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Better Buildings Workforce Accelerator – Technical Assistance Project

Northwest Energy Efficiency Council – Diversity, Equity, and Inclusion in Building Operator Certification Training

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1.0 Introduction

Through the U.S. Department of Energy (DOE), Better Buildings Workforce Accelerator (BBWA) technical assistance program, Pacific Northwest National Laboratory was asked to support the Northwest Energy Efficiency Council (NEEC) in evaluating its workforce development programming. Specifically, NEEC requested support from DOE and PNNL to conduct an audit of the Building Operator Certification (BOC) training program's diversity, equity, and inclusivity (DEI) within the context of participant recruitment and success. The BOC is a nationwide program that trains building operators operating in commercial and multifamily residential facilities from across sectors (e.g., hospitality, schools, multifamily housing, hospitals, etc.) in more efficient and effective practices for energy systems management to support operators and engineers in improving building energy efficiency.

This DEI analysis included an evaluation of existing training program data from the BOC between 2010 and 2020. It looked at the following dimensions of current participation: participant diversity, systemic barriers to success amongst specific groups, and advising on program evaluation and benchmarking for the future. To create boundaries to the nature and scope of analysis, NEEC and PNNL agreed to focus on data from the State of Washington to generate a proof of concept model for DEI analysis across other states where the BOC test is administered. Data was constrained to the 2010-2020 time frame due to the inconsistency in data from the program's early years.

The following sections outline the impetus and structure of the analysis conducted for NEEC, including recommendations for benchmarking and replicating the analysis here in other states. While the more academic literature does not draw strong links between the importance of DEI in energy system operator workforce development (such as through the BOC), it is the view of the author that a just, decarbonized system benefits from bringing in the perspective of those who are traditionally excluded from such technically-focused roles in society. To this end, the BOC program is succeeding at bringing in a more diverse population of participants in terms of two key metrics, gender, and veteran status, than the closest equivalent workforce benchmarks available from census data. BOC has more than average participation of these groups, and in the case of women, this is especially true given BOC participants are two to ten times more likely to be women than their workforce peers.

Despite these tremendous achievements, when measured against community-level metrics for socioeconomic status – specifically education and presence of non-English speakers – BOC participants are overwhelmingly identifying with communities that are better educated and have fewer individuals who do not speak English and live by themselves (linguistically isolated) than the state average. To address these challenges, BOC program leadership may want to consider alternative pathways to participant recruitment in underserved communities, including engaging community action groups, church communities, and others relevant to each respective area they want to reach. Furthermore, in doing so, BOC program leadership may want to re-evaluate the course materials to account for the differences in capabilities, time, and other stressors for those who come from less-advantaged communities.

2.0 Diversity, Equity, and Inclusion in Energy Efficiency

In the context of workforce development, the meaningful and deliberate shift towards increasing diversity, equity, and inclusivity (DEI) goes beyond merely checking boxes towards understanding, empathizing, and then creating systems and norms that reinforce an inclusive work culture. According to Ceridian, achieving this means creating an inclusive work culture through “every touchpoint in the employee experience” (January 13, 2021). From who is recruited to how they are empowered and respected within the context of a company’s culture – both inside the building walls and beyond – DEI in this respect is about what employees experience and perceive every day.

A cursory examination of resources on DEI and training, however, shows the focus is more on the training of DEI thinking and behavior within a given workforce. The training process itself is excluded from much of this conversation. Yet equitable access to training and development is part and parcel to creating an inclusive and empowered workforce. Like with an organization’s culture, a training and development culture should also embody the desired values of the training organization throughout the trainee experience. Diverse groups of experts provide essential experiential knowledge for addressing salient issues that individuals who are more like most of the industry may not observe.

Furthermore, as the body of research on energy efficiency demonstrates from users' perspective, meaningful shifts in energy use for disadvantaged communities are inexorably linked to questions of diversity, equity, and inclusivity. Equitable access and participation in the workforce by underrepresented groups is a fundamental part of creating just energy planning and operation. Those voices that are not heard have historically been negatively impacted by shifts in local, regional, and national energy systems (Nature 2020).

The purpose of this study was to bring the challenges incumbent for DEI amongst this unique and important workforce to support NEEC in planning pathways to ensure its programming reaches those audiences that could benefit the most from building operations training and support. With a rising emphasis on linking DEI and energy jobs as part of the current administration’s decarbonization vision, demonstrating a willingness and effort towards addressing the systemic biases inherent in training for the building operator sector positions NEEC well to be a leader in this new workforce development paradigm. The following section outlines the nature of this DEI analysis of existing BOC training, focusing on data sources, cleaning, and rectification with publicly available information about various social and environmental metrics that can signify a disadvantaged community.

3.0 Study Design

At the onset of this study, the overarching goal was to understand (a) what are the common characteristics and traits of those who choose to participate in the BOC training program and (b) are there any clear trends or gaps where NEEC can serve to provide greater opportunities for underserved communities to participate in the training program. To bound this initial pilot study, NEEC and PNNL jointly agreed to analyze data from Washington State alone. This approach allowed for more time to identify key metrics from publicly available sources to analyze the community characteristics of where training participants live and or work.

Data originated from NEEC databases for BOC training registrants and participants, with the latter being the data set augmented for the analysis. The registrant ID number was used to

rectify information gathered during the registration phase with the participant data – this allowed for merging key data such as veterans status and job title from the registrant data with the participant data to create a more comprehensive data set. All participants were asked to provide a ZIP Code for (a) their work address and (b) their home address, as well as a preferred primary location. With incomplete data for work and home addresses across multiple participants, a decision was made to focus on using the primary address as the "location" of each participant. This created limitations in clearly associating individuals with community-localized environmental or social risk factors – encouraging participants to provide their residential ZIP Code will address this gap. Furthermore, if it is possible to collect address information this level of detail will enable closer analyses of localized risk factors.

BOC registrant and participant data did not include information associated with socioeconomic factors (race, education, income), which created limitations in analyzing the DEI of the specific registrant population. Data streams at the ZIP Code level were brought in from many sources to create a "community-level" snapshot of social, health, economic, and environmental factors relevant to the ZIP code each participant designated as their primary.

U.S. Census: Information about race and ethnicity at the ZIP Code level was brought in from the 2019 American Community Survey (U.S. Census 2019). This information allowed for a "broad" understanding of the racial and ethnic makeup of participant's communities, and specifically for identifying any trends.

Environmental Protection Agency (EPA) Environmental Justice (EJ) Screen (U.S. Environmental Protection Agency 2021): The EJ Screen tool allows for the exploration of a variety of health and socioeconomic factors in a specified region to identify the potential for vulnerable communities to face specific challenges. Measurements in the EJ Screen tool were taken for the center of each given ZIP Code (1-mile radius) (as the GIS-based system does not allow for aggregation at a ZIP Code as a whole). The following factors were brought in to the BOC participant merged data set (as described above):

- **Ozone (parts per billion, ppb):** Ground-level ozone exposure can lead to sustained health issues, including severe asthma, reproductive issues, with children at the greatest danger. Work conducted by the Sierra Club notes that Black/African American communities are some of the most vulnerable to ozone exposure, leading to significantly higher incidents of asthma than in White communities (Sierra Club 2003).

- **NATA Air Toxics Cancer Risk (at-risk persons per million, MM):** Cancer risks are a known dimension of environmental justice. Higher rates of certain cancers amongst low-income communities and communities of color are well documented (American Cancer Society n.d.)

- **Hazardous waste proximity (facility count/km distance from site):** Like cancer risk, historical inequities have led to either the formation of low-income communities around hazardous waste sites or the location of these sites in low-income communities. The reasons for this are varied across the country and relate directly to several social and economic factors.

- **Superfund proximity (facility count/km distance from site):** Similar to hazardous waste proximity, but more focused on the most severe sites that have emergent and chronic impacts on the health of populations.

- **Linguistically isolated population (percent):** Linguistic isolation is the presence of a household with limited speaking in English (California Office of Environmental Health Hazard Assessment n.d.). According to the U.S. Census Bureau, this is a percent of all households in a given region where all individuals 14 years or older do not speak English well (ibid). Linguistically isolated populations may be unable to understand important health and safety information, and engage with social services to receive the care they need.

- **Population with less than a high school education (percent):** Low education strongly links to other vulnerable SES factors. Those without a high school education are at higher risk of poor health and premature death (Office of Disease Prevention and Health Promotion 2020). According to the 2020 Social Determinants of Health report, high school graduation is one of the key educational determinants of health. Communities with high percentages of individuals without a high school education may experience systemic and multigenerational inequities (e.g., a “poverty trap”).

- **Low-income population (percent)**

To create an easy to analyze metric for each of these factors at the community level measures at the community level were normalized against the state average (also provided in EJ Screen). As shown in the results section below, this allowed for an easy comparison of the characteristics of participant communities against each other and the state writ large.

In addition to the data streams aggregated for participant ZIP Codes, an additional metric, the Washington State Environmental Health Disparities factor, was included to provide a comprehensive metric for measuring community-level risk. The metric draws on data across the state in four categories (environmental exposures, environmental effects, sensitive populations, socioeconomic factors) and 19 indicators to score the risks to a given population from 0 – 10 (10 being the most at risk) (Washington State Department of Health 2021).

3.1 Limitations

Due to the nature of the dataset, metrics related to a specific participant's identity, presence as part of a vulnerable community, or other social/economic factors are limited to data resolution at the ZIP Code level. As such, there is little this analysis can say about *individuals per se*, but rather focuses on the conditions of the environment they inhabit and, presumably, live, work, and socialize within. Similarly, the limited dataset prevents a meaningful statistical analysis of the results. Thus, the following sections focus on descriptive statistics and overarching trends.

4.0 Results

Forty percent of BOC training participants self-identified as a building engineer/building operator, with a further 19.7% identifying as an HVAC technician/electrician/maintenance mechanic. Another 27.4% work in a supervisory role in the building operations space, either as a general manager or supervisor or as a manager that oversees resource conservation, energy, or sustainability.

Table 1. Participants in BOC Exam by Job Role (n= 117)

Role	Count	Percentage
Building Engineer/Building Operator	47	40.2%
HVAC Technician/Electrician/Maintenance Mechanic	23	19.7%
Resource Conservation Manager/Energy Manager/Sustainability Manager	16	13.7%
Supervisor/Manager	16	13.7%
Other	13	11.1%
Not Reported	2	1.7%

BOC participants come from a variety of different sectors and job roles. The single largest group work in property management (23.3%) followed by K-12 schools (18.3%), and local government facilities (16.7%) (Figure 1).

With BOC participant categories not fitting into specific job classes as identified in the BLS labor census (U.S. Bureau of Labor Statistics 2020), two other job categories, (a) Stationary Engineering and Boiler Operators, and (b) Heating, air conditioning, and refrigeration mechanics and installers, were used a metrics for measuring gender inclusivity. When measured against these job categories at the national level (as state-level data was unavailable) BOC trainees are between two and ten times more likely to be women than for the entire population of technicians in these fields above (Figure 2). Veterans participating in the BOC training program are also higher than the percentage of those in the State of Washington's workforce; however, female veteran representation is slightly under the state's total female veteran population (6.6% representation among veterans taking BOC testing versus 8.6% of all WA veterans being female) (Figure 3).

BOC training data did not include specifics regarding the race of participants. Given the limited sample of respondents in certain regions, it was difficult to determine with any certainty what level race directly played in shaping the breakdown of BOC participants. The same can be said for income, as BOC participants were not required to provide any information regarding their income.

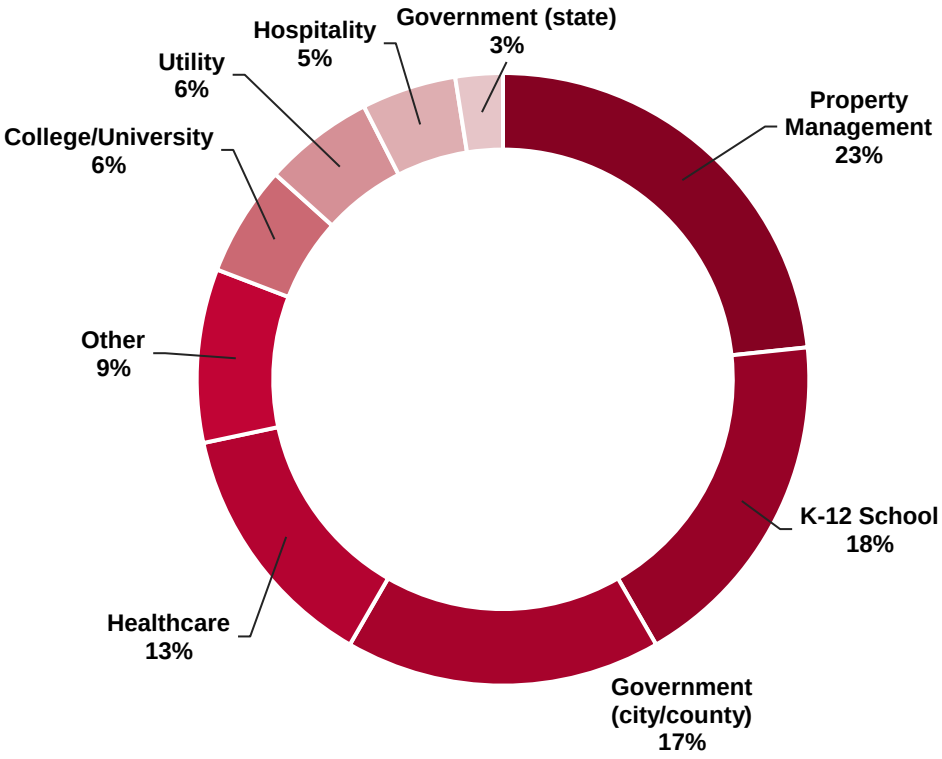

Figure 1. BOC Participants by Sector

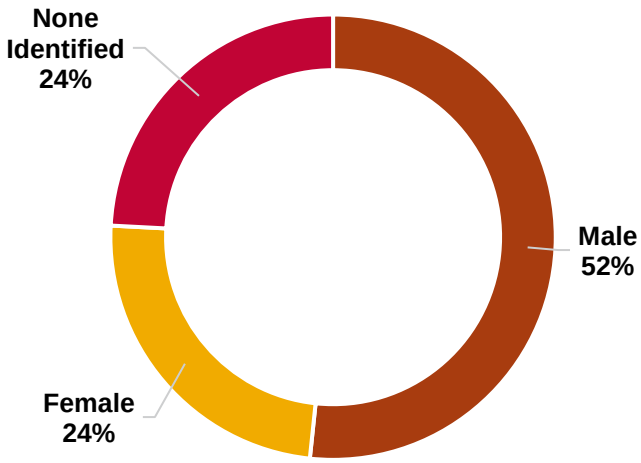

Figure 2. Participants by Gender

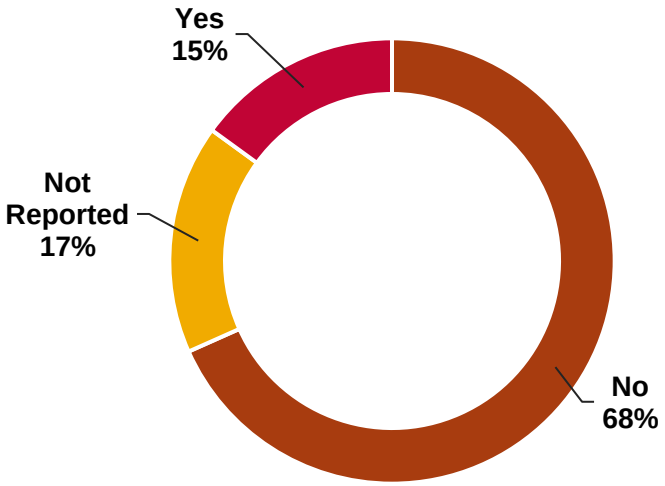

Figure 3. Participants by Military Veteran Status

4.1 BOC Participants by Social Vulnerability Factors

Respondents who participated in the BOC training program through examination were categorized by the level of linguistic isolation (percentage) in the community they designated as their primary ZIP Code. Figure 4 summarizes these results in a histogram normalized against the state average and segmented by whether they passed or failed the examination. Each column represents a group of BOC training program participants who come from communities with a similar level of linguistic isolation (either from the same ZIP Code or multiple ZIP Codes with the same value). For reference, a value of "1" on the horizontal axis (for this and any of the subsequent histograms) represents the normalized average of that measure for Washington State writ large. So, for example, 1 in Figure 4 below represents the normalized average percentage of linguistic isolation for all Washington communities.

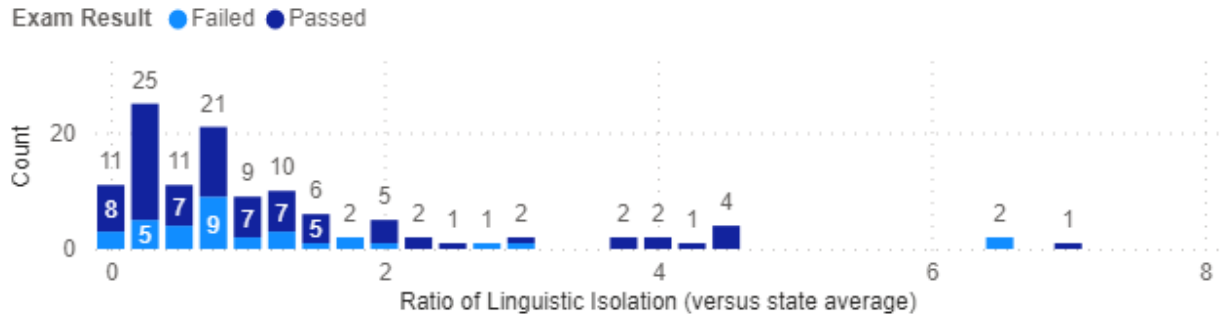

Figure 4. Participants by ZIP Code level Ratio of Linguistic Isolation

Participants tended to come from communities of lower than average linguistic isolation. However, 23 (19%) of the entire group of participants did come from communities with greater than average rates of linguistic isolation (between two and eight times). While this does not provide any information on the specific participants, we can postulate that these individuals work and live in communities where it is more likely than in others across the state they may engage

with individuals at work or home who have limited use of English. They may be the only members of their family who are fluent, or they may not be fluent at all. Regardless of speculation, the limited participation of those from linguistically isolated communities deserves further understanding beyond the current capabilities of this data set and, to an extent, the literature on energy efficiency.

Like linguistic isolation, most BOC participants come from communities with a higher than average attainment of High School education compared to the state average (Figure 5). Overall, 12% came from communities with two to five times higher rates of less than a high school education compared to the state average (n = 14). It is also worth noting that the three respondents from the least educated communities (between 2.8 and 5 times worse than the state average) all failed the test. This sample is insufficient to discern any significant statistical trend; however, its presence in conjunction with the literature poses an essential question about the conditions under which those three individuals exist and whether said conditions had any bearing on their ability to pass the examination.

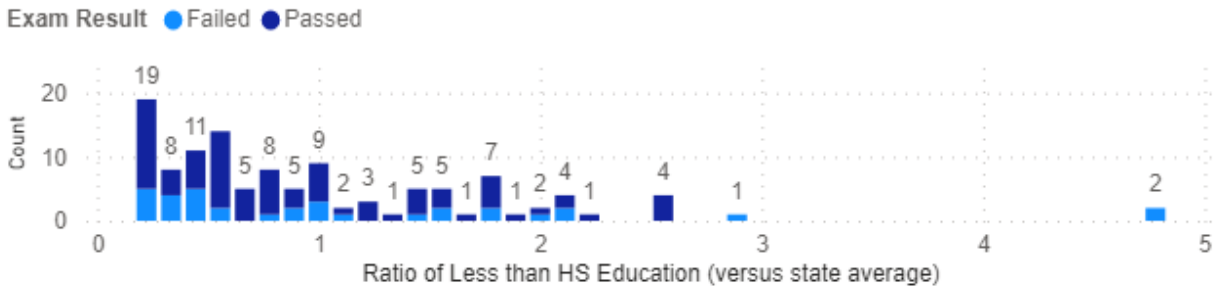

Figure 5. Participants by ZIP Code level Ratio of Less than High School Education

To a lesser extent than linguistic isolation and high school education, BOC participants tended to come from higher median income communities than the state average (Figure 6). Less than half (42%) BOC training participants who took the exam came from communities with higher proportions of residents who are designated as low income, though there appear to be no discernable patterns in terms of whether income plays a significant factor in shaping whether participants do better or worse at the exam.

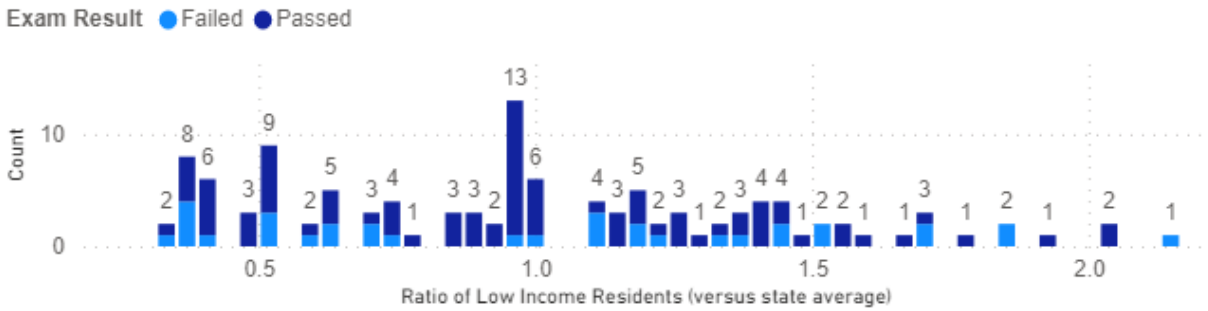

Figure 6. Participants by ZIP Code level Ratio of Low-Income Residents

Compared to the social factors, environmental and health factors showed no discernable trend towards inequitable participation by individuals from more vulnerable communities. As Figure 7 shows, more participants came from high-risk communities from a health perspective than not. This phenomenon may be a product of using primary ZIP Code as the geographical location, as those who listed their business as a primary address may be in areas zoned for commercial and

industrial activity, both present and historic (now “brownfield” sites). Overall, however, environmental factors did not show a discernable pattern than the socioeconomic dimensions analyzed above.

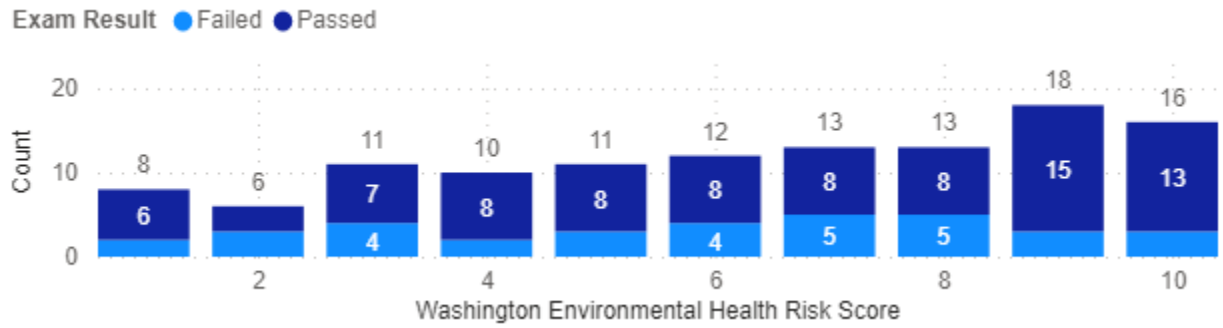

Figure 7. Participants by ZIP Code level Washington Environmental Health Risk Score

Figures 8 and 9 below examine the WA environmental health risk score against two key socioeconomic factors – HS education and Linguistic Isolation – to discern if there are common trends in overall “vulnerable community” participation in the BOC training program. Each bubble represents a group of participants who live in communities with the same values for each respective axis. Immediately noticeable are two trends – first, broadly health and social risk track together, with a more discernable trend occurring between environmental health and linguistic isolation (more linguistically isolated equals higher environmental health risk).

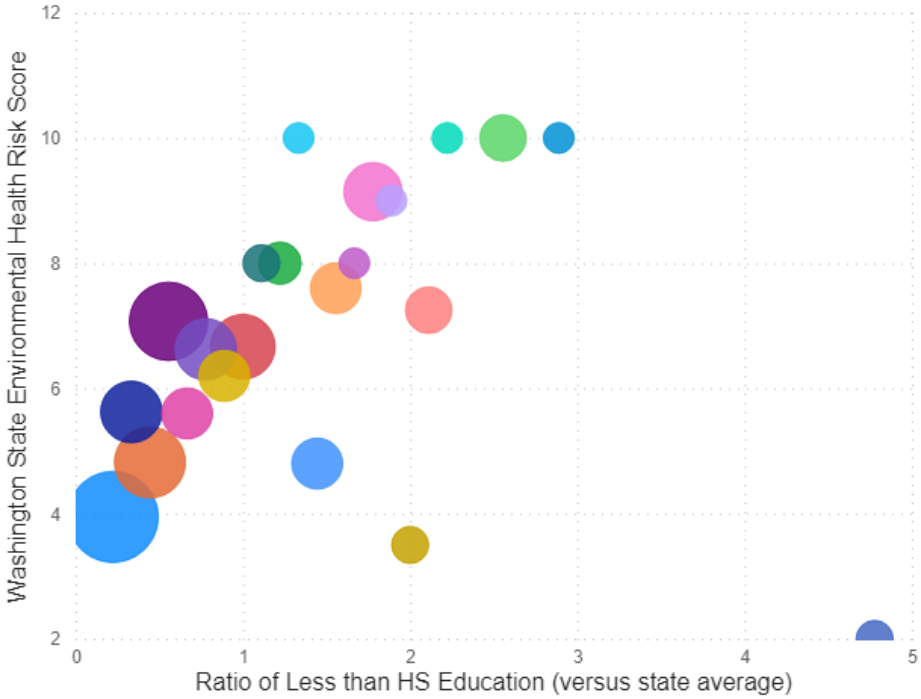

Figure 8. Environmental Health Risk versus Less than a High School Education Ratio (grouped by values – each color represents a different pair of social and health scores)

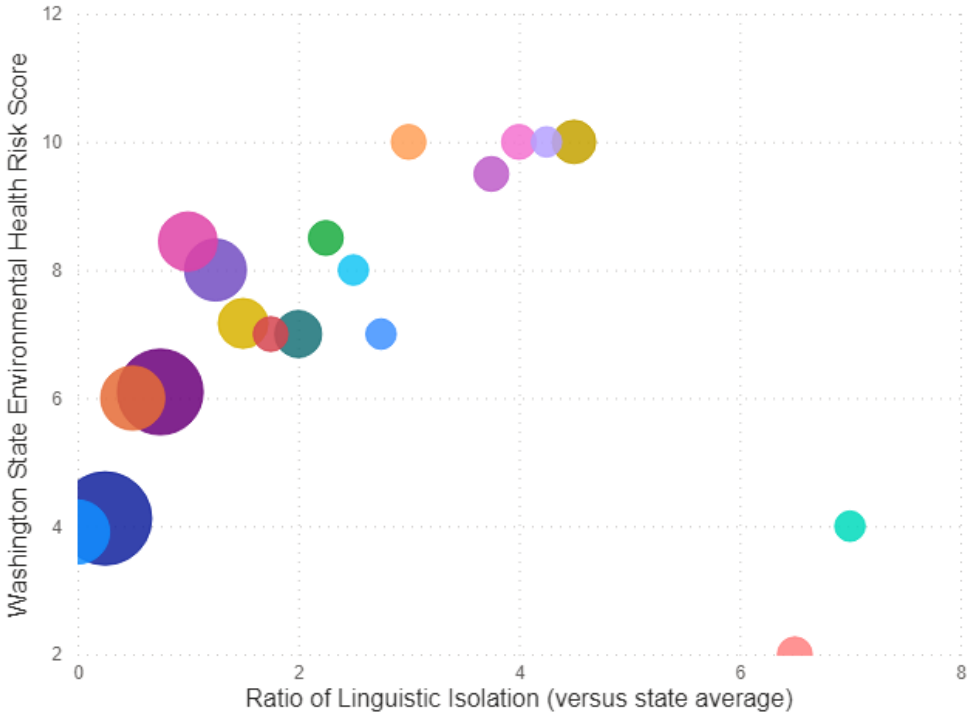

Figure 9. Environmental Health Risk versus Linguistic Isolation Ratio (grouped by values – each color represents a different pair of social and health scores)

Second, BOC participants came from communities with moderate environmental health risk and lower than state incidence of lack of high school education and linguistic isolation.

On a related note, while this study did not separate information based on rural/urban location (based on the lack of rural participants), drilling down from Figures 8 and 9 above to those respondents from the communities with the highest incidents of linguistic isolation and incomplete HS education show each comes from a rural community (one from the Olympic Peninsula and two from Central Washington). This result suggests careful attention must be paid to delivering programming in rural communities as the social challenges in these locations may be significantly different than those of other more urban participants.

5.0 Metrics for Benchmarking Programming

Benchmarking for equitable program participation for the BOC training will invariably shift based on a specific state's workforce, demographics, and history of inclusion and exclusion in specific parts of the workforce. Determining which factors matter or do not should be a collaborative effort of the BOC leadership team and be informed by input from local industry stakeholders, workforce development groups, and above all, an understanding of labor politics and history within a specific state. At the national level, metrics for three categories in the U.S. workforce – (a) Stationary Engineering and Boiler Operators, (b) Heating, air conditioning, and refrigeration mechanics and installers, and (c) Facilities Managers – may provide easily implemented metrics across all programming. As the BOC-test relevant workforce includes both of these categories (and others), the two listed above can work as initial benchmarks until alternative metrics (e.g., should the Office of Energy Jobs at DOE choose to publish its own workforce data) that more directly align with the commercial building energy efficiency workforce. The specific

demographics of relevance (based on U.S. Bureau of Labor Statistics 2020 data) are listed Table 2 (below).

Table 2. Workforce Benchmarks (by gender, race, and ethnicity)

BLS Job Category	**Total Population**	**Female (%)**	**White/Caucasian (%)**	**Black/African American (%)**	**Asian (%)**	**Hispanic or Latino (%)**
Stationary Engineering and Boiler Operators	56,000	10.6%	77.5%	14.4%	4.9%	10.7%
HVAC Mechanics and Installers	450,000	1.5%	81.5%	12.1%	3.1%	21.7%
Facilities Managers	134,000	25.0%	90.1%	4.9%	2.4%	12.6%

Shifting to state-specific dynamics, the analysis above has shown the value of socioeconomic metrics (to a lesser extent environmental health ones) to identify disparities in the dispersion of participants in terms of community vulnerability. The metrics used for socioeconomic difference (linguistic isolation, HS education, low income) are based on U.S. Census data and are readily available through either the EJ Screen tool or other databases. Depending on the state, other metrics may also be useful – all, however, should be defined in partnership with relevant community and industry groups to ensure proper representation of the issues at hand within a given community(ies).

5.1 Replicating Approach for Other Regions

Ultimately, meeting the needs of different populations beyond Washington will require working with the appropriate community groups to understand the salient workforce equity challenges and opportunities in each state. At the highest level, this should begin with conducting background research on labor issues within the state that are relevant to the BOC program. Historic inequities are often regarded as issues of the past, however as is common throughout all issues of vulnerable communities, the past challenges can shape the economic, material, and knowledge resources available. Utilizing the same metrics, supplemented by state-specific ones as are appropriate, will allow for cross-comparison without compromising the importance of local nuances.

5.2 Opportunities to Increase Outreach and Impact

Expanding impact and outreach with underserved communities can and should occur in concert with defining the metrics needed to achieve equitable program access in any area. Some types of community groups that are appropriate (not an exhaustive list) include the following:

(1) **Minority business groups** – Organizations like the Hispanic Contractor's Association, National Society of Black Engineers (NSBE), and the National Association of Minority

Contractors may not explicitly serve the population of interest for the BOC program. However, it may be possible to recruit more participants through their social networks and share more widely the benefits BOC training provides.

(2) **Local community organizations (chapters of national organizations or otherwise)** – Groups such as the NAACP, Kiwanas, Rotary, and others may not seem on the surface to have many similarities. However, their local chapters have significant touch with communities and, based on the need, may enable reaching underserved groups.

(3) **Education institutions** – Community colleges and technical colleges are always a go-to for young talent, but in the process, reaching out to those smaller schools that may serve specific populations (e.g., work primarily within an American Indian or Alaska Native community) can help provide potential BOC participants early exposure to the program's benefits.

(4) **Agricultural extension** – Working with Cooperative Extension (beyond energy programming) can, in many states such as Texas, Georgia, and Florida, reach very rural communities where it may be unrealistic to do targeted marketing otherwise. Extension agents and coordinators tend to come from rural communities themselves, and many in the family and consumer sciences space know their local public school leaders and those in the healthcare industry. Supporting their programming around energy efficiency, in general, can be a synergistic pathway to recruit BOC training participants.

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