

Who's Energy Insecure? Results from the 2020 Residential Energy Consumption Survey (RECS)

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ABSTRACT

According to results from the 2020 Residential Energy Consumption Survey (RECS), 27% of households faced a challenge paying energy bills or maintaining adequate heat or air conditioning, conditions associated with energy insecurity. This is a reduction compared to the 2015 RECS estimate, which found that 31% of households experienced energy insecurity.

The 2020 RECS, conducted during the COVID-19 pandemic, provides data on household energy insecurity for all U.S. households, regardless of income or program participation. Respondents were asked a series of questions about household energy challenges, ranging from reducing or forgoing food or medicine to pay energy costs to the inability to heat due to service disruptions and broken equipment. This paper explores household energy insecurity across a number of demographic, geographic, and structural characteristics of energy consumers and their homes. In addition to the occurrence of household energy insecurity, data are also available on the severity of energy issues, including the time period that some households are without heat or air conditioning. Consistent with findings from the 2015 RECS, demographic characteristics, such as race and income, remain the strongest predictors of energy insecurity.

Introduction and Literature Review

What is Household Energy Insecurity?

The definition of household energy insecurity has been developed over time and operationalized in a number of ways by researchers. Reames (2016) provides us a definition of household energy insecurity in “the inability of households to afford energy services for adequate heating and cooling, resulting in uncomfortable indoor temperatures, material deprivation, and accumulated utility debt.” An additional aspect of household energy insecurity to consider is severity, an idea investigated by Jessel, Sawyer, and Hernández (2019). While some households face persistent and long-term energy insecurity issues, which the authors describe as “chronic” energy insecurity, other households are only temporarily, or “acutely” energy insecure.

Measuring Household Energy Insecurity

While there are many ways to measure household energy insecurity, this paper uses a framework similar to that developed by Hernández (2016), which breaks household energy insecurity down into three parts: economic, physical, and behavioral aspects.

The economic aspect encompasses a household's inability to pay energy-related costs, including energy bills and equipment repairs. This aspect has been operationalized in a number

of ways, with researchers establishing a range of economic thresholds to identify a person or household as energy insecure. Reames (2016) focuses on heating energy burden, utilizing a household income threshold of 2% to identify a household as energy insecure. Hernández (2016) refers to a 10% income threshold for all indoor energy expenses. Using that threshold, Jessel, Sawyer, and Hernández (2019) state that 44% of low-income families (defined as 200% of the Federal Poverty Level) experienced economic energy insecurity, compared to 2% of families who are not low-income.

The physical aspect of household energy insecurity refers to the physical housing structure. Inefficient heating and cooling equipment, lack of adequate insulation, improperly sealed doors and windows, inefficient appliances, and deficiencies in other tangible parts of the housing all contribute to energy insecurity. Hernández (2016) discusses how these problems can affect renters in unique ways; landlords bear the upfront costs of efficiency upgrades and may have little reason to update or retrofit old features. These inefficiencies in infrastructure can lead to unsafe conditions in the summer and winter months, in addition to increased energy costs year-round.

Finally, the behavioral aspect refers to individual and household strategies and behaviors that affect energy insecurity (Hernández 2016; Jessel, Sawyer, and Hernández 2019). Hernández (2016) points out that “positive strategies had environmental and economic benefits and demonstrated resourcefulness; negative strategies presented risks to health, safety, and residential stability.” These strategies could be as simple as turning off heating and using blankets in order to save money. Reames, Reiner, and Stacey (2018) establish that geography and equipment availability impacts “behavior” in a number of ways. In a study of the impact of lighting on efficiency, they found that in the poorest areas, the cheapest and most available lightbulbs may be the less energy efficient ones, leading consumers to make a short-term economic choice, purchasing a cheaper bulb, which will increase their energy costs in the long term.

Socioeconomic Patterns of Household Energy Insecurity in Prior Research

The likelihood that a household experiences energy insecurity has been closely linked to race, income, education, housing tenure, and age (Hernández 2016; Reames 2016; Berry, Hronis, and Woodward 2018; Jessel, Sawyer, and Hernández 2019). Additionally, energy insecurity is linked to poor health outcomes (Hernández 2016; Jessel, Sawyer, and Hernández 2019; Graff and Carley 2020; Baker, Carley, and Konisky 2021). Jessel, Sawyer, and Hernández (2019) found that 35% of surveyed households with children and African-American heads of household reported experiencing energy insecurity, while 14% of households with children and White heads of household reported facing energy insecurity.

Black and Hispanic households are more likely to be insecure, in part, due to racial segregation and the historical condition of these physical households (Reames 2016; Jessel, Sawyer, and Hernández 2019). Bednar, Reames, and Keoleian found a correlation between race and high energy consumers, and separately for race and energy inefficient households (2017). Looking at households in Detroit, they found higher energy consumption in predominantly-White Census Block Groups and higher energy inefficiency in predominantly-Black Census Block Groups.

COVID-19 and Household Energy Insecurity

When analyzing household energy insecurity data from 2020, the potential impacts of the COVID-19 pandemic on measurement and outcomes should be considered (Graff and Carley 2020). At the beginning of the pandemic, laws about whether utilities could disconnect energy were established on a state-by-state basis beginning in March of 2020 (Baker, Carley, and Konisky 2021). In all, 33 states enacted mandatory moratoria on utility disconnections (NEADA 2021). In states without moratoria, certain individual utilities and regulatory commissions also provided their own guidance about disconnections. Despite these policies, Memmott et al. (2021) found that the likelihood of receiving a disconnection notice increased during the pandemic for certain groups. In the year before the pandemic, Black respondents were 1.9 times more likely to receive a disconnection notice than White respondents. During the pandemic, Black respondents were 3.4 times more likely to receive a disconnection notice than White respondents. Similar patterns were found for Hispanic respondents.

Methodology

The Residential Energy Consumption Survey (RECS) is a nationally-representative study of the characteristics and energy consumption of homes occupied as a primary residence. The RECS was first conducted in 1978 and has been administered 15 times, most recently in 2020. RECS is conducted in two phases: Phase one is an address-based, sample survey of households designed to produce key energy-use estimates at the national, regional, division, and state levels. Phase two is the Energy Supplier Survey (ESS), which collects billing data for responding households from their utility suppliers to allow EIA to estimate energy consumption and expenditures. EIA uses the housing characteristics data and the billing data as inputs to models which estimate disaggregated heating, cooling, refrigeration, and other household device consumption and cost. In 2020, 18,496 households responded to the RECS, the largest responding sample in the program's history.

The RECS questionnaire is divided into topical sections, such as Appliances, Electronics, and Space Heating. The Energy Assistance section asks respondents about challenges households may have faced in paying energy bills or about keeping their homes at an unsafe or unhealthy temperature. These questions have been included in various forms since the 1987 RECS through sponsorship from the U.S. Department of Health and Human Services (HHS) to support analysis of the Low Income Home Energy Assistance Program (LIHEAP). HHS has used RECS data to study LIHEAP-recipient households and populations likely to be eligible for LIHEAP. LIHEAP provides assistance to pay bills during the heating and cooling seasons, prevent service disruptions, and implement weatherization improvements.

The Household Survey portion of the RECS was traditionally conducted in person, with specially-trained interviewers administering the questionnaire to respondents. From the 1987 RECS to the 2009 study, the Energy Assistance questions were only asked of a subset of respondents, specifically those known to be LIHEAP recipients or low-to-moderate income respondents likely to be eligible for LIHEAP. For the 2015 survey, EIA implemented new modes of collection, including web and paper questionnaires. Due to the relatively low marginal cost, EIA decided to administer the Energy Assistance questions to all respondents across all survey

modes. This made it possible to produce estimates from the RECS of energy insecurity for the nation as a whole for the first time. For the 2020 survey, EIA moved to an entirely self-administered design, utilizing web and paper questionnaires, and the Energy Assistance section was again asked of all respondents, regardless of reported income.

Figure 1 shows examples of questions from the Energy Assistance section, as they appeared on the paper questionnaire. Questions not only captured the occurrence of one of these events (receipt of disconnection notice, keeping household at an unsafe temperature, etc.), but also the severity. Respondents answered whether an event happened “Almost every month”, “Some months”, “1 or 2 months”, or “Never”. The Energy Assistance section also had additional questions about how many days a home went without heat or air conditioning, whether anyone in the home needed medical attention because the home was too hot or too cold, and whether or not the household applied for home energy assistance to help restore heating or cooling when they were unable to use it. Five questions were used to determine whether a household was considered to be “energy insecure.” Those questions, shown in Figure 1, are questions 204, 205, 206, 208, and 212. If a household indicated that any of these occurred, they were considered “energy insecure.”

ENERGY ASSISTANCE

204. The following questions are about challenges your household may have had paying energy bills or maintaining heating and cooling in your home.

In the past year, how many months did your household reduce or forego expenses for basic household necessities, such as medicine or food, in order to pay an energy bill?

☐ Almost every month
☐ Some months
☐ 1 or 2 months
☐ Never

205. In the past year, how many months did your household keep your home at a temperature that you felt was unsafe or unhealthy?

☐ Almost every month
☐ Some months
☐ 1 or 2 months
☐ Never

206. In the past year, how many months did your household receive a disconnection notice, shut off notice, or nondelivery notice for an energy bill?

☐ Almost every month
☐ Some months
☐ 1 or 2 months
☐ Never → Go to #208

207. When you received that notice, did your household apply for and receive home energy assistance to help pay your energy bill?

☐ Yes
☐ No

208. In the past year, was there ever a time your household was unable to use your main source of heat because any of the following events happened? Please select all that apply.

☐ Your heating equipment was broken and you couldn't afford to pay for the repair or replacement
☐ You couldn't pay for electricity and it was disconnected
☐ You couldn't pay for natural gas and it was disconnected
☐ You ran out of fuel oil, propane, wood, or pellets because you couldn't afford a delivery
☐ None of these happened → Go to #211

209. About how many days was your household without heat?

days

210. When that happened, did your household apply for and receive home energy assistance to help restore your heating?

☐ Yes
☐ No

211. In the past year, did anyone in your household need medical attention because your home was too cold?

☐ Yes
☐ No

212. In the past year, was there ever a time your household was unable to use your air conditioner or other cooling equipment because any of the following events happened? Please select all that apply.

☐ Your air conditioning equipment or other cooling equipment was broken and you couldn't afford to pay for the repair or replacement
☐ You couldn't pay for electricity and it was disconnected
☐ None of these happened → Go to #215

213. About how many days was your household without air conditioning?

days

214. When that happened, did your household apply for and receive home energy assistance to help restore your cooling?

☐ Yes
☐ No

215. In the past year, did anyone in your household need medical attention because your home was too hot?

☐ Yes
☐ No

216. Including times when you received assistance for heating and cooling bills, has your household participated in a home energy assistance program that helps to pay energy bills or fix broken equipment?

☐ Yes
☐ No → Go to #218

217. In which of the following years did your household participate in a home energy assistance program? Please select all that apply.

☐ 2020
☐ 2019
☐ 2018
☐ 2017
☐ 2016
☐ Some other year(s)

Figure 1. Select questions from the 2020 RECS. (Question 204 was presented on the page prior to questions 205-217.) Source: EIA 2022.

In addition, this report draws on questions from other portions of the RECS to study relationships between the structure of the home and demographics of people residing in the home and household energy insecurity. Structural characteristics include the type of housing unit, the respondent's perception of how well insulated the home is and how drafty the home is, and whether the home lost power for more than 24 hours at a time. The demographic characteristics include whether the householder self-identifies as Hispanic, which racial group they identify with, their age, employment status, and education level. Other demographic characteristics include how many children are in the household, household income, whether the home is owned or rented, and whether the household received any energy assistance.

Results and Discussion¹

General Household Energy Insecurity Patterns

Results from the most recent RECS show that 34 million of the nation's 123.5 million households (27%) experienced some form of energy insecurity during 2020. The most commonly reported component of energy insecurity was having to reduce or forgo expenses for basic household necessities to pay energy costs, with 24.6 million households (20%) reporting having to do so. Additionally, 12.2 million households (10%) reported leaving the home at an unsafe temperature and 12.3 million households (10%) reported receiving disconnection or nondelivery notices.

The RECS also collected data on the severity of household energy insecurity. Respondents answered whether they experienced the challenge 1 or 2 months, some months, or almost every month in the past year. When considering patterns of energy insecurity, more than 9.2 million households (7%) reported experiencing energy insecurity almost every month. Almost 6.9 million (6%) households experienced having to reduce or forgo expenses for basic necessities to pay energy costs almost every month.

Respondent-reported household energy insecurity in the RECS decreased from 2015 to 2020. The overall measure of household energy insecurity decreased from 31% of households in 2015 to 27% of households in 2020. Most of this change can be attributed to a reduction in the number of disconnection notices reported by respondents. In 2015, 15% of households reported receiving disconnection notices in the preceding 12 months, while in 2020, 10% of households reported the same.

¹ All differences discussed are statistically significant at the $p < 0.05$ level unless otherwise noted.

U.S. household energy insecurity measures (2015 and 2020)

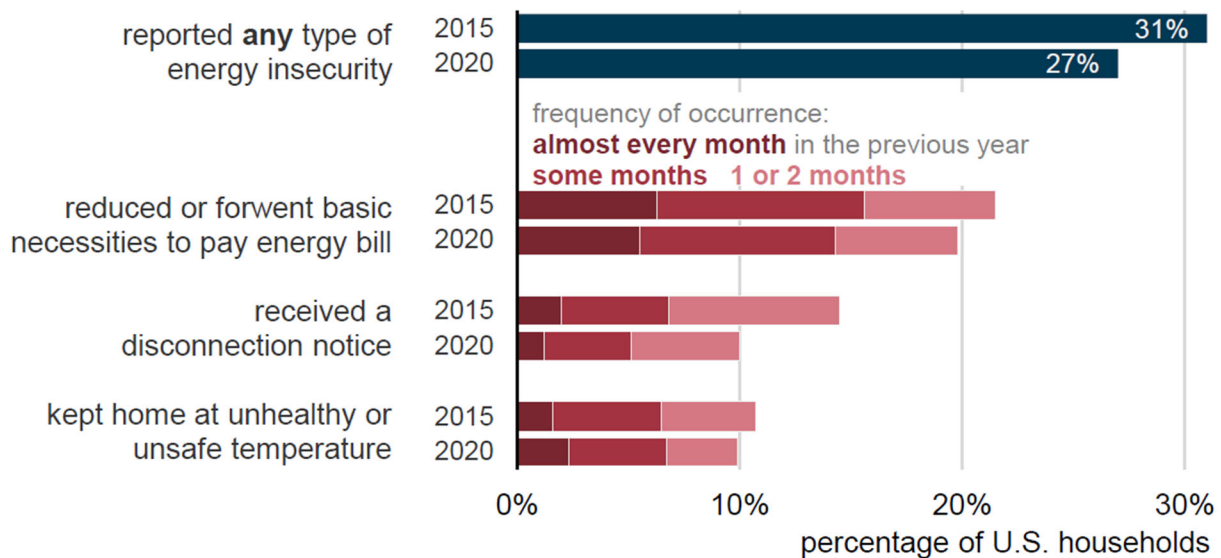


Figure 2. Comparison of household energy insecurity between 2015 and 2020. *Source:* EIA 2022.

Energy Insecurity by Geography

As seen in Figure 3, there were only minor differences in levels of household energy insecurity by geography. Regionally, 25% of households in the Northeast experienced energy insecurity, 24% of households in the Midwest, 30% of households in the South, and 27% of households in the West. However, only the difference between the South region and the other regions was statistically significant. Households in urban areas reported higher levels of energy insecurity (28%) than those in rural areas (24%). By climate region, households in the very cold/cold regions (24%) and marine regions (23%) reported significantly different, lower levels of energy insecurity than those households in mixed-humid (29%), mixed-dry/hot-dry (32%), and hot-humid (30%).

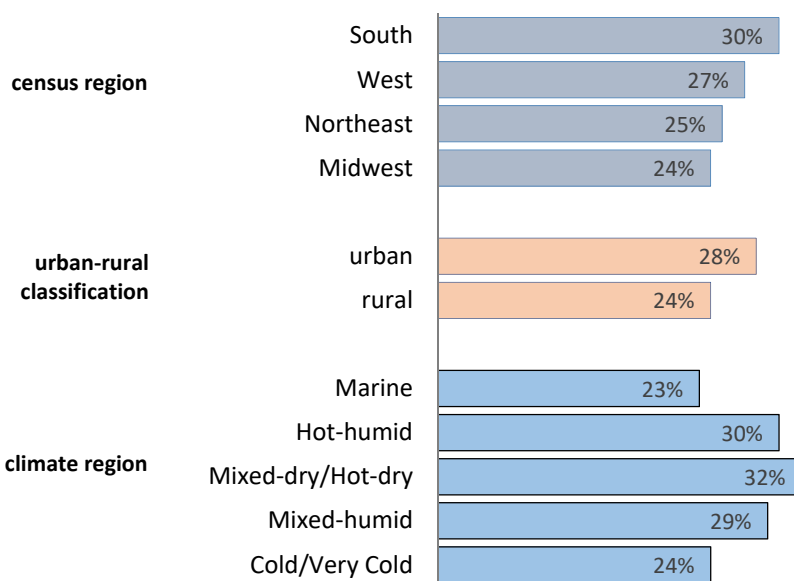


Figure 3. Geographic differences in household energy insecurity, 2020. *Source:* EIA 2022.

Energy Insecurity by Demographics

The characteristics that are most associated with energy insecurity are demographic characteristics. One of the largest differences in household energy insecurity was by race of the respondent. Of households where the respondent self-identified as Black or African American alone, 52% reported experiencing energy insecurity, compared to only 23% of respondents who identified as White alone, and 25% of respondents who identified as Asian alone. Households where the respondent identified as “Some other race” alone or as more than one race experienced energy insecurity at a rate of 47%. Additionally, 47% of respondents who identified as Hispanic or Latino experienced energy insecurity, compared to 25% of respondents who identified as not Hispanic or Latino.

There is an inverse relationship between the level of education of the respondent and the household’s likelihood of experiencing energy insecurity: 51% of households where the respondent reported having no high school diploma reported energy insecurity, compared to 35% of respondents with a high school diploma, 33% of respondents with some college or an associate’s degree, 19% of respondents with a bachelor’s degree, and 13% of respondents with a post-graduate degree reported some level of energy insecurity. We see a similar inverse relationship when looking at income and energy insecurity. Of those households making less than \$20,000 dollars a year, 51% reported experiencing energy insecurity. This percentage decreases steadily as income categories increase. However, 7% of households in the highest income category, households making over \$150,000, reported some amount of energy insecurity. Energy insecurity by employment status follows a similar pattern. Those respondents who were employed full-time reported an insecurity rate of 26%, while those that were employed part-time reported a 36% insecurity rate and those that were not employed reported a 48% insecurity rate. Retired individuals were least likely to report insecurity (19%). Lastly, of households that were

owner-occupied, 20% reported experiencing energy insecurity, while 41% of households that were renter-occupied experienced energy insecurity.

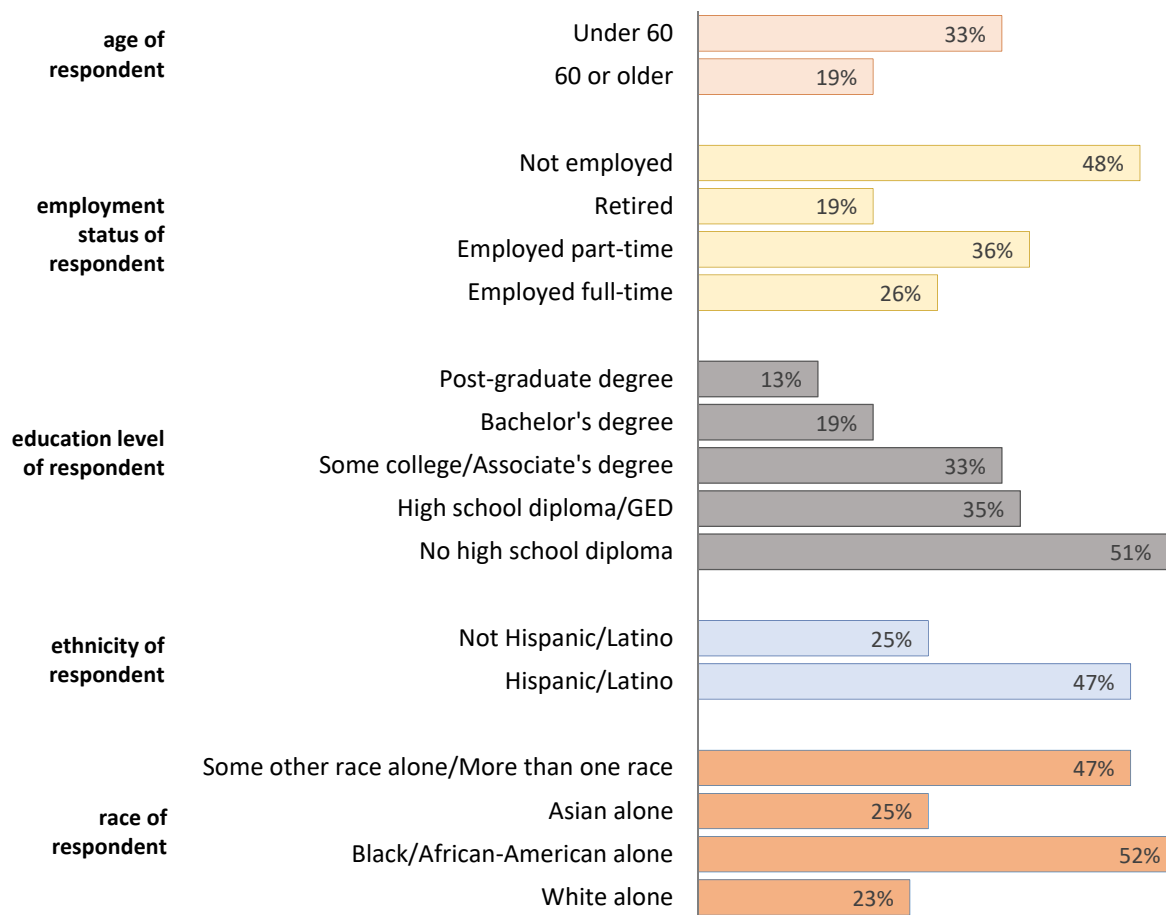


Figure 4. Household energy insecurity by select household respondent characteristics, 2020. *Source:* EIA 2022.

Households experiencing energy insecurity varied by household composition. Households where the respondent was 60 or older reported energy insecurity at a rate of 19%, while households where the respondent was younger than 60 reported energy insecurity at a rate of 33%. Presence of children was also correlated with household energy insecurity; 37% of households with children reported energy insecurity, while 23% of households without children reported energy insecurity. Finally, we found that starting with households with more than 2 members, as the number of household members increased, so did the likelihood that the respondent reported experiencing energy insecurity.

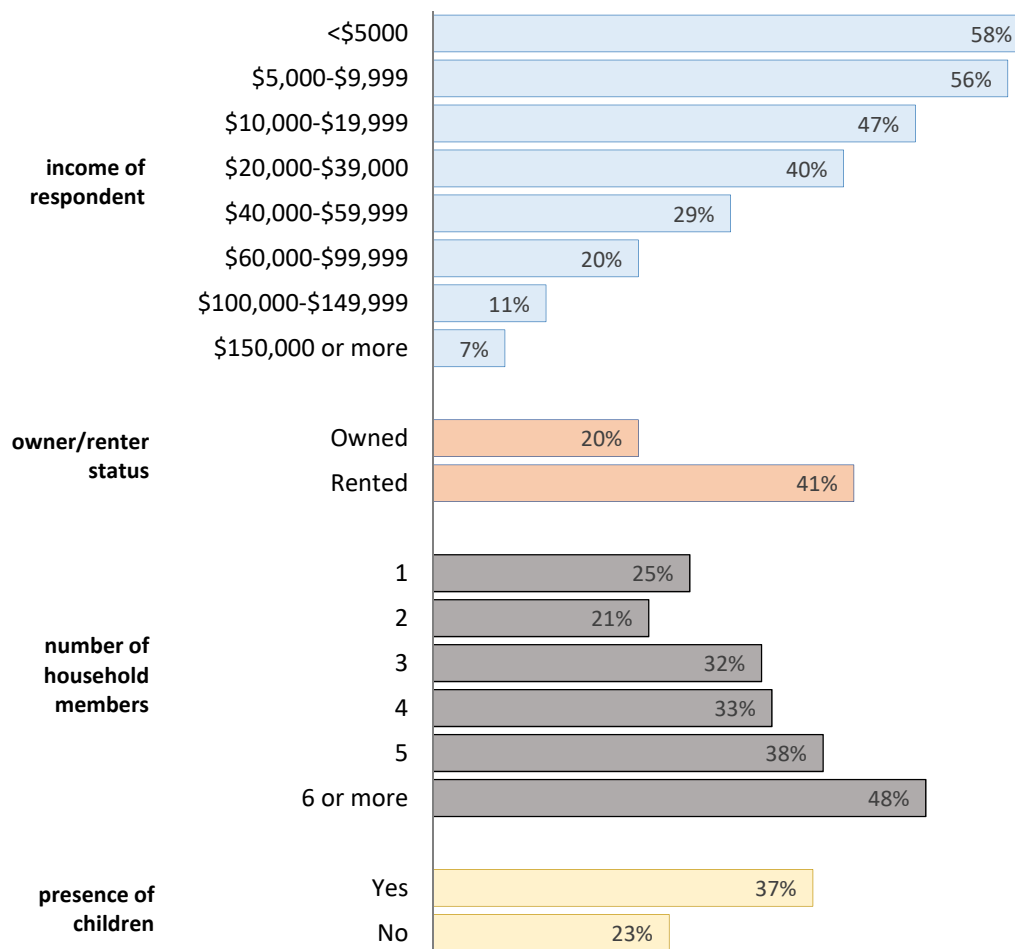


Figure 5. Household energy insecurity by select household demographic characteristics, 2020. *Source:* EIA 2022.

Energy Insecurity by Structural Features and Equipment

According to RECS data, households living in single-family detached homes were the least likely to experience energy insecurity (22%). Mobile home households experienced the most insecurity: of the 6.8 million households living in a mobile home, 3.2 million (47%) experienced energy insecurity. Apartment households also experienced higher levels of energy insecurity, with 45% of households in smaller apartment buildings (2-4 units) experiencing energy insecurity and 31% of households in larger apartment buildings (5+ units) reporting energy insecurity. These differences may be explained by variations in physical structure and by differences in household composition. Around 36% of households living in small apartment buildings and 32% of households living in mobile homes reported having poor insulation compared with only 16% of households living in single family detached homes. Households in older homes, built before the year 2000, were more likely to report energy insecurity (28%) than households in newer homes, built in 2000 or later (23%). Lower household income also contributes to this difference, with residents of smaller apartment buildings (33% below \$20,000)

and mobile homes (37% below \$20,000) earning lower incomes than households living in single family detached homes (9% below \$20,000).

There are also differences in energy insecurity related to specific physical characteristics of the house. Differences in reports of energy insecurity varied based on respondent-reported levels of insulation. In households that reported being adequately or well insulated, 24% reported experiencing energy insecurity. Of the almost 25 million households that reported poor insulation or no insulation, 47% of those reported experiencing energy insecurity. Reports of energy insecurity also varied by window type, with 37% of households who reported having single-pane windows experienced energy insecurity, compared to 22% of households with double- or triple-paned windows.

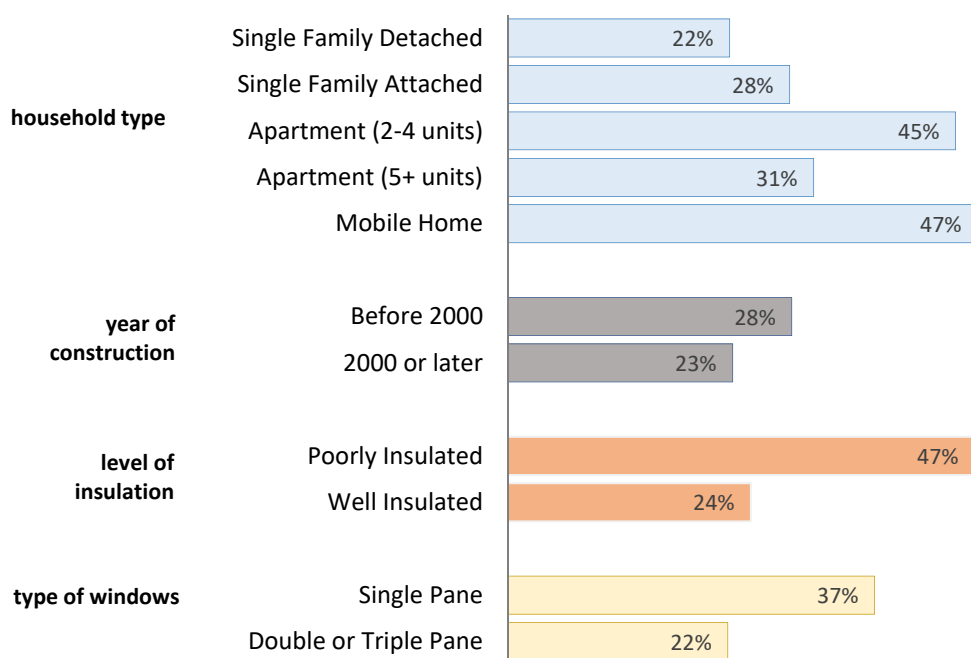


Figure 6. Household energy insecurity by select structural characteristics, 2020. *Source:* EIA 2022.

Behavioral Component of Energy Insecurity

As discussed in a previous section, 12.20 million households (10%) reported keeping their home at a temperature they felt was unsafe or unhealthy and 2% of households reported that this happened almost every month. A small percentage of U.S. households reported an inability to use heating equipment (4%) and/or cooling equipment (5%) because their equipment broke and they could not afford to fix it, or because they could not afford the fuel to run the equipment. Additionally, when asked how they control the temperature in their home, households that

experienced energy insecurity were more likely to simply turn their equipment on or off than households that did not report experiencing energy insecurity.²

Energy Assistance

In total, 5% of households reported that they participated in a home energy assistance program that helps pay bills or fix broken equipment (Question 216 in Figure 1). When asked if a household received energy assistance to help pay energy bills after receiving a disconnection notice, 3.2 million households (3% of all households or 26% of households that reported receiving a disconnection notice) reported that they had received assistance. When a household indicated that they had broken equipment or could not afford to pay heating or cooling bills, they were also asked if they had received assistance to address those challenges. Around 900,000 households (0.7%) reported that they had received assistance for heating-related challenges, and 500,000 households (0.4%) reported that they had received assistance for cooling-related challenges.

Predicting Energy Insecurity

The analysis outlined below uses a logistic regression to determine the characteristics that were most predictive of household energy insecurity. For this analysis, prior research was consulted to determine the initial list of RECS characteristics variables for the model. The independent variables used in the final model are described in Table 1. The dichotomous dependent variable was the household's energy insecurity status, as determined by the 2020 RECS. The regression was performed using the SURVEYLOGISTIC procedure in SAS.

P(Energy Insecurity)

$$\begin{aligned}
 &= \alpha + \beta_1(HHINCLESS10) + \beta_2(HHINC10TO20) + \beta_3(HHINC20TO40) \\
 &+ \beta_4(HHINC40TO60) + \beta_5(HHINC60TO100) + \beta_6(OVER60) + \beta_7(CHILD) \\
 &+ \beta_8(HISPANIC) + \beta_9(ANOTHERRACE) + \beta_{10}(RACEASIAN) \\
 &+ \beta_{11}(RACEBLACK) + \beta_{12}(EMPLOYNONE) + \beta_{13}(EMPLOYRET) \\
 &+ \beta_{14}(EMPLOYPT) + \beta_{15}(EDUCMA) + \beta_{16}(EDUCBA) + \beta_{17}(EDUCA) \\
 &+ \beta_{18}(EDUCHS) + \beta_{19}(RENTER) + \beta_{20}(ASSISTANCE) \\
 &+ \beta_{21}(MOBILEHOME) + \beta_{22}(MULTIFAMILY) + \beta_{23}(POORLYINSULATED) \\
 &+ \beta_{24}(DRAFTY) + \beta_{25}(LOSTPOWER)
 \end{aligned}$$

² When respondents were asked how they control the temperature in their home, additional response options included setting the thermostat to one temperature and leaving it there, manually adjusting the thermostat, using programmable or smart thermostat features, or some other way. Respondents could also report that they did not have control over the temperature in their home.

Table 1. Variables included in the logistic regression

Variable	Description
HHINCLESS10	Household income of less than \$10,000 in 2020
HHINC10TO20	Household income of \$10,000 to \$19,999 in 2020
HHINC20TO40	Household income of \$20,000 to \$39,999 in 2020
HHINC40TO60	Household income of \$40,000 to \$59,999 in 2020
HHINC60TO100	Household income of \$60,000 to \$99,999 in 2020
OVER60	Respondent to the RECS was 60 years of age or older
CHILD	Presence of children in household
HISPANIC	Respondent identified as Hispanic
ANOTHERRACE ³	Respondent selected a race other than White, Black or African American, or Asian alone
RACEASIAN	Respondent identified as Asian alone
RACEBLACK	Respondent identified as Black or African American alone
EMPLOYNONE	Respondent is out of the labor force
EMPLOYRET	Respondent is retired
EMPLOYPT	Respondent is employed part-time
EDUCMA	Respondent has a master's, professional, or doctoral degree
EDUCBA	Respondent has a bachelor's degree
EDUCAA	Respondent has some college or associate's degree
EDUCHS	Respondent has a high school diploma
RENTER	Respondent leased the housing unit surveyed
ASSISTANCE	Respondent reported receiving energy assistance
MOBILEHOME	Housing unit surveyed was a mobile home
MULTIFAMILY	Housing unit surveyed was an apartment building (any size)
POORLYINSULATED	Respondent reports home has no insulation or is poorly insulated
DRAFTY	Respondent reports home is drafty all or most of the time
LOSTPOWER	Household lost power for more than 24 hours at least once

The results of the logistic regression are shown in Table 2. The odds ratio for the intercept gives the likelihood that a household would report experiencing energy insecurity given a set of baseline characteristics. These characteristics are as follows:

- The household income in 2020 was \$100,000 a year or greater
- The respondent was under the age of 60
- The household had no children under the age of 18
- The respondent identified as White alone
- The respondent did not identify as Hispanic or Latino
- The household was owner-occupied
- The household did not report receiving energy assistance

³ ANOTHERRACE includes respondents who self-identified as *American Indian or Alaska Native* or as *Native Hawaiian or Other Pacific Islander* alone, or respondents who selected more than one racial category.

- The household was a single-family home
- The household was not reported to be poorly insulated or drafty
- The respondent was working full-time
- The household had not lost power for more than 24 hours within the last 12 months
- The respondent had not graduated from high school nor earned a GED

Odds-ratios that are greater than 1 indicate a positive relationship. That is, being a member of that category increases the likelihood of energy insecurity for that household, compared to the baseline characteristics. Odds-ratios smaller than 1 indicate a negative relationship: being a member of that category decreases a household's likelihood to be energy insecure compared to the baseline characteristics. A few variables were included in the initial model, but were found to not be significant, and were removed. Those variables were the year the household was built (before or after 2000), type of window panes (single vs double or triple), urbanicity, presence of LED lights, and geographic region.

Table 2. Odds-ratios and confidence intervals of the logistic regression results.

	Overall Insecurity Model**	
Variable	Odds Ratio	95% CI
Intercept	0.09*	0.07, 0.12
Household characteristics		
HHINCLESS10	6.65*	5.17, 8.56
HHINC10TO20	6.85*	5.63, 8.33
HHINC20TO40	5.56*	4.74, 6.52
HHINC40TO60	3.71*	3.14, 4.38
HHINC60TO100	2.36*	2.08, 2.68
OVER60	0.68*	0.59, 0.79
CHILD	1.57*	1.41, 1.76
HISPANIC	1.84*	1.61, 2.11
ANOTHERRACE	1.99*	1.65, 2.39
RACEASIAN	1.37*	1.10, 1.71
RACEBLACK	2.64*	2.31, 3.01
EMPLOYNONE	1.04	0.89, 1.22
EMPLOYRET	0.63*	0.53, 0.75
EMPLOYPT	0.97	0.84, 1.12
EDUCMA	0.56*	0.44, 0.70
EDUCBA	0.68*	0.55, 0.83
EDUCAA	0.92	0.75, 1.14
EDUCHS	0.82*	0.67, 1.00
RENTER	1.35*	1.18, 1.55
ASSISTANCE	2.36*	1.95, 2.85
Housing unit characteristics		
MOBILEHOME	1.48*	1.23, 1.77
MULTIFAMILY	0.74*	0.62, 0.88

POORLYINSULATED	1.61*	1.42, 1.83
DRAFTY	1.96*	1.70, 2.27
LOSTPOWER	1.41*	1.26, 1.59

*Significant at 95% level

** Max rescaled R-square = 0.32

In this model, the variable most associated with energy insecurity was income. Households making less than \$10,000 a year, those making between \$10,000 and \$19,999, and those making between \$20,000 and \$39,999 were all five to seven times more likely to be energy insecure than the reference group, those making \$100,000 a year or more. Even those households making \$60,000 to \$99,999 a year were more than twice as likely to be energy insecure than the reference category. The respondent's self-reported race was also a strong predictor of the likelihood the household reported energy insecurity. Households with Black respondents were 2.6 times more likely than households with White respondents to report energy insecurity. Respondents identifying as a racial category other than White, Black, or Asian were also more than twice as likely to report insecurity as the reference category. Respondents identifying as Hispanic or Latino were almost twice as likely to report energy insecurity compared to the reference category, as well. Finally, respondents who reported receiving energy assistance were more than twice as likely to report energy insecurity as those who did not receive assistance.

The respondent's educational attainment was predictive of the household experiencing energy insecurity, with respondents who had completed a master's, bachelor's, or high school degree less likely to experience energy insecurity than those respondents with less than a high school degree. This relationship was statistically significant even when controlling for income and employment.

For the 2020 RECS, respondents were asked if they experienced a power outage that lasted longer than 24 hours, as well as the reason for the outage. 22.7 million households (18%) experienced an outage lasting longer than 24 hours, with most of those (83%) being caused by natural disasters or weather events. For households experiencing energy insecurity, 22% experienced an outage lasting longer than 24 hours, and while the majority were caused by a natural disaster or weather event (76%), an additional 18% were caused when the utility had a planned or unplanned blackout. In the model, a household that experienced a power outage that lasted longer than 24 hours was almost 1.5 times more likely to experience energy insecurity.

Conclusions and Recommendations

Overall, household energy insecurity decreased from 31% in 2015 to 27% in 2020. While reports of each measure of energy insecurity went down, the most pronounced decrease was in disconnection notices, with a 5% reduction. This could be explained by the impact of pandemic-related policies that instituted utility disconnection moratoria in a number of states for several months during 2020. Another factor that could have reduced the number of disconnection notices received was the warm winter months in 2020. EIA found that despite more people staying home, residential energy use was actually down by 4% compared with 2019 (EIA, 2021). Lower overall energy bills may have been more affordable for households, leading to fewer falling behind on bills and risking disconnection.

The overall reduction in energy insecurity does not change the likelihood that certain households are more likely to be energy insecure than others. Households making less than \$20,000 a year are seven times as likely as those households with incomes of \$100,000 or greater to experience energy insecurity. However, it is notable that 7% of households in the highest income bracket also reported experiencing energy insecurity. It could be useful to analyze a dataset that includes more detailed data on income and household expenses to understand how households make decisions on how to allocate resources across housing, food, and energy costs, and how that allocation differs across income levels.

These findings build on previous analyses of 2015 RECS data by adding a few new statistically significant predictors of energy insecurity, such as respondent educational attainment. Educational attainment was predictive of the likelihood a respondent experienced energy insecurity, even when controlling for household income, region, respondent race, age, and a number of other factors. This could be capturing an indirect effect, where respondents with higher educational attainment have access to more monetary resources (including wealth, which is not directly measured in the RECS) and can more easily avoid experiencing energy insecurity. In order to tease out this effect, more information on a household's overall wealth or other resources, in addition to income, would be necessary.

This study considered the structural/physical, economic, and behavioral aspects of household energy insecurity, as well as how demographics and geography are related to energy insecurity. In terms of geography, those households in the South and in urban areas were more likely than households in other regions or rural areas to be energy insecure, respectively. These regional and geographic differences may also impact our finding that households reporting a power outage lasting for longer than 24 hours were more likely to be energy insecure than the households that did not report an outage. There are many possible interpretations of this finding, given that power outages can be caused by weather or by other infrastructure-related issues, and understanding the correlation could be the topic of future research.

Consistent with previous research on poverty and energy insecurity, we found that younger respondents were more likely than older respondents to experience energy insecurity. We believe this could be due to older respondents having more resources to draw on during times of economic hardship. Our finding that renters were also more likely to face energy insecurity than respondents who own their home further supports this hypothesis.

Finally, the physical structure of the home affects a household's likelihood of being energy insecure in a number of ways. Respondents living in mobile homes were 1.5 times more likely to be energy insecure than those respondents living in single family detached homes. Homes that are older, where respondents reported that the home is poorly insulated, or have single-pane windows were also more likely to face energy insecurity than homes that are newer, adequately insulated, or have double- or triple-pane windows. However, the magnitude of the effect of these variables in the logistic regression model is not as large as the income categories and demographic characteristics.

To build on the research outlined in this paper, we could analyze energy consumption patterns to understand if households experiencing energy insecurity have higher energy intensities per square foot compared with other similar households that are not experiencing energy insecurity. It would also be possible to compare expenditures on average and by square

foot for these households to gain insight into energy burden for this population. RECS data on household energy consumption and expenditures will be available in early 2023.

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