Redlining Case Study

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Introduction

The objective of this case study is to analyze if there is an association between historically redlined areas and energy equity. Specifically, finding if there is a relationship between the energy burden in census tracts and their previous Home Owners' Loan Corporation (HOLC) categorization.

Key Terms

- **Energy Equity:** Working towards a just future with access to affordable and clean energy for historically disadvantaged and marginalized communities. Energy Equity is best understood through four dimensions that focus on the past, present, and future in order to provide a holistic analysis of justice.
    - **Recognition**: The recognition pillar of energy equity acknowledges the inequities that are already exposing certain people to more environmental harm and a greater energy burden because of identity, economic structures, and historical discrimination of certain groups.
    - **Procedural**: The procedural dimension of equity focuses on creating an inclusive decision-making process where those who are most affected by high energy rates have a voice in creating policies to fix it, as well as offering intentionally accessible resources to minimize energy burden.
    - **Distributive**: Distributive justice focuses on the societal transition to clean energy, ensuring both individuals and communities are able to benefit from the transition financially and health-wise.
    - **Restorative**: Finally, restorative justice aims to design a system where equity is integrated into the decision-making processes from the outset, rather than applying equitable principles only after injustices have occurred.
- **Energy Burden**: The percentage of gross household income that is spent on energy costs. According to the U.S. Department of Housing and Urban Development, no more than 30% of income should go towards housing expenditures, of which 20% can reasonably go towards energy, giving us the 6% affordable energy burden figure (*Home Rent Limits*).
- **Federal Poverty Level (FPL):** A measure of income used by the federal government to determine eligibility for a variety of assistance programs. It also takes into account the size of a household, as income can go much further for one person than,

for example, a family of five. We use the levels 0-100, 100-150, 150-200, 200-400, and 400+ to represent what percent of the FPL one's income fits into.

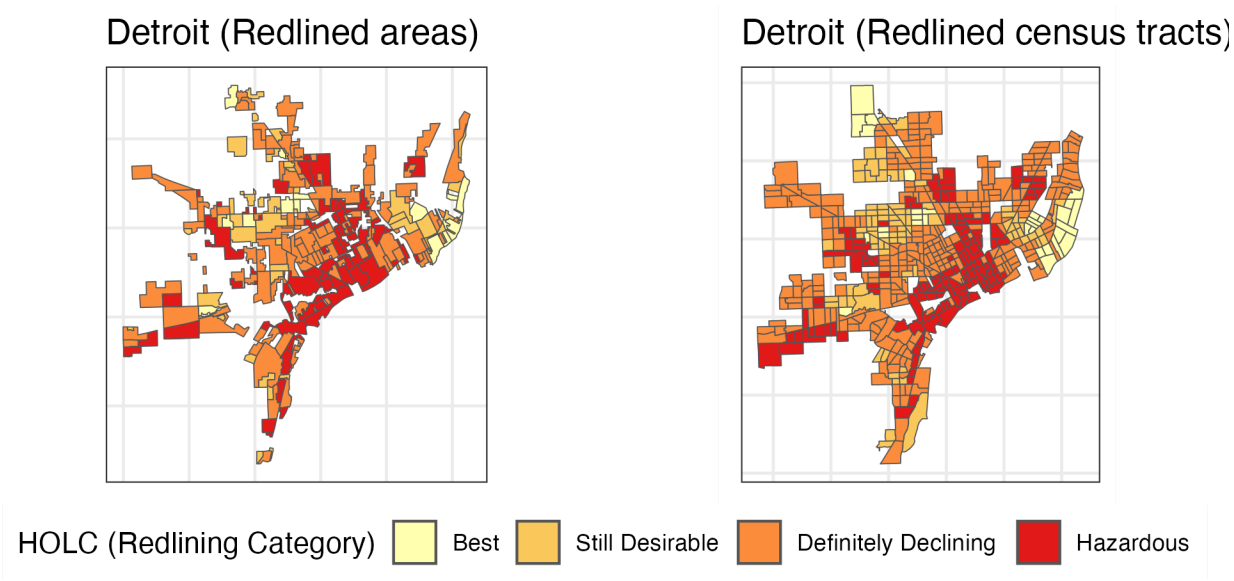
- **Redlining**: Between 1935 and 1940, the Home Owners' Loan Corporation graded residential neighborhoods as either A (Best), B (Still Desirable), C (Definitely Declining), or D (Hazardous). The categories were originally created to indicate the level of security for real estate investments, including mortgages and loans, in certain areas. However, the designations were racially-motivated and led to much loss of generational wealth among other inequities.

Methods

We worked with three main datasets for this project: geographic redlining data from Mapping Inequality, Census data from 2018, and Low-Income Energy Affordability Data (LEAD) from the Department of Energy (DOE). We chose to use 2018 Census data as it was the most recent dataset with the fewest missing census tracts when comparing GEOIDs with DOE LEAD data. The LEAD data was used because it is the only dataset that estimates energy burden at a national scale and can be disaggregated by FPL for all U.S. census tracts.

We focused only on the state of Michigan, specifically cities that were historically redlined including Battle Creek, Bay City, Detroit, Flint, Grand Rapids, Jackson, Kalamazoo, Lansing, Muskegon, Pontiac, and Saginaw.

We overlaid the redlining data onto the census tract data using EPSG 4269 (world reference used for GIS purposes). We then assigned each census tract the HOLC category that covered the largest area within it. We were able to easily combine DOE LEAD and Census data due to the shared use of Geographic Identifiers (GEOIDs), numeric codes used to identify census tracts.



The “Detroit (redlined areas)” map shows exactly what areas in Detroit were designated as “best,” “still desirable,” “definitely declining,” and “hazardous.” The “Detroit (Redlined census tracts) map is more complete as it contains all census tracts that overlap with an HOLC category. For each census tract, the redlining category that occupies the largest portion of land within the tract is assigned as its label.

Results

Most households in Michigan in cities that were historically redlined are in what were “definitely declining” areas (56%). Followed by “hazardous” (21%), “still desirable” (17%), and least being in “best” (6%) (Nelson et al., 2023; U.S. Census Bureau, 2018).

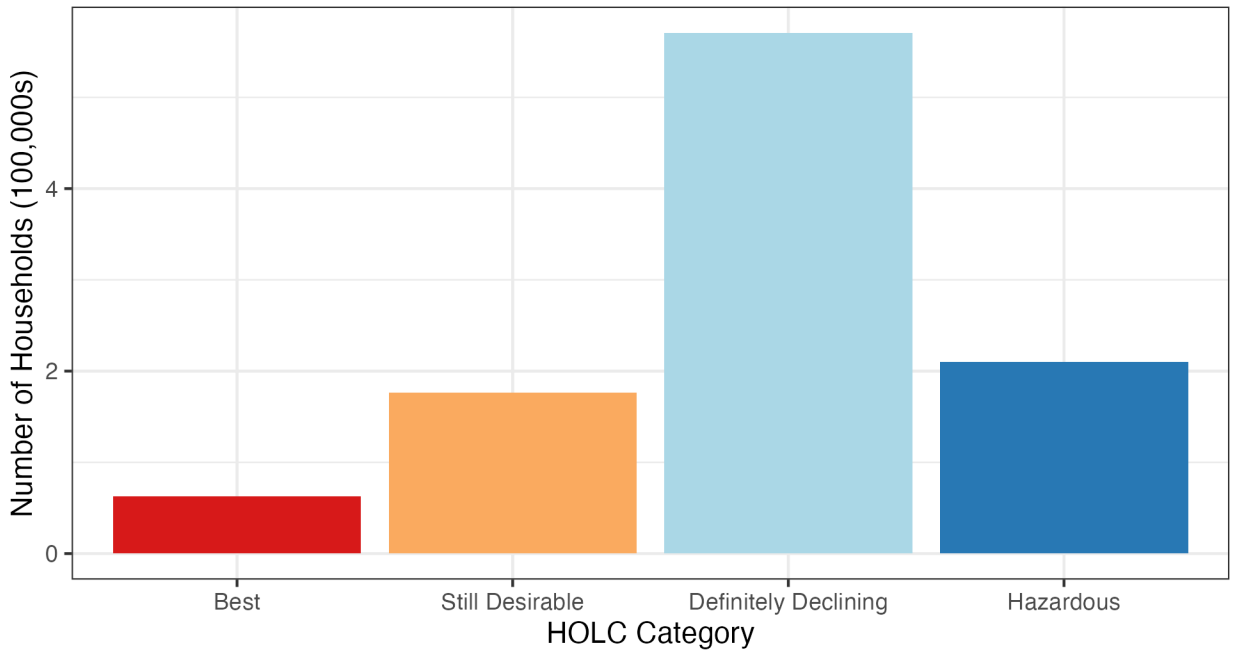


Fig 1: This graph illustrates the number of households currently residing in each HOLC category in all of the historically redlined cities in Michigan.

Most households in previously redlined Michigan cities are in the 400+ FPL category (44%), followed by 200-400 (30%). There are over 4 times more households in the 400+ FPL than 0-100 FPL (Ma, 2018).

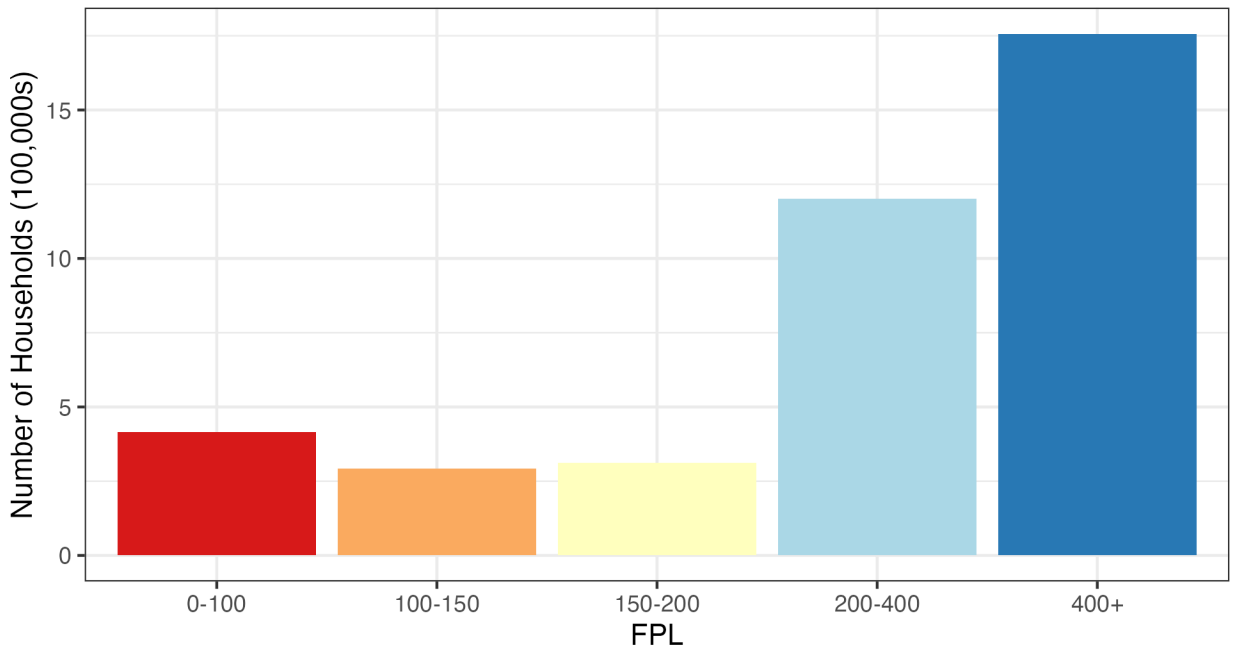


Fig 2: This bar chart illustrates the number of households within each Federal Poverty Level in historically redlined cities in Michigan.

Here we can see that the black line represents the "acceptable" energy burden of 6%, which is exceeded amongst all FPL groups below 200 (*Home Rent Limits*). The median energy burden decreases as FPL increases. For those in the 0-100 FPL range, the median energy burden is 3.8x the acceptable energy burden threshold of 6% and 11.5x higher than those in the 400+ FPL (Ma, 2018).

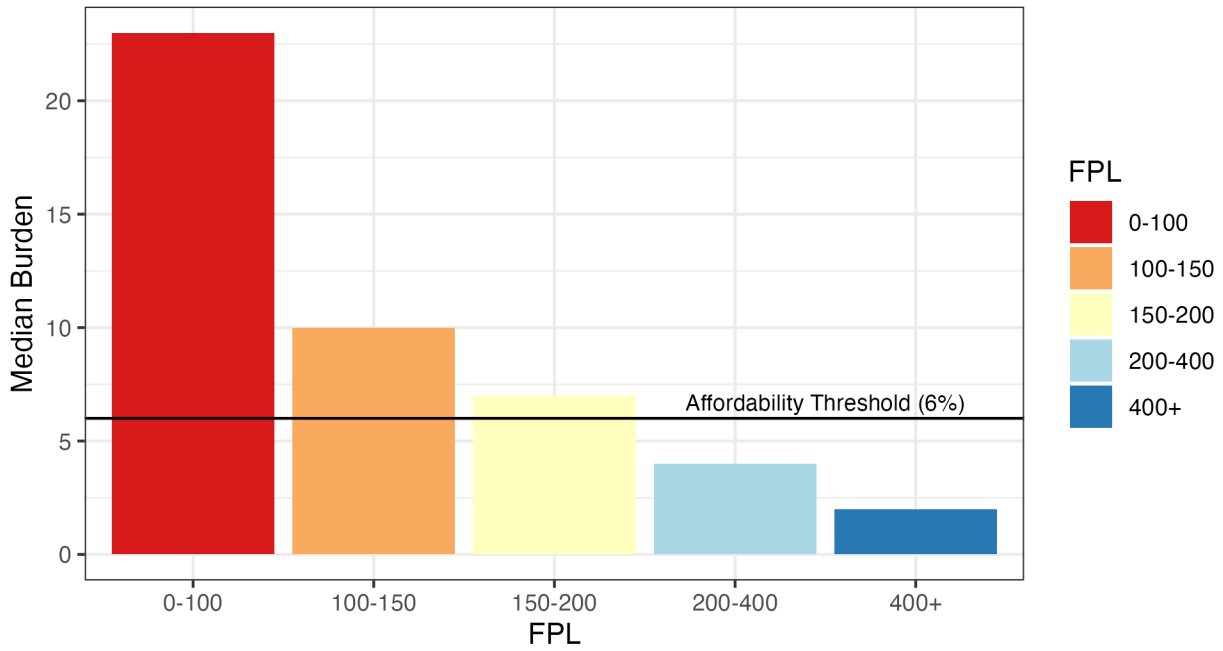


Fig 3: This graph illustrates the median burden of all households within each Federal Poverty Level in historically redlined cities in Michigan.

Although the pattern is less clear in the mean, the median shows an upward trend with increasing energy burden as the HOLC class decreases from "best" to "hazardous." It is worth noting that all median energy burdens fall below 6%, although all of the means are above it (Ma, 2018; Nelson et al., 2023).

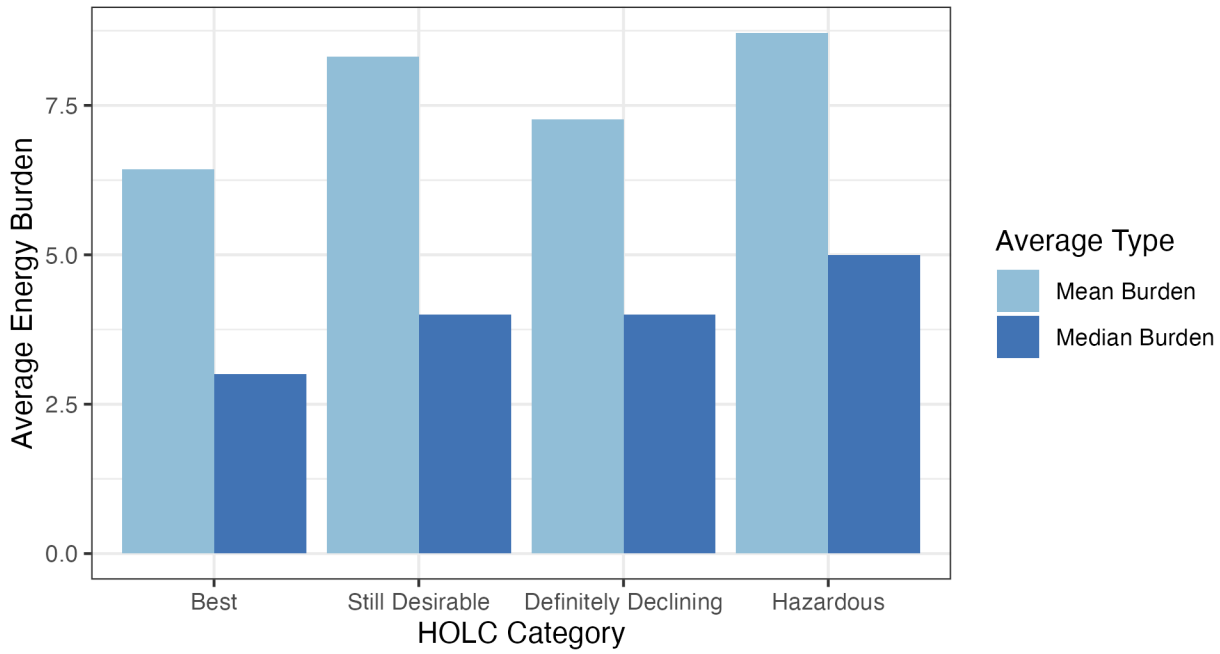


Fig 4: This graph compares 2 types of average energy burden (median and mean) of households in each HOLC group of historically redlined cities in Michigan.

After examining the number of households and median energy burdens in each HOLC and FPL in historically redlined areas of Michigan, there were still questions left unanswered. It appeared that there was a strong trend with FPL and burden, with another possible correlation between HOLC and energy burden. We decided to disaggregate the data to investigate these relationships more closely. By accounting for FPL and HOLC simultaneously, we were able to gain a more nuanced understanding of how energy burden was impacted by both of these factors, as well as how HOLC informed FPL.

The percentage of households that are in the 400+ FPL decreases as HOLC goes from Best to Hazardous. The percentage of households at 400+ FPL in areas previously rated as “Best” is nearly double (1.96 times) that in areas previously rated as “Hazardous” (Ma, 2018; Nelson et al., 2023). The inverse is true for 0-100 FPL which increases as HOLC goes from Best to Hazardous. The 100-150 and 150-200 FPL categories stay fairly consistent across HOLC groups (Ma, 2018; Nelson et al., 2023). This could suggest that historical racial discrimination’s trends continue today with more wealthy people living in areas that were historically deemed best for investment.

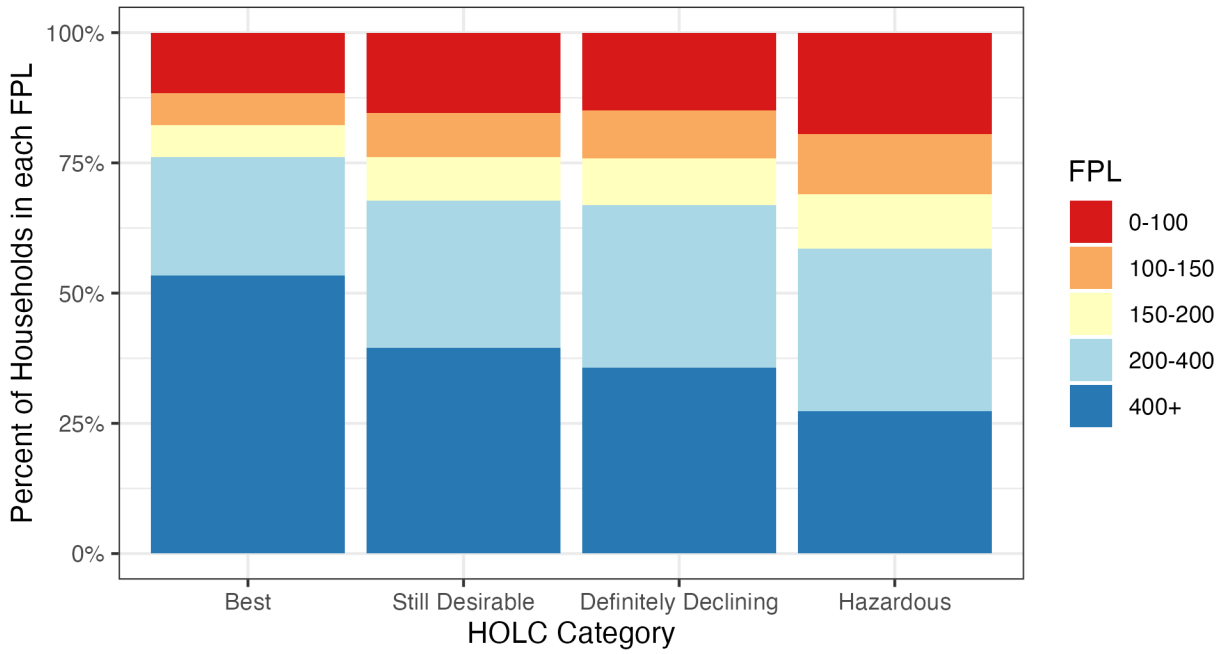


Fig 5: This graph shows the distribution of Federal Poverty Level within each HOLC category of historically redlined cities in Michigan.

The FPL follows an expected trend of median energy burden decreasing as FPL increases. Regardless of HOLC category, the trend of energy burden decreasing with higher FPLs from Figure 3 holds true. Notably, the range of energy burdens decreases dramatically between the lower to higher FPLs. The average Interquartile Range (IQR) of the 0-100 FPL amongst the HOLC categories is 14.75, while the average IQR of the 400+ FPL amongst the HOLC categories is 0.75 (Ma, 2018; Nelson et al., 2023). This indicates that wealthier communities experience less variance in energy burden.

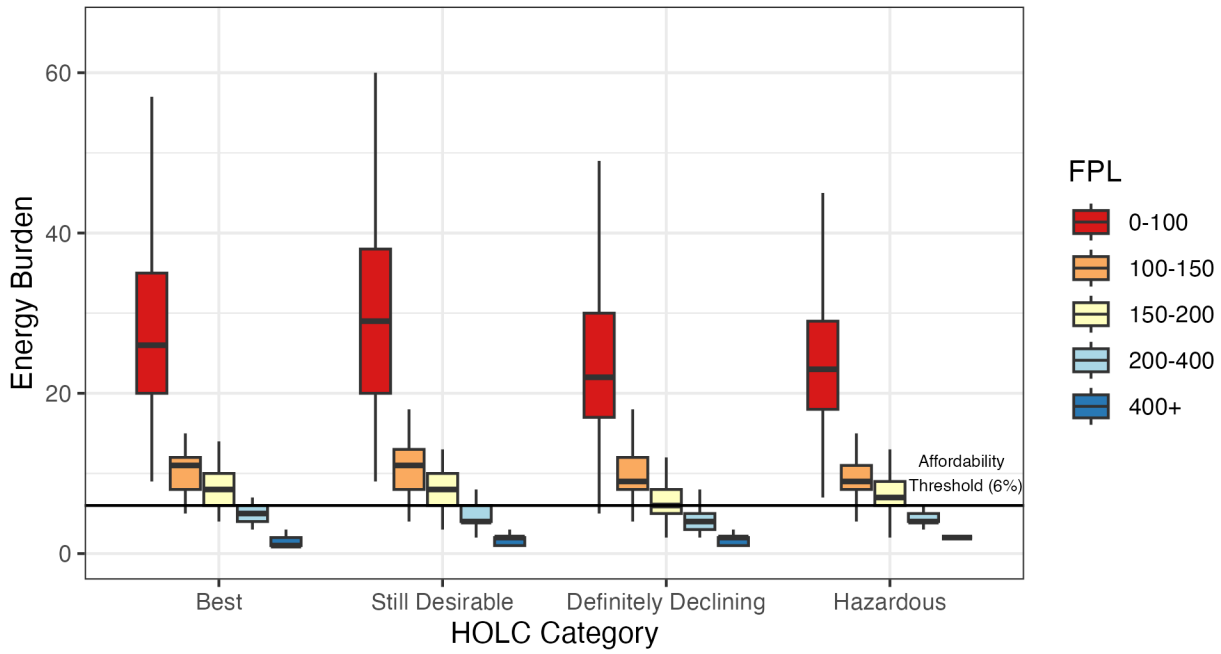


Fig 6: This boxplot shows the distribution of household energy burden for every FPL in each HOLC category. The boxplots show each respective median energy burden (the line through the center of the box) and the Interquartile Range (IQR, the box itself) which represents the range of the middle 50% of energy burdens. Additionally, the whiskers (lines above and below the box) represent the range of the lower and upper 25% of energy burdens. There is also a black line that represents the "acceptable" energy burden of 6%.

To fully understand the effect that historical redlining is still having, it is necessary to both widen and narrow the scope of the research. These redlined neighborhoods are still affected by the structural racism that was put in place, and are thus more susceptible to heat island effect and have worse access to healthy foods, although the research is still inconsistent (Swope, 2022). Nonetheless, figure 6 demonstrates how much the federal poverty level affects one's energy burden, and figure 5 shows that more people in worse HOLC areas also fall into lower FPLs. However, there is more room for research on other factors that can be associated with redlining and energy burdens, such as the racial makeup of an area. Specifically, it could be interesting to further disaggregate the data and compare all historically redlined areas of Michigan to non-redlined areas, or take a closer look at predominantly black cities like Detroit and Flint. Additionally, incorporating CDC's Social Vulnerability Index could help further visualize and understand the impacts of redlining and who's most affected by high energy burdens.

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