Energy Insecurity, Energy Justice & Equity Measurements, Low-Income Weatherization & Energy Efficiency Programming: National & Maryland Policies

Toby Harris
Master of Health Science Candidate
Johns Hopkins Bloomberg School of Public Health
Department of Environmental Health & Engineering
Adviser: Dr. Roni Neff
Second Reader: Jamal Lewis
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Table of Contents

Executive Summary

For many Americans, household energy use is a resource that is both considered necessary while being taken for granted**.** Yet more than 37 million Americans, mostly low-income and African American individuals, endure energy insecurity, or the inability to meet basic household energy needs. This essay characterizes the nature and extent of household energy-related inequities along economic and racial lines while exploring a framework for promoting energy justice. Federal and state energy efficiency and weatherization activities which can be used to alleviate energy inequities experienced by low-income and African American households across Maryland are then examined. Such energy efficiency and weatherization measures specifically address energy insecurity by upgrading a home's energy infrastructure and improving overall housing conditions. Mechanisms Maryland has attempted to implement to achieve greater energy justice, notably proposed policies from the 2020 Legislative Session are next analyzed with the outlined energy justice framework. With increasing calls for equity from advocates in the energy sector in addition to longstanding, systemic injustices further exposed by the ongoing COVID-19 pandemic, it is critical energy efficiency policy be grounded in equity. Specific mechanisms and metrics are further outlined in order to track and measure progress towards achieving such equitable energy outcomes.

Home Energy Use and Energy Costs

Households across the United States use different types of energy in order to power assorted energy end uses. These include energy utilization necessary for running various household apparatuses and devices, in addition to varying temperature control mechanisms such as air conditioning and heating units. Electricity is used in almost all homes across the United States and accounted for 44% of all household energy consumption in 2017 (Independent, 2019). This can be compared with the next largest share of household energy usage: 43% of residential sector energy usage stemmed from natural gas in 2017 (Independent, 2019). The next most utilized energy sources across the residential sector were fuel oil, kerosene and propane (Independent, 2019). While households across the United States utilize energy to power varied equipment and devices throughout the home, space heating and air conditioning generally constitute the greatest portion of a household's end energy usage: accounting for 51% of annual household energy consumption in 2015 (Independent, 2019). Variations in general geographic location and local

weather patterns also notably influence space heating and air conditioning usage and need to be considered when designing relevant policies and programming as well (Independent, 2019). Space heating and air conditioning are generally seasonal and intensive energy end uses, varying substantially by the number of household members, the availability of fuel and equipment types, in addition to home structure and size (Independent, 2019). In the United States, 75% of homes use two or more energy sources while mobile homes and households in the South are typically more likely to only depend on electricity to satisfy all household energy needs (Independent, 2019).

There are a number of factors that influence and dictate household energy usage. Generally, larger households and bigger homes use more energy when compared to smaller households and homes (Independent, 2019). Furthermore, households in the Northeast and Midwest regions of the United States typically utilize more energy than homes in the Southern and Western regions of the country (Independent, 2019). Household energy use also varies substantially between apartments and detached single-family homes; in 2015 almost three times more energy was used on average in single-family, detached homes when contrasted with units in apartment buildings with five or more residences (Independent, 2019**).** As part of a broader phenomenon known as split incentives, renting household units as opposed to accessing home ownership poses additional uncertainties relevant to energy usage (Disney 2013). Specifically, renting can limit the ability of occupants to control the functioning and repair of the energy efficiency infrastructure (Disney 2013). As landlords are not usually responsible for tenant utility bills, they lack incentives to invest in such weatherization and energy efficiency measures (Disney 2013). Ultimately, low-income renters are often unable to attend to these issues given the significant costs that are associated with such measures in light of fixed incomes and limited financial resources. In 2018, the U.S. Energy Information Administration determined that the average residential electric bill in the United States was $117.65 per month (U.S. Energy, 2020). As this paper further focuses on existing and proposed weatherization and energy efficiency programing in Maryland, it remains significant to note the average monthly residential bill for 2018 in Maryland was higher at $133.68 (U.S. Energy, 2020).

Energy Insecurity, Energy Inequities & Energy Justice

Energy Insecurity

Two metrics are used to assess the impact of home energy usage on residents: *Energy Burden* and *Energy Insecurity*. *Energy Burden*, or the proportion of gross annual income that is delegated to covering utility services, is used to contextualize household utility costs and serves as a useful measurement when comparing different communities (Ross, 2016). *Energy Insecurity*, or "the inability to adequately meet household energy needs," encompasses broader concepts that include wider social and economic factors (Hernández, 2016a). Unlike the energy burden metric, energy insecurity captures additional physical and financial challenges impacting households. In the paper *Understanding 'energy insecurity' and why it matters to health*, Hernández details three interconnected dimensions of energy insecurity: *economic, physical and behavioral* (Hernández, 2016a). Hernández notes that understandings of the assorted challenges associated with energy insecurity were guided by thorough accounts from participants and residents detailing energy costs as a leading cause of household hardships (Hernández, 2016a).

Specifically, *economic energy insecurity* captures the disparate economic challenges low-income households experience in response to paying disproportionately high energy costs (Hernández, 2016a). Hernández outlines how economic energy insecurity is connected to financial hardship and the subsequent prioritizing and choosing between different essential services and basic household needs that residents must make following strains to available resources (Hernández, 2016a). The notion of *physical energy insecurity* captures defects in the material structure of the home environment often found in lower-quality housing. These physical aspects include inefficient appliances, lighting or electrical systems, poorly functioning plumbing and malfunctioning cooling and heating systems, all of which can lead to residential exposures to harmful substances, thermal discomfort and greater energy costs (Hernández, 2016a). *Behavioral energy insecurity* refers to the different strategies, which can be both positive and negative, that residents use to help offset, manage and live with the impacts following from physical and economic energy insecurity (Hernández, 2016a). Such behavioral strategies were found to involve three, connected adaptive categories including "energy conservation and/or thermal comfort compensation, bill-paying, and shut-off avoidance and compensation" residents make in response to energy insecurity (Hernández, 2016a). The most recent data from the U.S. Energy Information

Administration's National Residential Energy Consumption Survey conducted in 2015 determined that roughly one-third of households in the United States (31%) recounted difficulties in paying off their energy bills or maintaining tolerable cooling or heating in their homes (U.S. Energy, 2018).

The frequency and duration of energy insecure circumstances contribute further complications for households. This is especially true when considering the connections between energy insecure events and severe weather events, including cold winters and heat wave; becoming more commonplace and frequent in the face of climate change (Hernández, 2013). Additional variations in exposure to such climatic events further fluctuate by geographic locations and add additional complexity when navigating the conditions energy insecure households can face. The Residential Energy Consumption Survey indicates that energy insecure events - which can be characterized by the presence of trade-offs, disconnection notices, and service interruptions - can be both episodic or chronic (Berry, 2018). Certain households undergo energy insecurity for only one to two months throughout the year while other households can face these challenges year-round without break (Berry, 2018).

Energy insecure residents are further at risk of experiencing thermal discomfort as well as household pest infiltration if siding or other components have lost their structural integrity. Exposure to these phenomena are known to worsen chronic health conditions, including illnesses like arthritis and asthma for instance (Lavigne, 2014; Ruth Ann Norton, 2017a; Ruth Ann Norton, 2017b). The upfront expenses required for energy efficiency repairs further present major barriers for residents, especially when considering low income households, while often limiting any immediate restorative measures (Hernández, 2016b; Reames, 2016). The assorted physical and financial burdens connected to household energy insecurity further raise significant hardships for impacted homes, both over time for individual households and intergenerationally within families (Lewis, 2019). While amplifying total utility costs and assorted economic hardships, energy insecurity can also lead to occupants' diminished wellbeing and comfort (Hernández, 2019). Despite its widespread prevalence across the nation, energy insecurity largely remains overlooked across political realms. The financial difficulties families experience from paying high utility services or bills, amending structural abnormalities or deficits in the home that impact total energy efficiency in addition to residents' comfort and the impacts of new behavioral responses to endure these physical and economic hardships remain politically neglected (Lewis, 2019).

Impeding residents from achieving optimal health and realizing full societal participation, energy insecurity can act as a biological and psychological stressor while posing economic and other additional hardships (Hernández, 2016a; Hernández, 2019). Specifically, heat and cold stressors in addition to hazardous environmental home exposures all contribute to energy insecurity and negatively impact residential health outcomes. Some of the most notable health impacts related to energy insecurity include the exasperation of respiratory illnesses or asthmatic events, chronic stress and mental health triggers (Lewis 2019a). Residents can further experience residential instability, familial disruptions and parental fear or stigma (Hernández, 2016b). These assorted physiological, psychological and other broader conditions related to energy insecurity can lead to severe consequences when considering health outcomes and levels of societal participation (Hernández, 2016b).

The combination of disproportionately high household energy costs and low household incomes often further necessitates making tradeoffs between settling bills for household utilities or acquiring additional essential household provisions, including medications and food (Knowles, 2015; United States Census Bureau, 2015). Younger children from such households are increasingly likely to experience diminished health and educational outcomes. Specifically, a lack of sufficient food for young children has specifically harmful impacts on physical development and long-term health effects, with a wider breadth of following, larger social implications. Households with children experiencing energy insecurity are at greater likelihood of experiencing poorer occupant health and food insecurity (Cook, 2008). Children from such households specifically have greater rates of hospitalization compared to children belonging to households that are energy secure (Cook, 2008). Investigations have determined that children from low-income families facing energy insecurity, exhibited through poor housing and related indicators, were more probable to experience hampered educational achievements and long-term health outcomes (Cook, 2008).

Energy Inequities, Racial and Economic Disparities

Energy insecure households are not evenly spread across this country; social inequities further contribute to the distribution of energy-related hardships in the United States. In 2016, the American Council for an Energy-Efficient Economy (ACEEE) studied energy burdens by evaluating what different households spent on utilities per square foot compared to the average household (Ross, 2016). The study found that, across forty-eight of the largest cities in the United States, energy burdens for low-income households were more than twice as large than the overall population, 7.2% compared to 3.5% (Ross, 2016). Low-income families, disproportionally made up of families with single incomes or one parent, the elderly and individuals with disabilities, are often obliged to inhabit aging housing options with substandard quality when needing to prioritize affordability (Ross, 2016). Low-income households and households with residents of color, specifically those with children, are more likely to experience energy insecurity when compared to other households (Ross, 2016; Hernández, 2016a; Hernández 2016b; Berry, 2018; U.S. Energy, 2018 United States Census Bureau, 2015). Housing of deteriorating substandard quality have a greater likelihood of also having energy inefficient appliances and fixtures, which raises the risk for lower income families to experience further energy burdens (Hernández, 2016a; Hernández 2016b).

Energy insecurity is known to excessively, inequitably and disproportionately affect African Americans across different economic standings (Hernández, 2016a). Following racist housing policies at both the local and federal level, including redlining amongst additional programming and practices, African Americans historically have been confined to lower resourced neighborhoods and areas while contributing to broader patterns of racial residential segregation (Arline T. Geronimus, 2000; Denton, 2003; Oliver, 2006; Rothstein, 2017). With the legacy of such racist policies and biased ongoing practices in the labor and housing markets, hindered opportunities exist for African American households to achieve social advancements. As such, African Americans remain more likely to live in energy inefficient households when compared with other racial or ethnic groups (Lewis, 2019a). Specifically, and as demonstrated by assorted research efforts, African Americans have the greatest likelihood of residing in more deteriorated, older homes with inadequately functioning energy infrastructure while possessing energy inefficient appliances and infrastructure with broader structural deficits (Hernández 2014; Hernández, 2016a).

In cities that are racially segregated, homes in areas with greater concentrations of people of color or low-income households are relatively more likely to have difficulties in both accessing and being able to afford modern energy infrastructure and appliances that improve a households' ability to be energy efficient (Bednar, 2017; Lewis, 2019a; Jesfale, 2006). The often, substandard state of these energy inefficient households, especially when considering those in historically residentially segregated areas, typically contain compromised components directly related to a home's energy inefficiency status. These include but are not limited to, inadequately sustained and inefficient ventilation (HVAC), cooling and heating systems, drafts or air leaks, and poor insulation (Ross, 2016; Hernández, 2015; Reames, 2016; United States Census Bureau, 2015). These structural conditions, coupled with a household's inability to access more recently renovated homes with advanced energy systems, all contribute to amplified costs of fundamental home utilities based on inefficient household energy usage (Lewis, 2019a).

Studies have demonstrated that African American residents also delegate a larger portion of their household incomes to paying energy bills when contrasted to alternative racial and ethnic groups (Ross, 2016; Berry,2018). Across all income levels, 5.4% of African American households faced energy burdens, almost twice as big when compared to 3.5% of energy burdened households across the nation (Ross, 2016). Particularly high rates of energy burdens are seen across African American inhabitants of large cities in the southeast region of the United States, following weather patterns that contribute to the use of air conditioning, exasperated poverty rates and additional systematic factors impacting such households (Ross, 2016). Racial connections within poverty systems and between assorted material hardships further influence the energy cost challenges inequitably borne by African American residents. Investigations have revealed that people of color are more likely to experience the "poverty tax," a notion capturing how low-income households often pay more for fundamental amenities (Karger, 2007). Efforts have documented how lower income consumers pay more for the same products, loans and housing options when compared to higher income families (Karger, 2007). For instance, a recent report from the Student Borrower Protection Center determined that borrowers refinancing their student loans through companies utilizing education data may endure a penalty for having attended either Historically Black Colleges and Universities (HBCUs) or Hispanic-Serving Institutions (HSI) (Student Borrower Protection Center, 2020).

Data demonstrates that African Americans are disproportionally subjected to trade-offs, for instance choosing between paying energy expenses or food and medicine. One investigation determined that 28% of African American households reported having waived food and/or medicine monthly in order to pay for energy, helping to elucidate the profound reach energy insecurity hardships can pose (Berry, 2018). As outlined, experiencing household energy insecurity exacerbates various health conditions, contributing to ongoing inequities in health outcomes. African American populations already undergo some of the poorest health outcomes and have the lowest life expectancy of all racial groups in the United States, with increased rates of diseases or health conditions particularly related to housing when contrasted with other racial or ethnic groups (Daniel, 2013; Bryant-Stephens, 2009; Claudio, 2008). These measures specifically include, poor sleep quality, poor mental health outcomes, unintentional injuries, lead poisoning, and asthma or additional respiratory diseases (Daniel, 2013; Bryant-Stephens, 2009; Claudio, 2008). African American residents already socially predisposed to existing health disparities undergo increased exposures to outlined household environments further harmful to health.

Research efforts have further revealed that a significant fraction of African American families have faced a multitude of injustices and unfavorable health outcomes connected to substandard housing and depreciated energy infrastructure systems throughout time (Woods, 2012; Aalbers, 2006). These assorted conditions include the racial residential segregation African American communities have experienced, the subsequent housing, energy and bundled burdens, utility shut-offs, economic trade-offs, material hardships, health disparities, extreme weather and climate impacts, exhaustions of individual's "resilience reserve," and the broader justness of energy transitions in addition to resulting gentrification or displacement occurrences (Lewis, 2019a). Investigations have revealed how challenges with paying energy bills and experiencing reduced thermal comfort, central aspects relating to energy insecurity, were connected to raised stress levels. Such elevated levels of stress hormones are damaging to long term health when chronically sustained, such as with the ongoing nature of experiencing energy insecurity and related hardships (Geronimus, 2000; Hernández, 2016a).

Energy Justice

The outlined burden low-income and African American households experience with energy insecurity highlights a clear need for greater energy justice. Revolutionizing systems of change, including household energy efficiency measures, are necessary to overcome energy and housing injustices that have limited many African American households and others from financially accessible residential comfort (Lewis, 2019a). Utilizing an energy justice framework exposes and then lessens inequalities stemming from a dearth of affordable access to household energy (Rehner, 2015; Lewis, 2019a). Deeply seated inequalities around the lack of affordable residential energy for low-income and African American households can be further revealed and then reduced through such a targeted framing and approach (Rehner, 2015; Lewis, 2019a).

Jenkins et al.'s energy justice framework, further described by Lewis et al., is grounded in four categories of justice: *recognition, procedural, distributional and restorative*. *Recognition Justice* relates to identifying and respecting the vulnerabilities and layered situations impacting groupings of people marked by misrepresentation or marginalization, which can be uplifted across understandings of energy related hardship (Day, 2012). *Procedural Justice* then refers to equality across decision making processes, encompassing the development and delivery of public policies influencing individual's capacity to ensure efficient energy services (Simcock, 2016). Third, *Distributional Justice* outlines the dispersal of material resources, asking if the present allocation of material benefits and burdens are fairly distributed (Sandel, 2010). Finally, *Restorative Justice* references the opportunities for beginning to rectify past and ongoing injustices after they have been more broadly recognized.

Achieving energy justice requires the realization of recognition justice, procedural justice, distributional justice and restorative justice. Appropriately directing housing interventions towards low-income and African American households can help residents realize greater energy justice. The following sections will first introduce the concepts of energy efficiency and weatherization then analyze the administration of federal and state energy efficiency and weatherization programming in Maryland. The energy justice framework will then be used to analyze relevant programming in Maryland. The manners in which achieving greater energy justice relate to broader energy equity will be further outlined. In order to ensure desired energy savings are being prioritized, targeted and achieved, a discussion around the need for establishing equity measurements in the energy field then follows.

Weatherization and Energy Efficiency Policy Context: National and Maryland Policies & Proposed Legislation - HB982/SB740

Introduction to Weatherization and Energy Efficiency

Household energy efficiency offers a tangible form of restorative justice, simultaneously allowing for investments in households, people and larger communities (Lewis, 2019a; Thompson, 2004). As previously outlined, substandard housing conditions contribute to premature mortality and disparate chronic illnesses, especially amongst African American populations in the United States. The linkage between environmental conditions and poor health has elsewhere been referred to as the "'energy insecurity' pathway to disease and disadvantage (Geronimus, 2000; Thompson, 2004; Lewis, 2019a)." These outlined unequal impacts stem from this country's history and continued legacy of racist housing programming and other related policies (Geronimus, 2000; Thompson, 2004; Lewis, 2019a). This progression however can be in part impeded by advancements in a home's energy efficiency as well as through improvements to the overall household structural quality.

Weatherization, a method of improving household energy efficiency, refers to the act of guaranteeing a building and its interior are shielded from outside conditions and outdoor elements such as wind, precipitation, and sunlight. Actions that modify a building in order to raise total energy efficiency while decreasing household energy usage are also included under weatherization measures. Common weatherization actions include but are not limited to:

- Repairing, updating, or tuning heating and cooling systems.
- Mitigating air filtration, repairing breaks in housing structural integrities.
- Installing insulation in attics, floors or walls.
- Blower door air infiltration reductions.
- Improving hot water systems.
- Completing lighting retrofits.
- Cleaning and tuning, making safety repairs to and finishing burner retrofits or replacements.
- Addressing health or safety items (Housing and Building, 2019; NREL, 2009).

Weatherization measures have the potential to decrease a household's yearly natural gas consumption by 32 percent, producing energy savings greater than $350 annually, in turn lessening household burdens relating to total energy cost (NREL, 2009). To maximize benefits however, weatherization practices should be paired with additional energy efficiency measures. These

include additional cosmetic upgrades such as updating appliances, lighting, faucets and showerheads with measures helping to decrease the loss of end-use energy, such as low flow water faucets (Ruth Ann Norton, 2017b).

It is worthwhile to briefly outline current trends relating to household health and safety items. In order to perform weatherization measures on a household, the home must first meet certain standards of health and safety. Health and safety hazards, which include the presence of lead-based paint, poor indoor air quality, mold and leaking roofs amongst other risks, often prevent the implementation of weatherization and related energy efficiency interventions. The presence of such hazardous conditions in eligible households will often compel energy efficiency programs to defer energy efficiency service delivery until all health and safety hazards are addressed. While deferral technically means that service delivery should ultimately be provided for, most deferred households typically never see any upgrades as no resources exist to assist low-income households amend the original health and safety hazards.

Separately, energy efficiency improvements can help eliminate additional various hazards that further impact occupants' health. For instance, weatherization efforts to mend structural holes that will decrease energy waste also serve to counteract pest infiltrations while limiting exposures to mold and additional harmful household health hazards (Tonn, 2002; Ruth Ann Norton, 2017a; Ruth Ann Norton, 2017b; Ruth Ann Norton, 2016). Other benefits stemming from energy efficiency measures include the promotion of residential stability, which can lead to wealth generation and increases to property values (Tonn, 2002; Nevin, 2009). Furthermore, household energy efficiency upgrades can spur community benefits such as economic growth, neighborhood revitalization, and resilience. These investments can help to support and stimulate the local economy by providing families and individuals with greater disposable incomes, which can help alleviate poverty and increase purchasing power while generating more local jobs (Bell 2014; IEA 2014).

National Weatherization & Energy Efficiency Policies

Presently, policies responding to the widespread energy insecurity experienced by considerable households across the nation are severely insufficient (Stephen Bird, 2012). Federal efforts to counteract energy insecurity are focused through the Low-Income Home Energy Assistance Program (LIHEAP) – supporting energy bill assistance – and the Weatherization Assistance Program (WAP) – backing weatherization and energy efficiency actions in low-income households (Lewis, 2019). With delivery designed differently across states, LIHEAP generally assists qualifying low-income households with energy crises, bill payment assistance to cover heating and cooling energy costs in addition to certain minor weatherization and energy-related home repairs. Between 15-25% of a state's LIHEAP budget can be transferred to their respective WAP programing. LIHEAP eligibility criteria are calculated as a percent of federal poverty guidelines and vary by state. Maryland for example utilizes criteria of 175 percent of federal poverty guidelines for family units of differing sizes (DHHS, N.D.). Benefit payment matrices and calculations also vary by state, with Maryland implementing proposed grants by varying income levels assigned to four poverty level groupings - 0-75%, >75%-110%, >110%-150%, >150%-175% - in addition to families living in subsidized housing, with minimum benefits for electric fuel types ranging from $120 to maximum benefits of $2,213 (DHHS, N.D.).

In addition, the U.S. Department of Energy's (DOE) WAP is the nation's single largest residential energy efficiency and weatherization program, specifically focused on increasing efficiency in dwellings occupied by low-income residents. WAP provides funding to all 50 states, the District of Columbia, Native American Tribes and the five U.S. territories who meet eligibility processes for energy conservation weatherization materials service delivery. The program aims to assist qualifying low-income households with the installation of energy conservation measures in their homes. After eligibility is determined an energy audit inspection is conducted and, providing existing building conditions permit, possible treatments to increase a unit's energy efficiency include assorted outlined delivery options.

While providing funds to assist with covering energy bills are important assets for many homes who experience extreme cold and heat predicaments, energy bill payment assistance fails to respond to the fundamental cause of the inefficiency, unlike weatherization or energy efficiency measures covered under WAP (Administration for Children, 2018). Historically and ongoing to this day, energy bill assistance programs only reach and support a small proportion of the total

qualifying households, while solely providing short-lived financial support (Lewis, 2019). On average, only 20% of eligible households qualifying for LIHEAP funds ever obtain assistance or programming as no additional resources can be made available without Congressional approval once LIHEAP reserves run out (Community Services, 2016). Assistance with energy bills are also usually provided once a year for either cooling or heating assistance, further posing a fundamental problem for families and households experiencing and having resulting needs for both energy services (Lewis, 2019). During September 2018, Congress advanced a bill to raise FY19 funding for LIHEAP by $50 million from $3.64 billion to $3.69 billion (Rep. Michael K. Simpson, 2018). Congress additionally raised FY19 financial backing for the Weatherization Assistance Program (WAP), by $6 million from $251 million to $257 million (Consolidated Appropriations Act, 2018). The final LIHEAP budget for fiscal year 2020 was $3.74 billion while funding for WAP was $308.5 million in fiscal year 2020 (Ohio Partners for Affordable energy, 2020; U.S. DHHS, 2020). With LIHEAP essentially financed at ten times the amount of WAP, a disparity in funding exists for programming needed to achieve energy justice.

Improved household energy efficiency can provide a concrete resolution to some of the issues of injustice and exclusion by prioritizing restorative targeted investment in the homes of African American households, low-income households and low-income, African American households in Maryland (Lewis, 2019). Substantial federal efforts are still needed across the nation to further realize energy efficiency savings measures for these populations. The next sections of this paper highlights Maryland weatherization and energy efficiency polices and provides context on low-income households' experiencing energy insecurities in Maryland. This information is then tied to proposed legislation outlining the need for specific low- and middle-income housing energy performance targets from the 2020 legislative session in the Maryland General Assembly; House Bill 982 and Senate Bill 740 - PUBLIC UTILITIES – LOW-INCOME AND MIDDLE-INCOME HOUSING – ENERGY PERFROMANCE TARGET. Shortfalls and opportunities for improvements in the ability of existing programming to fully realize weatherization and energy efficiency measures in low-income households in Maryland will be highlighted, in light of the common prevalence of health and safety hazards that frewquently prevent essential energy efficiency works.

Maryland Context, Weatherization & Energy Efficiency Policies

Across Maryland, low-income residents unsustainably experience inadequately insulated apartments or homes and the resulting high energy costs (Laflamme N.D.). Monthly residential electric bills have been higher in Maryland when compared to the United States average: $133.68 as opposed to $117.65 (U.S. Energy, 2020). From Baltimore City to more rural areas of the state, low-income residents often experience living conditions that contain drafty windows, undependable electrical arrangements and nonfunctioning HVAC systems (Laflamme N.D.). As a proportion of total income, low-income residents in the state of Maryland pay 550% more for energy than non-low-income occupants in the state; 55% of these low-income households are comprised of Asian, Hispanic or Black residents (Laflamme N.D.). Disparities by race or ethnicity impacting access to good quality, reasonably priced housing similarly guide wider dispersals of household energy burdens. Funds that low-income residents must allocate to unusually costly utility bills mean that money cannot be used to obtain daily household essentials, ranging from medical bills and school supplies to food (APRISE, 2018). At present funding levels in the state, 130 years would be needed for Maryland's current programming to finish energy efficiency advancements in all 450,000 eligible low-income households in the state (Laflamme N.D.).

In Maryland, DHCD oversees the WAP program and other energy efficiency or weatherization programs funded by Maryland's Strategic Energy Investment Fund and participating Maryland utility companies (Housing and Building, 2019). Annual household income limits of 200% of the federal poverty level dictate qualification for households of differing sizes across the state (Maryland DHCD, N.D.). Low-income residents in the state of Maryland over the age of 60, families with children and families with members who have a disability may receive preference (Maryland DHCD, N.D.). For rental properties, the landlord must agree to participate while tenants must be income eligible, similarity 200% of the federal poverty level (Housing and Building Energy Programs: & Community Development Administration, 2019).

The Maryland Energy Administration and the DHCD further support the 2008 EmPOWER Maryland Energy Efficiency Act to advance the state's obligations to extend reasonably priced and dependable energy for all households in the state (Maryland Energy Administration, N.D.; Stefen Samarripas, 2017). EmPOWER provides loans and grants for the purchase and installation of cost-effective energy conservation metrics established by an initial energy audit (Program Description, Draft for Public Comment). The EmPOWER program utilizes

an audit driven system, as opposed to a more rigid list of pre-authorized measures, to utilize all cost-effective programming with the intent to maximize energy savings (Program Description, Draft for Public Comment). The EmPOWER program utilizes a holistic approach to energy efficiency by examining the entire building. Framing the home as a complete energy system with interconnected components impacting energy performance further maximizes potential energy and greenhouse gas savings while improving indoor air quality (IAQ) and home safety (US EPA, 2017).

Once households are determined eligible for EmPOWER, household energy audits first provide an estimate of operating expense savings to the property owner and utility expense savings to the tenant predicted to arise from energy conservation measures that have been identified. EmPOWER, like many other energy efficiency programs, presently only provides funding for measures connected to direct energy savings. The following energy efficiency measures are further available through EmPOWER:.

- Water heating equipment, retrofits or replacements and conservation measures.
- Instillation of ENERGY STAR qualified HVAC systems.
- Adding insulation in attics, floors, and walls.
- Window installment.
- Measures relating to draft stopping and duct sealing.
- Lighting retrofits and upgrading appliances and fixtures such as refrigerators.
- The generation of renewable energy.
- Fixing electrical problems and minor health and safety improvements such as installing bathroom ventilation and smoke detectors.
- Installing low flow faucet aerators and shower heads.
- Adding smart thermostats.
- Installing energy star roofing shingles.
- Addressing ventilation matters (Peschau, N.D.; Energy Efficiency For All, 2019; United States Environmental Protection Agency, 2017).

In addition, EmPOWER has a health and safety budget of $1,000 that can be used to perform pre-energy efficiency hazard remediation. However, in a lot of cases, this budget is not large enough to address all health and safety issues. This means that the residents in low-income and African American households that disproportionately occupy such older, deteriorating homes remain continuously exposed to health damaging hazards while staying energy insecure.

The DHCD oversees two specific EmPOWER energy efficiency and housing affordability program, the Low-Income Energy Efficiency Program (LIEEP) and the Multifamily Energy Efficiency and Housing Affordability (MEEHA) Program (DHCD 2020; DHCD 2020b). For low-

income households to be eligible to receive energy efficiency upgrades to their homes as part of LIEEP, they must meet certain income qualifications based on household size while being utility customers with one of six participating companies – BGE, Delmarva Power, FirstEnergy, Pepco, SMECO or Washington Gas (Housing and Building Energy Programs: Maryland Department of Housing and Community Development, 2020). From 2009 to 2011, to further promote affordability and energy efficiency in the state's multifamily rental housing developments for households with low and moderate incomes, Maryland advanced the first MEEHA I EMPOWER program. MEEHA I intended to reduce Maryland per capita electricity consumption and peak demand by 15% relative to the 2007 baseline quantity by the end of 2015 in multifamily rental housing developments for household's with low and moderate incomes (Maryland Department of Housing and Community Development: Housing & Building Energy Programs, 2019). The aim of MEEHA specifically was to "promote energy efficiency and affordability in the state's multifamily rental housing developments for low- and moderate-income households. . . . improvements are intended to reduce a building's energy use and lower utility bills for occupants (Program Description, Draft for Public Comment)." The program further mandated that utilities implement cost-effective demand response programs, but no current goals were established for the degree of demand reduction each Utility must target after 2015 targets have been met (PUBLIC SERVICE COMMISSION OF MARYLAND, 2019). During the first three years, the Maryland Public Service Commission (PSC) determined that low-income utility programs, including LIEEP and MEEHA were just reaching 21% of expected participation rates; in 2011, the PSC ordered the DHCD to run the EmPOWER program MEEHA II from 2012 to 2016 (Maryland Department of Housing and Community Development: Housing & Building Energy Programs, 2019).

In 2017, Maryland enacted a nation-leading, 2% per-year electricity savings overarching target for the EmPOWER program. Though this target has been quite effective, it has not been equitable. While this 2% target is for all homes in the state, most of the savings have accrued to non-low-income households. Based on the data available, low-income households have had electricity savings of much less than 1% (Laflamme, 2020). Historically, low-income households have been a costlier sector to deliver energy efficiency programming to considering the substandard housing stock this population usually occupies and the extent of weatherization and energy efficiency works needed.

Energy Justice Framework: Maryland Weatherization + Energy Efficiency Programming

A meager 9 percent of low-income households in Maryland eligible for weatherization assistance have received such services understanding the frequency of health and safety deferrals (Laflamme, 2020). Anecdotal evidence from contractors with the Green & Healthy Homes Initiative (GHHI)[1] and the DHCD health and safety work group suggest that the main health and safety hazards in Maryland preventing energy efficiency are leaky roofs and mold. In situations where a household is unable to receive deep energy efficiency upgrades performed on their home because of health and safety hazards, DHCD will often perform cosmetic energy efficiency upgrades. Deep energy efficiency retrofits include measures such as insulation, duct sealing, and hot water heater and HVAC replacements. Cosmetic energy efficiency upgrades refer to light bulb replacement and low flow faucet and shower heads. Deep energy efficiency retrofits are needed to produce notable energy savings. For Maryland to achieve more equitable energy savings, deep energy efficiency retrofits should be targeted to low-income and African American households who need and would stand to benefit the most from resulting savings.

It is relevant to analyze Maryland's energy efficiency and weatherization programming through each type of justice included in the energy justice framework– *recognition, procedural, distributional and restorative* (Lewis, 2019a). R*ecognition justice* acknowledges and recognizes assorted vulnerabilities and multifaceted contexts across individual households and assorted social groups (Lewis, 2019a). In Maryland, recognition justice means centering the comments and rights of energy insecure households and social groups that typically have been misrepresented or marginalized (Lewis, 2019a). Recognition justice is further achieved by identifying the increased likelihood African American and low-income households have of being energy insecure and acknowledging the conditions that contribute to these associated hardships. Based on available data, Maryland weatherization and energy efficiency programming clearly are not providing adequate or appropriate levels of energy justice for low-income households and it is likely the same for African American residents in the state.

[1] The Green & Healthy Homes Initiative (GHHI) is a national organization with a long-standing history of advocating for families and children on the important issues of creating healthy, safe and energy efficient homes. Their model revolves around creating and maintaining healthy home environments that allow families to better thrive. GHHI further achieves healthy homes through the alignment of resources in order to upgrade houses with improved energy efficiency measures, while simultaneously resolving health and safety issues. Their collective efforts to coordinate lead hazard reductions, asthma trigger controls, fall/injury preventions, energy efficiency efforts, weatherization upgrades and housing rehabilitation service delivery options have helped countless children and families across the nation reside in healthy homes that do not put their residents in compromised health, economic or social positions.

P*rocedural justice* requires impacted households to participate in and shape responses aiming to alleviate conditions contributing to energy insecurity. It is crucial agencies across differing governmental levels determine and outline opportunities for impacted communities to participate in developing solutions to alleviate energy related hardships (Bouzarovski, 2015). The DHCD can encourage impacted households to engage in this process by issuing appropriate outreach campaigns and compensation to involve residents in conversations around program development and implementation. For instance, successful outcomes were generated after working group meetings on health and safety hazards to inform EmPOWER programming. Individuals and households experiencing energy insecurity can similarly be recruited for such focus group meetings and regulatory processes governing programing development in order to guide interventions towards areas of greatest concern relating to energy insecurity.

Distributional justice involves the unfair dispersal of energy insecurity across the United States, specifically understanding disproportionate hardships African Americans and low-income households experience with energy insecurity in Maryland and across the country (Lewis, 2019). With increased distributional justice, the dissemination of the harms and advantages of energy service rates and delivery would be proportionally distributed across varying income and racial or ethnic groupings. As outlined, low-income and African American households pay disproportionately larger utility bills and experience related hardships when compared to other sociodemographic groups. Despite paying into EmPOWER programming like all households, low-income households generally do not receive services nor see the benefits of energy efficiency upgrades as funds and measures are unevenly directed towards non-low-income households.

Finally, better achieving *restorative justice* remains dependent on actions that highlight past wrongs and injustices when considering energy insecurity and its associated hardships for low-income and African American households. Greater restorative justice efforts would address and amend such residents increased likelihood of residing in hazardous, energy inefficient homes following government sanctioned racist housing policies. Addressing these ongoing wrongs and injustices holds especial importance as low-income and African America households would be able to realize the assorted benefits of energy efficiency programming as measures ensure that original health and safety hazards can be addressed. Restorative justice measures would specifically offer a recommended set of actions to better such responsible factors influencing energy insecurity both in Maryland and across the country.

House Bill HB982/Senate Bill SB740 - LOW-INCOME AND MIDDLE-INCOME HOUSING – ENERGY PERFROMANCE TARGET

As outlined, while Maryland's 2% per-year electricity savings target is for all homes in the state, most of the energy savings produced have accrued to non-low-income households. Presently, no direct federal or energy efficiency savings goal in Maryland exists for low-income households. Backed by the Energy Efficient Maryland advocates, also known as the Maryland Coalition of Energy Efficiency for All[2], legislation (HB982/SB740) was introduced in the State House of Delegates and the Senate during the 2020 Maryland legislative session to establish an annual energy savings goal of 1% of total annual electricity demand and 0.5% of annual gas demand for low-income households in the state (Laflamme N.D.). These bills were trying to help achieve greater energy justice for low-income households across Maryland through differing means. By acknowledging the disparities low-income households experience with utility costs and energy insecurity, this legislation begins addressing aspects related to recognition justice. In guaranteeing that disparities in energy insecurity are reduced through a targeted savings goal, distributional justice is addressed as the benefits and harms of energy service are more equitably allocated across different socioeconomic groups. As this population has been a costlier sector to deliver programming to, a deliberate metric related to low-income households means that those Maryland residents will not be disregarded or neglected in the pursuit of cheaper savings.

Achieving a 1% energy savings goal would require the DHCD to perform deep energy upgrades in low-income households, which also means that there needs to be a mechanism to address existing health and safety hazards to allow for these energy upgrades. To solve for this problem, the legislation also attempted to include an additional set of funds the DHCD can use to amend health and safety home hazards. Realizing such targeted energy savings goals would mean enhanced energy equity for all low-income Maryland state residents as households would experience reductions in their energy bills following reduced electricity usage while also experiencing improved living conditions.

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[2] Energy Efficiency for All (EEFA) is a national coalition, devoted to better connecting the housing and energy sectors to improve the realized benefits following from energy efficiency efforts for millions of low-income families across the United States (Elevate Energy, Energy Foundation, National Housing Trust, Natural Resources Defense Council, N.D.). While these efforts are national in scope, there are twelve states - California, Georgia, Illinois, Louisiana, Maryland, Michigan, Minnesota, Missouri, New York, North Carolina, Pennsylvania, and Virginia- where energy, housing, health, and environmental organizations have partnered together to form EEFA state coalitions that explore policy solutions at the state and local level. Each of these state coalitions use assorted strategies to simultaneously call for increased funding while actively contributing to and advancing federal, state, and utility weatherization and energy efficiency programs. Lucy Laflamme with the National Resource Defense Council acts as the state lead of the Mid-Atlantic EEFA coalition and Policy/Technical Assistance Specialist Jamal Lewis with GHHI is an active member of EEFA. Both mentors provided considerable knowledge and assistance pertinent to relevant legislative efforts through extensive virtual and in person collaborations.

Equity Measurements in Energy Efficiency Programming

As the state of Maryland continues to advance policy and programming measures related to weatherization and energy efficiency, it remains critical that equity stay central to guiding decisions if the extent of energy injustices and number of energy insecure households in our state are to be lessened. The following section aims to introduce predeveloped and prespecified equity measurements Maryland can use for accountability efforts to assess its' programming's ability to achieve energy justice while fostering greater energy equity. The 1% low-income savings goal included in HB982 and SB740 would have served as an important introductory mechanism for weatherization and energy efficiency service implementation to be more equitable across all households in Maryland. Such efforts nonetheless still require corroboration through the use of equity measurements in order to guarantee that programming is fully addressing weatherization and energy efficiency matters for prespecified populations while realizing such final energy savings outputs and outcomes.

Jamal Lewis and Carlos Martín further prepared and released a concept paper reviewing the current state of equity measurements, with a specific and novel consideration for energy efficiency programs and relevant content (Lewis, 2019b). While the practical and analytical applications of equity measurements continue to develop, the authors nonetheless identify six general areas that hold specific meaning for programming focused on energy efficiency. These six equity dimensions include *historical legacies, awareness of populations, inclusion of voices, access discrimination, output differences, and disparate impacts* (Lewis, 2019b). Realizing greater equity across these six domains remains critical in order to guarantee past injustices are rectified as present discrepancies in energy insecure experiences are alleviated (Lewis, 2019b).

First tackling *historical legacies* concerning energy efficiency, it is significant to note the history of the delivery and production of energy has been inequitably distributed between communities throughout time (Lewis, 2019b). Deepening more thorough and contextual understandings of energy insecurity is crucial to understanding historical legacies and entails a completer appreciation off how historical consequences guide ongoing disparities in areas and communities for which an intervention is planned (Lewis, 2019b). Metrics to assess progress towards energy equity in the context of historical legacies include efforts aiming to quantify the total number of households impacted by past and ongoing energy insecurity and related hardships.

Such measurements examining historical legacies can further include other sociodemographic groupings' past and present experiences to highlight inequities in energy insecurity.

Next, possessing a *detailed awareness* of communities impacted by intended interventions and who historically and ongoingly have experienced disparities, is needed when pursuing energy justice (Lewis, 2019b). Reviews of historical energy service delivery can help recognize groups adversely served or otherwise under or inadequately served (Lewis, 2019b). Such reviews could also potentially offer further insights into which specific service provision options might start to repair those relationships. Equity measurements that could be used to examine momentum gained in realizing greater energy equity in the context of detailed awareness include works that rate the completeness of demographic and energy usage data or information across different populations.

When designing an intervention and subsequently staffing, managing or executing programming, *perceptions and insights from all stakeholders and recipients* is required to satisfy equity aspects in program development and practice (Lewis, 2019b). To work against these discrepancies in inclusion, efforts can further include perspectives or voices from groups typically demographically underrepresented in professional positions (Lewis, 2019b). Equity measurements that could be used to examine such inclusion of all voices in efforts aimed at energy equity include quantitative and qualitative process evaluations pointing to the nature of such residential engagement and incorporation of stakeholder feedback.

The fourth component applicable to broader energy efficiency equity works involves guaranteeing applications for services and broader eligibility practices are not discriminatory, have *equitable access* and are implemented fairly (Lewis, 2019b). In other words, such processes must not be exclusionary. In order to identify possible differences amongst service reception and uptake, programs can examine their guidelines for eligibility and procedures guiding current marketing, soliciting, recruiting and processing practices (Lewis, 2019b). These variations in recruitment mechanisms, can include increasing the length of engagement intervals for low-income of African American households with young children or the elderly for instance, and help to progress acceptance and usage rates for such underserved and often marginalized populations (Lewis, 2019b). Engaging with impacted residents before and after service delivery to first identify then measure appropriateness, impressions and influence of such targeted, varied efforts can serve as metrics to rate this dimension within broader energy equity.

The next related area encompasses examining *variations across service outputs*, specifically considering how such differences might point to fundamental variations across groups' preceding conditions, needs or limitations with respect to an intervention and its fundamental design (Lewis, 2019b). As various energy efficiency program offerings can lead to identical final outputs, mean outcome variations amongst participants in a group of interest can be observed in practical measures from differences in final energy outputs or outcomes (Lewis, 2019b). Metrics that can be used to assess progress towards energy equity in this domain include the degree to which identified energy efficiency and weatherization measures are completed to guarantee that households receive the appropriate number of measures that maximize benefits.

Lastly, the authors note that holding other variables constant, a service can potentially yield *undesirable and involuntary generated impacts* across groups, withstanding equality between treatments and general access to interventions (Lewis, 2019b). It is thus relevant to pay special attention to this area in order to guarantee equity is realized across program delivery. As energy efficiency of a home is advanced, the overall quality similarly improves and may lead property owners to charge more rent. Measures to examine gentrification could include metrics to assess the number of renters that received energy efficiency work who remain in their homes a year or two after the work is completed. Further metrics that can be used to review efforts relating to this domain of energy equity include geographic and demographic information for subgroups along with overarching energy outcome data for all service program members for included energy usage objectives. Measuring equity across energy efficiency services guarantees that utility program performance is adequately tracked, reviewed and evaluated in pursuit of broader aims.

Conclusion and Recommendations

Across the United States, low-income homes allocate 8% of annual incomes to household energy costs; low-income households in Maryland dedicate 13% of their yearly household incomes to cover these utilities (APRISE, 2018*).* Withstanding the availability of weatherization and energy efficiency programming in Maryland, low-income and African American households in the state will continue to disproportionately experience energy burdens and energy insecurity without new targeted advancements and accountability metrics. With the state's current program design, it would take one hundred and thirty years to finish energy efficiency advancements in all 450,000 eligible low-income households in Maryland (Laflamme N.D.). Thus, targeting weatherization and energy efficiency programming towards low-income and African American residents in the state emerges as a mechanism to promote greater energy equity as energy justice is achieved for these households. By establishing a 1% low-income energy savings goal, Maryland would be able to improve all eligible homes in 13 years (Laflamme, 2020).

With the early conclusion of the 2020 Maryland General Assembly Session, neither HB 982 nor SB 740 advanced out of committee. Similar legislation setting a 1% low-income energy savings target is planned for the next legislative session in Maryland while similar aims should be pursued more broadly across other states and the nation. Governmental agencies will continue to incur greater costs if the upstream, causal factors driving energy insecurity are not addressed and downstream de facto energy bills or cash assistance remains the prevailing response and status quo. At the federal level, without underscoring the importance of downstream bill assistance programming offered through LIHEAP, WAP ought to be financed at an equal or greater amount given the preventative, long term benefits these corresponding weatherization measures have for alleviating causes of energy insecurity.

Weatherization and energy efficiency measures further provide clear opportunities to reinvest in residents and provide restoration for low-income and African American households by providing tangible advances to restorative justice. These changes could be realized through related measures which produce improvements to home quality and stability, residential physical and biopsychosocial health while raising homes values. Furthermore, local residents could be trained and employed for the jobs needed to execute such housing renovations and related retrofits that weatherization and energy efficiency measures entail. Literature suggests that housing interventions that promote warmth and energy efficiency are among the most effective options to

improve health outcomes by way of housing conditions and the socio-economic determinants of health (Hernández 2016a; Thomas, 2015). While bettering general housing conditions, these specific measures are known to further decrease fuel expenses while improving residential comfort and occupants sense of pride in the home, all contributing to both indirect and direct advances in residential health (Hernández 2016a; Thomas, 2015). While equity in energy service delivery has been quantified and qualified in ways that allow for ascertainments and measurements, more than one single component will ultimately be needed to guarantee energy justice is being realized. Impacted populations should remain central to planning processes when it comes to determining such equity markers and broader energy efficiency policy development processes. Achieving greater equity in the energy field directly relates to improved equity for broader society, understanding the expansive nature challenges of energy insecurity produce for impacted households.

In addition, measures to reach African American residents can moderate the impacts these households experience from being intergenerationally delegated to energy inefficient and poor-quality homes following racist housing policies and programming (Lewis, 2019a). Information about accessing and utilizing weatherization and energy efficiency measures thus needs to be appropriately directed toward African American households, especially considering low-income households, in order to counteract the perpetuated cycle of unjust housing and energy efficiency outcomes along racial lines. Targeted outreach efforts would also specifically help to further improve and increase the paybacks of policies outlining enhancements to the quality of housing and residential health.

Other states already are recognizing the importance of including specific savings goals and programming for low-income households when designing state plans for improving energy efficiency. For instance, the New Jersey Board of Public Utilities specifically included low-income lifetime savings as a recommended metric when developing utility specific performance indicators (QPIs) that consider anticipated attributable savings to energy efficiency programming (New Jersey Board of Public Utilities, 2019). The State Board of Public Utilities maintains that metrics are a crucial component of energy efficiency program design since metrics dictate the way utility program performance will be tracked, reviewed and evaluated (New Jersey Board of Public Utilities, 2019). New Jersey's Board of Public Utilities also maintains that a distinct, pre-

specified focus is needed to raise adequate attention to energy inefficiency savings for low-income customers (New Jersey Board of Public Utilities, 2019).

In 2019, the Governor and legislature in New York State passed *The New York Climate Leadership and Community Protection Act (CLCPA)* to create electric sector targets for decreasing greenhouse gas emissions while expanding clean energy in the state (S. 6599 A. 8429, 2019). Additionally, the CLCPA requires that at a minimum, 35-40% of resulting benefits from the programing be directed to and received by historically disadvantaged communities (S. 6599 A. 8429, 2019). Moreover, a companion bill to the CLCPA establishes a permanent environmental justice advisory board comprised of representatives from community-based organizations working with low-income and communities of color on environmental matters, members of the business community and members of state or national organizations promoting research and education around environmental conservation (Governor's Press Office, 2019). Outlined efforts in New York and New Jersey are important steps towards realizing greater energy equity by advancing all four measures in the energy justice framework -recognition, procedural, distributional and restorative. Without a target driving energy savings in low-income homes and buildings, Maryland will continue to lag behind other states in delivering services where they are needed most.

Call for Equity, COVID-19

Given the timing of this paper's submission, it remains significant to highlight connections to and the need for equity more broadly across society as the COVID-19 pandemic continues to influence public health across the United States. The impacts of COVID-19 have further highlighted and exacerbated existing inequities seen across racial and economic lines throughout the nation. Housing conditions that make staying at home during this pandemic even more challenging take new precedence when considering shelter-in-place orders that increase the period of time residents are exposed to assorted household hazards highlighted throughout this paper. These impacts hold particular relevance to the substandard environmental conditions impacted individuals from low-income and African American households routinely face following their increased likelihood of living in older, deteriorated homes with health and safety hazards in addition to failing energy systems (Hernández 2014; Hernández, 2016a). Moreover, the inefficient energy infrastructures in these homes will make fully paying utility bills that much more difficult for residents ordered to increase the amount of time they spend in their homes while reducing their opportunity to obtain incomes. Social determinants of health hold widespread impacts across various sectors. Calls for greater equity in household energy efficiency measures relate to notions of accessing and measuring equity when examining ongoing outcomes and responses realted to the COVID-19 pandemic. Explicitly considering equity measurements when discussing COVID-19 serves especially relevant understanding the environmental implications this disease poses to predisposed low-income and African American households already experiencing energy insecurity.

Linkages between disproportionate burdens in COVID-19 infection, morbidity or mortality rates and disparate exposures to air pollution or other hazardous environmental and housing conditions, in addition to residential socioeconomic demographics, are becoming increasingly clear. Preliminary analysis demonstrates that small increases in long term exposure to PM 2.5 leads to a notable increase in the COVID-19 death rate (Wu, 2020). Moreover, preliminary evidence further suggests that the virus responsible for COVID-19 can persist on outdoor particulate matter; environmental conditions in low-income and African American neighborhoods with higher concentrations of air pollution could contribute to the virus persisting in the atmosphere for extended durations (Setti, 2020). Earlier efforts have further highlighted existing *pollution inequity* that exists across the United States. Investigations have revealed that PM 2.5

pollution is overwhelmingly produced by the non-Hispanic white majority's consumption of services and goods (Tessuma, 2019). However, exposures to such hazardous PM 2.5 are disproportionately experienced by Hispanic and black minorities (Tessuma, 2019).

Unequal implications for such effected populations must be taken into consideration when developing broader measurements and equity assessments that will be used to gauge this pandemic and related crisis. As outlined throughout this essay, racist housing policies have contributed to African American households being more likely to live in denser communities with poorer quality housing stock and additional likelihood of exposures to assorted environmental and social hazards with significant health implications. It is especially important to note how these assorted harmful exposures can contribute to African American's increased risk of developing respiratory illnesses including pulmonary diseases, asthma and lung diseases, in addition to cancer, amongst other stress and environmentally related chronic diseases (NAACP, 2015). The increased likelihood of chronic health conditions means that African American populations already socially predisposed to COVID-19 undergo additional health burdens and risks following increased susceptibilities to the physiological effects of COVID-19 (Adams, 2020). Reports and surveillance from across the nation reveal that African-American populations have both been more likely to contract COVID-19 and die from the disease when compared to other racial or ethnic groups (CDC, 2020). It is clear COVID-19 is producing broader disparate impacts for lower income households and African American residents, notions of equity must remain central to limit such ongoing disparities.

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References

Administration for Children & Families: Office of Community Services. (2018). LIHEAP fact sheet. Retrieved from https://www.acf.hhs.gov/ocs/resource/liheap-fact-sheet-0

APRISE: Applied Public Policy Research Institute for Study and Evaluation. (2018). *Maryland low-income market characterization report: Prepared for the Maryland office of people's counsel*. Retrieved from http://mlrt.opc.maryland.gov/pdf/APPRISE%20Maryland%20Low-Income%20Market%20Characterization%20Report%20-%20September%202018.pdf

Ariel Drehobl and Lauren Ross. (2016). *Lifting the high energy burden in America's Largest Cities: How energy efficiency can improve low income and underserved communities*. Energy Efficiency for All & American Council for an Energy-Efficient Economy. Retrieved from https://aceee.org/sites/default/files/publications/researchreports/u1602.pdf

Arline T. Geronimus. (2000). To mitigate, resist, or undo: Addressing structural influences on the health of urban populations. *American Journal of Public Health, 90*(6), 867-872. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1446247/pdf/10846503.pdf

Arline T. Geronimus and J. Phillip Thompson. (2004). To denigrate, Ignore, Or Disrupt: Racial inequality in health and the impact of a policy-induced breakdown of African American communities. *Du Bois Review: Social Science Research on Race, 1*(2), 247-279. Retrieved from https://doi.org/10.1017/S1742058X04042031

Christopher W. Tessum, Joshua S. Apte, Andrew L. Goodkind, Nicholas Z. Muller, Kimberley A. Mullins, David A. Paolella, Stephen Polasky, Nathaniel P. Springer, Sumi K. Thakrar, Julian D. Marshall, and Jason D. Hill. (2019). Inequity in consumption of goods and services adds to racial–ethnic disparities in air pollution exposure. *Proceedings of the National Academy of Sciences, 116*(13), 6001-6006. doi:10.1073/pnas.1818859116

Casey Bell. 2014. "Understanding the True Benefits of Both Energy Efficiency and Job Creation." *Community Development Investment Review* 10 (1): 109–16. https://www.frbsf.org/community-development/files/cdir_vol10issue1-Understanding-the-True-Benefits-of-Energy-Efficiency-and-Job-Creation.pdf

Centers for Disease Control and Prevention (CDC): National Center for Immunization and Respiratory Diseases (NCIRD), Division of Viral Diseases. (2020). Cases of coronavirus disease (COVID-19) in the U.S. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.html

Consolidated Appropriations Act, 2018, (2018). Retrieved from https://www.govinfo.gov/content/pkg/BILLS-115hr1625enr/pdf/BILLS-115hr1625enr.pdf

Danielle England, & Lee Peschau. *MEEHA-EmPOWER -- Program Description -- Draft for Public Comment.* N.D.. Maryland: Maryland Department of Housing and Community Development. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwiIgabflPjmAhVtJDQIHe86Do4QFjAAegQIBhAC&url=http%3A%2F%2Fservices.housingonline.com%2Fnhra_images%2FMEEHA-EmPOWER%2520--%2520Program%2520Description%2520--%2520Draft%2520for%2520Public%2520Comment.doc&usg=AOvVaw2XAG1QyKwCUeJ6A4CSyhmB

Department of Health and Human Services, (HHS). *LOW INCOME HOME ENERGY ASSISTANCE PROGRAM (LIHEAP) MODEL PLAN – MARYLAND FY 2020 SF - 424 - MANDATORY: Maryland energy assistance program (MEAP) benefit matrix*. Retrieved from https://liheapch.acf.hhs.gov/docs/MD_BenefitsMatrix_2019.pdf

Diana Hernández. (2013). Editorial: 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, 103*(4), e32-e34. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3673265/pdf/AJPH.2012.301179.pdf

Diana Hernández. (2016a). Understanding 'energy insecurity' and why it matters to health. *Social Science & Medicine, 167*, 1-10. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5114037/pdf/nihms-828737.pdf

Diana Hernández Yumiko Aratani Yang Jiang. (2014). *Brief: Energy insecurity among families with children*. Mailman School of Public Health, Columbia University. Retrieved from http://nccp.org/publications/pdf/text_1086.pdf

Diana Hernández, E. S. (2019). Energy insecurity and its ill health effects: A community perspective on the energy-health nexus in New York City. *Siegel Energy Research & Social Science, 47*, 78-83. Retrieved from https://reader.elsevier.com/reader/sd/pii/S2214629618301075?token=DAA69F31BB9653268F08DA47CC954DAE99B8189C199DA52EBA251D2CD6C60D254225F7253885E0E3D2954A2A727BF578

Diana Hernández and Douglas Phillips. (2015). Benefit or burden? Perceptions of energy efficiency efforts among low-income housing residents in New York City. *Energy Research & Social Science, 8*, 52-59. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4819256/pdf/nihms-763034.pdf

Diana Hernández, Yang Jiang, Daniel Carrión, Douglas Phillips, and Yumiko Aratani. (2016b). Housing hardship and energy insecurity among native-born and immigrant low-income

families with children in the united states. *Journal of Children & Poverty, 22*(2), 77-92. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5016025/pdf/nihms758712.pdf

Elevate Energy, Energy Foundation, National Housing Trust, Natural Resources Defense Council. About energy efficiency for all. Retrieved from https://www.energyefficiencyforall.org/about/

Energy and Water, Legislative Branch, and Military Construction and Veterans Affairs Appropriations Act, 2019, pub. L. no. H.R. 5895 (2018). Retrieved from https://www.congress.gov/bill/115th-congress/house-bill/5895/text

Eric Lavigne, Antonio Gasparrini, Xiang Wang, Hong Chen, Abderrahmane Yagouti, Manon D Fleury and Sabit Cakmak. (2014). Extreme ambient temperatures and cardiorespiratory emergency room visits: Assessing risk by comorbid health conditions in a time series study. *Environmental Health, 13*(5), 1-8. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3922624/pdf/1476-069X-13-5.pdf

Gordon Walker and Rosie Day. (2012). Fuel poverty as injustice: Integrating distribution, recognition and procedure in the struggle for affordable warmth. *Energy Policy, 49*, 69-75. Retrieved from https://reader.elsevier.com/reader/sd/pii/S0301421512000705?token=2D2B67FA4E31E173B636D89B1FD5E6C189ADA014EA2D68AD442CC3A3F2DCF2A66056865253270A3798FFC5EA0D649558

Governor's Press Office. (2019). Governor Cuomo signs legislation to create permanent

environmental justice advisory board and interagency coordinating council. Retrieved from https://www.governor.ny.gov/news/governor-cuomo-signs-legislation-create-permanent-environmental-justice-advisory-board-and

Harriet Thomson, Carolyn Snell and Christine Liddell. (2016). Fuel poverty in the European Union: A concept in need of definition? *People, Place and Policy, 10*(1), 5-24. Retrieved from https://extra.shu.ac.uk/ppp-online/wp-content/uploads/2016/04/fuel-poverty-european-union.pdf

Hilary Thomson, Sian Thomas, Eva Sellstrom, and Mark Petticrew. (2009). The health impacts of housing improvement: A systematic review of intervention studies from 1887 to 2007. *American Journal of Public Health, 99*(53), S681-S692. Retrieved from https://ajph.aphapublications.org/doi/full/10.2105/AJPH.2008.143909?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub%3Dpubmed

Housing and Building Energy Programs: Maryland Department of Housing and Community Development. (2020). EmPOWER Maryland low income energy efficiency program. Retrieved from https://dhcd.maryland.gov/Residents/Pages/lieep/default.aspx

Housing and Building Energy Programs: Maryland Department of Housing and Community Development. (2020b). Multifamily Energy Efficiency and Housing Affordability Program. Retrieved from https://dhcd.maryland.gov/HousingDevelopment/Pages/meeha/meehaempower.aspx

Housing and Building Energy Programs:, & Community Development Administration. (2019). Weatherization assistance program. Retrieved from https://dhcd.maryland.gov/Residents/Pages/wap/default.aspx

Howard Jacob Karger. (2007). The “Poverty tax” and America's low-income households. *Families in Society: The Journal of Contemporary Social Services, 88*(3), 413-417. Retrieved from https://doi.org/10.1606/1044-3894.3650

IEA (International Energy Agency). 2014. *Capturing the Multiple Benefits of Energy Efficiency*. Paris: IEA. https://webstore.iea.org/capturing-the-multiple-benefits-of-energy-efficiency

Independent Statistics & Analysis: U.S. Energy Information Administration. (2019). Use of energy explained: Energy use in homes. Retrieved from https://www.eia.gov/energyexplained/use-of-energy/homes.php

Jamal Lewis, Diana Hernández & Arline T. Geronimus. (2019a). Energy efficiency as energy justice: Addressing racial inequities through investments in people and places. *Energy Efficiency,* Retrieved from https://doi.org/10.1007/s12053-019-09820-z

Jamal Lewis, & Carlos Martín. (2019b). *WHITE PAPER: The state of equity measurement: A review for energy-efficiency programs*. Retrieved from https://www.urban.org/sites/default/files/publication/101052/the_state_of_equity_measurement_0.pdf

James Berry, Independent Statistics & Analysis: U. S. Energy Information Administration. (2018). *2015 residential energy consumption survey: Table HC11.1 household energy insecurity, 2015*.U.S. Energy Information Administration, Office of Energy Consumption and Efficiency Statistics. Retrieved from https://www.eia.gov/consumption/residential/data/2015/hc/php/hc11.1.php

Jerome Adams. *White House Briefing - Surgeon General: Jerome Adams Coronavirus.* (2020, April, 10). [Video/DVD] Retrieved from

https://cdn.jwplayer.com/players/tNZ1JCue-HWSueGzu.html

John T. Cook Deborah A. Frank. (2008). Food security, poverty, and human development in the United States. *New York Academy of Sciences, 1136*, 193-209. Retrieved from https://nyaspubs.onlinelibrary.wiley.com/doi/full/10.1196/annals.1425.001

John T. Cook, Deborah A. Frank, Patrick H. Casey, Ruth Rose-Jacobs, Maureen M. Black, Mariana Chilton, Stephanie Ettinger de Cuba, Danielle Appugliese, Sharon Coleman, Timothy Heeren, Carol Berkowitz, Diana B. Cutts. (2008). A brief indicator of household energy security: Associations with food security, child health, and child development in US infants and toddlers. *Pediatrics, 122*(4), e868-e. Retrieved from https://pediatrics.aappublications.org/content/pediatrics/122/4/e867.full.pdf

Kirsten Jenkins, Darren McCauley, Raphael Heffron, Hannes Stephan & Robert Rehner. (2015). Energy justice: A conceptual review. *Energy Research & Social Science, 11*, 174-182. Retrieved from https://doi.org/10.1016/j.erss.2015.10.004

Leonardo Setti, Fabrizio Passarini, Gianluigi De Gennaro, Pierluigi Baribieri, Maria Grazia Perrone, Massimo Borelli, Jolanda Palmisani, Alessia Di Gilio, Valentina Torboli, Alberto Pallavicini, Maurizio Ruscio, PRISCO PISCITELLI, Alessandro Miani. (2020). SARS-cov-2 RNA found on particulate matter of Bergamo in northern Italy: First preliminary evidence. Retrieved from https://doi.org/10.1101/2020.04.15.20065995

Louis Lee Woods, I. (2012). The federal home loan bank board, redlining, and the national proliferation of racial lending discrimination, 1921–1950. *Journal of Urban History, 38*(6), 1036-1059. Retrieved from https://journals.sagepub.com/doi/pdf/10.1177/0096144211435126

Lucy Laflamme. (N.D.). *How 1 percent energy savings will help lower energy costs for low – income Marylanders*. Energy Efficient Maryland. Retrieved from https://assets.ctfassets.net/ntcn17ss1ow9/4x17Lqh5PGTJwPyPSYJitn/5252e527e4ff01a8f166424d52669399/How_1_Percent_Energy_Savings_Will_Benefit_Low-Income_Marylanders.pdf

Lucy Laflamme, Jamal Lewis, Toby Harris. (2020). *Charkoudian testimony: House economic matters hearing HB982.* Unpublished manuscript.

Manuel B. Aalbers. (2006). 'When the banks withdraw, slum landlords take over': The structuration of neighbourhood decline through redlining, drug dealing, speculation and immigrant exploitation. *Urban Studies, 43*(7), 1061-1086. Retrieved from https://journals.sagepub.com/doi/pdf/10.1080/00420980600711365

Martin Schweitzer Bruce Tonn. (2002). *Nonenergy benefits from the weatherization assistance program: A summary of findings from the recent literature*. Oak Ridge National Laboratory. Retrieved from https://library.cee1.org/system/files/library/1146/312.pdf

Maryland Department of Housing & Community Development. (2019). *Weatherization grantee health and safety plan*. Retrieved from https://dhcd.maryland.gov/Residents/Documents/wap/HealthSafetyPlan.pdf

Maryland Department of Housing and Community Development. Weatherization assistance program. Retrieved from https://dhcd.maryland.gov/Residents/Pages/wap/default.aspx

Maryland Department of Housing and Community Development: Housing & Building Energy Programs. (2019). *ENERGY EFFICIENCY PROGRAM OPERATIONS MANUAL*

v.5-2019. Maryland: Maryland Department of Housing and Community Development. Retrieved from https://dhcd.maryland.gov/Residents/Documents/wap/POM-v5-2019.pdf

Maryland Energy Administration. EmPOWER Maryland. Retrieved from https://energy.maryland.gov/Pages/Facts/empower.aspx

Massey, D. S., & Denton, N. A. (2003). *American apartheid: Segregation and the making of the underclass*. Cambridge, Mass: Harvard Univ. Press.

Melvin Oliver, T. S. (2006). *Black wealth / white wealth A new perspective on racial inequality*. New York.

Michael J. Sandel. (2010). *Justice: What's the right thing to do?* ((1st pbk. ed). ed.). New York: Farrar, Straus and Giroux.

Molly Knowles, Jenny Rabinowich, Stephanie Ettinger de Cuba, Diana Becker Cutts, Mariana Chilton. (2015). "Do you wanna breathe or eat?": Parent perspectives on child health consequences of food insecurity, trade-offs, and toxic stress. *Maternal and Child Health Journal, 20*(1), 25-32. Retrieved from https://link.springer.com/article/10.1007%2Fs10995-015-1797-8

NAACP, Environmental and Climate Justice: Cornell Williams Brook, Jacqueline Patterson. (2015). *NAACP statement on president Obama's clean power plan*. Retrieved from https://www.naacp.org/latest/naacp-statement-on-president-obamas-clean-power-plan/

Neil Simcock. (2016). Procedural justice and the implementation of community wind energy projects: A case study from South Yorkshire, UK. *Land use Policy, 59*, 467-477. Retrieved from https://reader.elsevier.com/reader/sd/pii/S0264837716300618?token=2D30924F375F2

30B82F5C6825218FE0792E65E85D1388C04DD3F0C2143BA3368B72B008B929023440AD9661E1FAE7657

New Jersey Board of Public Utilities. (2019). *Energy efficiency and peak demand program administration straw proposal: Draft for public comment*. Retrieved from https://www.nj.gov/bpu/pdf/publicnotice/EE_%26_Peak_Demand_Program_Administration_Straw_Proposal_122019.pdf

Norman Disney & Young: HVAC HESS: Heating, Ventilation & Air - Conditioning High Efficiency Systems Strategy Australian Government: Department of Agriculture, Water and the Environment. (2013). *Factsheet overcoming split incentives*. Retrieved from https://www.environment.gov.au/system/files/energy/files/hvac-factsheet-split-incentives.pdf

NREL: National Laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. (2009). *Weatherization and intergovernmental program*. Retrieved from https://www1.eere.energy.gov/wip/pdfs/wap_factsheet.pdf

Ohio Partners for Affordable energy. (2020). The trump administration's FY 2021 budget – an insult to the poor. Retrieved from http://www.opae.org/2020/02/12/the-trump-administrations-fy-2021-budget-an-insult-to-the-poor/

Office of Community Services: Administration for Children & Families: U.S. Department of Health & Human Services. (2016). LIHEAP Q & as for consumers. Retrieved from https://www.acf.hhs.gov/ocs/resource/consumer-frquently-asked-questions

PUBLIC SERVICE COMMISSION OF MARYLAND. (2019). *The EmPOWER Maryland energy efficiency act REPORT OF 2019: With data for compliance year 2018*. Maryland: Retrieved from https://www.psc.state.md.us/wp-content/uploads/2019-EmPOWER-Maryland-Energy-Efficiency-Act-Standard-Report.pdf

Rick Nevin. (2009). Energy-efficient housing stimulus that pays for itself. *Energy Policy, 38*, 4-11. Retrieved from https://reader.elsevier.com/reader/sd/pii/S030142150900696X?token=7DC7E7E1D1AF0407AA85DCECC711E1FCE5D15AA2065BFE81D2FE9FDA3D7F843828B127CF0EBCDCE457B7322C16F3DF5C

Rodney D. Green, Marie Kouassi, Padma Venkatachalam & Johnnie Daniel. (2013). The impact of housing stressors on the mental health of a low-income African-American population. *The Review of Black Political Economy, 40*, 53-100. Retrieved from https://journals.sagepub.com/doi/pdf/10.1007/s12114-011-9109-z

Rothstein, R. (2017). *The Color of Law: A Forgotten History of How Our Government Segregated America.. New York ; London: Liveright publishing corporation, a division of W.W. norton & company, 2017.* (First edition ed.). New York ; London: Liveright Publishing Corporation, a division of W.W. Norton & Company.

Ruth Ann Norton, Brendan Wade Brown, Catherine Lee, Kiki Malomo-Paris, Jamal Lewis. (2017a). *Achieving health and social equity through housing: Understanding the impact of non energy benefits in the united states*. Retrieved from https://www.greenandhealthyhomes.org/wp-content/uploads/AchievingHealthSocialEquity_final-lo.pdf

Ruth Ann Norton, Brendan Wade Brown, Kiki Malomo-Paris. (2017b). *Weatherization and its impact on occupant health outcomes.* Green & Healthy Homes Initiative. Retrieved from https://www.greenandhealthyhomes.org/wp-content/uploads/Weatherization-and-its-Impact-on-Occupant-Health_Final_5_23_2017_online.pdf

Ruth Ann Norton, Brendan Wade Brown, Kiki Malomo-Paris & Elizabeth Stubblefield-Loucks. (2016). *Non-energy benefits of energy efficiency and weatherization programs in multifamily housing: The clean power plan and policy implications*. Green & Healthy Homes Initiative. Retrieved from https://www.greenandhealthyhomes.org/wp-content/uploads/ghhi.pdf

Stefan Bouzarovski, Saska Petrova. (2015). A global perspective on domestic energy deprivation: Overcoming the energy poverty–fuel poverty binary. *Energy Research & Social Science, 10*, 31-40. Retrieved from https://reader.elsevier.com/reader/sd/pii/S221462961500078X?token=2370FBFE8244E3B0659E65B6144B37733E5A15481675D95BDA3C7D4B49809B2CA2EB14BE0597EDA4D50F996F3CA8D8E0

Stefen Samarripas. (2017, October 4,). Energy efficiency can keep housing affordable for Maryland's low-income families. Retrieved from https://www.aceee.org/blog/2017/10/energy-efficiency-can-keep-housing

Stephen Bird, D. H. (2012). Policy options for the split incentive: Increasing energy efficiency for low-income renters. *Every Policy, 48*, 506-514. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4819331/pdf/nihms763054.pdf

Stewards of Affordable Housing for the Future, Energy Efficiency For All. (2019). *MARYLAND DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT: Multifamily energy efficiency & housing affordability program*. Retrieved from https://sahfnet.org/sites/default/files/uploads/md_meeha_-_may_2019.pdf

Student Borrower Protection Center. (2020). *Educational Redlining*. Retrieved

from https://protectborrowers.org/wp-content/uploads/2020/02/Education-Redlining-Report.pdf

S. 6599 A. 8429: State of New York 2019-2020 regular sessions SENATE - ASSEMBLY, (2019). Retrieved from https://legislation.nysenate.gov/pdf/bills/2019/S6599

Thomson H, Thomas S. Developing empirically supported theories of change for housing investment and health. Soc. Sci. Med. 2015; 124:205–214. [PubMed: 25461878]

Thomas Parker Hughes. (1993). *Networks of power: Electrification in western society, 1880-1930*. Baltimore: JHU Press.

Toby Harris, Jamal Lewis, Green & Healthy Homes Initiative. (2020). *GHHI written testimony - HB982 testimony 2.27.2020.-2.* Unpublished manuscript.

Tony Gerard Reames. (2016a). A community-based approach to low-income residential energy efficiency participation barriers. *Local Environment, 21*(12), 1449-1466. Retrieved from https://www.tandfonline.com/doi/pdf/10.1080/13549839.2015.1136995?casa_token=a3yN4dFDAuMAAAAA:hKq4u1aqkayfazD2hCisxYDghxyl8nTf8ZIgsCq-4uixPFFva6D7aYfM6lH-4Cy1qPaIDatscZwU

Tony Gerard Reames. (2016b). Targeting energy justice: Exploring spatial, racial/ethnic and socio-economic disparities in urban residential heating energy efficiency. *Energy Policy, 97*, 549-558. Retrieved from https://reader.elsevier.com/reader/sd/pii/S0301421516304098?token=53ED4ADCABC39BA182516677EF12B6E1EB6335ED4AB9D9B0968A06A48C85B3D097789AE758FE6AEA6A6E8295C9FC1529

Tyra Bryant-Stephens. (2009). Asthma disparities in urban environments. *The Journal of Allergy and Clinical Immunology, 123*(6), 1109-1206. Retrieved from https://www.jacionline.org/article/S0091-6749(09)00689-7/pdf

U.S. Energy Information Administration. (2018). One in three U.S. households faces a challenge in meeting energy needs. Retrieved from https://www.eia.gov/todayinenergy/detail.php?id=37072

U.S. Energy Information Administration. (2020). *T5.a: 2018 average monthly bill- residential (data from forms EIA-861- schedules 4A-D, EIA-861S and EIA-861U)*. Retrieved from https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf

U.S. Department of Health and Human Services. (2020). LIHEAP and WAP funding: FY 2020 . Retrieved from https://liheapch.acf.hhs.gov/Funding/funding.htm

United States Census Bureau. (2015). *American housing survey*. Retrieved from https://www.census.gov/programs-surveys/ahs/data/interactive/ahstablecreator.html#?s_areas=a00000&s_year=n2015&s_tableName=Table 5&s_byGroup1=a7&s_byGroup2=a1&s_filterGroup1=t1&s_ filterGroup2=g1&s_show=S

United States Environmental Protection Agency. (2017). *Energy efficiency and renewable energy in low-income communities, case study: EmPOWER Maryland leveraging relationships and experience*. Retrieved from https://www.epa.gov/sites/production/files/2017-07/documents/empower_maryland_case_study_7-19-17.pdf

Virginia A.Rauh, Philip J. Landrigan, and Luz Claudio. (2008). Housing and health: Intersection of poverty and environmental exposures. *The New York Academy of Sciences, 1136*, 276-288. Retrieved from https://nyaspubs.onlinelibrary.wiley.com/doi/epdf/10.1196/annals.1425.032

William J. Fisk. (2000). Health and productivity gains from better indoor environments and their relationship with building energy efficiency. *Annual Review of Energy and the Environment, 25*, 537-566. Retrieved from https://www.annualreviews.org/doi/10.1146/annurev.energy.25.1.537

Xiao Wu, Rachel C. Nethery, M. Benjamin Sabath, Danielle Braun, Francesca Dominici. (2020). *Exposure to air pollution and COVID-19 mortality in the united states.* Unpublished manuscript. Retrieved from https://doi.org/10.1101/2020.04.05.20054502