Improving Equity in Energy Efficiency: Identifying Priority Areas for Investment

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ABSTRACT

The equitable distribution of energy efficiency services and benefits is an area of increasing focus for energy efficiency program administrators (PAs). In Massachusetts, a group of PAs engaged an independent evaluator to analyze a key indicator of equity in program records – differences in participation rates across different demographic groups. The study used data from the American Community Survey (ACS) and tax parcel data to analyze historic program participation rates for several demographics, e.g., renters, households with low and moderate incomes, households with limited English fluency, customers living in multifamily housing, and customers living in housing built before 1950.   Many of these variables tend to cluster together into geographic "hotspots," such that if a census block group has a high concentration of one characteristic, it is likely to have a high concentration of the other characteristics as well. Moreover, many of these hotspot communities have historically had lower program participation rates than other communities. Finally, many of these same communities are also considered environmental justice municipalities by the state of Massachusetts. PAs are using this insight to target program investments and measure progress. For example, PAs are using ACS demographic information and participation rates to help program partners target their outreach efforts using interactive mapping tools. PAs are working with environmental justice municipalities to provide dedicated outreach and customized marketing to increase participation rates. PAs are also using this information to target workforce development efforts. This paper will describe the analysis done to identify geographic "hotspots" based on census data. The paper also describes a community outreach metric which identifies priority areas based on demographic information and past participation. The paper explains one way the PAs used demographic information and participation rates to target investments to specific geographic areas. This type of demographic and participation analysis is likely to be useful to other jurisdictions that are seeking to enhance program equity and better serve all customers. The paper will be specifically of value to PAs in other regions, state regulators, and evaluation firms charged with analyzing equity in participation.

Introduction

In the last several years, scholars, activists, regulators, utilities, and stakeholders have increasingly been engaged in discussions about how to improve equity as it relates to energy systems, including energy efficiency. Research has shown that participation in efficiency programs is often not equitably distributed. Studies on energy efficiency programs in California, Oregon, Rhode Island, Washington, and Florida found rural households, renters, non-English speakers, low- and middle-income households and households living in older homes tend to be underrepresented in energy efficiency program participants (Wirtshafter and Samiullah 2005, Navigant 2017, Marti and Nowak 2016, Rubado, et al. 2018, NWPCC 2018, Zhao, et al. 2012). A meta-data study on California energy efficiency program evaluations found participants in general residential programs to be disproportionately high-income, white, English-speaking, college-educated homeowners as compared to the ratio of the same groups within the general population (Marti and Nowak 2016). A study by the Energy Trust of Oregon in 2018 showed that participation rates across their energy programs were lowest in the least affluent areas (Rubado, et al. 2018).

In Massachusetts, ratepayer funded energy efficiency programs, which are administered under the brand Mass Save®[1], have dedicated a portion of program funds specifically to low-income programs since at least 2010. The low-income programs serve customers with incomes up to 60% of the state median income (SMI) and provide no-cost energy efficiency measures such as efficient heating systems, appliances, and weatherization.   Mass Save® programs also include special incentives for renters and moderate-income customers, as well as focused investments in high-need communities. However, little research had been done on the equity of participation in energy efficiency programs in the state. In 2018, the Massachusetts Energy Efficiency Advisory Council (EEAC) and the PAs that sponsor Mass Save® agreed to evaluate participation levels in energy efficiency programs and potential unaddressed barriers to participation for residential customers. The research produced two studies: "Residential Nonparticipant Customer Profile Study" (DNV, 2020) and "Residential Nonparticipant Market Characterization and Barriers Study" (Illume, Navigant, and Cadeo, 2020).

The first of these studies (DNV, 2020), which is the focus of this paper, conducted an analysis of historic participation levels by income level, ownership status, and language spoken in the home, among other characteristics. The study found that historic participation rates in energy efficiency programs in Massachusetts were negatively associated moderate income households[2], renter households[3], and limited English-speaking households[4], when measured at the Census block group level and when participation was based on location participation (i.e., whether a building had been served by the program)[5]. However, when participation was measured accounting for the depth of savings[6], participation was positively correlated with concentration of low-income households[7] and households in multifamily housing[8] at the block group level. The study found it is likely that Mass Save's successful efforts to serve large low-income multifamily buildings contributed to this dichotomy.

To aid efforts to increase participation among renters, moderate-income customers, and language isolated customers, the DNV study identified geographic "hot spots" with high concentrations of populations of these characteristics. The study also included a community outreach metric which identified communities with low historic participation and high concentrations of demographic and housing characteristics associated with low participation.

Since that research was completed, the PAs and EEAC have continued to work together on the topic of equity and improving access to energy efficiency programs in Massachusetts. The PAs developed a definition of equity included in their three-year energy efficiency plan which states that equity is, "the process of establishing more equal access to and participation in energy efficiency, particularly among

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[1] Berkshire Gas, Cape Light Compact, Eversource, Liberty Utilities, National Grid and Unitil work together as Mass Save® to help residents and businesses across Massachusetts save money and energy, providing energy efficiency programs and services while simultaneously leading the state to a clean and energy efficient future.

[2] Defined as annual household income between $45,000 and $74,999 according to the American Community Survey variable B19001. While this measure does not factor in household size, subsequent analyses that were able to integrate household size agreed with these findings.

[3] As identified in the American Community Survey variable B25003.

[4] As identified in the American Community Survey, choosing households that reported *both* a primary language other than English, *and* limited English proficiency, using ACS variable C16002.

[5] Location participation provides a view into what percentage of buildings had any participation in the program, regardless of building size or whether individual utility customers moved in or out of the building.

[6] Participant savings divided by consumption of all customers

[7] Based on ACS variable B19001, with annual incomes less than $45,000.

[8] Using ACS variable B25024, selecting households in buildings with 5 or more units.

those groups who have historically participated at lower rates, including renters/landlords, moderate-income customers, English-isolated families, and microbusinesses." (Mass Save® PAs 2021, 17) The PAs also worked with the Department of Energy Resources to identify a list of environmental justice municipalities based on demographic characteristics and past participation that would be prioritized for energy efficiency investment in the three-year plan. When the Massachusetts Department of Public Utilities ("MA DPU") reviewed the PAs three-year plan they modified the criteria that should be used. Finally, the PAs and EEAC have identified strategies to improve program equity and selected a set of metrics to measure progress on equity over the next three years.

This paper summarizes the analysis of hot spots and the community outreach metric completed by DNV, as well as a mapping tool developed to help stakeholders use this data to identify communities in need of additional program outreach. The paper also describes how the PAs are defining and prioritizing environmental justice municipalities. Finally, the paper considers how the results of this research are being used in Massachusetts to improve equity in energy efficiency programs.

Creation of Hot Spot Areas

DNV conducted a "hot spot" analysis in which target areas with selected demographic and housing characteristics were identified using the Getis-Ord Gi statistic. This statistic assumes a null hypothesis that there are no spatial patterns, and all data is geographically randomly distributed. If clusters of data are observed in spatial proximity, then the result is a hot (or cold) spot. To identify geographic "hot spots," DNV analyzed block-group level demographic and housing data reported by the American Community Survey (ACS) in 2019[9]. Specifically, for each block group DNV identified the following characteristics:

- Percentage of households that are moderate income, where "moderate income" is defined as households with incomes between 56 and 85% of statewide median income, independent of household size;[10]
- Percentage of households that are renter-occupied;
- Percentage of households with a primary language other than English;
- Percentage of households that are in structures of 5 or more units, which is considered a proxy for multifamily buildings; and
- Percentage of structures that were built prior to 1950.

Because block groups had different numbers of customers, DNV chose to normalize the data based on the above-mentioned metrics versus the population size in the block group. While there are many approaches to accomplish data normalization, this study was designed to use a simple, extendable, and replicable method, and one that did not overly emphasize numeric ranges. The method relied on a simple 0 to 1 fraction corresponding to the percentage from each of the above bullets for the analysis variables of interest. These percentages are summed together to produce a score, ranging between 0 and 5. For example, a block group with 20% of households that meet each characteristic would have a score of 1 (0.2+0.2+0.2+0.2+0.2=1). The scores were then mapped, and clusters of adjacent block groups with

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[9] The ACS data is five-year average data for 2015-2019.

[10] This definition of moderate income differs from the program definition used in Massachusetts, where moderate income customers are defined as having a household income of 61% to 80% of state median income, factoring in household size. The definition of moderate income used for the analysis described in this paper was as close as possible to the program definition, considering ACS data available.

high scores (greater than a z-score of 1.65, equivalent to a P-value of 0.9) were identified as "hot spots," whereas clusters of adjacent block groups with low scores (less than a z-score of -1.65, equivalent to a P-value of 0.9) are considered "cold spots." Finally, to provide a more intuitive visual representing where customers would be located the uninhabited areas, such as lakes, wetlands, and forests were washed out using a shaded overlay. The results are shown in Figure 1 in the Results section.

In addition to identifying hot spots based on demographic and housing characteristics, DNV and the PAs developed a community outreach metric. The community outreach metric is designed to help identify geographic areas that have demographic characteristics associated with lower participation in energy efficiency programs, as well as actual lower historical participation in such programs. This metric is computed for each block group by summing the percentage of renters, moderate income customers[11], and limited English proficiency customers, and then dividing that sum by the energy efficiency program participation rate at the account level.[12] The metric is then aggregated to the municipal level. Note that households that match multiple demographic characteristics (e.g., moderate income renters) are counted multiple times. The resulting metric is high for municipalities that have high percentages of renters, moderate income customers, and limited English proficiency customers, and low past participation rates. The metric does not depend on community size.

After the community outreach metric was developed, the PAs and DNV developed an interactive mapping tool to display demographic characteristics at the block group level, along with historic participation levels. The mapping tool starts with Google Earth as a foundation, so all the information that Google maintains and makes available through Google Earth and Google Maps – network routing, business hours, contact data, and even time series street views – is built into the tool. The mapping tool also combines utility account participation data, billing data, and available demographic data (often from the American Community Survey) and adds overlays on top of the Google maps. These overlays provide a visual cross-tabulation of demographics and participation data. This allows users to quickly identify areas (usually Census block groups) that simultaneously have high concentrations of the demographic variable of interest (e.g., renters) and low or high participation rates. The mapping tool allows users to zoom in to examine specific parts of neighborhoods that may face barriers to participation in energy efficiency programs and low historic participation rates, and relate these areas to specific streets, landmarks, and buildings.[13]

Results

The hot spot analysis for Massachusetts finds that areas with high percentages of moderate-income households, renters, households with a primary language other than English, households in

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[11] Moderate income customers are defined in the same way for the community outreach metric as for the hotspot analysis.

[12] Account participation is defined as whether a unique utility account has participated in an energy efficiency program at least once over a certain timeframe (in this case, 2013-2017). This variable is helpful to understand past participation at the individual level, but since account numbers change when residents move in or out of a building, areas with a high proportion of dwellings with frequent resident turnover (e.g., rented apartments) will tend to have lower account participation rates. Account participation is calculated separately for block groups that have electric and gas accounts through the utilities that sponsor the energy efficiency programs, and then aggregated for block groups that have both types of accounts. For the purposes of the community outreach metric, account participation is not weighted by consumption.

[13] The tool can identify specific non-participant accounts; however, data security concerns restrict access of this information to non-utility users.

multifamily buildings, and an older housing stock exist across the state, but are especially concentrated in urban areas. Hotspots identified in the research are shown in Figure 1. They include Agawam, Amherst, Arlington, Attleboro, Beverly, Boston, Brookline, Brockton, Cambridge, Chelsea, Chicopee, Clinton, Everett, Fall River, Fitchburg, Framingham, Gardner, Gloucester, Greenfield, Holyoke, Haverhill, Lawrence, Leominster, Lowell, Lynn, Malden, Marlborough, Medford, Melrose, Methuen, Milford, New Bedford, Nahant, Northampton, Peabody, Pittsfield, Quincy, Revere, Salem, Somerville, Southbridge, Springfield, Taunton, Waltham, Watertown, West Springfield, and Worcester (DNV 2020, Figure 4-1 and Appendix D).

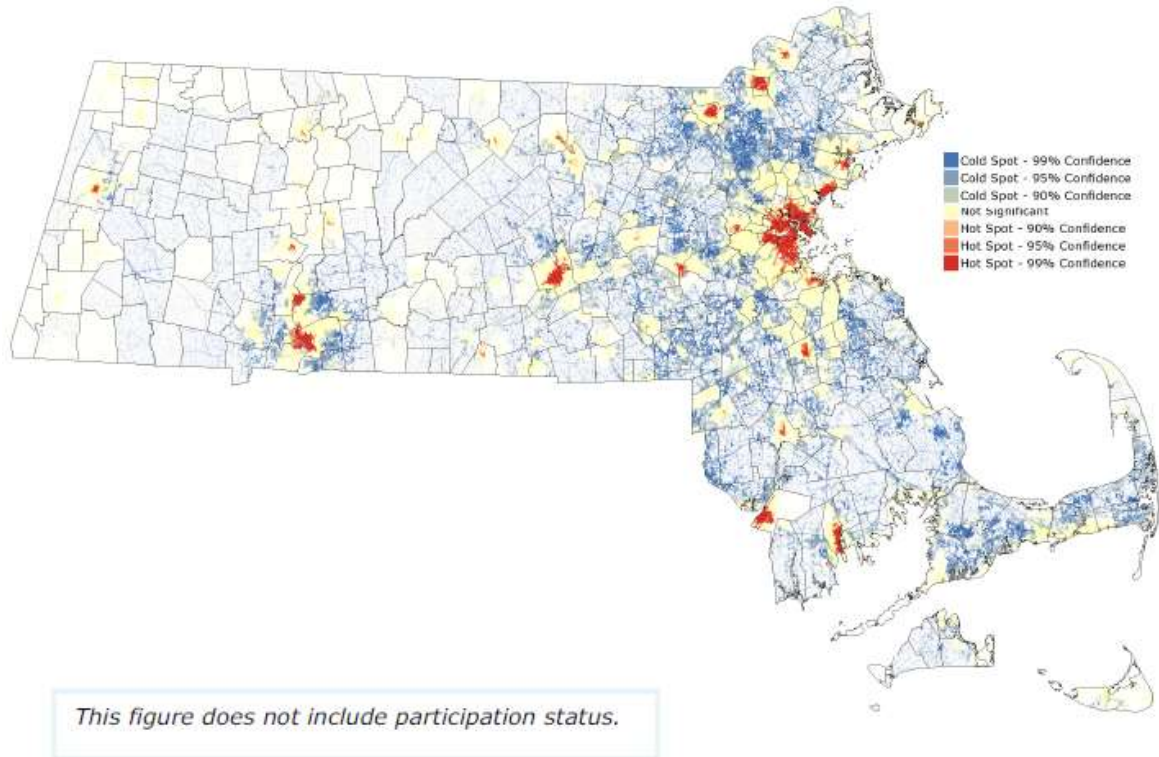*This figure does not include participation status.*

Figure 1. Statewide ACS variable hot spot map, showing inhabited areas only. *Source:* DNV 2020

The community outreach metric produces similar results to the hotspot analysis. The municipalities with the highest community outreach metric scores, with a value greater than 10, are shown in Table 1. Although the numeric score in isolation is not meaningful, the relative value of the score is intended to show the extent to which the community have barriers to participation in energy efficiency programs. All the municipalities shown in Table 1 are also considered hot spots in Figure 1 above.

Table 1. Municipalities with Community Outreach Metric Scores Greater than Ten

Utility Service Type	Town	Renter %	Moderate Income %	Limited English %	Unweighted Account Level Participation Rate	Community Outreach Metric
Dual Fuel (Gas and Electric)	Lawrence	70%	15%	25%	6%	18.57
Dual Fuel (Gas and Electric)	Fall River	65%	17%	9%	6%	15.07
Dual Fuel (Gas and Electric)	Fitchburg	48%	14%	5%	6%	11.96

Utility Service Type	Town	Renter %	Moderate Income %	Limited English %	Unweighted Account Level Participation Rate	Community Outreach Metric
Gas Service Only	Taunton	38%	17%	5%	5%	11.26
Dual Fuel (Gas and Electric)	New Bedford	58%	16%	13%	8%	10.77
Dual Fuel (Gas and Electric)	Chelsea	74%	17%	27%	11%	10.34
Dual Fuel (Gas and Electric)	Everett	61%	20%	16%	9%	10.33

Source: DNV 2020

The Massachusetts PAs worked with DNV to extend the use of participation and demographic data for program targeting and outreach. The initial focus was on municipalities participating in the Community First Partnership program.[14] The goal was to develop an easy-to-use, interactive tool for community partners to help them identify and target specific areas in their town to increase program participation without compromising their customers' private and confidential information. To that end, DNV created a Google-based mapping tool that combined utility participation data at the census block level with other sources of public information such as tax data and the US Census American Community Survey (ACS). The tool had to: 1) be simple to use and intuitive for non-technical users, 2) show roads and landmarks, 3) leverage existing data work and be easy to update and maintain, and 4) be operating system-agnostic and not require licensing fees. The maps are interactive and will allow cities and towns to identify which layers of data are most important to them and to prioritize geographic areas accordingly.

The maps were started with an initial set of 10 municipalities which included: Andover, Cambridge, Chelsea, Framingham, Haverhill, Lawrence, Marshfield, Methuen, Newton, and Westborough. Maps for all Massachusetts cities and towns are completed and will be posted and publicly available in 2022.

The results include a KML[15] file for each town that Google Earth™ uses to overlay the participation and demographic data on top of a typical Google Map. The map includes landmark and other information available via Google Map as well as the block group participation and demographic metrics. Each participation and demographic variable is provided as its own semi-transparent layer. This allows the user to activate the variables they are interested in exploring. For example, if a user wants to identify the areas that have high proportions of renters and low participation rates, they would activate the renter and participation layers. The map colors are set so the darkest block groups are the ones with highest renter rates and lowest participation rates. Figure 2 shows at a high level the hierarchy of how individual layers comprised of ACS data and Program Administrator participation and customer data are stacked together to provide a multidimensional picture of community characteristics. Google's search features are included in the maps, so that uses can identify individual locations of interest <u>outside</u> of any Program Administrator held data. Examples of this include searching for "rental" or "affordable housing"; or on the C&I side being able to target specific types of chains like "McDonalds" or "Dunkin".

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[14] See   https://www.masssave.com/learn/partners/community-partnership for more information about the Community First Partnership program. Note that the partnership program was updated in 2021, and eligibility, requirements, and other aspects of program design were adjusted at that time.
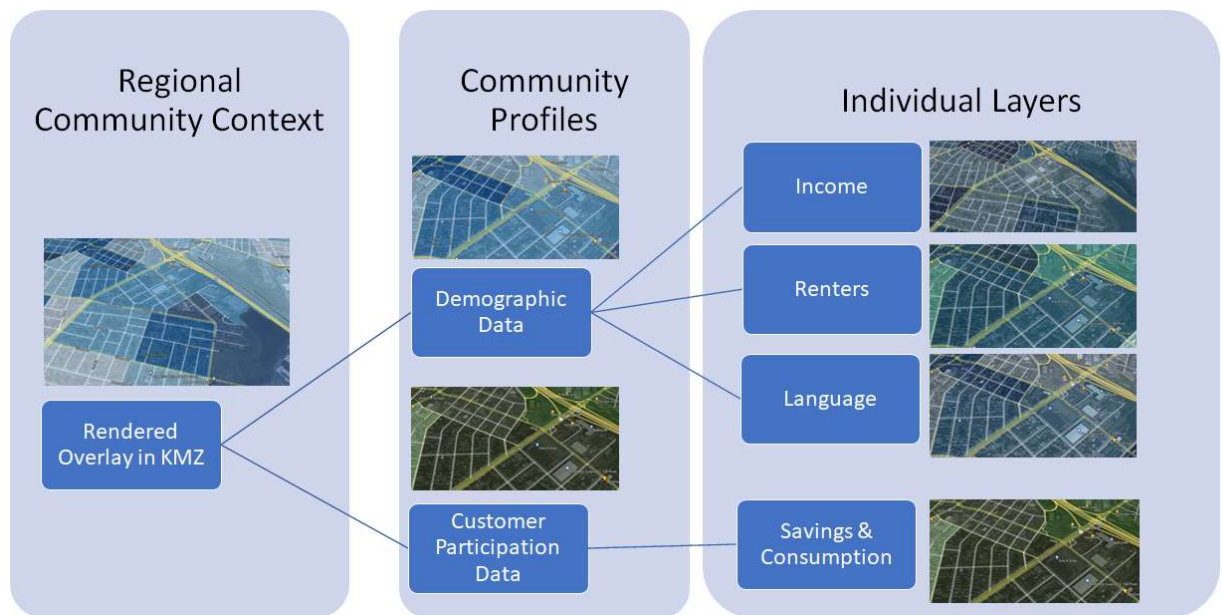[15] KML is the file format used by Google Earth™

Figure 2. Flow model of how individual layers with the same color schemes (ACS data) and transparencies assemble into regional, community, and individual attribute insights in the KMZ files

Application of Study Results

In light of the research above, the PAs suggested a variety of strategies to increase equity in Massachusetts energy efficiency programs in their 2022-2024 plan[16]. Some of these strategies focused on increasing participation among certain demographic groups that have historically participated at lower rates (including moderate income customers, renters, and customers that face language access barriers). Other strategies were geographically based, recognizing that certain geographic areas (often with high concentrations of the demographic target groups above) tend to participate at lower rates. To better serve customers in these geographic areas, PAs updated and expanded the Community First Partnership program, and are providing the mapping tools described above, as well as resources including:

- Up to $60,000 per year to support project costs and funding to hire a part-time Energy Advocate
- Comprehensive training in energy efficiency offerings, especially residential weatherization, residential heating and cooling upgrades, and Small Business Turnkey program
- Co-branded marketing materials
- Monthly progress reports
- Program participation guide
- Best practices to encourage program participation, training; and
- Local event support, such as guest speakers for local events.

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[16] The 2022-2024 plan was submitted to the Department of Public Utilities on November 1, 2021. All elements of the plan, and associated PA commitments, are subject to DPU approval.

The MA DPU in their order modified from the proposed plan the criteria that the Program Administrators should use to identify specific communities for targeted investment and priority status in being selected as a Community First Partner. The MA DPU ordered that the PAs use a three-pronged test described below to identify communities eligible for the Program Administrators' targeted equity investment and outreach strategies ("Targeted Hard-to-Reach Communities"). . These targeted Hard-to-Reach Communities ("HTR") municipalities meet the following criteria[17]:

(1) The municipality is served by an electric and/or gas Program Administrator.
(2) The municipality contains at least one environmental justice population as defined by the Secretary of Energy and Environmental Affairs (EEA) Environmental Justice Policy.[18] These areas are Census block groups that meet one or more of the following:
   o Annual median household income is not more than 65% of the statewide annual median household income,
   o Minorities comprise 40% or more of the population,
   o 25% or more of the households lack English language proficiency, or
   o Minorities comprise 25% or more of the population and the annual median household income does not exceed 150 percent of the statewide annual median household income.
(3) The municipality has a historically low participation rate. The Department defined "historically low" participation as those municipalities with a combined consumption-weighted participation rate of 27 percent or less, five percent below the statewide average.

Municipality-wide, the City of Boston would not meet the criteria for inclusion as a Targeted Hard-to-Reach Community based on the MA DPU criteria. The City of Boston, however, contains nearly a tenth of the Commonwealth's population. Accordingly, the MA DPU agreed with the PAs proposal to prioritize the following neighborhoods in the City of Boston: Allston, Brighton, Dorchester, East Boston, Fenway, Mattapan, Mission Hill, and Roxbury.

There is some overlap between the HTR municipalities that meet the criteria above and the hotspots described earlier: 22 of the 60 HTR municipalities are also hotspots.

In Massachusetts, PAs are using the HTR municipality list to prioritize outreach in several ways. First, they have committed to increase investment in the HTR municipalities for the 2022-2024 period compared to the prior three-year term. PAs are also planning to increase the number of energy efficiency program participants in these municipalities for the 2022-2024 period compared to the prior three-year term. PAs intend to establish partnerships with municipalities, community organizations, or business associations in at least 75% of HTR municipalities. These partnerships may be formal or informal partnerships that aim to improve service to one or more of the identified underserved customer groups. In addition, PAs are using targeted lists of high need communities to select areas for investment in workforce development. For example, the Clean Energy Pathways program, which focuses on training and developing job placements for women and minorities in the energy efficiency field, focused recruitment

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[17] See https://www.mass.gov/doc/2022-2024-three-year-energy-efficiency-plans-order/download
[18] See Environmental Justice Policy of the Executive Office of Energy and Environmental Affairs) (Updated June 24, 2021) available at https://www.mass.gov/doc/environmental-justice-policy6242021-update/download.

and workforce development partnerships in four EJ municipalities: Springfield, Boston, Lawrence, and Fall River.

In addition to geographically focused efforts informed by the work to identify HTR municipalities, the PAs are working to serve more of the individuals across the state who are in demographic groups that tend to participate in energy efficiency programs at lower rates. For example, for moderate-income customers, the PAs plan to offer new enhanced incentive on HVAC equipment. The PAs are also working to address customer language barriers through the creation and implementation of a language access plan. PAs are partnering with inclusive and multilingual community-based organizations and seeking to improve the customer journey for customers who speak the most common non-English languages in Massachusetts—Spanish, Portuguese, and Mandarin. The PAs will also increase outreach to renters and landlords, including covering 100 percent of the cost of weatherization for individually-metered rental units and conducting targeted outreach to owners of 5–25-unit buildings in municipalities with an above-average density of rental units.

Conclusions

Customers with certain demographic and housing characteristics have historically participated in energy efficiency programs in Massachusetts at lower levels. While separate research has identified why this may be the case and specific barriers that have hampered participation (Illume, Navigant, and Cadeo 2020), this paper has discussed ways to identify those communities most in need of additional assistance to support their participation.

When selecting an approach for identifying communities for additional assistance, outreach, and investment, it is important to use clear, transparent criteria that can be reproduced by stakeholders. Using publicly available data wherever possible will enhance the transparency of the approach, even if such data (e.g., Census data) may be imperfect and incomplete. Combining PA data on energy efficiency program participation with public data on demographic and housing characteristics can be helpful to get a comprehensive picture of patterns of participation.

The process of improving equity in energy efficiency programs will require a sustained and focused effort on the part of PAs, regulators, and stakeholders. The barriers to participation are real and addressing them to the greatest extent possible will require ongoing attention and investment, close engagement with the communities affected, and measurement of progress over time. Metrics that identify communities most in need are one part of the solution to ensure that PAs can prioritize their efforts to engage these communities in energy efficiency.

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