energy-saving actions, and the participant's role to take those actions to reduce energy usage.

  - Action Plan: During the visit, the auditor should work with the participant to identify potential energy-saving opportunities and assess which are feasible and the participant is willing to undertake. The output from the education should be a usage-reduction goal for the participant and an action plan. The action plan provides motivation and direction for customers to reduce energy usage.

- Follow-Up: The program should follow-up with the participant to assess any issues with implementing the action plan, provide adjustments if usage increases, and commend the participant if usage declines.

E. Service Delivery

Service delivery decisions include the implementation organization and the type and level of quality control.

- Implementation Organization: Energy efficiency delivery organizations include private, for-profit contractors, weatherization agencies, and other nonprofit organizations. Private contractors can be more effective at managing cash flow, have the ability to more quickly hire additional staff if needed, and have more sophisticated data management tools and capabilities. Private contractors may have less knowledge or experience with other public programs and may have less ability to coordinate programs or refer participants to other needed services. Also, for-profit contractors may be focused on profit at the expense of service quality.

  Weatherization agencies often provide ratepayer-funded LIEE service delivery for multiple utilities, as well as WAP service delivery. The WAP agencies' involvement in multiple programs can create a greater ability to provide joint service delivery of electric and gas utility programs and/or WAP.

  Because WAP has an extensive set of policies, procedures, and training, these agencies can reduce administrative costs for utility managers who often choose to conform to these technical and administrative procedures in their own programs.

  - Service Delivery Organization: Program managers should assess these advantages and disadvantages and consider using a combination of various types of service providers.

  - Oversight: The WAP agencies' experience can be a large benefit for a small utility program that does not have the level of expertise within their LIEE staff. However, the utilities should still be sure to provide adequate supervision and quality control to ensure that their priorities are followed and their goals are met.

  - Training and Certification: Home energy efficiency auditors and inspectors should have proper training and certification to provide high-quality and effective service delivery. Building Performance Institute Building Analyst (BPI BA) certification or Home Energy Professional (HEP) certification are recommended for auditors and inspectors.

- Quality Control: Third-party quality control is an integral aspect of delivering high-quality energy efficiency services.

  - Quality Control Components: Quality control assessments should go well beyond determining whether invoiced measures are present in the home and ensuring that there are no health and safety issues. The quality control reviews should assess the

comprehensiveness of the installed measures, whether there were any important missed opportunities, and the effectiveness of the implemented services. Diagnostic testing should be included, at least on a sample of the inspected jobs, to review safety and quality of installations.

- Participant Interviews: Interviews with program participants during the quality control visit will furnish important information on energy education provided as part of service delivery, and the extent to which the contractor communicated with the client to assess the circumstances in the home and provide the most effective service delivery.

- Education: The program should take advantage of this participant communication to follow up on energy education and provide additional recommendations for behavior changes where warranted.

F. Data and Evaluation

Data systems, evaluation, and cost-effectiveness testing are important components to ensure that the program is implemented effectively and meets its goals.

- Data Systems: The data tracking system is a critical aspect of any energy efficiency program, as it plays a role in efficient and effective program management, operations, and evaluation. The LIEE administrator needs program data to ensure that the program meets performance requirements, verify the program's fiscal integrity, potentially coordinate with other programs, and provide required reports to regulatory bodies and/or stakeholders. The administrator, service delivery contractors, and quality assurance contractors need information to ensure that the program operates efficiently and effectively. Researchers need data to assess participation, targeting, home characteristics, comprehensiveness, inspection results, projected impacts, and measured impacts.

  - Database: One central database should be used for the program.

  - In-Field Data Collection: Computerized in-field data collection where a tablet with pre-loaded participant data is used on site to enter participant, home, and audit data should be considered.

  - Key Data Fields: Key fields should be databased so that they can be analyzed, relationships can be explored, and summary statistics can be reviewed.

  - Streamlined Data: The data system should be streamlined to include only those fields that have an identified purpose with respect to program management, operations, reporting, or evaluation.

- Evaluation: Third-party evaluation is critical to ensure that the program is maximizing its efficiency and effectiveness.

- Evaluation Regularity: Evaluation should be conducted on a regular basis to ensure that the program is implemented efficiently and effectively, and that expected results are achieved.

- Billing Analysis: The impact evaluation should use utility usage data that is weather-normalized and a comparison group to control for other changes in usage outside of program influences. A TRM or engineering approach cannot provide an accurate assessment of savings to ensure that climate and affordability impacts are achieved.

- Process Evaluation: The process evaluation should provide additional information on why the program is or is not meeting expectations; and how performance, participant satisfaction, and energy savings can be improved.

- Performance Measurement: A cyclical process of assessment, refinement, testing, and re-assessment is required to achieve and document improvement in implementation over time and to confirm that program refinements lead to greater energy savings.

- Cost-Effectiveness Testing: Several different cost-effectiveness tests are used to evaluate the costs and benefits of energy efficiency programs. The test that is most commonly used is the Total Resource Cost Test that takes the utility and participant perspectives into account and assesses whether the total costs of energy will decline as a result of the program. While this test theoretically takes all benefits that impact the utility and the participants into account, jurisdictions generally do not factor the non-energy benefits into the assessment, including other fuel and water savings, reduced maintenance costs, health, safety, and comfort.

  - Balanced Cost-Effectiveness Testing: A test that accurately estimates the net benefits of the program would provide a balanced approach, factoring in the non-energy benefits or including an adder to account for non-energy benefits that relate to the impacts of the investments for each fuel.

  - Low-Income Baseline: The baseline for low-income households should be the equipment that is present in the home, as these households are constrained and are unlikely to replace that equipment until it fails. Using the current code as the baseline for LIEE would place a high bar on the level of energy savings needed for the measure to be considered cost-effective.

  - Measure Prioritization: Cost-effectiveness testing can be used effectively to prioritize measures that will provide the greatest reduction in energy usage for the lowest cost. However, research is needed to confirm and validate that expected savings from prioritized measures are realized.

G. Further Research

This report attempted to draw conclusions and make recommendations as to the best practices for LIEE design and delivery. However, the study identified several areas where additional

research is needed to provide firm recommendations for program implementation. Some of the key areas for additional research are summarized below.

- Utility Incentives: What are the best strategies to provide incentives for utilities to furnish the most effective LIEE programs? How do decoupling, EERS, and performance incentives best work together?

- Financing: Will low-to-moderate-income households take advantage of financing offerings at a significant rate, or is no-cost programming imperative to achieve commensurate low-income participation? Which financing methods have the most potential for low-income households?

- Raided Funds: LIEE resources may be less likely to be raided for other purposes if they are not segregated into an efficiency-specific account and the utility is required to fund programs based on an EERS or a funding requirement. Is this method sufficient to ensure that planned resources are directed to LIEE programming? Are there other models that provide greater assurance of continued program access to dedicated LIEE funding?

- Coordination: What are the most successful models for improving coordination between various LIEE funding sources and can they be replicated?

- Health and Safety Investments: What is the right level of investment in health and safety issue remediation and how can the necessary funding be made available for this purpose?

- Non-Energy Benefits: What levels of NEBs can be expected from LIEE and can an adder be used rather than continued investment in expensive research to document the magnitude of these benefits? What level NEB adder is most appropriate in various environments?

- Innovative Methods: Which new approaches have achieved significant savings and should be replicated as part of the LIEE comprehensive investment strategy?

- Environmental Justice: Are LIEE programs effectively reaching this population segment? If not, how can their reach be improved?

- LIEE Savings: What level of energy savings can be achieved through the implementation of various LIEE program models? More studies using billing analysis compared to the TRM approach are needed.

- Relative LIEE Savings and Cost-Effectiveness: It is often claimed that LIEE programs do not save as much energy and are not as cost-effective as general residential energy efficiency programs. We argue that LIEE programs can save as much or more energy than market rate residential programs when health and safety barriers can be overcome. Savings in low-income homes can be higher because these properties have greater opportunities for energy savings, and the low-income baseline is a lower level of

efficiency. Additionally, when using the TRC, the participant and program costs must be included in the cost side of the equation, so full program funding as opposed to shared participant funding does not impact the test. Last, market rate programs may have higher marketing costs that LIEE programs. Additional research should be conducted to compare these savings and costs.