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The Value of Adding Home Energy Score to Low-Income Energy Efficiency Programs

NASEO
National Association of State Energy Officials

Disclaimer

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Introduction

Residential energy efficiency programs, often operated or overseen by State Energy Offices, provide benefits that help states meet energy goals: they increase energy efficiency, relieve energy burden, and improve public health. Residential energy efficiency programs designed specifically for low-income communities have the added benefit of providing services for a vulnerable population. All states administer the federally funded U.S. Weatherization Assistance Program (WAP) operated by the U.S. Department of Energy (DOE) and a subset of states operate a low-income residential energy efficiency programs that complement WAP supported by the State Energy Office.

The benefits participants experience can be enhanced by obtaining an energy label, which provides additional value to participants by documenting the upgrades and improvements to their home. There are several ways to provide the documentation of energy efficiency improvements: providing a list of completed measures, providing energy savings figures, or providing the results of a post-work audit.

Labels provide several benefits to program participants and administrators: they can inform administrators on housing stock, provide consumer protection after home improvements, help homeowners make informed decisions regarding their home, motivate future home energy improvements, and help homebuyers understand the energy systems of potential new homes. Through documentation of energy efficiency status, homeowners are better prepared to describe and promote these features in real estate transactions.

Labels in real estate transactions have documented benefits: studies show that homes with energy efficiency improvements sell faster and for relatively higher prices. A label can add economic value to the home.

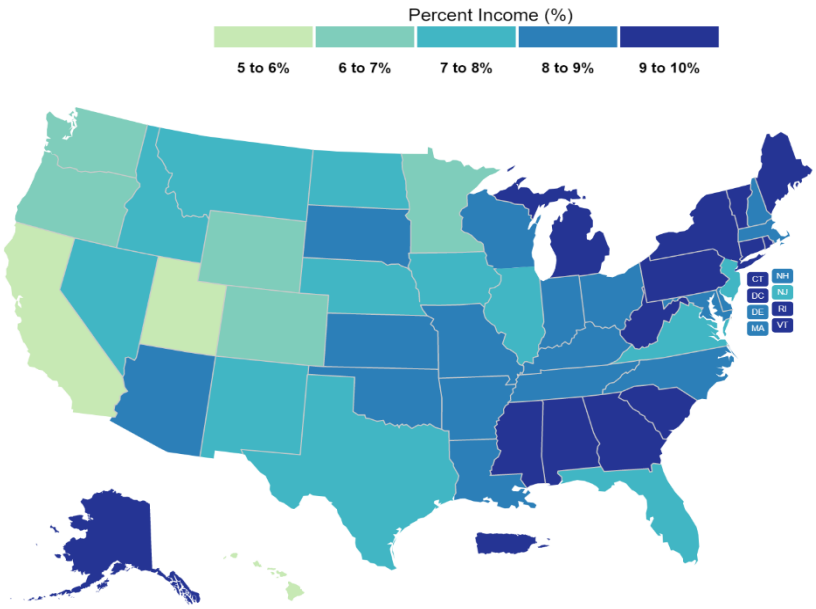
The intended audience of this paper is State Energy Officials, and the opportunities identified in this paper are specific to the functions of State Energy Offices. Other courses of action to reach low-income populations with residential energy efficiency are not addressed here.

Benefits of Serving Low-Income Communities

Energy efficiency improvements in low-income households can yield multiple benefits for both residents and the state – including energy savings. Many states are committed to improving the energy efficiency of their economies.[1] A National Renewable Energy Laboratory (NREL) analysis finds that, depending on the state or territory, households below 80 percent of area median income can potentially save between 13 percent and 31 percent of electricity use if energy efficiency improvements are implemented.[2] On-site fuel savings range from 0.8 trillion British Thermal Units (TBtu)/year in the District of Columbia to 154.5 TBtu/year in New York State.[3] These savings can be achieved with cost-effective energy efficiency upgrades such as insulation, HVAC, and lighting improvements. State-by-state efficiency upgrade results are in Appendix A. For each of the 48 contiguous states, potential on-site fuel savings, electricity savings, and energy bill savings for low-income households and all households are listed. The resulting reduction in energy bills provide economic and environmental benefits to the residents.

Figure 1. Energy Burden (% income) for the United States

Source: U.S. Department of Energy



[1] As of May 2019, 27 states have an energy efficiency resource standard (EERS) in place that requires electric savings from customer-facing energy efficiency programs. 18 of those also have an EERS for natural gas. This and state-by-state information is available in an ACEEE Policy Brief. ACEEE, 2019, "State Energy Efficiency Resource Standards (EERS)" https://aceee.org/sites/default/files/state-eers-0519.pdf

[2] U.S. DOE, 2018, "Low Income Household Energy Burden Varies Among States — Efficiency Can Help In All of Them" https://www.energy.gov/sites/prod/files/2019/01/f58/WIP-Energy-Burden_final.pdf

[3] E. Wilson, C. Harris, J. Robertson, and J. Agan, 2019, "Evaluating energy efficiency potential in low-income households: A flexible and granular approach" *Energy Policy* https://www.sciencedirect.com/science/article/pii/S0301421519300527?via%3Dihub

Improving the energy efficiency of low-income homes can also curtail energy burden (the percentage of household income spent on energy costs). According to DOE's analysis of census data, low-income households face an energy burden three times higher than medium- and high-income households.[4] Low-income households – which make up about 44 percent of all U.S. households – spend 8.6 percent of their income on energy costs.[5,6] Utility bills are the most common driver for households seeking payday loans, which can cause a cycle of repeat usage and debt.[7] For low-to-moderate income (LMI) households, Alabama, Alaska, Arizona, Georgia, Maine, Michigan, Mississippi, New York, Puerto Rico, and South Carolina have the highest energy burden of 10 percent. California, Hawaii, and Utah have the lowest at 5 percent. State-by-state energy burden figures are available in Appendix B.

Energy efficiency upgrades can also benefit residents by improving public health outcomes. Low-income populations disproportionally live in homes with poor air quality and humidity control. [8] These conditions result in excess moisture and can trigger respiratory symptoms. However, energy efficiency improvements can create healthier homes. A DOE literature review of studies assessing the health impacts of energy efficient upgrades found that even base[9] energy efficiency work can create healthier living environments. Base energy efficiency work, such as upgrades supported by WAP, resulted in positive health-related outcomes such as improved general health, reductions in some asthma symptoms, fewer cases of hypertension and upper respiratory risks, and some improvements in indoor air quality contaminants.[10] Other energy improvements have been shown to provide additional health benefits.[11] Energy efficiency improvements at scale can also improve outdoor air quality. The U.S Environmental Protection Agency (EPA) developed a set of values state governments can use to estimate the outdoor air quality-related public health benefits of

[4] U.S. DOE, n.d., "Low Income Community Energy Solutions" https://www.energy.gov/eere/slsc/low-income-community-energy-solutions. Accessed February 20, 2020.
[5] Ibid
[6] U.S. DOE calculated this figure using the Department of Housing and Urban Development (HUD) income limits that determine eligibility for assisted housing programs. HUD's definition of low income is families whose incomes do not exceed 80% of the median family income for the area. More information is available at https://www.huduser.gov/portal/datasets/il.html#2018_data
[7] W. Berg and A. Drehobl, 2018, "State-Level Strategies for Tackling High Energy Burdens: A Review of Policies Extending State- and Ratepayer-Funded Energy Efficiency to Low-Income Households" *Proceedings of the 2018 ACEEE Summer Study on Energy Efficiency in Buildings* https://aceee.org/files/proceedings/2018/#/paper/event-data/p390
[8] D. Hernández, 2013, "Energy Insecurity: A Framework for Understanding Energy, the Built Environment, and Health Among Vulnerable Populations in the Context of Climate Change" *American Journal of Public Health* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3673265/
[9] Base energy efficiency work is defined as at least two of the three core energy efficiency elements: air sealing, insulation, and heating upgrades in the DOE literature review.
[10] J. Wilson, D. Jacobs, A. Reddy, E. Tohn, J. Cohen, and E. Jacobsohn, 2016, Home Rx: The Health Benefits of Home Performance" https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Home%20Rx%20The%20Health%20Benefits%20of%20Home%20Performance%20-%20A%20Review%20of%20the%20Current%20Evidence.pdf
[11] Ibid

investments in energy efficiency and renewable energy.[12] Dollar benefits (cents per kilowatt-hour) derived from four different energy efficiency and renewable energy strategies are available. The four strategies are uniform energy efficiency, peak energy efficiency, solar energy, and wind energy.

EPA generated a low estimate and a high estimate of a monetary benefit per kilowatt-hour reduced or avoided depending on region and discount rate options. Peak energy efficiency is the most valuable of the four in California, the Northeast, and the Southeast using either a 3 percent or 7 percent discount rate.[13] Energy efficiency – both uniform and peak – is the most valuable in the Great Lakes/Mid-Atlantic, where it is worth 3.14 – 7.95 cents per kilowatt-hour for uniform energy efficiency and 3.19 – 8.08 cents per kilowatt-hour for peak energy efficiency.[14] The table of benefits is available in Appendix C.

Existing Low-Income Programs

The Federal Government and State Energy Offices[15] offer programs specific to low-income citizens to reduce their energy bills, including direct bill assistance and energy efficiency improvement programs. Some states also offer market-rate programs, either in tandem with low-income programs or as standalone programs. Programs without income requirements are still useful in achieving energy goals; however, a review of residential programs offered by California investor-owned utilities found there are benefits to designing programs specifically for low-income people. The meta-analysis of program evaluations found untargeted programs (i.e., programs without income restrictions) may disproportionally serve higher income populations.[16] For example, participants in

Energy efficiency and renewable strategies to improve outdoor air quality

- **Uniform energy efficiency**: Energy efficiency programs, projects, and measures that achieve a constant level of savings over time.
- **Peak energy efficiency**: Energy efficiency programs, projects, and measures that achieve savings from 12:00 p.m. – 6:00 p.m.; when energy demand is high.
- **Solar energy**: Programs, projects, and measures that increase the supply of solar energy available.
- **Wind energy**: Programs, projects, and measures that increase the supply of wind available.

Source: U.S. Environmental Protection Agency

[12] U.S. EPA, 2019, "Public Health Benefits per kWh of Energy Efficiency and Renewable Energy in the United States: A Technical Report" https://www.epa.gov/sites/production/files/2019-07/documents/bpk-report-final-508.pdf
[13] Ibid
[14] Ibid
[15] This paper only examines low-income targeted programs offered by the Federal Government and State Energy Offices. Programs offered by utilities, Public Service Commissions, and other agencies are not included here.
[16] M. Frank and S. Nowak, 2016, "Who's Participating and Who's Not? The Unintended Consequences of Untargeted Programs" *Proceedings of the 2016 ACEEE Summer Study on*

untargeted whole-home retrofit and appliance programs were disproportionately high-income and college-educated, while low-income households represented a larger participant share in the untargeted refrigerator recycling program.[17] Participant characteristics are correlated with the amount of upfront capital required to participate in the program; the more expensive the program, the more likely participants are to have high incomes, be college-educated, white, homeowners, and English-speaking.[18] States interested in reaching low-income communities may consider designing programs specific to the needs of those communities.

To better understand the potential of home energy labels in low-income programs, the following sections explore the breadth and variety of existing low-income energy programs. Many of these programs feature income eligibility requirements to access incentives, rebates, and/or preferential financial terms. Together, these programs bring energy efficiency resources to thousands of low-income homeowners and renters each year but rarely include home energy labels for program participants. Federal and state-level examples are highlighted below.

Weatherization Assistance Program

DOE operates WAP, which provides free weatherization improvements to low-income households. WAP funds are distributed to state government agencies, such as State and Territory Energy Offices. That funding is administered through local agencies that complete weatherization projects at no cost to the property owner. WAP funds support energy efficiency upgrades in approximately 35,000 homes every year; spending about $6,500 per house saves households $283 on average per year.[19,20] As many as 20-30 million families are eligible for assistance.[21] States have the discretion to set priorities, and some states prioritize households with residents over 60 years old, families with children, and families with a member that have a disability.[22] States can supplement federal funding with state funding. Washington, for example, offers the Weatherization Plus Health program, which provides funding for energy efficiency and asthma-symptom-reliving improvements to people with asthma.[23]

Low Income Home Energy Assistance Program

The Low Income Home Energy Assistance Program (LIHEAP) is a federal program administered by the U.S. Department of Health and Human Services. It provides

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Energy Efficiency in Buildings
https://aceee.org/files/proceedings/2016/data/papers/2_542.pdf
[17] Ibid
[18] Ibid
[19] U.S. DOE, 2019, "Weatherization Works!"
https://www.energy.gov/sites/prod/files/2019/07/f64/WAP-Fact-Sheet-2019.pdf
[20] U.S. DOE, n.d., "Where to Apply for Weatherization Assistance"
https://www.energy.gov/eere/wipo/where-apply-weatherization-assistance. Accessed February 20, 2020.
[21] Ibid
[22] Ibid
[23] Washington State Department of Commerce, n.d., "Weatherization Plus Health (Wx+H)"
https://www.commerce.wa.gov/growing-the-economy/energy/weatherization-and-energy-efficiency/matchmaker/weatherization-plus-health-wxh/. Accessed February 20, 2020.

funding to reduce the costs of energy bills, relieve energy crises, and, depending on the state, complete weatherization upgrades. LIHEAP funds are administered by states, and distributed either directly by the state or through local partners. Individuals can access funding based on their location, income, costs, family size, and other factors. Local offices must prioritize households with members that are elderly, disabled, or with young children. Up to 15 percent of LIHEAP funds can be transferred to WAP for energy efficiency upgrades. Results from a survey of 624 LIHEAP households found that average benefits distributed were $307 in Fiscal Year (FY) 2018, and that the energy burden in participating households decreased to 19 percent from 23 percent pre-LIHEAP.[24] Fifty-four percent of respondents credited LIHEAP for their ability to keep their homes at safe and healthy temperatures.[25] Due to limited funding, only about 20 percent of households that are eligible for LIHEAP receive benefits.[26]

Home Energy Solutions Income-Eligible (Connecticut)

Home Energy Solutions Income-Eligible is a rate payer-funded and utility-implemented energy efficiency program for households with low incomes in Connecticut. It provides direct install weatherization services including an energy assessment, air sealing, duct sealing, and lightbulbs at no cost. Contractors that deliver the program are required to evaluate all opportunities for upgrades which may be available at low or no cost. Households with an income less than 60 percent of state median income are eligible to participate.[27] In 2019 28,848 households participated in the program saving on average $250 per year for services valued at an average of $1,200 per home.[28] This program is offered in tandem with Home Energy Solutions, which provides the same services to households with incomes above 60 percent of state median income for a fee. As of February 2020, the fee is $75.[29] The Connecticut Department of Energy and Environmental Protection works with the major utilities to coordinate the deployment of both programs.

Clean Energy Communities Low-to-Moderate Income Grant Program (Maryland)

The Maryland Energy Administration operates the Clean Energy Communities Low-to-Moderate Income Grant Program. Grants are available on a competitive basis to entities that serve low-income Marylanders. A total of $5.8 million was available for

[24] National Energy Assistance Directors' Association, 2018, "2018 National Energy Assistance Survey Final Report" http://box2085.temp.domains/~neadaorg//wp-content/uploads/2015/03/liheapsurvey2018.pdf
[25] Ibid
[26] U.S. HHS, 2016, "LIHEAP Q & As for Consumers" https://www.acf.hhs.gov/ocs/resource/consumer-frquently-asked-questions
[27] U.S. DOE, n.d., "Case Study: Connecticut's Efforts to Scale Up Integrated Energy Efficiency and Renewable Energy for Low-Income Homes" https://betterbuildingssolutioncenter.energy.gov/sites/default/files/CS_CTs%20Efforts%20to%20Scale%20Up%20EERE%20LI%20Homes_FINAL_1.pdf. Accessed February 20, 2020.
[28] Energize Connecticut, 2020, "Energy Efficiency Board 2019 Programs and Operations Report" https://www.energizect.com/sites/default/files/Final-2019-Annual-Legislative-Report-WEB02262020_2.pdf
[29] Energize Connecticut, n.d., "Home Energy Solutions – Core Services" https://www.energizect.com/your-home/solutions-list/home-energy-solutions-core-services. Accessed February 20, 2020.

fiscal year 2020[30]; the availability is allocated per region of the state.[31] The program defines low-income as those at or below 175 percent of the federal poverty level and moderate income is defined as above low-income but at or below 85 percent of median income by county.[32] Residential retrofits that consist of an energy audit and cost-effective energy efficiency measures are eligible, as well as commercial retrofits and new construction that serve LMI communities.[33] Preferred projects are ones that maximize energy savings per dollar of state funds invested, demonstrate a positive impact on Maryland's LMI residents, show the ability to scale up or down as funding allows, and demonstrate positive past performance. Another consideration is the ability to serve residents ineligible for upgrades through other programs.[34] Funding is available to local governments and non-profit organizations.[35]

Home Energy Retrofit Opportunities for Seniors (Nevada)

The Nevada Governor's Office of Energy funds a weatherization program for Nevadans over the age 60 in owner-occupied homes at or below 200 percent of federal poverty guidelines.[36] It complements the Nevada Weatherization Assistance Program by providing additional funding for this vulnerable population. An in-home assessment determines which measures will be installed including air sealing, appliances, insulation, HVAC, and windows.[37] Up to $8,000 in improvements are available for each home free of charge.[38] The Nevada Housing Division administers the program utilizing a network of weatherization agencies.[39] Since 2014, 812 homes have been improved.[40] On average, projects saved 7,454 kWh and 279 therms, with an average investment of $4,183.[41] These investments have resulted in an average of 65 percent reduction in

[30] D. Fisher, May 8, 2020. Personal communication with Maryland Energy Administration.
[31] Maryland Energy Administration, n.d., "FY20 Clean Energy Communities Low-to-Moderate Income Grant Program" https://energy.maryland.gov/govt/Pages/CleanEnergyLMI.aspx. Accessed April 7, 2020.
[32] Ibid
[33] Ibid
[34] Ibid
[35] Maryland Energy Administration, n.d. "FY20 Clean Energy Communities Low-to-Moderate Income Grant Program Application Instructions and Application Form" https://energy.maryland.gov/govt/Documents/FY20%20Application%20Exercise%20and%20Final%2010_7_2019.docx. Accessed April 7, 2020.
[36] Nevada Governor's Office of Energy, n.d., "H.E.R.O.S. Home Energy Retrofit Opportunities for Seniors" http://energy.nv.gov/uploadedFiles/energynvgov/content/Programs/HEROS%20Flyer%20English.pdf. Accessed February 20, 2020.
[37] Ibid
[38] R. Yochum, April 24, 2020. Personal communication with Nevada Governor's Office of Energy.
[39] Nevada Governor's Office of Energy op. cit.
[40] R. Yochum op cit.
[41] Ibid

energy use.[42] Occupants saved $1,226 on average each year on energy bills; the return on investment was realized in 2.53 years.[43]

Comfort Partners (New Jersey)

The New Jersey Clean Energy Program – managed by the New Jersey Board of Public Utilities, Division of Clean Energy – partnered with New Jersey investor-owned electric and gas utilities to offer a program for income-eligible families. The resultant program, Comfort Partners, provides a full energy audit direct, install measures, energy education, and health and safety measures as appropriate.[44] The services are provided free of charge.[45] In 2018 the New Jersey Board of Public Utilities entered in to a memorandum of understanding with the New Jersey Department of Community Affairs, the administrator of the WAP in New Jersey, to coordinate the implementation of both programs in order to reach customers that are not served comprehensively by either program alone.[46] The programs have similar missions and networks that can be leveraged to create more energy savings for low-income communities. Previously customers were referred between programs but there was not active coordination of service delivery.[47] Comfort Partners has aided over 114,000 families since the program launched in 2001.[48]

Home Performance with ENERGY STAR (New Jersey)

As part of the New Jersey Clean Energy Program, the New Jersey Board of Public Utilities, Division of Clean Energy offers a Home Performance with ENERGY STAR program.[49,50] The program provides a process for conducting whole-home improvements outside of WAP to a broader customer base. The national average cost

[42] Nevada Governor's Office of Energy, 2019, "Fact Sheet Home Energy Retrofit Opportunities for Seniors (H.E.R.O.S.) Program (NRS 701A.450)" http://energy.nv.gov/uploadedFiles/energynvgov/content/Programs/HEROS%20Fact%20Sheet%20November%202019.pdf
[43] R. Yochum op cit.
[44] The New Jersey Board of Public Utilities and The New Jersey Department of Community Affairs, 2018, "Memorandum of Understanding Between The New Jersey Board of Public Utilities and The New Jersey Department of Community Affairs" https://www.state.nj.us/dca/divisions/dhcr/offices/docs/wap/Memorandum_of_Understanding_Comfort_Partners.pdf
[45] Ibid
[46] Ibid
[47] Ibid
[48] New Jersey Clean Energy Program, n.d., "Comfort Partners" https://njcleanenergy.com/residential/programs/comfort-partners/comfort-partners. Accessed February 20, 2020.
[49] Home Performance with ENERGY STAR is a program available from the U.S. Department of Energy. For each home in the program, an audit, energy efficient work, and a post-work audit is required. Every program must have a qualified workforce and a quality assurance plan. Home Performance with ENERGY STAR is offered by local governments and utilities across the country. For more visit www.energystar.gov/homeperformance.
[50] The Connecticut Home Energy Solutions – Income Eligible program is also a Home Performance with ENERGY STAR program.

for a Home Performance with ENERGY STAR project is $5,500.[51] To lower the cost for people with moderate-incomes (those with lower incomes are directed to Comfort Partners), a bonus incentive is available in order to lower participation costs and increase access to energy efficiency at all income levels. Starting in 2020, projects that save an estimated 5 percent energy can access a $500 bonus incentive; $750 is available for 20 percent estimated savings, and $1,000 for 25 percent estimated savings.[52] This is in addition to incentives and loan terms available to all participants in the Home Performance with ENERGY STAR program that are also based on energy savings achieved.[53] 4,267 Home Performance with ENERGY STAR projects were completed in New Jersey in 2018.[54]

Assisted Home Performance with ENERGY STAR (New York)

New York State Energy Research and Development Authority (NYSERDA) administers the Assisted Home Performance with ENERGY STAR program, which provides incentives for moderate-income customers. New Yorkers that meet eligibility requirements can receive a 50 percent discount on energy efficiency projects for a total up to $4,000.[55] Up to $8,000 is available for multifamily homes up to four units,[56] and low-interest loans are available for any remaining balance.[57] Households with an income less than 80 percent of county median income qualify.[58] Participants also have access to Community Energy Advisors, entities dedicated to helping residents, businesses, and building owners reduce energy use and costs.[59] Advisors can guide participants through the process and are available for questions.[60] Approximately 3,000 households are served annually.[61]

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[51] U.S. DOE, 2019, "Home Performance with ENERGY STAR: Program Overview and Progress Update" https://www.energystar.gov/sites/default/files/asset/document/HPwES_2018_progress_update_0.pdf

[52] New Jersey Clean Energy Program, 2019, "FY2020 Notice of Changes Home Performance with ENERGY STAR® (HPwES) Program https://njcleanenergy.com/files/file/Residential%20Programs/HP/FY2020/Notice%20of%20NJCEP%20Program%20Changes%20HPwES%20FY20%20cl.pdf

[53] Ibid

[54] U.S. DOE, n.d., "Home Performance with ENERGY STAR Project Completion by State and Sponsor" https://www.energystar.gov/sites/default/files/asset/document/tableofcompletedprojects_0.pdf. Accessed February 20, 2020.

[55] NYSERDA, n.d., "Assisted Home Performance with ENERGY STAR®" https://www.nyserda.ny.gov/All-Programs/Programs/Assisted-Home-Performance-with-ENERGY-STAR. Accessed February 20, 2020.

[56] Ibid

[57] NYSERDA, n.d., "Frequently Asked Questions" https://www.nyserda.ny.gov/All-Programs/Programs/Assisted-Home-Performance-with-ENERGY-STAR/FAQs. Accessed February 20, 2020.

[58] Ibid

[59] NYSERDA, n.d., "Community Energy Advisors" https://www.nyserda.ny.gov/Contractors/Find-a-Contractor/Community-Energy-Resource. Accessed February 20, 2020.

[60] NYSERDA, n.d., "Frequently Asked Questions" https://www.nyserda.ny.gov/All-Programs/Programs/Assisted-Home-Performance-with-ENERGY-STAR/FAQs. Accessed February 20, 2020.

[61] C. Coll, May 6, 2020. Personal communication with NYSERDA.

EmPower New York (New York)

Similar to New Jersey's Comfort Partners program, EmPower New York is a free weatherization service for low-income families offered by NYSERDA. Eligible households are those with income below 60 percent of state median income.[62] The program is funded by a system benefit charge with supplemental funding from the Regional Greenhouse Gas Initiative and LIHEAP.[63] After a home energy assessment and in-home energy education, New Yorkers may receive lighting, insulation, air sealing, electric load reduction, and replacement of inefficient refrigerators and freezers.[64] As opposed to New York's Assisted Home Performance with ENERGY STAR, EmPower New York is available to renters and owners. To date, 165,000 households have received energy efficiency upgrades through the program.[65]

Home Rehabilitation Loan Program for Rural Low-Income Households (Washington)

Washington offers a unique deferred loan program for rural communities in U.S. Department of Housing and Urban Development designated non-entitlement areas.[66] Initially available in November 2018, this program provides loans to improve health, safety, and durability of homes; energy improvements is one category of approved work.[67] Homeowners[68] with a household income at or below 200 percent of the federal poverty level are eligible.[69] Additionally, senior citizens and families with members that have a disability, are a veteran, or young children are given priority.[70] Applicants can receive a loan up to 80 percent of the tax assessed value of their home or up to $40,000, whichever is less for their loan.[71] Borrowers can make payments as desired, but the loan is not due until the house is sold, transferred, or is no longer the primary residence. There is an interest rate applied that is based on consumer price index; loans issued in 2019 have a 1.9 percent interest rate.[72] The program is offered by the Washington State Department of Commerce.

The Value of Home Energy Labeling

Introduction

[62] NYSERDA, n.d., "EmPower New York Eligibility Guidelines" https://www.nyserda.ny.gov/All-Programs/Programs/EmPower-New-York/Eligibility-Guidelines. Accessed February 20, 2020.
[63] C. Coll op cit
[64] Ibid
[65] Ibid
[66] Non-entitlement areas are defined as cities with populations of less than 50,000 (except cities that are designated principal cities of Metropolitan Statistical Areas) and counties with populations of less than 200,000.
[67] Washington State, n.d., "Home Rehabilitation Loan Program (HRLP) – Washington State Department of Commerce" https://www.commerce.wa.gov/growing-the-economy/energy/weatherization-and-energy-efficiency/rural-rehab/. Accessed February 20, 2020.
[68] Only owner-occupied houses are eligible.
[69] Washington State op. cit.
[70] Ibid
[71] Ibid
[72] Ibid

Broadly, residential energy efficiency labeling refers to programs or policies that provide standardized information about the energy performance of a home. In addition to providing information to occupants, labels are useful to convey information to other stakeholders. Residential energy labels are typically accompanied with analysis that scores energy efficiency on a binary ("efficient" versus "not efficient") or on a scale. Many energy labels are designed to be principally used in the real estate market to convey energy use and cost information before renting or buying a home. With energy labels prospective residents can better understand the true cost of living; energy bills can exceed insurance and taxes for many homes.[73] Aggregating and displaying energy information on a label provides a decision-making tool because it allows people to fairly compare energy use between homes. Research shows that when available, energy information is valued in real estate transactions: a study in Chicago by Elevate Energy found that homes that disclosed energy costs sold for more[74] and faster than their counterparts.[75]

The Value to Families with Low-Incomes

Low-income families benefit from inclusion of labels in low-income energy efficiency programs:

- Documenting the work performed to improve energy efficiency provides an opportunity to communicate the value during real estate transactions.
- A trusted third-party source of energy information (like State Energy Offices) is more likely to be relevant during real estate transactions than other sources.
- Providing labels after low-income energy efficiency projects provides access to the value associated with energy efficiency at point of sale to families that would otherwise be excluded from the benefits.
- Uniform documentation, like the Home Energy Score (discussed in detail below), allows for easy comparison of results across energy efficiency programs and jurisdictions.

Labeling Landscape

Theories of market transformation suggest that labels that provide insight on energy performance will spur home performance projects as homeowners seek high-performing homes and the associated price premium, and home sellers and landlords gain incentive to make efficiency upgrades.[76]

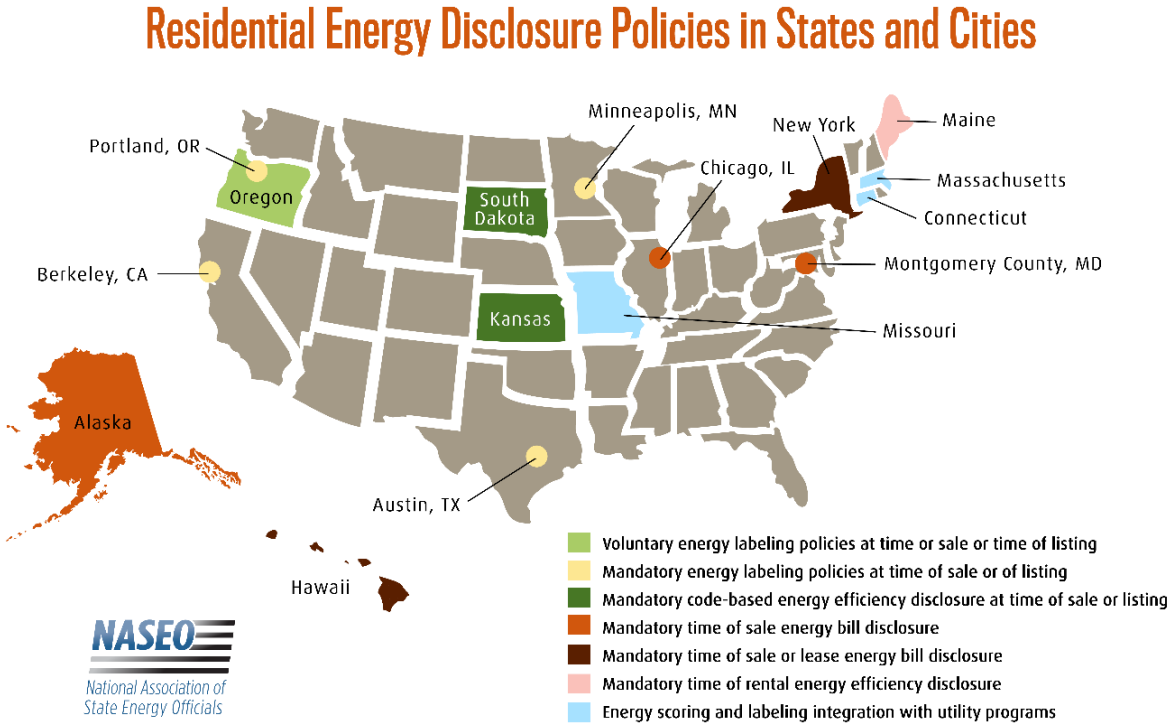
[73] NASEO, n.d., "Home Energy Labeling & Its Benefits" https://empress.naseo.org/energy-labeling. Accessed February 20, 2020.
[74] Homes with disclosed energy costs sold for a higher percentage of the asking price compared to homes that did not disclose energy costs.
[75] Elevate Energy, 2015, "Energy Cost Disclosure in Chicago Residential Listing: Eighteen Months Out" https://www.elevateenergy.org/wp/wp-content/uploads/ECD_Analysis_YEAR2.pdf
[76] P. Brookstein and J. Caracino, 2019, "Making the Value Visible: A Blueprint for Transforming the High-Performing Homes Market by Showcasing Clean and Efficient Energy Improvements" https://www.elevateenergy.org/wp/wp-content/uploads/Making-the-Value-Visible-A-Blueprint-for-Transforming-the-High-Performing-Homes-Market-by-Showcasing-Clean-and-Efficient-Energy-Improvements.pdf

Research from a 2019 E2e working paper on Austin's Energy Conservation Audit and Disclosure (ECAD) ordinance suggests that homes that are more energy efficient receive higher price premiums compared to a counterfactual.[77] The ordinance requires most single-family home sellers in Austin, Texas to complete an energy audit and provide the results to potential buyers. The study finds that disclosure leads to additional investment in energy-saving measures; in fact, it is one of few examples where government disclosure policies show socially beneficial effects.[78] Where jurisdictions have access, the data in aggregate is also useful for local governments as they plan potential energy efficiency and greenhouse gas emission reduction policies.[79] For example, cities and states with home energy label information can determine the most needed energy efficiency improvements (water heater, HVAC, etc.) in their residential building stock, estimate associated reductions in greenhouse gas emissions, and plan incentives accordingly.

[77] E. Myers, S. Puller, and J. West, 2019, "Effects of Mandatory Energy Efficiency Disclosure in Housing Markets" http://e2e.haas.berkeley.edu/pdf/workingpapers/WP044.pdf
[78] Ibid
[79] NASEO op. cit.

Residential energy efficiency labeling is an emerging field. Approximately a dozen jurisdictions (cities and states) have a home energy labeling policy, including both mandatory and voluntary programs.[80] Others require the disclosure of energy bills without the analysis that a label would provide. Utilities, like the ones described in the discussion section below, offer labels after home performance work. For more generalized information on home energy labeling policies, the Energy Metrics to Promote Residential Energy Scorecards in States (EMPRESS) project provides information on the value of labels and key considerations in developing a labeling policy or program.[81] It includes information on the benefits of mandatory and voluntary programs, metrics that are valuable, and case studies.

Figure 2. Cities and States with Residential Energy Disclosure Policies



Source: NASEO (Updated January 2020)

As labeling and other "green" home features spread, the real estate community is acknowledging the growing interest among homebuyers in energy efficiency homes. Sixty-nine percent of the respondents to a National Association of REALTORS® survey said that promoting energy efficiency features in listings is very or somewhat valuable.

[80] NASEO, "Home Energy Labeling" n.d., https://www.naseo.org/issues/buildings/home-energy-labeling. Accessed February 20, 2020.
[81] For more information visit https://www.empress.naseo.org.

However, 50 percent of respondents were not sure if homes with green certifications are on the market longer than homes without a certification.[82] Financing products are also increasingly recognizing the value of disclosure. Home Energy Score (discussed in more detail in the next section) is one of the approved reports required for Fannie Mae's HomeStyle Energy and Freddie Mac's GreenCHOICE mortgage loan products.[83,84] Fannie Mae borrowers with a Home Energy Score of 6 or higher are eligible for a 2 percent stretch on their debt-to-income ratio.[85,86] The Federal Housing Administration's Energy Efficiency Home policy also allows a 2 percent stretch on debt-to-income ratios for borrowers with a Home Energy Score of 6 or higher or when cost-effective energy improvements identified by the Home Energy Score would increase the Home Energy Score to a "6".[87] It is important to be cognizant of the impacts labeling and valuation of energy efficiency may have on underserved and disadvantaged communities. There is a tension between valuing energy efficiency in real estate transactions and keeping housing and property taxes affordable for the people already there. The City of Cleveland Residential Tax Abatement program addresses this issue. Under the program, one hundred percent of the increase in real estate property tax caused by qualified improvements can be eliminated for 15 years.[88] Tax abatement requires meeting the Cleveland Green Building Standard, which in turn requires compliance with a nationally recognized rating system.[89]

Residential energy efficiency labeling is nascent but there are opportunities to expand the practice via existing low-income efficiency programs. In doing so, program participants can access the benefits of home energy labels.

Home Energy Score

U.S. Department of Energy's Home Energy Score is an example of a nationally applicable residential energy efficiency label designed for existing homes. Another example is RESNET's HERS Index, which is commonly used for new construction and code compliance. Home Energy Score is intended to be used beyond energy assessments: the mission of the program is "to build market value for home energy

[82] National Association of REALTORS, 2019, "Energy Efficiency Brings Buyers, More Agents Say" *REALTOR Magazine* https://magazine.realtor/daily-news/2019/04/19/energy-efficiency-brings-buyers-more-agents-say
[83] Fannie Mae, 2019, "B5-3.3-01: HomeStyle Energy for Improvements on Existing Properties (08/07/2019)" https://www.fanniemae.com/content/guide/selling/b5/3.3/01.html
[84] Freddie Mac, n.d., "GreenCHOICE Mortgages℠" https://sf.freddiemac.com/working-with-us/origination-underwriting/mortgage-products/greenchoice-mortgages. Accessed April 22, 2020.
[85] Fannie Mae op cit.
[86] Debt-to-income ratio is monthly debt payments divided by gross monthly income. It is how lenders determine borrower eligibility.
[87] U.S. HUD, 2015, "Mortgagee Letter 2015-22" https://www.hud.gov/sites/documents/15-22ML.PDF
[88] City of Cleveland, n.d., "Tax Abatement" http://www.city.cleveland.oh.us/CityofCleveland/Home/Government/CityAgencies/CommunityDevelopment/TaxAbatement. Accessed February 20, 2020.
[89] Options for compliance include Enterprise Green Communities Criteria, LEED Silver Certification, and the National Green Building Standard.

efficiency among single-family and townhomes." [90] Home Energy Score accomplishes this by valuing, understanding, and allowing for financing of home energy efficiency improvements with nationwide household recognition.

Available to be deployed nationally,[91] Home Energy Scores are created through a simplified audit. During an in-home assessment, 50 data points are collected and submitted to DOE's online tool. Blower door test information can be included, but is not required.[92] The Home Energy Score is an asset assessment tool, meaning it evaluates heating, cooling, hot water, and the envelope but not the plug load or occupant behavior.[93] This method allows the home performance to be measured independently of user behavior, something that is especially valuable to the real estate market, where only the home's assets are transferred to new owners. The report provided to the recipient communicates the house's energy efficiency on a 1-to-10 scale, where 10 is the most efficient. The tool adjusts for local climate so that the results are comparable across the county.[94] In addition to the numerical score, the report provides all of the data points used to create the score and automatically generates recommendations for future cost-effective energy improvements.[95] Additional methodology information is provided in Appendix D.

State Energy Offices interested in adding Home Energy Score to existing energy efficiency programs will need to work closely with DOE to review and meet program administration requirements. Before the Home Energy Score can be deployed, qualified individuals conducting the assessments need to be identified and/or trained, the IT infrastructure to integrate Home Energy Score with software (if any) needs to be completed, and a quality assurance plan needs to be approved.[96] State Energy Offices can train building science and home improvement professionals to create Home Energy Scores if they possess a qualifying credential.[97] Approved and trained individuals are Home Energy Score Qualified Assessors™ (Assessors).

The Home Energy Score program has quality assurance requirements to assure the data is valid to be used in real estate transactions and mortgage financing. All new Assessors need to be mentored by a more experienced individual and 5 percent of Home Energy Scores must be re-scored by a dedicated quality assurance assessor.

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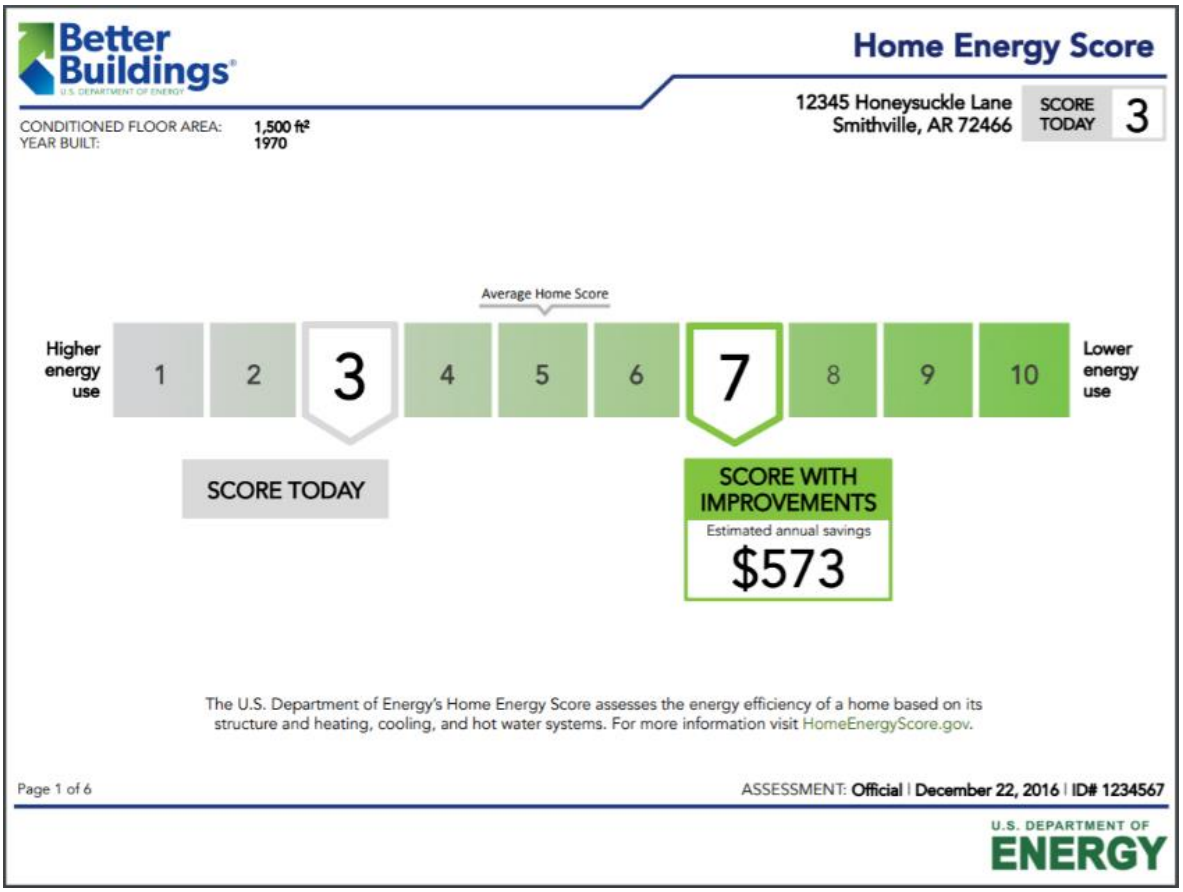
[90] U.S. DOE, n.d., "About the Home Energy Score" https://betterbuildingssolutioncenter.energy.gov/home-energy-score/home-energy-score-about-score. Accessed February 20, 2020.
[91] Home Energy Score works in the continental U.S. and Alaska.
[92] Analysis conducted by NREL determined the measured air leakage rate is unlikely to change a home's energy score on the 10-point scale as compared to a qualitative assessment of sealed or unsealed.
[93] U.S. DOE, 2017, "Home Energy Score Scoring Methodology" https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Home%20Energy%20Score%20Methodology%20Paper%20v2017.pdf
[94] Ibid
[95] Ibid
[96] For more information visit https://betterbuildingssolutioncenter.energy.gov/home-energy-score/home-energy-score-partners-become-a-partner.
[97] Individuals must possess a pre-qualifying credential before offering the Home Energy Score. Pre-qualifying credentials are posted on the U.S. DOE website at https://betterbuildingssolutioncenter.energy.gov/home-energy-score/become-assessor.

These can be conducted in the field or remotely: DOE has protocols for both.[98] Home Energy Score implementors will also need to decide if it is necessary to integrate Home Energy Score into an existing software tool. The Home Energy Score can be used independently of other auditing tools, but if connected through the Home Energy Score's application programming interface (API), programs can eliminate double data entry.[99]

[98] Home Energy Score mentoring and quality assurance guidance is available at https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/HEScore%20Mentoring%20and%20QA%20Guidelines.pdf.
[99] Home Energy Score API documentation is available at https://hes-documentation.labworks.org/home/api-definitions.

Figure 3. Sample Home Energy Score Report Cover



Source: U.S. Department of Energy

Key Features of the Home Energy Score

- "Score Today" indicates the level of energy efficiency on a scale of 1-to-10. In this example the current score is 3 out of 10.
- "Score with Improvements" displays how a home would score if all cost-effective energy efficiency measures are implemented. The potential score in this example is 7. This household is expected to save $573 on energy bills annually if all cost-effective improvements are made.
- Cost-effective recommendations (provided on additional pages) are divided in two categories: recommendations that can save energy immediately and recommendations to implement when it is time to replace equipment or materials.
- All the information collected in the in-home assessment to generate the Home Energy Score is provided on additional pages under "Home Facts".

Key Points and Opportunities

Low-income energy efficiency programs help State Energy Offices meet energy-related goals but including a home energy label at the end of the process is a way to increase the value for participants: in addition to improved comfort, efficiency, and bills, participants can have documentation that communicates that value to the real estate market.

Even if occupants do not plan on selling their home (or if they are not able to do so as renters), documenting the energy efficiency of the house can still be useful to State Energy Offices and stakeholders. Labels create a catalog of high-performing homes and this data in aggregate can inform policymaking. Even in regions without a linkage between labels and the real estate market, including labels in income-eligible efficiency programs can help administrators understand how energy efficiency policies might impact LMI households and how a program might engage with the real estate market in the future.

Home energy labels are an opportunity to diversify the beneficiaries of energy efficiency programs while supporting efforts to meet energy-related state goals. State Energy Offices can add a home energy label to their existing programs to articulate the value of energy efficiency improvements. This will grow in importance as the real estate market slowly changes to incorporate the value of energy efficiency in the price of a home. Effectively designed programs could accelerate the consideration of energy costs in real estate decision-making, which can help low-income buyers and renters better assure they can afford utilities at a given property. Findings from the previously mentioned E2e paper demonstrate the need: ignorance of energy efficiency in one's own home is a market failure that a disclosure policy can help resolve.[100] A seller without full knowledge of their home cannot provide complete information to a potential buyer. Knowledge fulfillment can start with a disclosure policy.

Specific effort needs to be made so that LMI homeowners and renters can benefit from the incorporation of energy efficiency in real estate transactions. As the number of efficient homes with labels grow, State Energy Offices can help diversify the homeowners that are benefiting from verified energy efficiency.

Opportunities for State Energy Offices

1. *Engage Communities and Plan for LMI Needs*

   State Energy Offices should consider engaging LMI communities to understand what issues are important to them, and hear what solutions interest them. In some jurisdictions, it will be important to ensure that the valuation of energy efficiency does not significantly increase the cost of renting or owning a home. There is concern among some stakeholders that valuation of efficiency retrofits could have adverse impacts on LMI residents by increasing the value of a high scoring home or by decreasing value of a low scoring home. Energy efficient homes have lower utility bills but may also have a higher assessed value and therefore higher property

[100] E. Myers et al. op. cit.

taxes. One potential solution is a tax abatement for homeowners that participate in income-qualified energy efficiency (with documentation) programs. The City of Cleveland serves as one example. The city offers a tax abatement program for homeowners that achieve the certifications required for the Cleveland Green Building Standard, but further research is needed to identify additional solutions, including specific ones for renters. State Energy Offices might engage with developers to understand how they set rents and what would be required to make energy efficiency improvements while keeping rent affordable. State Energy Offices might also conduct focus groups, or something similar, to learn about what people look for in a home, their understanding of affordability, and their perception of how energy efficiency affects costs. NASEO will foster conversations on the intersection of labeling and low-income programs among State Energy Offices, DOE, and other stakeholders.[101]

2. Consider the Home Energy Score During Policy Development

Energy labeling programs are often driven by climate change plans, energy efficiency targets, and concerns about energy affordability. Home energy labeling, including for LMI residents, is a tool that states should consider when formulating their climate, affordability, and energy goals, well as energy justice programs. A labeling option worth considering is the Home Energy Score. Home Energy Score allows for some customization to make the output relevant and useful for local communities. Together, pre- and post-work Home Energy Scores provide documentation of energy saved and improvements made.

Some energy efficiency program administrators are already generating Home Energy Scores before and after improvements are made: Portland, Oregon; Focus on Energy (Wisconsin); Green Homes Institute (Michigan); Berkeley, California; Conservation Consultants (Pennsylvania); Columbia Water & Light (Missouri); Ft. Collins, Colorado; Building Performance Institute (Connecticut); and National Grid (Rhode Island).[102] Not all of these programs have mechanisms to automatically provide Home Energy Scores to the real estate market (e.g. transmitting them to the local multiple listing service), but they are still providing a service by producing standard documentation of the work performed.

State Energy Offices can support the local adoption of Home Energy Score. In addition to informing cities and other jurisdictions of the value of Home Energy Score, State Energy Offices can establish the infrastructure (relationship with DOE, databases, workforce requirements, etc.) for local jurisdictions to use in order to implement a Home Energy Score program. More information is available in *Home Energy Labeling: Steps states can take to support city-based home energy labeling initiative*.[103]

[101] Contact Maddie Koewler at mkoewler@naseo.org if you want to participate in these discussions.
[102] G. Dickey. December 13, 2019. Personal communication with Boston Government Services.
[103] Available at https://www.naseo.org/data/sites/1/documents/publications/Home%20Energy%20Labeling%20Dec%202019.pdf

3. *Add Home Energy Score to Existing Residential Low-Income Energy Efficiency Programs*

Program administrators interested in adding Home Energy Score to an existing program could add a requirement for a Home Energy Score to be generated during the final inspection phases of existing energy efficiency upgrade programs. A pre-work Home Energy Score is useful for comparison purposes, but a post-work Home Energy Score is necessary to achieve the documentation described in this paper. After the retrofit work is complete, the administrator would dispatch a Home Energy Score Assessor to the house to conduct the assessment. The result will be provided to the homeowner. This visit can be done in conjunction with quality assurance or other follow-up protocols. If using a pre- and post-work scoring approach, a State Energy Office could choose to use the recommendations automatically generated by Home Energy Score to write scopes of work. Alternatively, the administrator could direct Assessors to provide customized recommendations informed by specific state goals to show the home's expected score after improvements. Program administrators can separately analyze the results and decide whether to engage with the real estate industry, such as by making results available to automatically populate a real estate multiple listing service.

Depending on the data collected at the time, previously completed projects could receive a Home Energy Score. U.S. DOE can determine if data, credentialing, and quality assurance meet the requirements to generate a Home Energy Score. This step has the added benefit of greater engagement with constituents and could result in additional efficiency interventions in previously visited homes. However, it is important for program administrators to address privacy issues around labeling proactively and as early in the process as possible. Previous attempts to obtain retroactive permission (e.g. months or years after program participation) from homeowners to release Home Energy Scores for multiple listing service use in Connecticut have been unsuccessful.[104]

4. *Design A Single Family Low-Income Residential Energy Efficiency Program around the Home Energy Score*

A new low-income program can be designed around the Home Energy Score. The automatically generated recommendations from the Home Energy Score can determine the work that will be done in the home, and a post-improvement Home Energy Score can lead to engagement with real estate professionals. Depending on consumer demand and incentives available to complete Home Energy Score, there may be workforce development benefits as individuals may be interested in completing Home Energy Score training. State Energy Offices implementing such

[104] Additional information and considerations are available as part of the EMPRESS project at https://empress.naseo.org/resources/privacy.

a program would need to consider administration costs. DOE can provide on-boarding and ongoing implementation support.[105]

Conclusion

Serving low-income communities with energy efficiency programs can help states achieve several energy-related goals including improving energy efficiency, reducing energy burden, and improving resident health outcomes. Several states have programs designed specifically for low-income communities that provide free weatherization services or unique financing for home performance projects. Energy efficiency program administrators and policy developers are exploring and implementing residential energy labeling as an added benefit for participants and policymakers. Labeling is a relatively small but important field that values energy efficiency and makes efficiency improvements visible to the real estate market. A standardized format, like the Home Energy Score, can be used to make comparisons and reduce market confusion. Linking labels to existing low-income programs can diversify the pool of individuals that benefit from verified energy efficiency and help states achieve energy, health, and affordability goals.

[105] Home Energy Score program contact information is available at https://betterbuildingsinitiative.energy.gov/home-energy-score/contact.

Appendix A

For a paper published in *Energy Policy*, NREL identified the energy saving potential in residential buildings by state and the specific potential in low-income households after implementing cost-effective measures. Results are limited to the 48 contiguous U.S. states. For the purposes of this section, low-income is defined as less than 80 percent area median income. Other income bracket analysis is available in the paper *Evaluating energy efficiency potential in low-income households: A flexible and granular approach*.[106]

Table 1. State-Level Potential for Fuel, Electric, and Utility Bill Savings

Alabama					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
4.7	10.7	2509	6968	366	958
Arizona					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
1.7	4.7	1771	5344	224	670
Arkansas					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
3.5	8.5	1416	4139	187	519
California					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
18.4	51.7	5142	14,701	945	2696
Colorado					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
7.9	21.5	974	3038	169	502
Connecticut					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
18.1	49.4	598	1642	367	973
Delaware					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
1.4	3.6	334	1023	79	232

[106] Available at https://www.sciencedirect.com/science/article/pii/S0301421519300527.

Table 1. State-Level Potential for Fuel, Electric, and Utility Bill Savings (continued)

District of Columbia					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
0.3	0.8	47	116	9	24
Florida					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
1.2	3.3	6481	19,620	739	2228
Georgia					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
5.7	14.5	4253	11,208	553	1445
Idaho					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
2.4	7.1	395	1122	59	172
Illinois					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
27.2	70.9	2766	8149	497	1394
Indiana					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
17.2	43.7	2911	8291	462	1279
Iowa					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
8.1	22.6	871	2726	178	521
Kansas					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
6.5	17.2	965	2844	177	502
Kentucky					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
6.6	18.1	2475	7266	317	902

Table 1. State-Level Potential for Fuel, Electric, and Utility Bill Savings (continued)

Louisiana					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
2.4	6.2	1391	3897	154	417
Maine					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
10.3	31.1	222	669	181	519
Maryland					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
5.3	13.9	2033	5751	404	1123
Massachusetts					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
24.6	70.6	1106	2943	529	1460
Michigan					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
40.7	110.8	3261	9135	778	2120
Minnesota					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
13.8	42.8	1501	4754	302	915
Mississippi					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
2.3	6.0	1434	4131	194	544
Missouri					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
12.5	32.3	2575	7294	404	1097
Montana					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
2.2	6.8	236	698	41	126

Table 1. State-Level Potential for Fuel, Electric, and Utility Bill Savings (continued)

Nebraska					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
5.1	12.5	557	1732	97	275
Nevada					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
1.7	4.6	558	1788	82	252
New Hampshire					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
7.2	22.8	209	622	126	373
New Jersey					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
18.6	57.3	1377	4173	417	1291
New Mexico					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
2.2	5.8	597	1772	91	269
New York					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
51.3	154.5	2187	6623	1047	3145
North Carolina					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
7.5	18.1	5096	14,899	746	2107
North Dakota					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
1.8	5.3	146	565	35	108
Ohio					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
33.4	86.9	4974	14,436	915	2558

Table 1. State-Level Potential for Fuel, Electric, and Utility Bill Savings (continued)

Oklahoma					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
6.3	15.9	2206	5867	275	721
Oregon					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
4.5	14.3	1568	3859	209	551
Pennsylvania					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
35.5	94.8	2674	8232	1083	3158
Rhode Island					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
4.0	12.7	117	372	94	267
South Carolina					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
2.9	6.7	2214	6535	330	920
South Dakota					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
1.7	5.3	183	650	37	116
Tennessee					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
4.8	13.9	3652	9488	389	1030
Texas					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
11.5	27.9	8619	23,699	992	2685
Utah					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
2.7	7.1	461	1384	70	206

Table 1. State-Level Potential for Fuel, Electric, and Utility Bill Savings (continued)

Vermont					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
4.1	12.6	95	289	77	221
Virginia					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
7.0	18.5	3353	10,210	514	1489
Washington					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
5.7	17.4	2752	6799	324	838
West Virginia					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
3.0	8.0	868	2722	154	453
Wisconsin					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
14.9	45.3	1265	4098	281	849
Wyoming					
Potential on-site fuel savings (TBtu/year)		Potential electricity savings (GWh/year)		Potential energy bill savings (million $/year)	
Low-income	All incomes	Low-income	All incomes	Low-income	All incomes
1.2	3.7	128	397	24	72

Appendix B

The Low-Income Energy Affordability Data (LEAD) Tool is available from the DOE. The tool allows stakeholders to explore energy burden and energy costs for low-income populations across the United States. The data is available at the county, city, and census tract level in addition to state and national data. Users of the tools can select income-level criteria. This analysis reflects people with incomes less than 80 percent of area median income. Data is available for the 50 states, District of Columbia, and Puerto Rico.[107]

Table 2. Energy Burden as a Percentage of Income for Low-Income Communities

State/Territory	Energy Burden as % of income	State/Territory	Energy Burden as % of income
Alabama	10	Montana	7
Alaska	10	Nebraska	7
Arizona	8	Nevada	7
Arkansas	8	New Hampshire	8
California	5	New Jersey	7
Colorado	6	New Mexico	7
Connecticut	9	New York	10
Delaware	8	North Carolina	8
District of Columbia	9	North Dakota	7
Florida	7	Ohio	8
Georgia	10	Oklahoma	8
Hawaii	5	Oregon	6
Idaho	7	Pennsylvania	9
Illinois	7	Puerto Rico	10
Indiana	8	Rhode Island	9
Iowa	7	South Carolina	10
Kansas	8	South Dakota	8
Kentucky	8	Tennessee	8
Louisiana	8	Texas	7
Maine	10	Utah	5
Maryland	8	Vermont	9
Massachusetts	8	Virginia	7
Michigan	10	Washington	6
Minnesota	6	West Virginia	9
Mississippi	10	Wisconsin	8
Missouri	8	Wyoming	6

[107] Available at https://www.energy.gov/eere/slsc/maps/lead-tool.

Appendix C

EPA calculated the public health benefits of investing in energy efficiency and renewable energy for the paper *Public Health Benefits per kWh of Energy Efficiency and Renewable Energy in the United States: A Technical Report*.[108] These are useful estimates for policy makers considering the public health impacts of energy efficiency and renewable energy investments.

Table 3. Public Health Benefits of Energy Efficiency and Renewable Energy

Region	Project Type	3 percent Discount Rate		7 percent Discount Rate	
		2017 ¢/kWh (low estimate)	2017 ¢/kWh (high estimate)	2017 ¢/kWh (low estimate)	2017 ¢/kWh (high estimate)
California	Uniform EE	0.48	1.08	0.42	0.96
	Peak EE	0.52	1.17	0.46	1.04
	Solar	0.51	1.15	0.45	1.03
	Wind	0.48	1.09	0.43	0.97
Great Lakes/Mid-Atlantic	Uniform EE	3.51	7.95	3.14	7.09
	Peak EE	3.57	8.08	3.19	7.21
	Solar	3.67	8.29	3.27	7.39
	Wind	3.35	7.59	2.99	6.77
Lower Midwest	Uniform EE	2.31	5.23	2.06	4.66
	Peak EE	2.11	4.77	1.88	4.25
	Solar	2.19	4.96	1.96	4.42
	Wind	2.35	5.32	2.10	4.74
Northeast	Uniform EE	1.65	3.73	1.47	3.33
	Peak EE	2.24	5.07	2.00	4.52
	Solar	1.94	4.38	1.73	3.91
	Wind	1.58	3.56	1.41	3.18
Pacific Northwest	Uniform EE	1.13	2.55	1.01	2.28
	Peak EE	1.12	2.54	1.00	2.27
	Solar	1.17	2.64	1.04	2.35
	Wind	1.13	2.55	1.01	2.27
Rocky Mountains	Uniform EE	1.03	2.32	0.92	2.07
	Peak EE	0.98	2.21	0.87	1.98
	Solar	0.99	2.25	0.89	2.01
	Wind	1.07	2.41	0.95	2.15
Southeast	Uniform EE	1.78	4.02	1.58	3.58
	Peak EE	1.87	4.24	1.67	3.78
	Solar	1.83	4.15	1.64	3.70
	Wind	1.76	3.98	1.57	3.55
Southwest	Uniform EE	0.71	1.62	0.64	1.44
	Peak EE	0.70	1.59	0.63	1.42
	Solar	0.73	1.64	0.65	1.46
	Wind	0.77	1.73	0.68	1.54

[108] Available at https://www.epa.gov/sites/production/files/2019-07/documents/bpk-report-final-508.pdf.

Table 3. Public Health Benefits of Energy Efficiency and Renewable Energy (continued)

Texas	Uniform EE	1.58	3.58	1.41	3.19
	Peak EE	1.39	3.13	1.24	2.80
	Solar	1.42	3.22	1.27	2.87
	Wind	1.63	3.69	1.45	3.29
Upper Midwest	Uniform EE	3.12	7.06	2.78	6.30
	Peak EE	2.75	6.22	2.45	5.55
	Solar	2.89	6.53	2.58	5.83
	Wind	3.20	7.23	2.85	6.45

Appendix D

The underlying methodologies and calculations used to create Home Energy Scores are outlined below. Additional detail is available in the paper *Home Energy Score Scoring Methodology*.[109]

Calculation Methodology

The data required to produce a Home Energy Score can be found on the *Home Energy Scoring Tool Data Collection Form*.[110] The energy models used to generate reports are available in the *Home Energy Score Scoring Methodology*.

Energy Efficiency Recommendation Generation

The tool applies a fixed cost from the NREL National Residential Efficiency Measures Database[111] and generates recommendations that provide the highest performance level with a payback time of 10 years or less. The National Residential Efficiency Database provides (and Home Energy Score recommendations are generated by) national averages for measure costs. Recommendations are provided in two categories. Type 1 improvements can help the homeowners save energy immediately. The cost-benefit analysis includes the full cost of installation. Type 2 improvements are recommended at the time of product replacement. The incremental cost between new efficient equipment and the installed equipment is used in cost-benefit analysis. The Home Energy Scoring Tool v.2017 does not include solar PV as an automatic recommendation. Recommendations considered during the improvement analysis are in the following table.

Energy Savings Estimates

The tool uses state average utility rates to calculate estimated energy savings. This information is provided by DOE's Energy Information Administration.

100,000 Score Analysis

By December 2018, 100,000 Home Energy Scores were issued. For that occasion, simple analysis was conducted on that data. The average home in the data set receive an initial Home Energy Score of 4.7 (out of 10) and an upgrade score of 7.3.[112] On average each home could cost-effectively reduce energy use by more than 20 percent. The most common cost-effective recommendations in the dataset are:

- Installing an ENERGY STAR® water heater
- Installing an ENERGY STAR heating system
- Having the home professionally air sealed

[109] Available at https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Home%20Energy%20Score%20Methodology%20Paper%20v2017.pdf.
[110] Available at https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/A3%20-%20Tool%20Data%20Collection%20Form%20%28v.2018%29_0.pdf.
[111] Available at https://remdb.nrel.gov/.
[112] Home Energy Score reports only include whole numbers on the 1-to-10 scale. Fractions are only used in analysis.

- Sealing ducts
- Installing an ENERGY STAR air conditioner
- Installing or increasing the amount of attic insulation[113]

Table 4. Recommendations Considered During Home Energy Score Analysis

Category	Measure
Basement / Foundation wall insulation	Up to R19
Central air conditioner	ENERGY STAR® (SEER 14)
Attic insulation	Up to R60
Cool roof	High Slope - 15% reflectivity
Duct insulation	R6
Duct sealing	Reduce leakage to 10% of total airflow
Floor insulation	Up to R38
Gas boiler	ENERGY STAR (85% AFUE)
Gas Furnace	ENERGY STAR (95% AFUE North, 90% AFUE South)
Heat pump	ENERGY STAR (SEER 14, HSPF 8.2)
Envelope/Air sealing	75% of existing leakage (25% reduction)
Oil boiler	ENERGY STAR (85% AFUE)
Oil furnace	ENERGY STAR (85% AFUE)
Propane furnace	ENERGY STAR (90% AFUE)
Propane Boiler	ENERGY STAR (85% AFUE)
Room air conditioner	ENERGY STAR v 3.0 (EER 11.3)
Roof EPS insulation	Add R5 exterior foam sheathing
Skylights	ENERGY STAR (Double-pane solar-control low-E argon gas wood frame)
Wall insulation	R13
Water heater, electric	ENERGY STAR (heat pump, EF 2.76)
Water heater, natural gas storage	ENERGY STAR (0.67 energy factor)
Water heater, propane storage	ENERGY STAR (0.67 energy factor)
Windows	ENERGY STAR (Double-pane solar-control low-E argon gas wood frame)

[113] U.S. DOE, n.d., "100,000 Home Energy Score So Far and Counting!" https://betterbuildingssolutioncenter.energy.gov/beat-blog/100000-home-energy-scores-so-far-and-counting. Accessed February 20, 2020.