Inequalities in Energy Transitions: Insights from Historical Shifts in Fuels for Home Heating

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The Biden administration has set ambitious goals at the intersection of clean energy transition and environmental justice, particularly through the Justice40 Initiative, which aims to direct 40% of the overall benefits of federal climate and clean energy investments to disadvantaged communities. This dual focus not only seeks to accelerate the shift towards renewable energy sources but also to rectify historical inequities by ensuring that marginalized populations have equitable access to the economic and health benefits of a sustainable future.

Understanding disparities in historical adoption of energy technologies in U.S. home heating can help to inform potential patterns of adoption for newer technologies, such as heat-pumps, that are critical for the realization of the U.S.'s energy transition plan, especially in light of the environmental equity goals established through programs such as Justice40. Historical disparities in the adoption of home heating technologies are likely responsible for higher energy expenditures (Lyubich, 2020; Batlle et al., 2024) as well as in-home and local pollution exposure (Barreca et al., 2014).

This paper investigates historical disparities in adoption of heating technologies and factors that explain these disparities over the period 1940-2000. This time period saw the end of the transition from wood to coal for heating; the transition from coal to natural gas; and the start of the transition to electric heat. In 1940 at the national level, coal was the most common heating fuel and wood was the second most common.[1] In 1950, coal remained the most common and natural gas had become the second most common. By 1960, natural gas had become the most common heating fuel and fuel oil the second most common. By 1980 (and persisting through 2000), natural gas remained the most common and electricity had become the second most common.

To investigate these issues, the paper brings together newly digitized census tract level data on home heating for 1940 and 1950 and existing data for 1960 onward. Census tract level data allows for analysis of heating fuel transitions at a fine geographic scale. In particular, it makes it possible to disentangle the effects of climate, housing characteristics, and historical disparities related to race in a way that is not possible with state or county data.

Drawing on these data, the analysis first documents racial disparities from 1940-2000 in the transition from wood to other fuels; in the transition from coal to cleaner fuels such as natural gas, fuel oil, and electricity; and in the transition from natural gas and other fuels to electricity. We then investigate how much of this disparity can be explained by other factors, such as differences in heating degree days, the age of the local housing stock, availability of different fuel types and renter- vs owner-occupied dwellings. Renter-occupied dwellings are less likely to have energy efficient appliances (Davis, 2012). Racial differences in home ownership is one reason why White households are more likely to receive energy efficiency incentives (Jacobsen, 2024).

The paper has two main findings so far. First, Figure 1 shows that census tracts where at least

[1]National statistics are from https://www.census.gov/data/tables/time-series/dec/coh-fuels.html

50% of the population is made up of Black residents lagged significantly in adoption of new heating fuels.[2] In 1940, these census tracts lagged in adopting coal, natural gas, and fuel oil. Specifically, 29% of predominantly Black census tracts reported using coal, natural gas, or fuel oil as compared to 49% of predominantly White Census tracts. In 1960, predominantly Black census tracts lagged in moving to natural gas, fuel oil, and electricity, which were significantly cleaner than coal. Specifically, 73% of predominantly Black census tracts reported using natural gas, fuel oil, or electricity as compared to 84% of predominantly White census tracts. In 1980, predominantly Black census tracts also lagged in moving to electricity. Specifically, 11% of predominantly Black census tracts reported using electricity as compared to 18% of predominantly White census tracts. Though shrinking, this gap persisted through 2000.

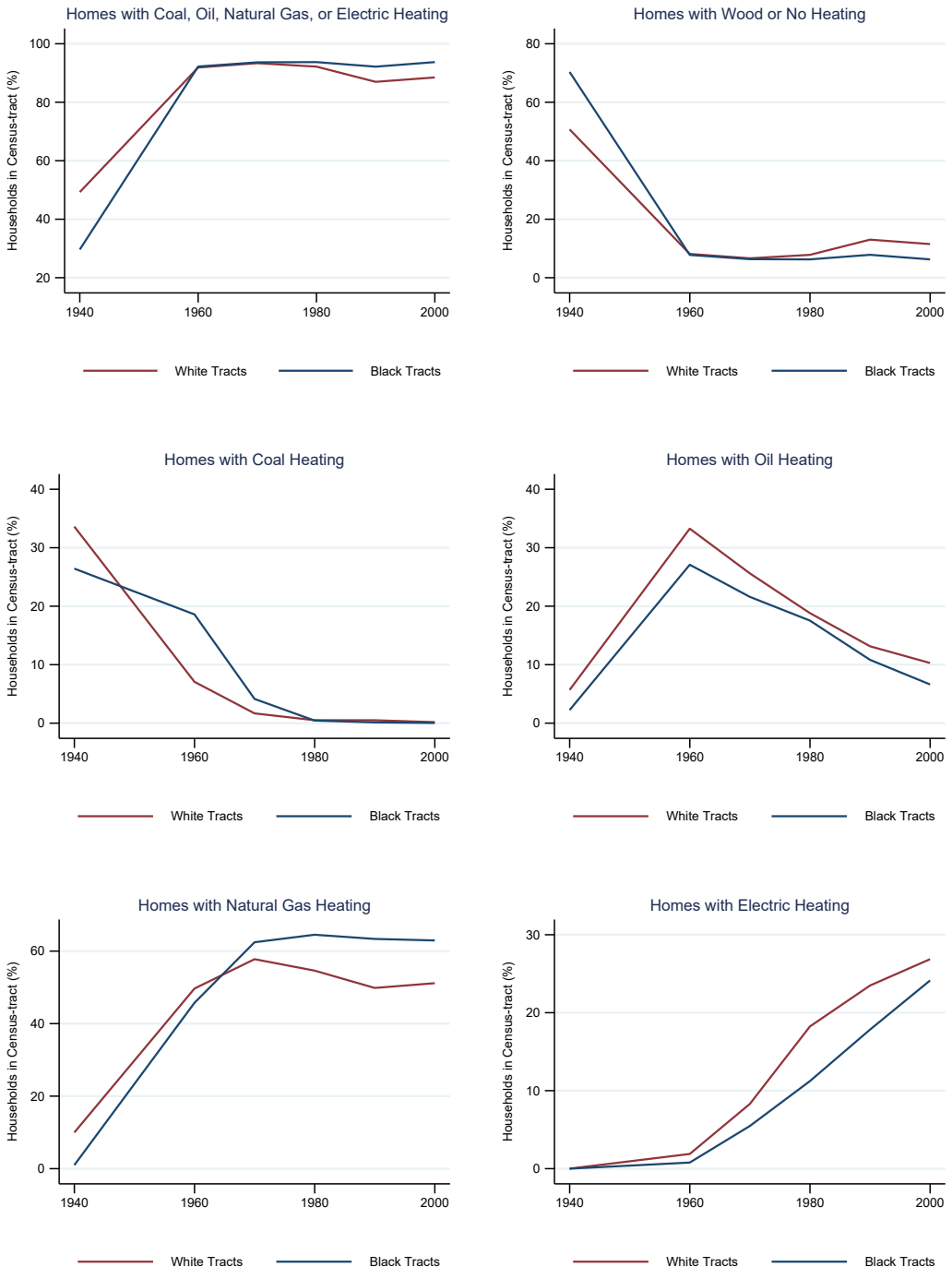
Second, owner- vs renter-occupied dwellings appears to only explain a small portion of the overall racial gap in the home heating transition between 1940 and 2000. We find that in 1940, only 1.5% of homes in predominantly Black and owner-occupied census tracts had non-wood home heating, compared to 51% in predominantly White and owner-occupied census tracts. For census tracts with more renter-occupied dwellings, this racial gap remained, but was significantly reduced, at 23% for Black census tracts and 40% for White census tracts. One plausible explanation is that landlords, particularly of larger multi-family dwellings, may have been quicker to adopt coal, natural gas, or fuel oil for central-heating boilers. Starting in 1980, however, this pattern flipped, and the racial gap in home heating became slightly larger in renter-occupied census tracts than owner-occupied ones. Despite the interesting nuance over time in the differential adoption rates in census tracts with predominantly owner- vs renter-occupied dwellings, this factor appears to only explain a small portion of the overall racial gap.

These findings suggest that if left to market forces alone, the current energy transition in the U.S. could deepen racial disparities in access to energy-efficient technologies, household energy costs, and exposure to local air pollution. Specifically, marginalized communities, often low-income and predominantly people of color, may struggle to afford costly but energy-efficient technologies like heat pumps, which would lead to unequal uptake of these innovations. As a result, households that cannot access these technologies may face higher energy expenditures due to reliance on older, less efficient systems. This financial burden could exacerbate existing income inequalities and contribute to energy poverty, where a larger share of household income is spent on energy. Furthermore, as these older technologies are typically more polluting, communities already experiencing environmental injustices could face worsening local air quality, leading to poorer health outcomes. In essence, without targeted policies or interventions, the energy transition risks replicating historical inequities in access to clean energy and its benefits, particularly for low-income and minority communities.

[2]These census tracts are 9% of all census tracts over the sample period.

This paper contributes to the literatures on energy justice and energy transitions by examining the long-term racial disparities in the adoption of energy-efficient technologies and their broader implications. The existing literature on energy and environmental justice has highlighted inequities in energy access and environmental quality (Banzhaf et al., 2019; Pizer and Sexton, 2019; Lyubich, 2020; Bennear, 2022; Batlle et al., 2024), but few studies, particularly in economics, have documented these disparities over a long historical period. Our paper addresses this gap by using new data to provide one of the first economic analyses of racial disparities in heating fuel use across time, shedding light on both the persistence and causes of these inequalities. By focusing on the U.S. energy transition, we explore how market-driven adoption of energy technologies has historically disadvantaged marginalized communities and how this pattern may continue if left unchecked. Specifically, we show how higher costs for energy-efficient technologies may disproportionately affect lower-income, predominantly non-White households, exacerbating disparities in energy expenditures and local air pollution. Our contribution lies not only in documenting these disparities but also in analyzing their roots, offering key insights into how future energy transitions can address historical inequities.

Figure 1: Racial Gap in Home Heating Transition, 1940-2000



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