Keeping the (decarbonized) lights on

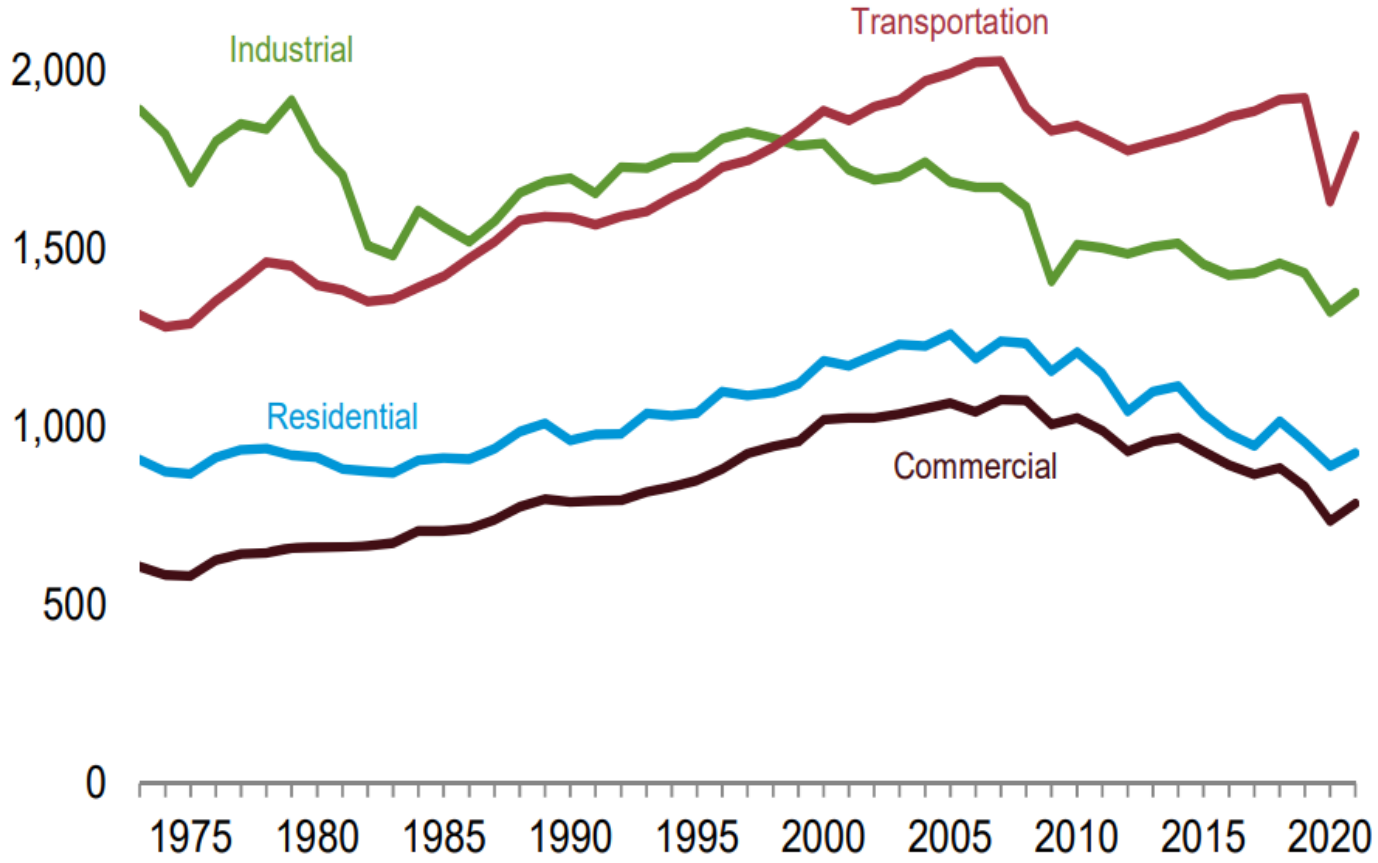
US housing, equity, and the energy transition

Carlos Martín

December 2, 2022

JCHS
JOINT CENTER FOR HOUSING STUDIES
OF HARVARD UNIVERSITY

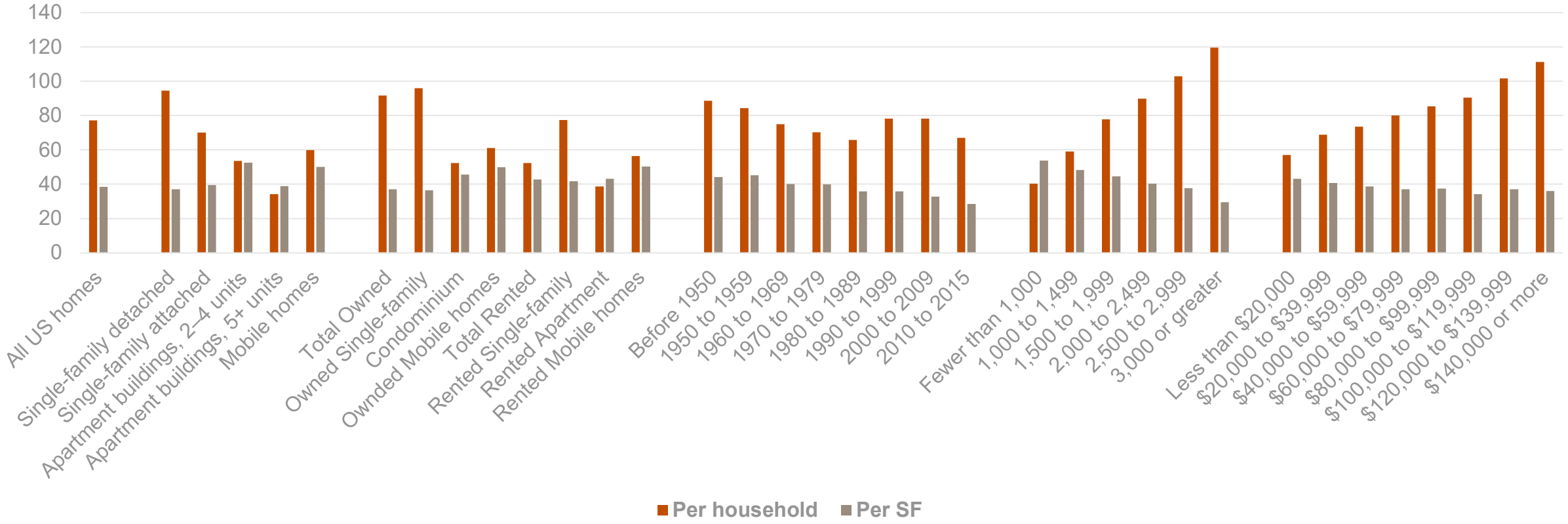
Residential energy use accounts for roughly 20% of US greenhouse gas emissions.



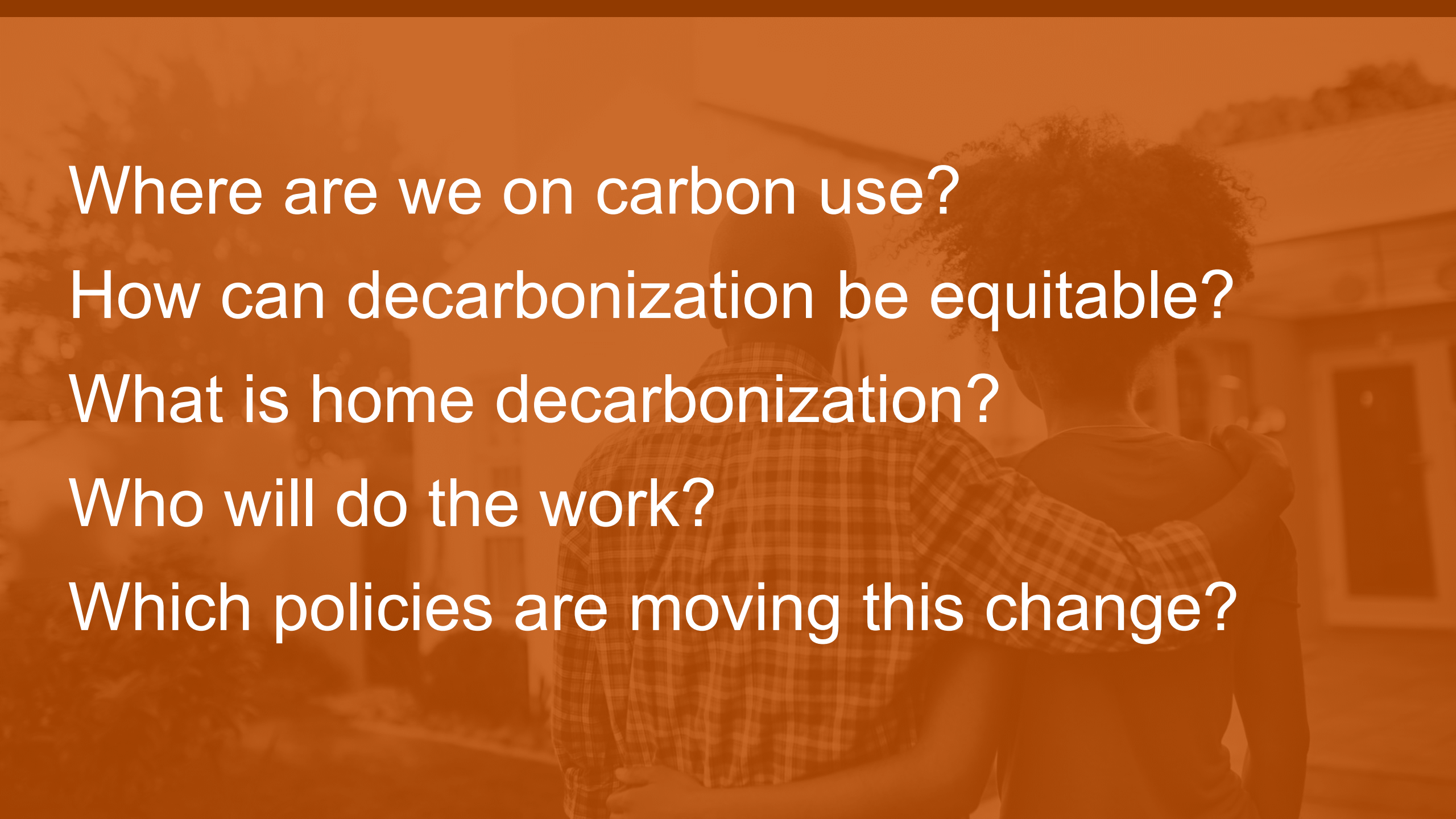
Source: US Energy Information Administration Monthly Energy Review (Last Update: November 22, 2022)

Residential energy use, housing and home system qualities, cost burdens, and other hardships are not equally distributed.

TOTAL ENERGY CONSUMED BY US HOMES PER HOUSEHOLD AND PER HOME SQUARE FOOTAGE IN 2015 (*million BTUs and thousand BTUs, respectively*)



Source: Author tabulations of U.S. Energy Information Administration, 2015 Residential Energy Consumption Survey HC Table Series.



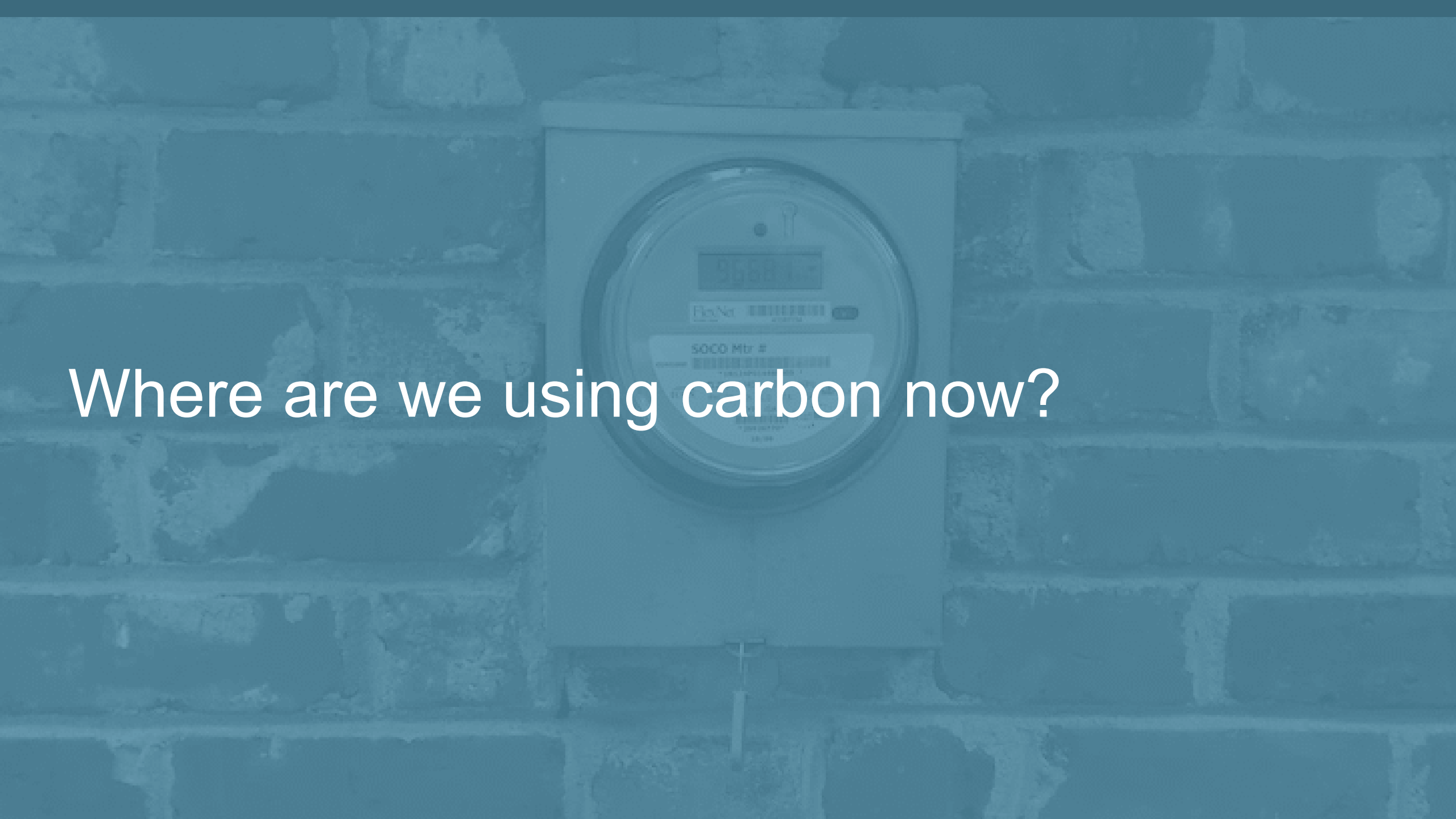
Where are we on carbon use?

How can decarbonization be equitable?

What is home decarbonization?

Who will do the work?

Which policies are moving this change?

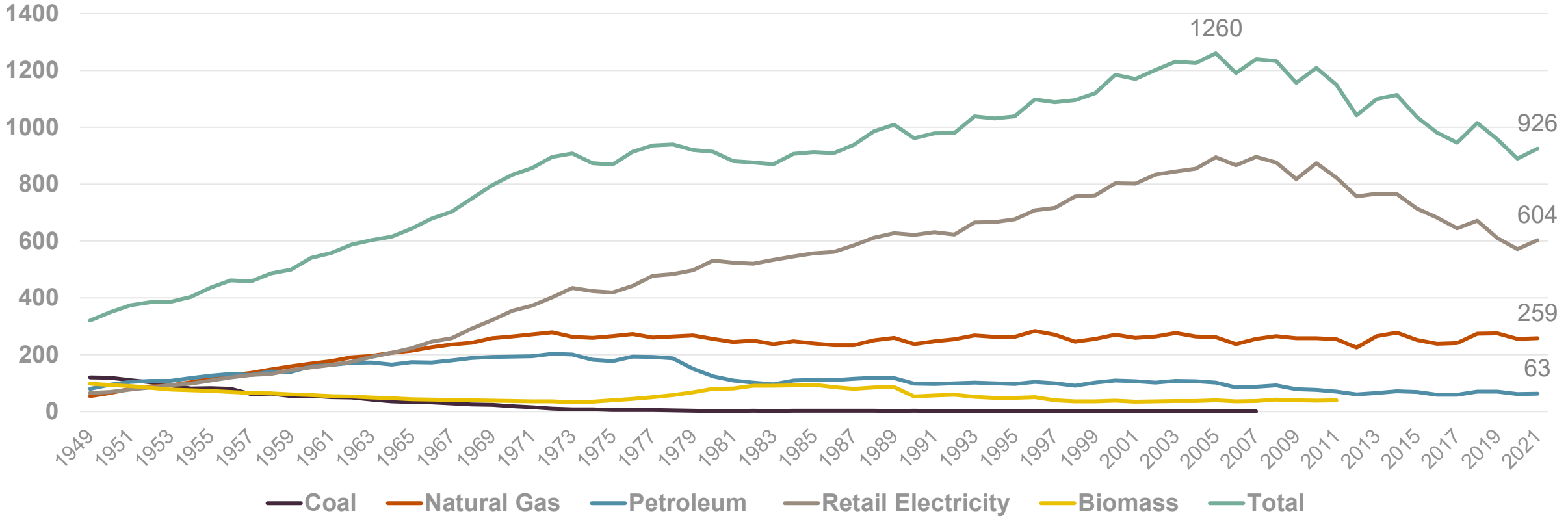


Where are we using carbon now?

Residential greenhouse gas emissions come from both direct use of carbon-based fuels and carbon-sourced electricity.

ANNUAL CO2 EMISSIONS FROM RESIDENTIAL ENERGY CONSUMPTION, 1949-2021

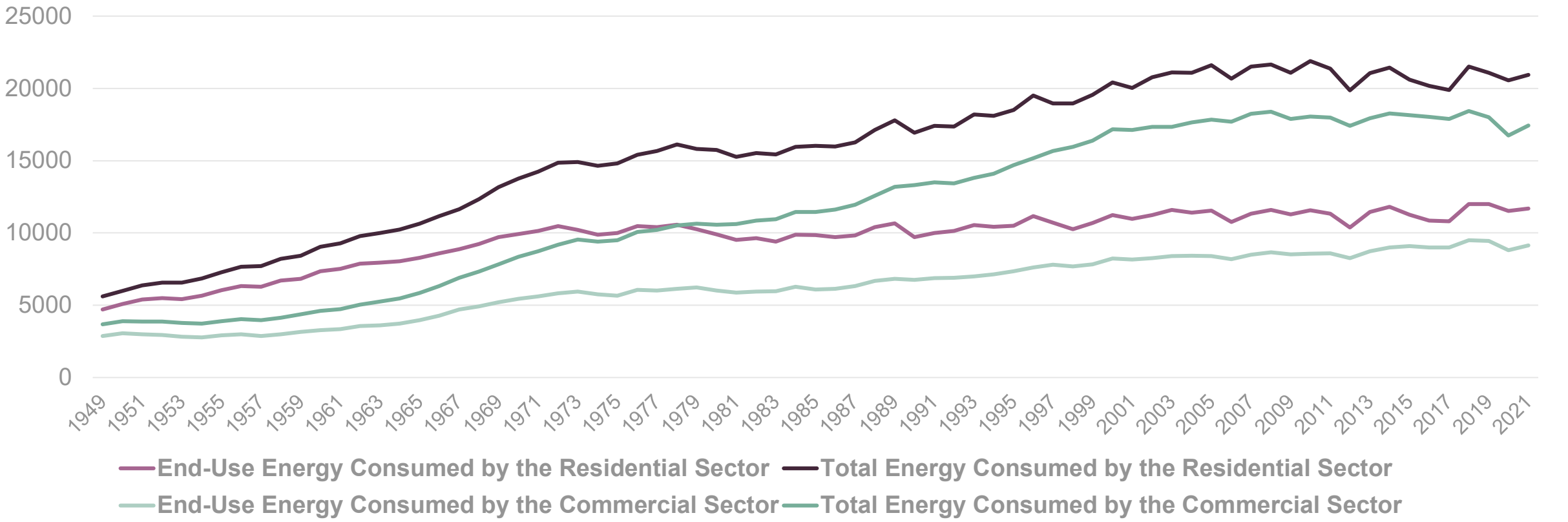
(*million metric tons of carbon dioxide*)



Source: US Energy Information Administration Monthly Energy Review (Last Update: November 22, 2022)
Note: Petroleum includes kerosene, distillate fuel oils,

Carbon-based energy consumption remains the building sector's largest contributor to climate change.

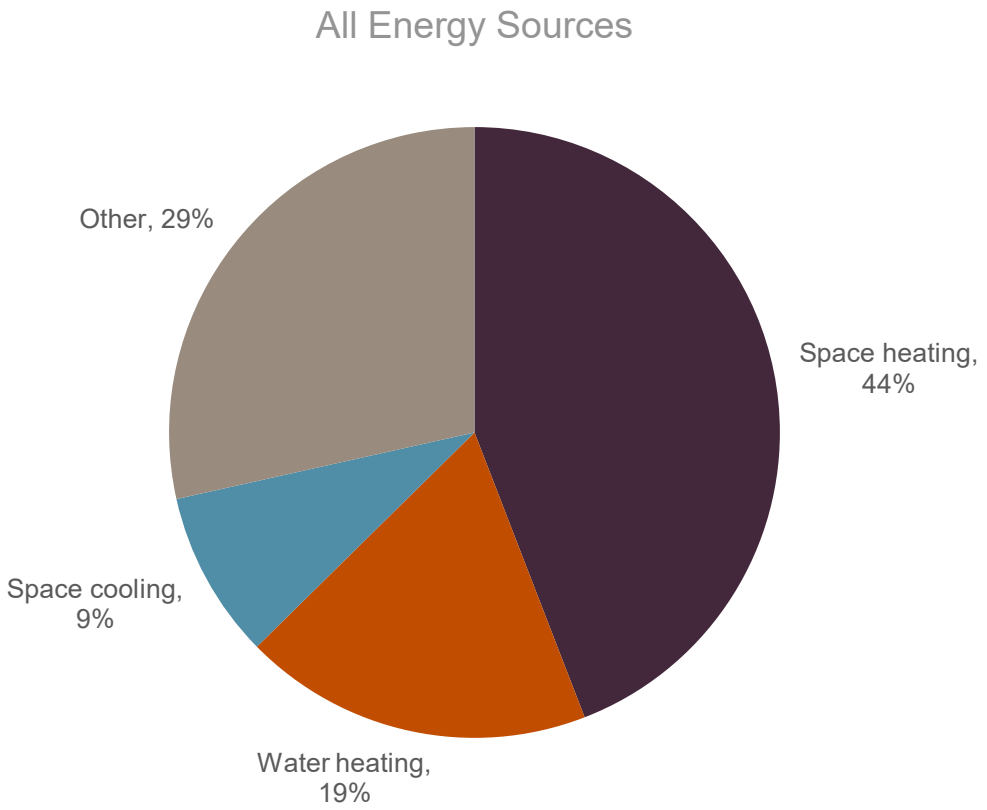
ANNUAL TOTAL ENERGY CONSUMED BY BUILDING SECTOR, 1949-2021

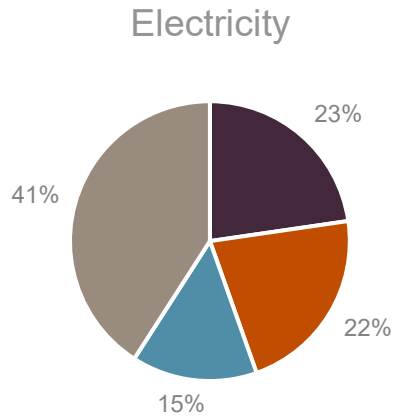


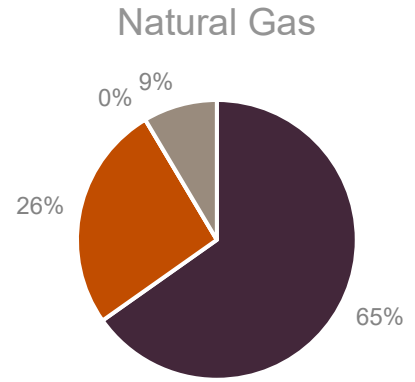
Source: US Energy Information Administration Monthly Energy Review (Last Update: November 22, 2022)

Most carbon-based energy is used in homes disproportionately for indoor heating and water heating.

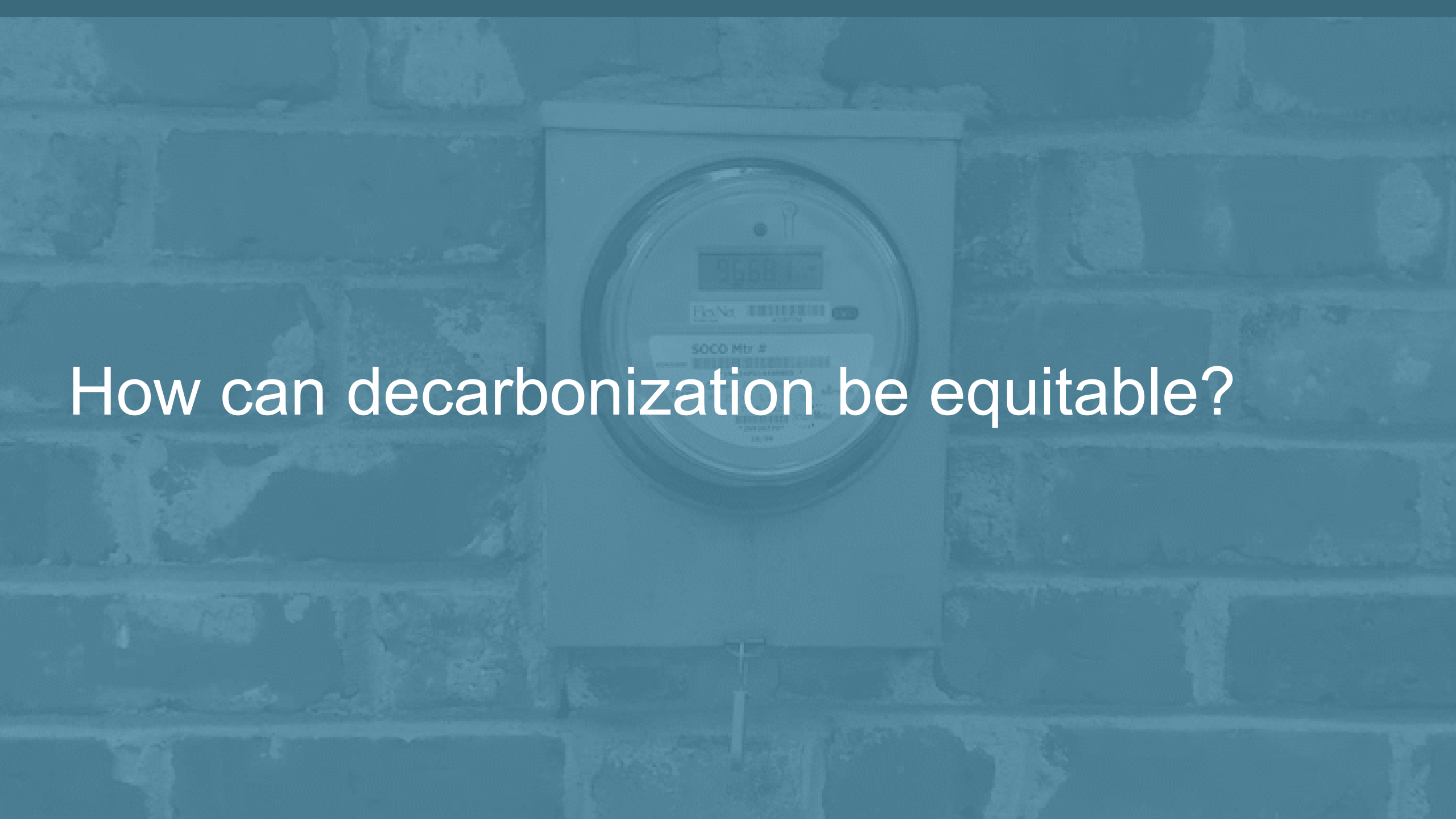
SHARE OF AVERAGE HOME ENERGY CONSUMPTION BY END USE







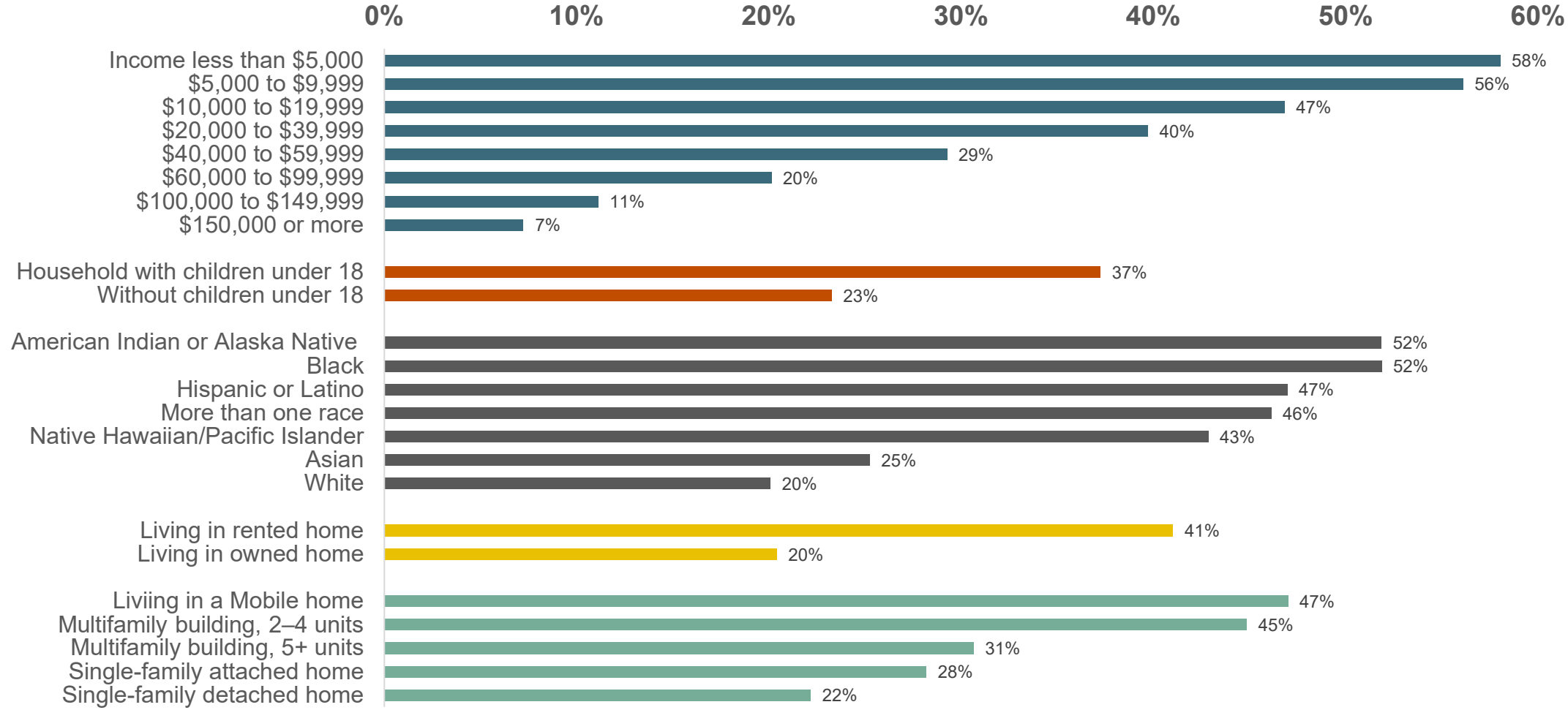
Source: Author tabulations of 2015 Residential Energy Consumption Surveys (EIA).



How can decarbonization be equitable?

Disparities in energy insecurity reflect demographic and housing inequity.

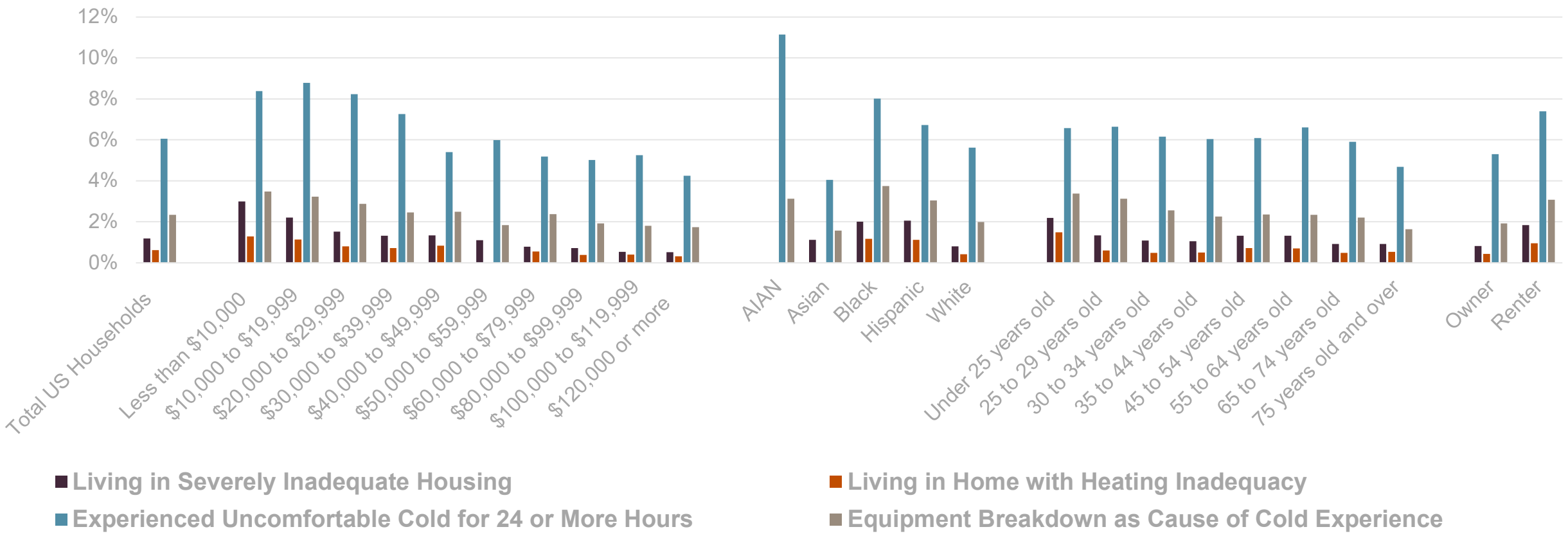
SHARE OF US HOUSEHOLDS EXPERIENCING ANY HOUSEHOLD ENERGY INSECURITY, 2020



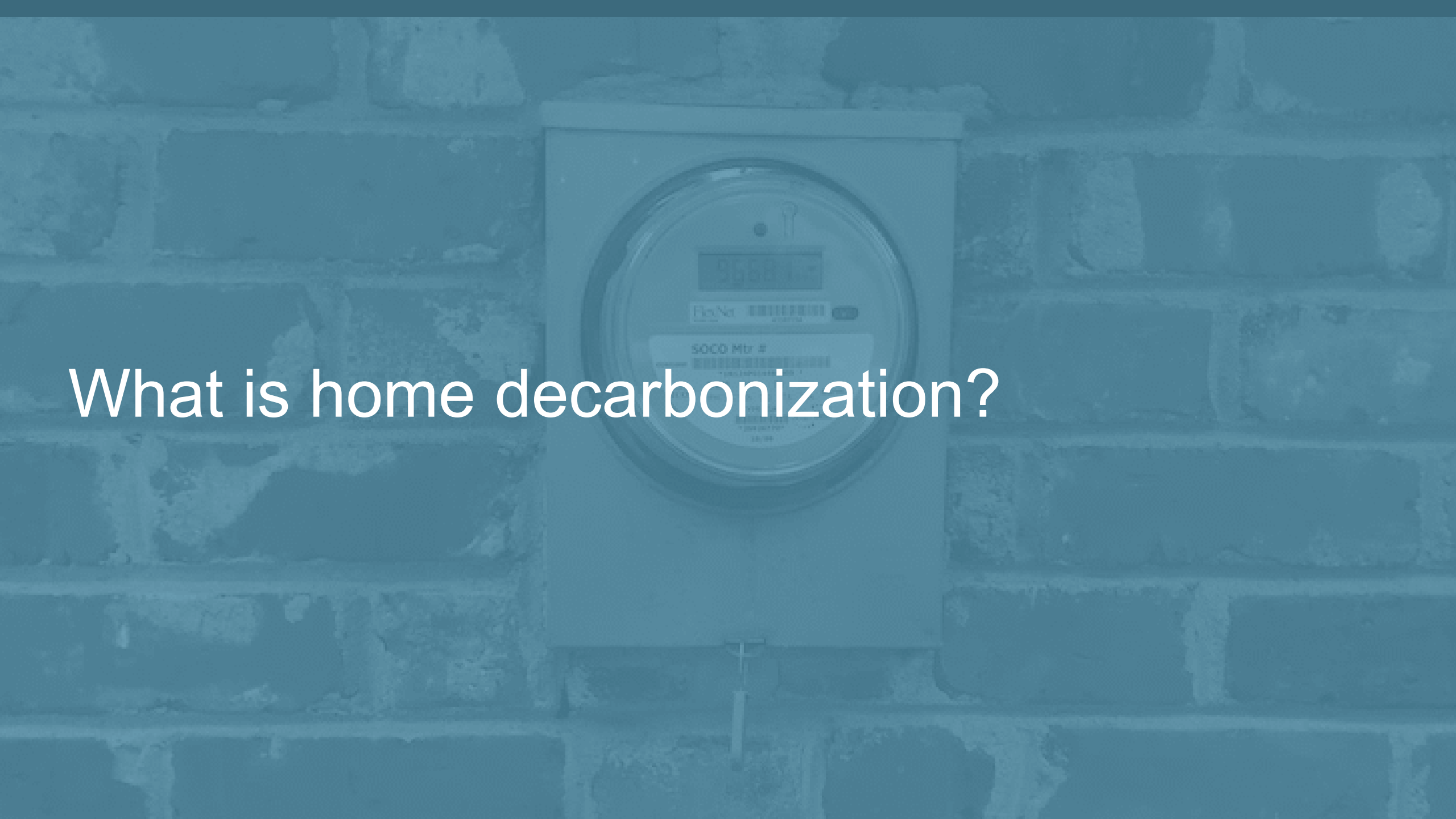
Source: Author tabulations of 2020 RECS.

Many—particularly low-income households—live in housing conditions that exacerbate energy hardship.

PERCENTAGE OF GROUP EXPERIENCING AN ENERGY-RELATED HOUSING HAZARD (%)



Source: Author tabulations of 2019 AHS.



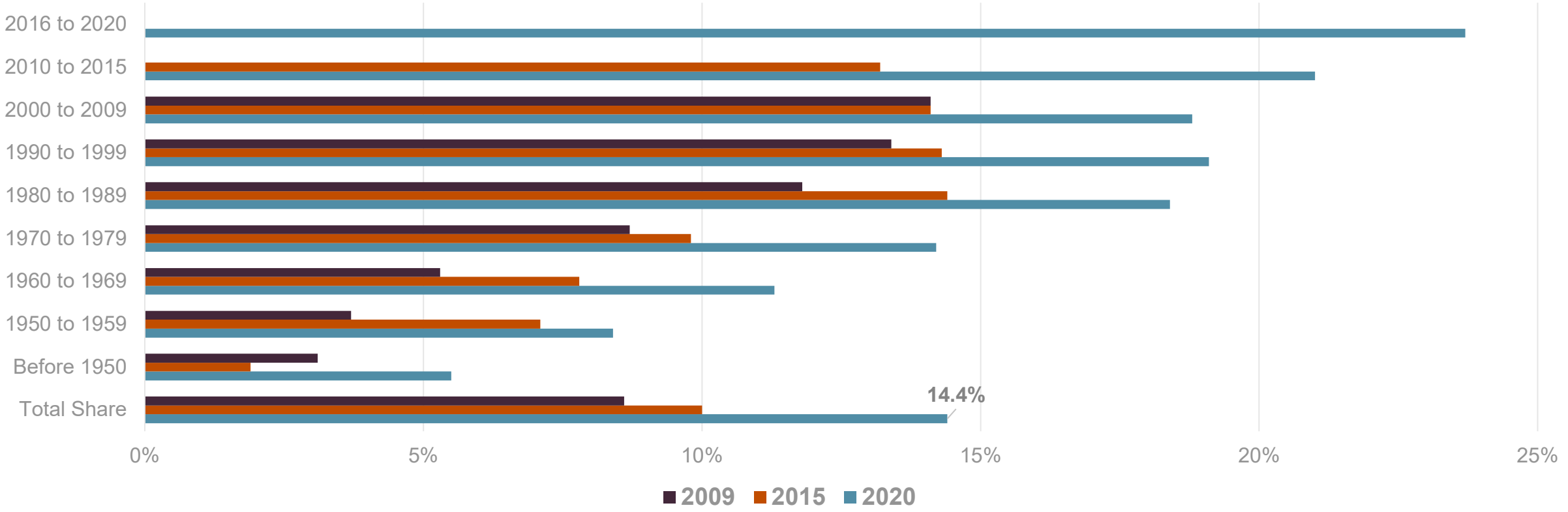
What is home decarbonization?

There are a range of physical changes that can be done in existing homes and that can be integrated into future ones that decrease the housing stock's carbon-based energy use.

- Electrification
- Energy efficiency improvements
- Digitalization
- Distributed (renewable) energy production
- Embodied energy reductions

Overall electrification rates are increasing in both new construction and replacements in existing ones.

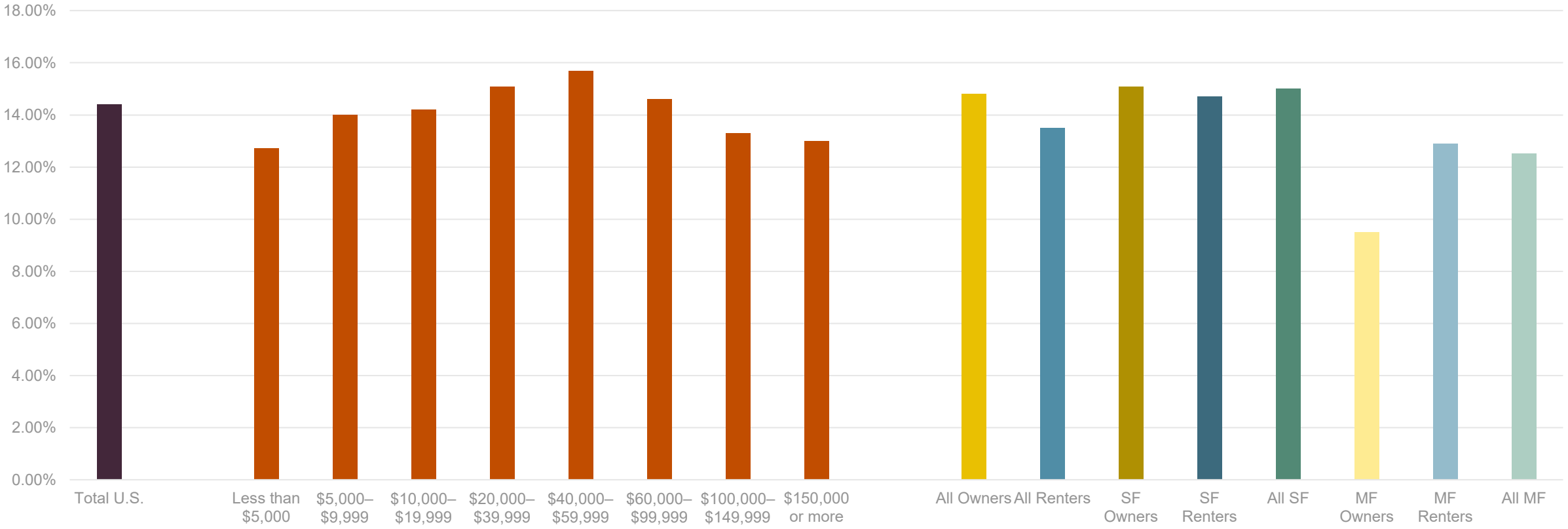
SHARE OF HOMES WITH ELECTRIC HEAT PUMPS BY YEAR OF CONSTRUCTION (%)



Source: Author tabulations of 2009, 2015, and 2020 RECS.

Electrification rates are increasing in different homes somewhat proportionally.

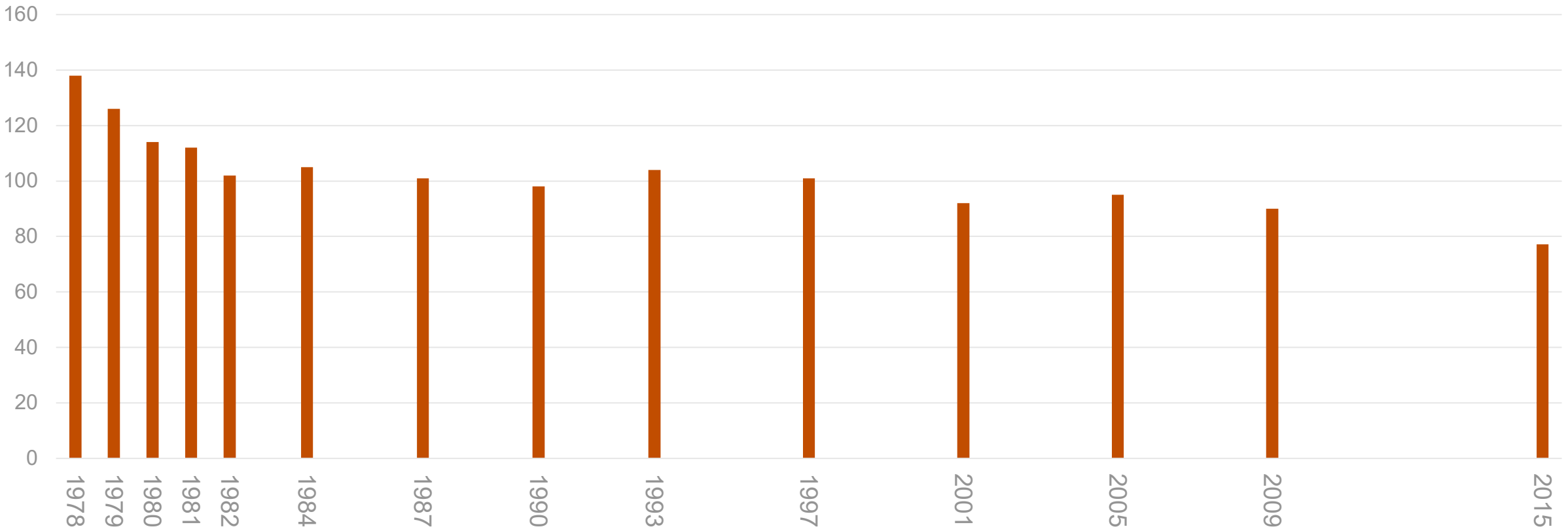
SHARE OF HOMES WITH ELECTRIC HEAT PUMPS BY HOUSEHOLD INCOME AND HOUSING TENURE AND BUILDING TYPE, 2020 (%)



Source: Author tabulations of 2020 RECS.

The trend towards more energy-efficient homes is strong.

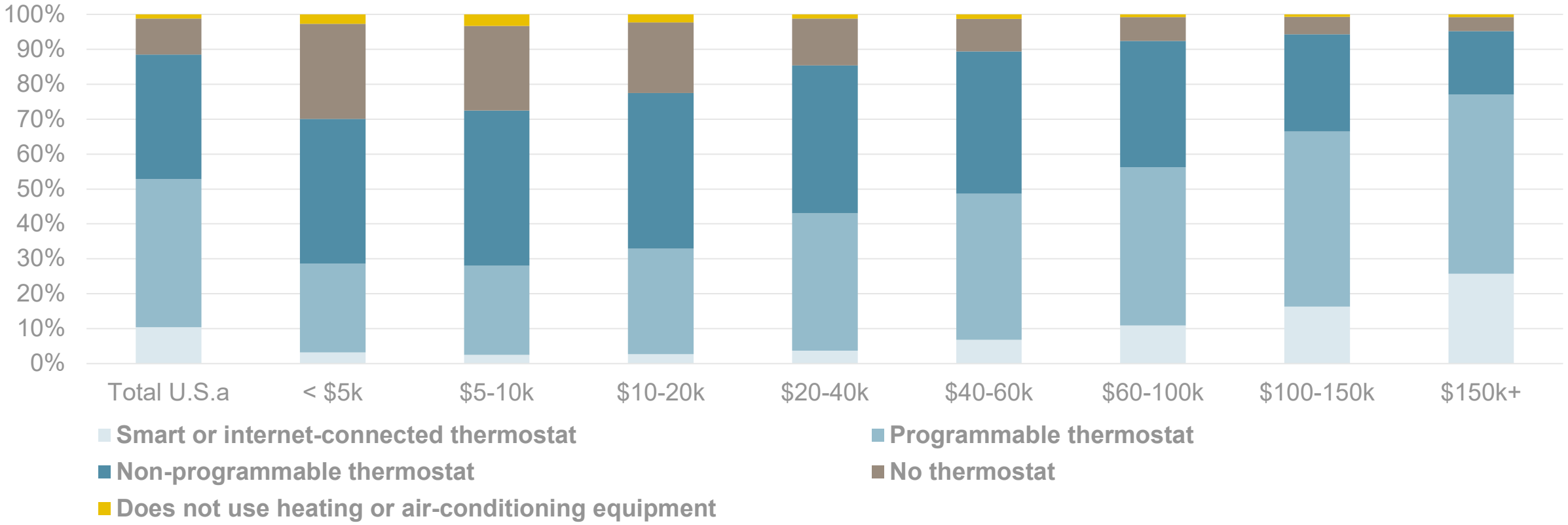
AVERAGE RESIDENTIAL CONSUMPTION (million BTUs)



Source: Author tabulations of Residential Energy Consumption Surveys (EIA) for every years of data collection.

Digitalized air-conditioning controls are not evenly distributed.

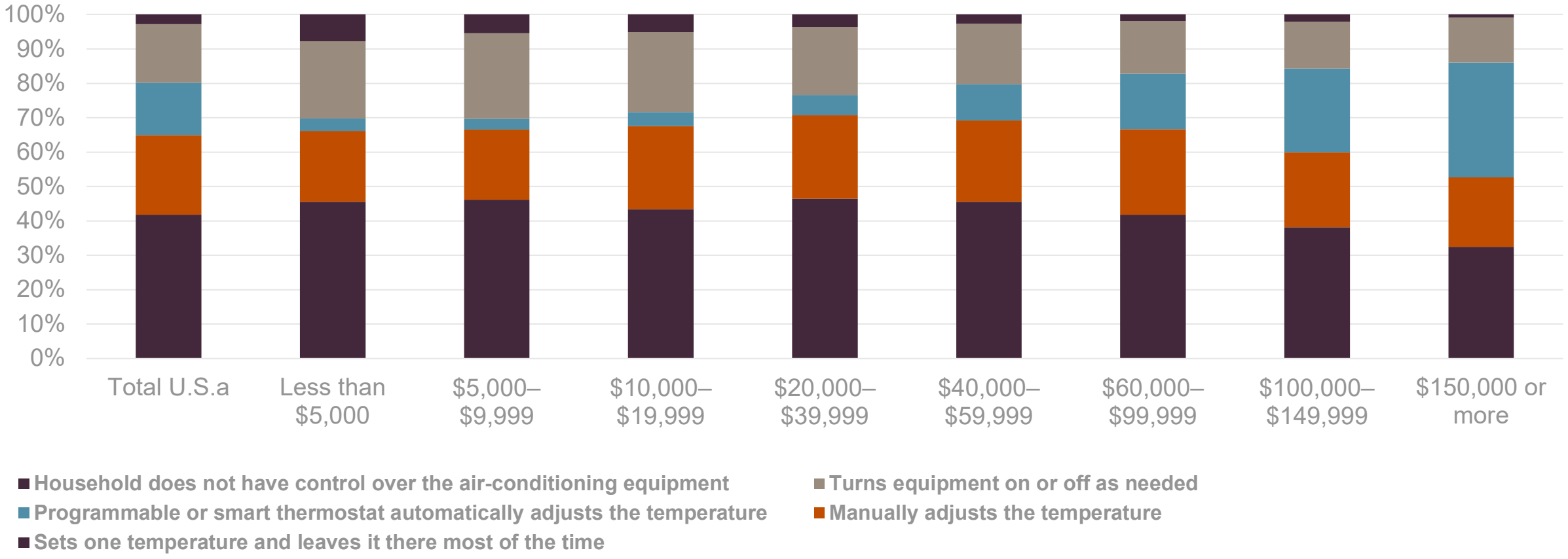
TOTAL SHARES OF THERMOSTAT TYPES BY INCOME GROUP (%)



Sources: RECS 2020

Digitalized air-conditioning control are also not evenly used.

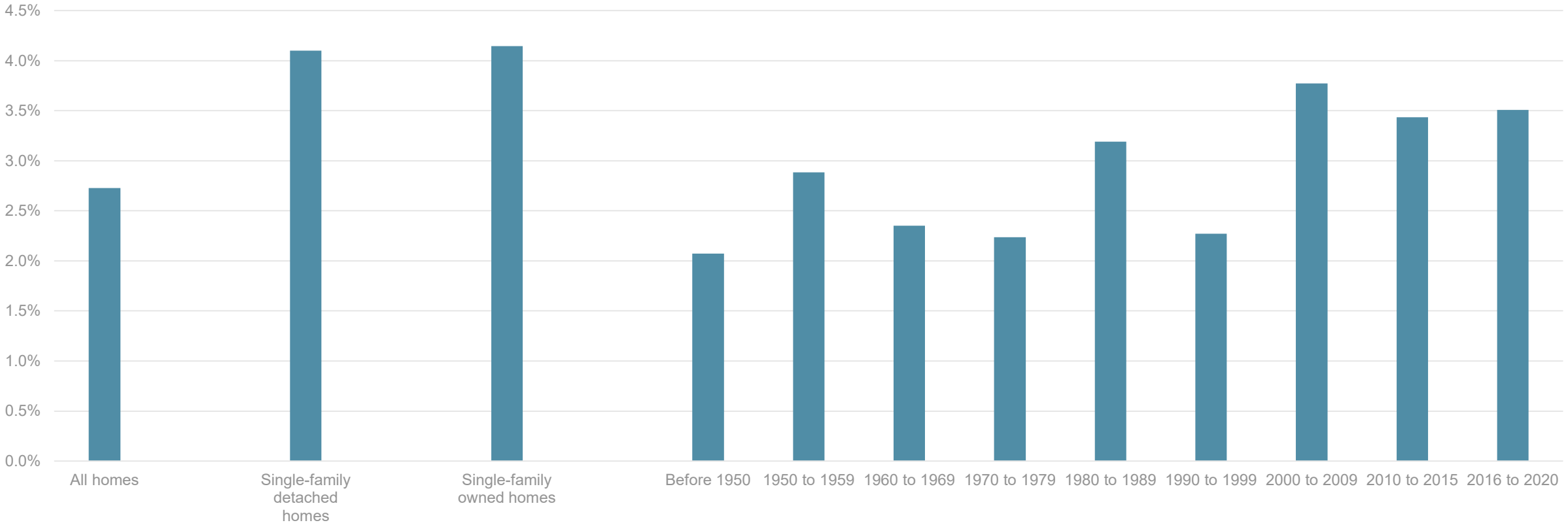
TOTAL SHARES OF THERMOSTAT PROGRAM BEHAVIOR BY INCOME GROUP (%)



Sources: RECS 2020 for homes with thermostats only.

Distributed electric production (i.e., renewables) is the least diffused decarbonization intervention.

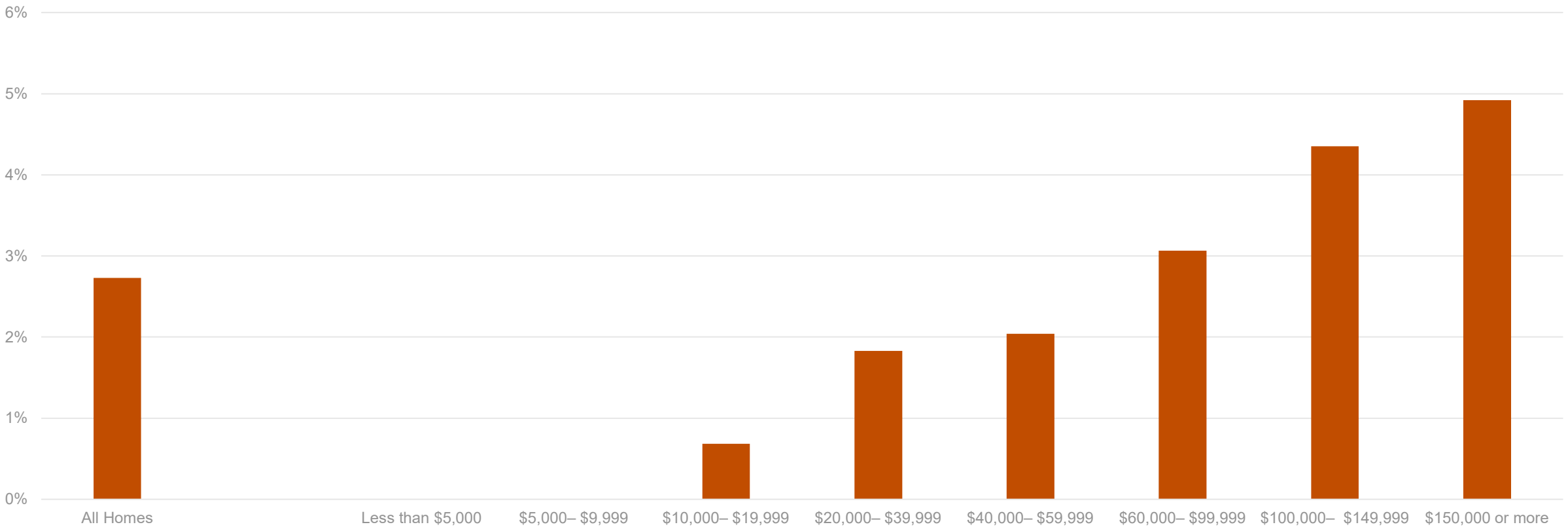
SHARE OF HOMES WITH DISTRIBUTED SOLAR GENERATION BY SELECT TENURE AND YEAR OF CONSTRUCTION (%)



Source: Author tabulations of 2020 Residential Energy Consumption Survey (EIA).

Distributed renewables are also not evenly adopted.

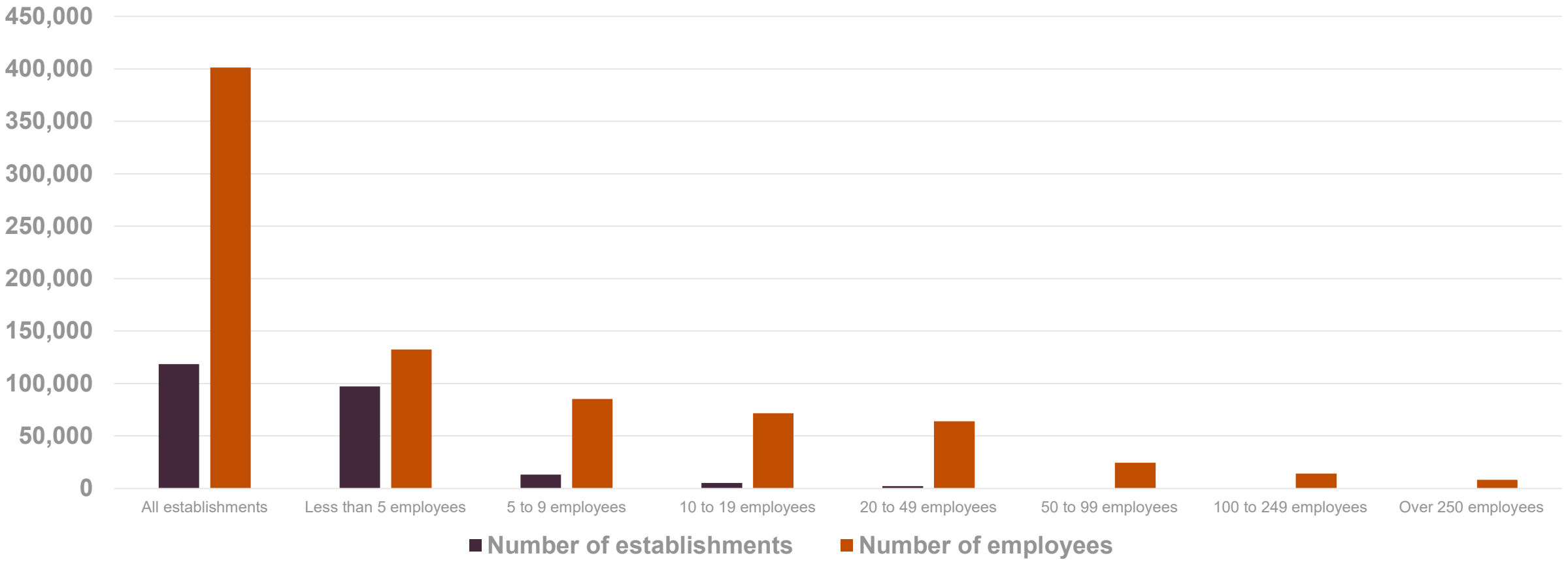
SHARE OF HOMES WITH DISTRIBUTED SOLAR GENERATION BY HOUSEHOLD INCOME (%)



Who will do the work?

Most residential remodeling employees work in small establishments.

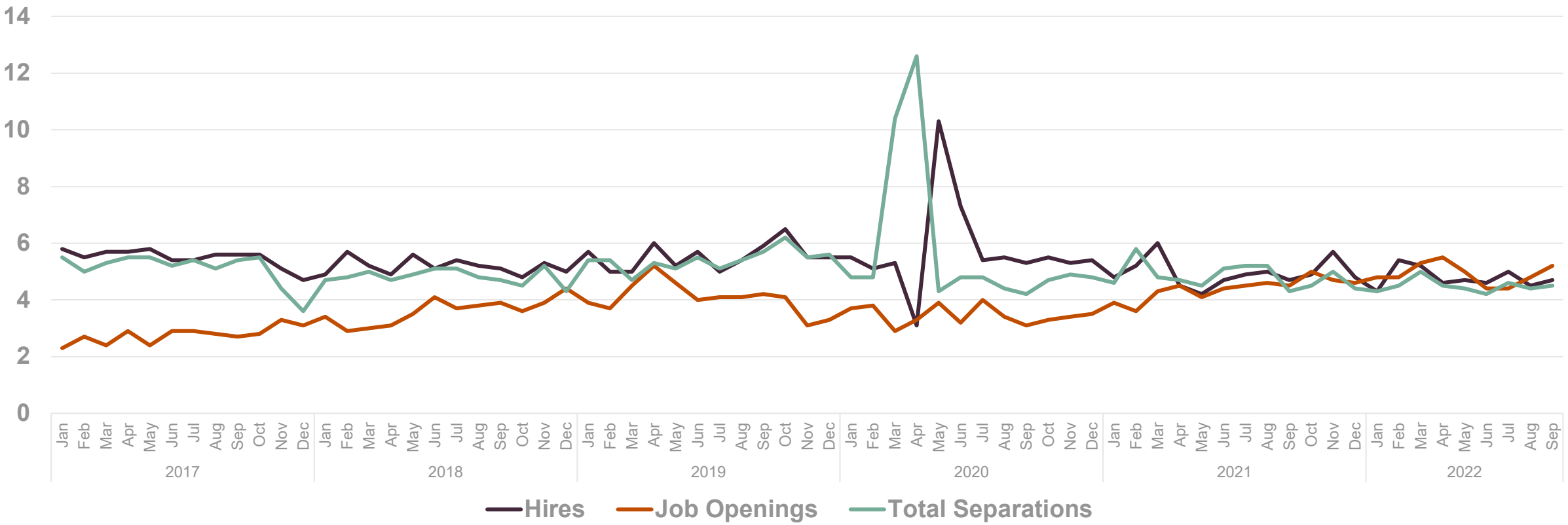
RESIDENTIAL REMODELING ESTABLISHMENTS AND BY EMPLOYMENT, 2020 ESTIMATES



Source: US Census County Business Patterns, 2020 Estimates

Construction job openings continue to trend up, and the workforce shortage for decarbonization interventions grows.

RATES OF JOB OPENINGS, HIRES, AND TOTAL SEPARATIONS FOR CONSTRUCTION (%)



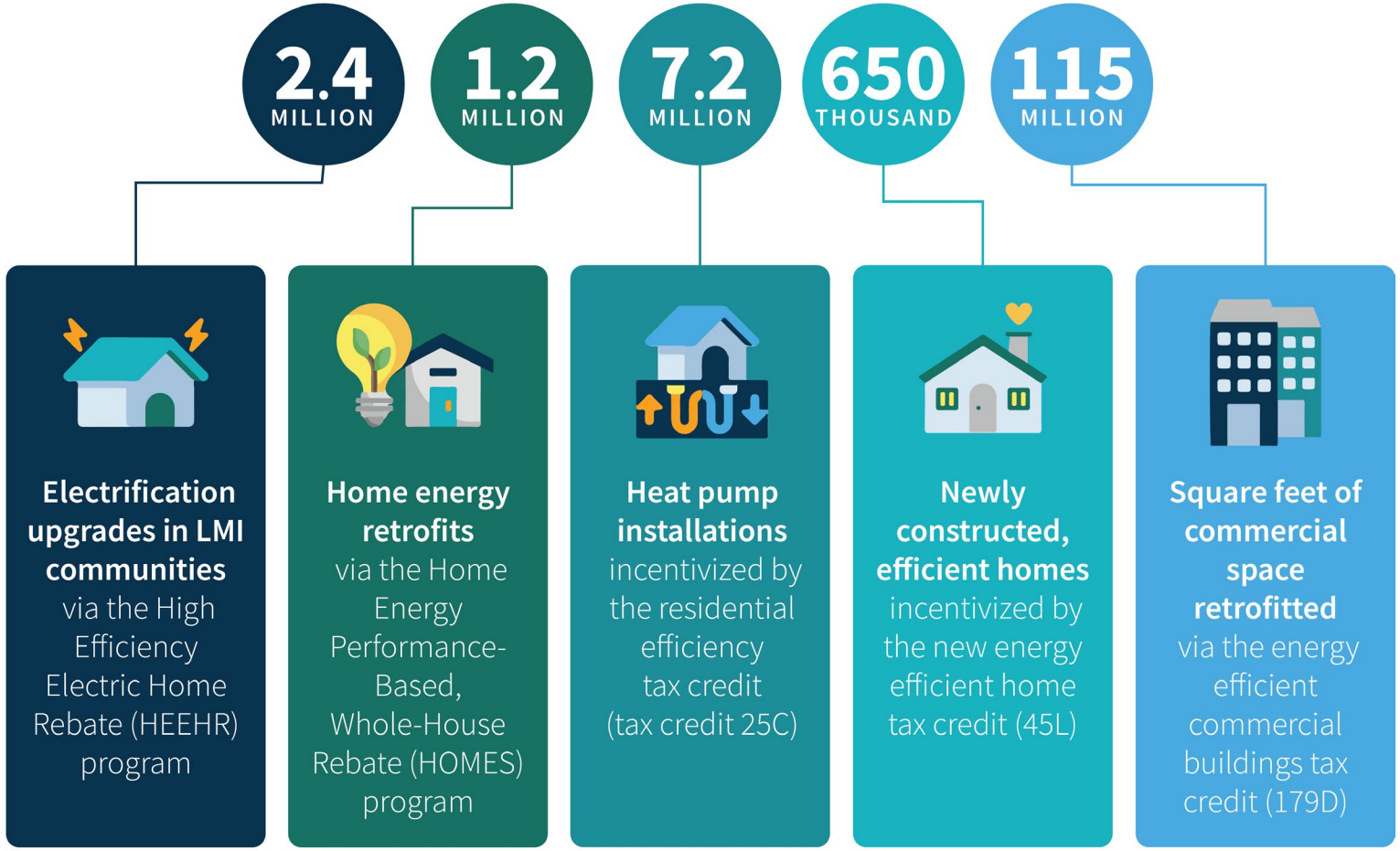
Notes: All rates are seasonally-adjusted. Job openings are all positions that are open (not filled) on the last business day of the month. Hires are all additions to the payroll during the month. Separations are all employees separated from the payroll during the month due to quits, layoffs, and other causes. Rates are determined by dividing the employment element by the total industry employment. Data for September 2022 preliminary.
Source: US Bureau of Labor Statistics, Job Openings and Labor Turnover Survey.

Which policies are moving this change?

Civil-sector programs, combined with private finance and public funds, have been working in the trenches for decades.

- Federal research and programs
  - DOE
  - EPA
  - HUD
- National advocacy organizations
  - American Council for an Energy-Efficient Economy
  - National Association of State Energy Officials
  - National Energy Assistance Directors Association
  - National Association for State Community Services Programs
  - National Energy and Utility Affordability Coalition
  - Energy Efficiency for All
  - Network for Energy, Water, & Health in Affordable Buildings
  - Equitable Building Electrification Fund
- Research and service groups
  - RMI
  - Building Decarbonization Coalition
  - Energy Trust of Oregon
- National housing intermediaries
  - Enterprise Community Partners
  - National Housing Trust
  - Stewards of Affordable Housing for the Future
  - GHHI
- Civic energy service providers
  - Elevate Energy
  - Association for Energy Affordability

The 2021 Infrastructure Investments and Jobs Act and 2022 Inflation Reduction Act directly fund home decarbonization.



Source: https://rmi.org/the-inflation-reduction-act-could-transform-the-us-buildings-sector/

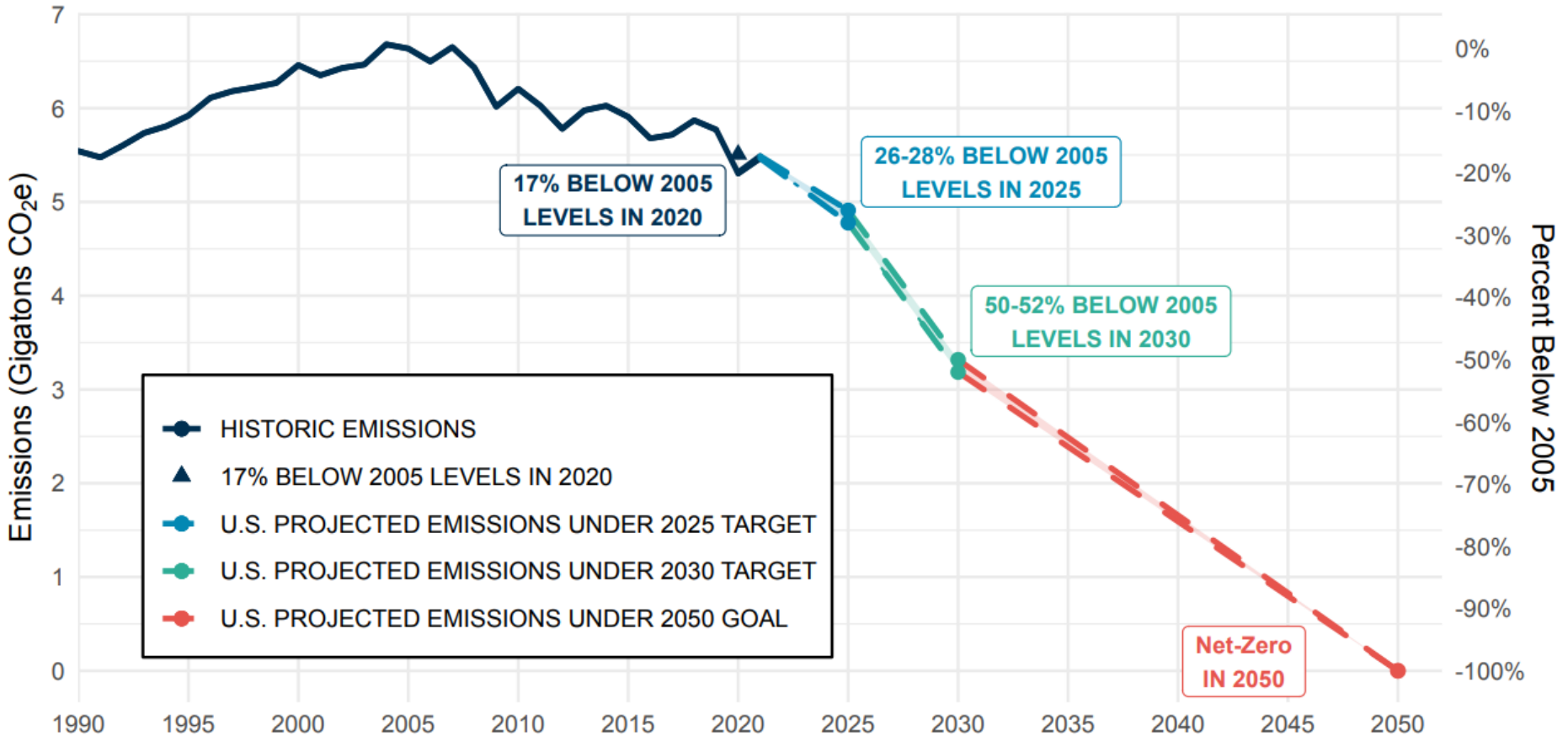
But the income continuum of decarbonization opportunity has many holes through which low-income households may slip.

- WAP eligibility is 200% of the federal poverty rate
  - In 2022, $55,500 for a family of four
  - Approximately 38.8 million households (about 30 percent of US housed households)
- Rebate eligibility is intended for 80-120% area median income
  - In 2020, $54,106 - $81,025 (using US median)
  - Approximately 25 million households (about 19 percent of the US housed households)
- Tax credits intended for those will tax liability and resources to cover intervention cost upfront (e.g., above 120% area median income)
  - In 2021, approximately 51 million households (remaining 50 percent of the US housed households)

- IIJA and IRA implementation of point-of-sale, income verification, and varying duplication of benefits (e.g., not using HOMES and HEEHR for the same project but allowing HEEHR and 25c for a bigger project) can cause additional red tape that increase the holes.

When?

US has committed to reduce net GHG emissions 50-52% below 2005 levels in 2030, and to be net-zero by 2050.



Source: White House (2021). The Long-Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050. Published by the United States Department of State and the United States Executive Office of the President, Washington DC. November 2021.

Fixing the short

Maximizing benefits progressively while directly reducing decarbonization burdens.

The next decade is the test for market transformation, for carrots, and for the diffusion of interventions.

- Advanced quantification of the physical problems with qualification of household burdens
- Prioritize tangible and accessible interventions to eligible households for decarbonization assistance—including redefining household eligibility, project scope, and case management
- Support local civil-sector organizations as intermediaries for harder-to-serve households and owners
- Collaborate with industry to ensure speedy, quality, and affordable decarbonization services
- Continue federal R&D for more efficient and cost-effective decarbonization interventions
- Ensure lifecycle savings benefit the payer household first—before the owner, utility, and provider

Thank you