Introduction:

This document explains the research methodology Greenlink Analytics'(Greenlink) uses to create the equity maps found in the Greenlink Equity Map (GEM). The data provided by these maps is beneficial for cities and communities to better understand the efforts needed to provide substantial equity benefits in a given area.

Greenlink is an Atlanta-based energy research and consulting NGO offering data and deep industry knowledge in the clean energy space based out of Atlanta. Greenlink Analytics has developed methodologies to evaluate 70+ equity indicators at a neighborhood census tract level.

The Greenlink Equity Map (GEM) platform and website were created for cities and communities to collect critical data information needed to build sustainable partnerships, equitable climate and social solutions, and to better understand the efforts needed to provide substantial equity benefits in a given area.

Currently the maps use data from 15 equity indicators at a neighborhood census-tract level across 50 US cities. One major indicator that is at the intersection of climate and equity and becoming an increasingly important topic in equity conversations is utility burden, i.e. the percent of income spent on particular expenses (electricity, gas, and water). Utility burdens are not evenly shared across society: low-income communities face electric, gas, and water burdens that far exceed national averages.

Greenlink's current equity maps are able to not only describe the average utility burden residents in a neighborhood face, but also estimate the number of households in burden by neighborhood. Moreover, the mapping is able to depict additional equity indicators that are correlated with utilities burdens, such as evictions and foreclosure rates.

Utility Burden:

A utility burden represents the percentage of annual income that a household or an individual pays toward their electricity, gas, and/or water bills. While all households experience a unique utility burden, recent conventions have established that a household is typically considered "in burden" if their energy bills (gas and electric) exceed 6%, and in "energy poverty" if their energy bills exceed 10% of their annual income.[1] Proximate causes of excessive utility burdens can be attributed to a number of issues such as poor insulation, outdated appliances, and/or excessive utility use.[2] There are also structural and systemic causes that cause low-income and communities of color to face higher barriers to accessing opportunities to alleviate high utility burdens,[3,4,5] including low wages, the wealth gap, and other financing barriers,[6] historical governmental policies such as redlining,[7] housing quality,[8] and even higher costs for energy-efficient equipment from neighborhood retailers.[9]

Utility burden is not evenly shared across society and is quickly becoming known for its importance in equity conversations. Low-income communities face utility burdens that far exceed national averages. Coupled with the fact that utility bills are the most common reason that people turn to short-term loan products, utility burdens are increasingly contributing to chronic poverty in the United States.[10]

A primary purpose of Greenlink Analytics' interactive web tool is to bridge the gap between local government officials, city residents, and policy decision makers in order to make more informed, insightful decisions regarding a city's utility burden. Through this tool, users are able to see the average utility burden within each census tract (neighborhood) of their city, the number of households affected by various burden thresholds, and other socio-demographic indicators within each neighborhood. This tool can be used to help communities, advocates, and policymakers collectively understand the conditions of different neighborhoods and determine the appropriate level of resource allocations for policies such as energy efficiency programs. Such actions can improve: the democratic process, by enabling community engagement and

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[1] Drehobl, A., and L. Ross. 2016. *Lifting the High Energy Burden in America's Largest Cities: How Energy Efficiency Can Improve Low-Income and Underserved Communities*. Washington, DC: American Council for an Energy Efficient Economy. www.aceee.org/research-report/u1602.

[2] Brown, MA, A Soni, MV Lapsa, KA Southworth, M Cox. *forthcoming*. "Low-Income Energy Affordability in an Era of Energy Abundance," *Progress in Energy,* Vol 1. https://dx.doi.org/10.1088/2516-1083/ab250b

[3] Ross, L., A. Drehobl, and B. Stickles. 2018. *The High Cost of Energy in Rural America: Household Energy Burdens and Opportunities for Energy Efficiency*. Washington, DC: ACEEE. www.aceee.org/research-report/u1806.

[4] Jessel, S., S. Sawyer, and D. Hernández. 2019. "Energy, Poverty, and Health in Climate Change: A Comprehensive Review of an Emerging Literature." *Frontiers Public Health* 7: 356. www.ncbi.nlm.nih.gov/pmc/articles/PMC6920209/.

[5] Berry, C., C. Hronis, and M. Woodward. 2018. "Who's Energy Insecure? You Might be Surprised." In Proceedings of the *ACEEE 2018 Summary Study on Energy Efficiency in Buildings*, 13: 1–14.

[6] Jargowsky, P. 2015. *Architecture of Segregation: Civil Unrest, the Concentration of Poverty, and Public Policy*. New York and Rutgers-Camden: Century Foundation, and Center for Urban Research and Education. apps.tcf.org/architecture-of-segregation.

[7] Rothstein, R. 2017. *The Color of Law: A Forgotten History of How Our Government Segregated America*. Liveright Publishing.

[8] Bednar, D., T. Reames, and G. Keoleian. 2017. "The Intersection of Energy Justice: Modeling the Spatial, Racial/Ethnic and Socioeconomic Patterns of Urban Residential Heating Consumption and Efficiency in Detroit, Michigan." *Energy and Buildings* 143: 25–34. doi.org/10.1016/j.enbuild.2017.03.028.

[9] Reames, T., M. Reiner, M. Stacey. 2018. "An incandescent truth: Disparities in energy-efficient lighting availability and prices in an urban U.S. county." *Applied Energy* Vol 218. doi.org/10.1016/j.apenergy.2018.02.143.

[10] Levy, R. and J. Sledge. 2012. A Complex Portrait: An Examination of Small-Dollar Credit Consumers. Chicago. Center for Financial Services Innovation.

participatory processes; equity outcomes, by highlighting distributional issues, and; the efficiency of government operations, by identifying the causes of energy burden that can then be focused on and addressed.

The purpose of this document is to outline the methodology for calculating utility burdens. This document begins by outlining the modeling steps and offering an example of one city's energy burden followed by a more detailed breakdown of each modeling step and a discussion of policy implications.

Methodology

Data from nearly 75,000 census tracts are processed and cleaned to calculate the utility burdens at a neighborhood level across the entirety of the US. This data is drawn from the American Community Survey, as reported in the Integrated Public Use Microdata Series and the Census Bureau's publication of ACS data. Data is cleaned and prepared to take into account renters that have a certain utility included in their rent, or households that use complete electricity or natural gas. Cleaned data is then sorted and filtered into 62 representative brackets to increase the visibility into variations in energy burden across a neighborhood and a community, as well as to minimize estimation errors in the results. To determine utility burden of a particular census tract, utility spending from large scale geographies is synchronized with income data from a neighborhood scale income data through a weighted average process.

Other data sources such as the Centers for Disease Control and Prevention (CDC) 500-Cities Project or Princeton's Eviction Lab are utilized to provide additional context that can help inform policymakers and residents alike. These data sources are linked through unique geographic identifiers and are consistent with each utility data point.

Greenlink Analytics has broadened the aspects through which utility burden can be viewed and understood. For example, a common analysis in this space may provide the median energy burden for a home within a certain geography; Greenlink Analytics can expand upon this to provide demographic details about energy burden, the number of people experiencing energy burden, and the financial resources required to lift people out of burden. This level of detail is critical to evaluating the impacts of current systems, highlighting efforts most likely to provide substantial equity benefits, and detailing the scale of the effort required to provide these benefits.