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Ceiling Fan and Ceiling Fan Light Kit use in the U.S.—Results of a Survey on Amazon Mechanical Turk

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Abstract

This report outlines the methods and results of an online survey conducted to quantify the use of residential ceiling fans and ceiling fan light kits in the United States (U.S.). Although a number of previous ceiling fan studies exist, most are at least a decade old and provide limited information on many aspects of ownership and usage. We surveyed people across the U.S. using Amazon Mechanical Turk, and we analyzed the surveys from 2550 people. We found ceiling fans hours of operation per day to be distributed bimodally with an arithmetic mean of 6.4 hours per day. We estimated the mean annual energy use per fan to be 99 kilowatt-hours. We also provide estimates of usage at each speed of operation, regional variance of usage, ceiling fan light kit characteristics, and several other topics. By providing usage details applicable to the whole country, this survey provides an important new piece of information for assessing the use of ceiling fans and ceiling fan light kits in the U.S.

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1 Introduction

1.1 Ceiling fans and ceiling fan light kits

A ceiling fan is a non-portable device, mounted to the ceiling, which circulates air via the rotation of blades. In warm months, the air circulation from a ceiling fan can make room occupants feel cooler and more comfortable by displacing heated air next to occupants' skin and increasing the rate of evaporation of occupants' perspiration (Swezey, 1953). In cool months, a ceiling fan can help to spread heated air more evenly throughout a room (Calwell and Horowitz, 2001). Most ceiling fans also have an attached light kit that provides light.

According to the 2009 Residential Energy Consumption Survey (RECS) (U.S. Energy Information Administration, 2011), 73% of U.S. households have at least one installed ceiling fan, and there are 239 million ceiling fans installed in U.S. homes. Annual sales of ceiling fans in the U.S. averaged 21 million units between 2007 and 2010, according to consumer surveys conducted by the NPD Group (NPD Intellect, 2011). Although ceiling fans are a common household appliance, little is known about their energy use.

1.2 Previous studies

There are a small number of surveys and field studies that have investigated ceiling fan use in the U.S.

RECS 2009 includes two questions on ceiling fans. RECS reports the number of ceiling fans used within a household and, in broad terms, the frequency with which the most-used fan is used in the summer (e.g., "Used only a few days or nights, when it's really needed", "Used quite a bit"). This information is useful for estimating the number of ceiling fans throughout the U.S. but provides limited information on the way that those fans are used.

Sonne and Parker (1998) of the Florida Solar Energy Center performed a field study of ceiling fan use in two homes in Miami, Florida. The occupants of one home were considered "*uninformed*" regarding energy efficiency and ceiling fan use and left their fans on most of the time. The occupants of the other home were considered "*informed*" on such matters and operated their fans much less frequently. The study measured ceiling fan operation for one year and reported average hours of use and estimated power consumption.

Calwell and Horowitz (2001) provided estimates of annual ceiling fan energy consumption per household for the nation and for each census division. Their estimates came from a model relating hours of operation to cooling degree days, and they calibrated the model with hours of use from small samples in Florida and Canada.

RLW Analytics (2002) performed two studies of ceiling fan use in California. In the first study, they measured the operation of approximately 150 ceiling fans and ceiling fan light kits in 62 homes in California for one year. They reported typical usage patterns and estimated energy consumption for the fans. They also asked owners several questions about ceiling fan use, including whether owners increased the air conditioning thermostat temperature when using the ceiling fan.

In the second survey (See Section 4 of RLW Analytics, 2002), RLW Analytics measured the ceiling fan and air conditioning use of 81 ceiling fans in 25 new homes in Sacramento, California, for an average of 35 days. This study reported the frequency with which ceiling fans and air conditioners were used together.

The 2009 California Residential Appliance Saturation Study (RASS) also provided information on the number of ceiling fans in homes in California (California Energy Commission, 2013). In this study, households served by the major utilities in California were sent a survey that they could either fill out and mail in or fill out online. This survey provides information on the number of ceiling fans within the household, but it provides no information on ceiling fan use.

1.3 Current study

The data from past studies of ceiling fans may not be adequate to make accurate estimates of national energy use. First, RECS is the only source of nation-wide information, but it provides no detailed information on patterns of use. Second, the studies that provided detailed usage measurements have covered only single states—California or Florida. Third, most of these reports are at least ten years old, so it is possible that usage patterns have changed since that time. Finally, some information important for estimating ceiling fan national energy use was not collected by any of the previous studies.

We developed an online survey of ceiling fan use to address many of the questions not adequately answered by previous studies. We designed the survey to gather a representative sample of ceiling fan users from across the country. The survey covered many aspects of ceiling fans and their use, as outlined below:

- Hours of operation, speed of operation, and energy use
- Regional variation in use
- Fan characteristics
- Interaction of fan characteristics with usage patterns
- Interaction with air conditioning
- Usage overnight and when no one in the room
- Light kits
- Additional questions

1.3.1 Hours of operation, speed of operation, and energy use

The amount of time fans are on and the time spent at each speed are key factors in determining their energy use. RECS provides information on the number of ceiling fans in homes nationwide, but RECS does not provide detailed information on the way those fans are used. As a result, there is a need for additional information on the frequency and speed of usage for fans nationwide.

1.3.2 Regional variation in use

Regional climatic variations may result in differences in the frequency and speed of ceiling fan operation. Previous studies that looked at detailed usage patterns have been isolated to single states (e.g., Florida or California), and those patterns may not accurately be extrapolated into patterns of use across the country.

1.3.3 Fan characteristics

Previous studies have not provided any information on fan characteristics. Fan size and other characteristics can have a large impact on energy use. In order to accurately measure energy consumption, it is valuable to know the size of fans, the age of the fans, and information on the controls (e.g., switches and dimmers) used for fans.

1.3.4 Interaction of fan characteristics with usage patterns

Previous studies have not investigated the interaction between fan characteristics and fan usage. For example, does the size or control type affect the frequency with which fans are used?

1.3.5 Interaction with air conditioning

Fans are often advertised as a way to reduce the cost of air conditioning, informing potential customers that they can set their air conditioner thermostat to a higher temperature when they have the ceiling fan running. The study by RLW Analytics (2002), however, suggested that few people in California do this. It is not known how many users in other parts of the country adjust the thermostat when their ceiling fans are running.

1.3.6 Usage overnight and when no one in the room

For some appliances, a significant portion of energy use can occur when the appliance is not being used for its intended purpose. For ceiling fans, it has been noted previously that some users leave fans on when no one is in the room, resulting in extra energy use without any benefit from the cooling effects of the fan (Sonne and Parker, 1998). Similarly, it is not known how frequently people leave ceiling fans running at night outside of bedrooms.

1.3.7 Light kits

Most previous studies have investigated ceiling fans only, and they have not investigated the use of the light kits attached to ceiling fans. Therefore, there are a number of unknowns about the usage of ceiling fan light kits that affect their energy use. These include the distribution of lamp types, socket types, and number of sockets; the fraction of light kits operated with dimmers; and whether dimmers are used if installed.

1.3.8 Additional questions

In addition to the questions already outlined, our survey investigated several other topics. For example, we asked about the use of outdoor fans and the use of fans in reverse rotation. We provide detailed results for some topics in this report; we provide all the questions in Appendix A; and we provide the basic results for all questions in Appendix B.

2 Methods

2.1 Survey Design

2.1.1 Overview

We designed the survey to be completed by respondents using a web browser. We used multiple-choice radio buttons and fill-in-the-value questions. The survey included a total of 43 questions and 113 fields. The questions could be classified into 5 major categories, based on the topic addressed: demographics, ceiling fans only, light kits only, both ceiling fans and light kits, and questions to test respondents' attention and honesty. The following sections outline each category, and Appendix A contains the full text of the questionnaire.

2.1.2 Demographic questions

Ten of the survey questions were designed to gather information on the demographic characteristics of each respondent and his or her household. For seven of these questions, we used the same format and wording as RECS 2009, except we included the option for respondents to choose "Don't know" or "Decline to state":

- Zip code
- Gender
- Hispanic or Latino origin
- Race
- Highest education level
- Number of household members
- Home ownership

For three of the demographic questions, we included "Don't know" or "Decline to state", and we modified the question or possible answers from the similar question in RECS 2009:

- Age of household members: RECS asked the age category of each household member, and we asked for the number of household members within each age category. We also used a different set of age bins than RECS.
- Annual household income: we used a different set of income bins than RECS.
- Type of home: we included "dormitory" and "something else" within the possible responses.

2.1.3 Ceiling fan questions

Twenty-seven of the survey questions were focused on the characteristics and use of ceiling fans in the respondent's home. These included questions to determine all of the following:

- The number of fans in the home

- The characteristics of the ceiling fans
- The general patterns of use of the fans
- The use of fans with air conditioning
- Fan operation during the night or when no one is in the room
- The use of reverse fan rotation
- The use of outdoor fans

2.1.4 Light kit questions

Six of the survey questions were focused on the characteristics and use of ceiling fan light kits. These included questions on the number of light kits, the characteristics of the light kits and their controls, and the use of the light kits.

2.1.5 Test of respondents' attention and honesty

One of the questions was specifically intended to test whether respondents were paying attention and answering honestly. We asked participants to identify the number of hours in a day. This type of question has been used in other surveys as a way to screen out people who are randomly selecting answers or not paying attention (Greenblatt et al., 2013a).

We also included two questions that allowed us to check for conflicting answers. We asked respondents (a) the total number of household members, and (b) the number of household members within each age category. The sum of the household members within each age category should be equal to the total number of household members.

2.2 Deployment

2.2.1 Amazon Mechanical Turk

We deployed the survey on Amazon Mechanical Turk (AMT) (Amazon.com, 2013). AMT is an internet marketplace operated by Amazon.com. AMT allows requesters to post tasks and workers to complete those tasks in exchange for a monetary payment. Amazon started AMT as a way for programmers to crowdsource tasks that required human intelligence, but it has also become popular as way to perform surveys of the general population (Greenblatt et al., 2013a; Greenblatt et al., 2013b; Williams et al., 2012; Paolacci, Chandler, & Ipeirotis, 2010).

2.2.2 Survey components

We deployed the survey between July and September 2012. We first deployed a pilot survey, and 100 respondents completed it. All respondents were paid $1.25 for completing the pilot survey. The pilot allowed us to identify weaknesses in survey design, including unclear questions. Based on the feedback we received from the pilot survey, we adjusted several questions to improve the survey. We also increased the

payment amount slightly based on the average time respondents spent completing the survey.

After refining the survey, we deployed it to the general population, and 2000 respondents completed the survey. All respondents were paid $1.50 for completing the survey. We imposed no restrictions on the demographics of the respondents at this stage.

We then compared the demographics of the survey respondents to the weighted demographics in RECS 2009. RECS is weighted to be representative of the population of the U.S., so we used it to identify demographic subgroups in our survey that were under-represented relative to their presence in the U.S. These subgroups may be under-represented as a result of selection bias (survey takers must have internet access), as well as self-selection bias (survey takers choose to participate). (See Greenblatt et al., 2013a for further discussion of these potential biases.) We identified seven demographic subgroups that (a) had a small number of respondents in our initial sample, or (b) were substantially under-represented in our initial sample relative to their representation in U.S.

In order to mitigate the effect of selection biases in our survey, we then deployed the survey to AMT again, this time restricted to respondents from one or more of the targeted demographic subgroups. A total of 1250 additional respondents completed the survey, and all respondents were paid $1.50 for completing it. Table 1 describes the number of additional respondents we surveyed for each demographic subgroup.

Table 1. Demographic subgroups targeted for additional sampling

Demographic subgroup	**Number of additional respondents surveyed**
Black or African-American	100
Hispanic or Latino	100
No college education	350
Resident of Nevada, Arizona, or New Mexico (i.e. Mountain South RECS division)	30
Resident of Arkansas, Louisiana, Oklahoma, or Texas (i.e. West South Central RECS division)	50
One-person households	270
Household contains person(s) at least 60 years old	350
Total number of additional respondents	**1250**

2.2.3 Respondent requirements

We placed several requirements on the AMT workers that performed our survey.

AMT workers were permitted to answer the survey only if they had been approved for payment in at least 95% of the AMT tasks they had completed previously. This requirement should result in a pool of respondents with a reputation of performing reliably.

We also included a header at the start of the survey, indicating that:

- The respondent must be at least 18 years old.
- The respondent must have at least one ceiling fan in their primary residence.

We included two additional requirements for the demographic subgroup surveys:

- The respondent must be a member of the specified demographic subgroup.

- The respondent must not have previously completed the pilot or general population survey.

Finally, the header also indicated that the respondent would not be paid if they did not answer all required survey questions.

2.3 Screening

We used seven criteria to select the respondents to include in the analysis. We collected a total of 3250 respondents from the general population and demographic subgroup samples, and we screened out 700, leaving 2550 respondents that we included in the analysis. We did not use any of the respondents from the pilot survey in the analysis.

We retained respondents who:

- Had at least 1 ceiling fan
- Skipped 4 or fewer questions
- Spent at least 90 seconds completing the survey
- Answered the test question (i.e. the number of hours in a day) correctly
- Had an absolute difference of 2 or less between (a) the total number of household members, and (b) the sum of household members for whom age categories were indicated. We chose 2 as a threshold for this difference because it seemed to be the likely limit for honest mistakes when estimating the age groups of household members.
- Had a zip code that was valid and within the 50 states covered by RECS 2009
- Completed all survey questions that we used to estimate energy consumption. These included questions 1, 3, 4, 5, 8, 9, 11, and 12.

The criteria that excluded the largest number of respondents were: (1) completion of all survey questions used to estimate energy consumption (243 respondents); (2) the absolute difference in household size reported in total and by age group (148 respondents); (3) the test question (103 respondent); and (4) the number of skipped questions (96 respondents).

2.4 Demographic weighting

Even after combining the general population sample with the demographic subgroup samples, our full sample did not have the same demographic distribution as the U.S. population. To compensate for these differences, we weighted the respondents to more closely match the U.S. population. Weighting is a common method used to adjust survey demographics to more closely match the general population (Marsden & Wright, 2010; Greenblatt et al., 2013a).

We weighted the respondents to match the demographic distribution in RECS 2009, based on five demographic variables:

- RECS division
- number of household members
- race
- the number of 20-29 year olds in a household (0, 1, 2, 3 or more)
- highest education level

We used a cell weighting approach, in which we weighted each sample based on the weighting of that sample's combination of demographic variables within RECS 2009. We chose these demographic variables because they provide the best correction of the known biases in the AMT population. Section 4.4 of Marsden & Wright (2010) provides a general overview of cell weighting. Section 3.5.2 of Greenblatt et al. (2013a) provides an explanation of the particular cell weighting method—referred to as the "simultaneous weighting method"—used for the present survey.

3 Analysis, results, and specific discussion

3.1 Overview and format

This section contains details of the analysis and results of several topics covered by the survey. For each topic, we explain the survey questions, the analysis performed, and the results. We also include any specific discussion relevant to the topic.

We refer to survey questions by number at many points in this section. We have included the full wording and format of all survey questions and responses in Appendix A.

This report provides detailed results for key topics covered by the survey. We have tabulated the results of all other topics in Appendix B. For example, we asked people questions about outdoor fans in the survey, but we do not provide any detailed analysis of outdoor fans in this report.

The results we report are for data that has been demographically weighted. We provide unweighted numbers in one table, and we identify them as such.

For several questions, we report the proportions of respondents for each answer. These proportions add up to 100% for all of the answers reported. These proportions do not include the small number of respondents who answered "Don't know" or left the question blank.

We report 95% confidence intervals (CI) for the several results. We use the notation 95% CI [X, Y], where X indicates the lower bound of the 95% confidence interval, and Y indicates the upper bound. Confidence intervals for operating hours and energy consumption are the confidence intervals of the arithmetic means of the estimates for all respondents. Confidence intervals of proportions represent only the uncertainty due to the number of samples and the proportion. We cannot accurately quantify many other sources of uncertainty, such as the potential uncertainty in the accuracy of respondents' survey responses (due to, for example, recollection bias, estimation bias, or social desirability bias).

We calculated 95% confidence intervals for proportions by using the normal approximation to the binomial distribution (Steel et al., 1996). For simultaneous confidence intervals of proportions, we used the Bonferroni correction (Shaffer, 1995) to increase the size of the individual confidence intervals, resulting in a 95% confidence level across all intervals. We identify the Bonferroni-corrected confidence intervals when we present them in the text.

In many figures, we also indicate the size of the sample used to calculate a mean or confidence interval or both. We do this only when the size of the sample is different

than the sample numbers most commonly used. We do not indicate the size of the sample if the sample is approximately all of the respondents or all of the respondents within a geographic division.

3.2 Geographic divisions

In order to show the regional variation in ceiling fan use, we report the results of many questions nationally as well as by RECS division. Figure 1 shows the ten divisions reported by RECS 2009. Most of these divisions are the same as the divisions reported in the U.S. Census. There is one difference: RECS splits the Mountain census division into Mountain North and Mountain South.

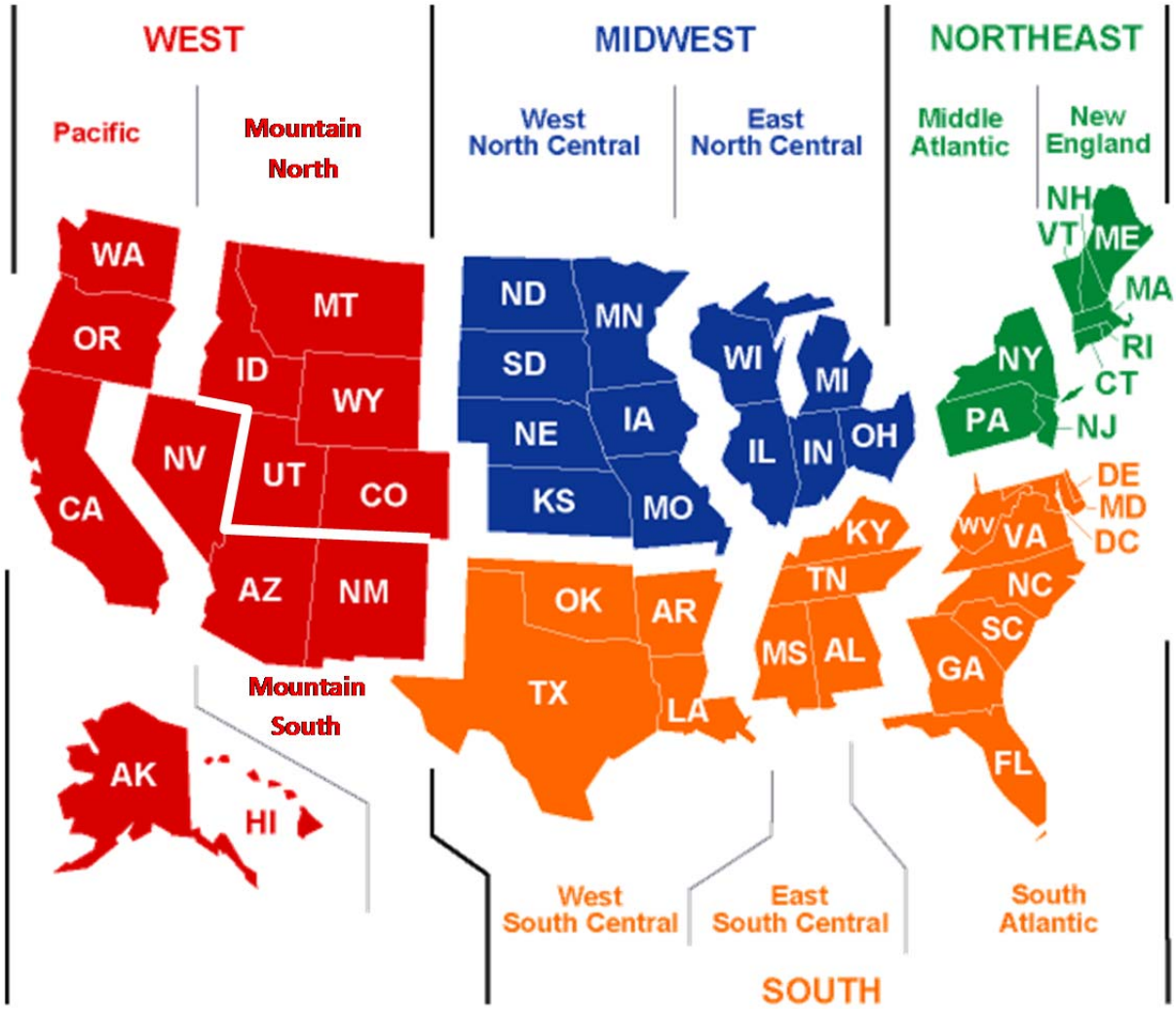

Figure 1. Map of RECS divisions. We used the ten divisions that are exploded and labelled with capital case (e.g. Pacific, Mountain North). The divisions are contained within larger census regions, which are labelled in uppercase (e.g. WEST, MIDWEST). Map adapted from http://www.eia.gov/emeu/reps/maps/us_census.html

Table 2 shows the number of survey respondents for each division, the unweighted percentage of our sample, and the percentage of the sample after respondents were weighted to match the number of U.S. households (as reported in RECS 2009) in each division.

Table 2. Number of survey respondents by division.

RECS division	**Unweighted survey responses**	**Unweighted percentage of total responses**	**Weighted percentage of total responses**
New England	108	4.2	3.8
Middle Atlantic	308	12.1	11.1
East North Central	381	14.9	16.1
West North Central	185	7.3	7.5
South Atlantic	581	22.8	22.0
East South Central	134	5.3	7.2
West South Central	280	11.0	13.2
Mountain North	78	3.1	3.3
Mountain South	97	3.8	4.1
Pacific	398	15.6	11.7
Total	2550	100.0	100.0

3.3 Number of ceiling fans per household

Question 1 asked respondents for the number of ceiling fans in their home. We assumed that respondents who answered '10 or more' fans for question 1 had 10 fans. Table 3 shows the total number of ceiling fans reported by all respondents and by respondents in each division. It also shows the estimated mean number of ceiling fans per household, which is also shown in Figure 2.

Table 3. Total number of ceiling fans reported by survey respondents.

RECS division	Fans reported	Mean number of fans per household
All Divisions	7695	2.93
New England	256	2.31
Middle Atlantic	869	2.63
East North Central	1051	2.72
West North Central	506	2.56
South Atlantic	2099	3.36
East South Central	429	3.02
West South Central	1016	3.52
Mountain North	176	2.24
Mountain South	344	3.49
Pacific	949	2.38

Figure 2 shows the mean number of ceiling fans per household nationally and for all divisions. The Mountain South and West South Central divisions have the most ceiling fans per household, and the Mountain North and New England divisions have the least. We estimated the national mean number of ceiling fans per household to be 2.93, 95% CI [2.80, 3.05]. These numbers are only for homes with ceiling fans. Our estimate is very similar to the national mean number of ceiling fans per household with ceiling fan(s) reported in RECS 2009: 2.90, [2.83, 2.97]. Additionally, the mean number of ceiling fans per household was within the 95% CI of our estimate for each division in RECS.

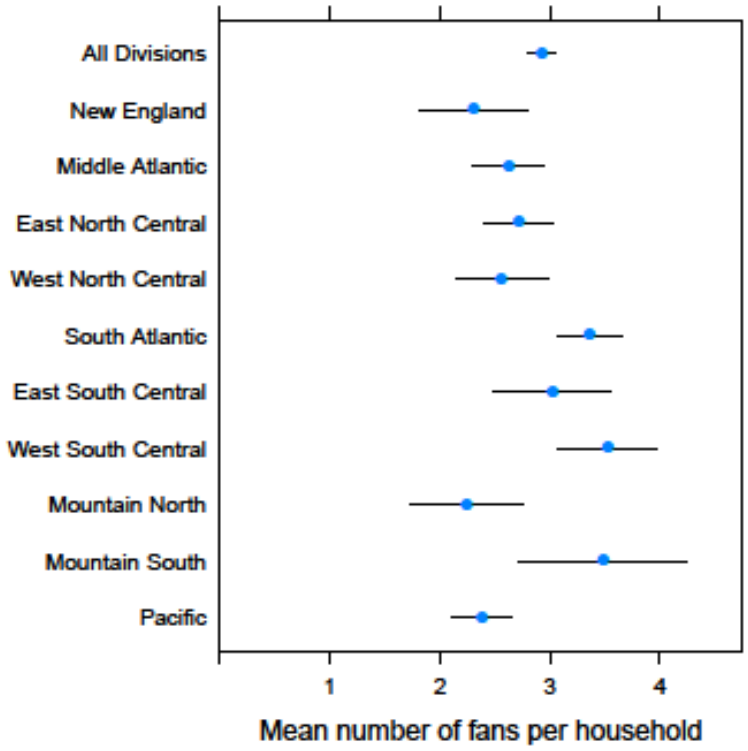

Figure 2. Mean number of ceiling fans per household with ceiling fan(s). Horizontal bars represent the 95% confidence interval for each mean.

3.4 Operating hours

3.4.1 Analysis overview

We used several steps to estimate ceiling fan operating hours for each respondent. We first estimated the proportion of days of each month that the respondent operated one or more fans. We then estimated the hours per day that the respondent operated their most-used fan. From these values, we calculated the hours of operation for the respondent's most-used fan. We then used that number to estimate the hours of operation for all other fans in the respondent's household.

We have not estimated light kit hours of operation or energy consumption, because we included few questions on light kit operation in the survey. As a result, any estimates of hours or energy for light kits would need to rely mostly on data from sources other than our survey.

3.4.2 Hours for most-used fan

In question 3, respondents reported the frequency with which they used one or more ceiling fans for each month. We converted the categorical responses into a quantitative proportion of each month, using the values in Table 4. We excluded all respondents with "Don't know" or blank responses for all months, but we included respondents if only a portion of their responses were "Don't know" or blank.

We converted blank responses to 0, because there were many blank responses, and we found during the pilot survey that respondents left months blank when they did not use a fan during that month. We converted "Don't know" responses to 0.25 because that was the lowest non-zero response level. We assumed that months marked as "Don't know" corresponded to a small amount of use.

We also investigated the sensitivity of the results to (a) allocating a different proportion to the "A few days" responses (from 0.05 to 0.25), (b) allocating a different proportion to the "Don't know" responses (from 0.0 to 1.0), and (c) removing respondents with any "Don't know" responses in question 3. We found that these changes in the analytical assumptions would change the calculated mean operating hours by less than 1%.

Table 4. Estimated proportion of month that one or more fans were operated.

Response	**Proportion of month**
Every day	1.0
Most days	0.75
Half the days	0.5
A few days	0.25
Never	0
Don't know	0.25
Blank	0

Question 4 asked respondents the number of hours per day that their most-used ceiling fan was in use (a) during the month that the fan is used most, and (b) during a month when fan usage is relatively low. We used these values to estimate the number of hours per day that the most-used fan was operated for each month in the year. We assigned the "most" hours to the month(s) with the highest frequency in question 3, the "low" hours to the month(s) with the lowest frequency, and we linearly interpolated the hours

for month(s) with intermediate frequency. For a small number of respondents who provided only a single frequency in question 3 or a single hour value in question 4, we used the average of the hour values or the single hour value, respectively.

We calculated the hours for the most-used fan in each month by multiplying the proportion of the month derived from question 3, the number of hours per day derived from question 4, and the number of days in the month (e.g., January has 31 days). We then added the hours per month for all twelve months to estimate the annual hours for the most-used fan.

3.4.3 Hours for other fans

Questions 8 and 11 asked respondents for the amount that their second and third most-used fans were used relative to their most-used fan. We converted those responses into a proportion of the use of the most-used fan, using the values in Table 5. We removed all respondents who left these questions blank or answered with "Don't know".

Table 5. Estimated proportion of most-used fan hours for second and third most-used fans.

Response	**Proportion of most-used fan hours**
The same amount	1.00
Almost as much (70-90%)	0.80
About half as much	0.50
About 1/3 as much	0.33
Far less (10%)	0.10
Not used	0.00

A small number of respondents reported a larger proportion for their third most-used fan than they reported for their second most-used fan. We assumed that these respondents were estimating the use of the third most-used fan relative to their second most-used fan. Therefore, we calculated their third most-used fan proportion by multiplying the proportions reported for the second most-used and third most-used fans.

We calculated the proportion of use of any remaining ceiling fans in the household by extrapolating from the proportions used for the second and third most-used fans. Respondents reported the number of fans in their home in question 1. We did not, however, include questions specifically asking the amount of use for these fans. Instead,

we assumed that the rate of decrease in use between the second and third most-used fans would continue for the remaining fans in the household.

For example, if a respondent used their third most-used fan half as much as their second most-used fan, we estimated the use of the fourth fan to be half of the third fan's use, and we estimated the use of the fifth fan to be half of the fourth fan's use, and so on. We used this approach to estimate an amount of use for all of the fans reported in question 1. We assumed that respondents who answered '10 or more' fans for question 1 had 10 fans.

We then calculated the annual hours of use for all fans other than the most-used fan by multiplying the annual hours for the most-used fan by the proportion of use estimated for all other fans.

3.4.4 Results

We added the hours for all fans in a household to estimate the household's annual ceiling fan hours of use. We then divided by the number of fans in the household and by 365 to get the mean hours per fan per day for each household.

Figure 3 shows the distribution of operating hours per fan per day. The distribution is broad but bimodal: although most fans operate for less than 5 hours per day, over 3% of fans operate for 24 hours per day. To illustrate the shape of the distribution, we fit a log-normal distribution to all hours below 24, and we added a schematic of a delta function at 24 hours. This shows that operating hours for most fans can be characterized by a positively-skewed distribution. On the other hand, there are also a large number of fans that respondents report operating 24 hours per day. Table 6 shows the values of the summary statistics shown in Figure 3.

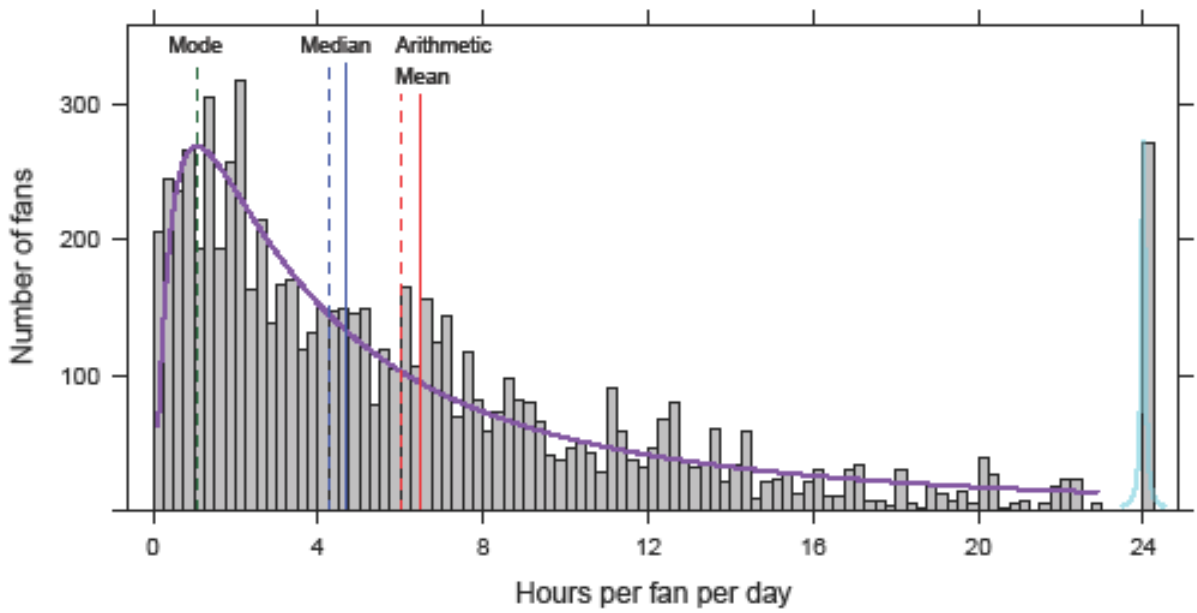

Figure 3. Distribution of hours per fan per day. Grey vertical bars show the histogram of hours. Solid vertical lines show the median and arithmetic mean of all results. The purple line shows a lognormal distribution fit to all results less than 24 hours, and the dashed vertical lines mark the mode, median, and arithmetic mean of this fitted distribution. The cyan line shows a delta function representing the large number of observations at 24 hours.

Table 6. Values of summary statistics shown in Figure 3.

Subset of results	**Mode**	**Median**	**Arithmetic Mean**
Hours for all fans	Not shown	4.69	6.45
Distribution fit to all values less than 24 hours	1.06	4.25	6.02

We have chosen to report the arithmetic mean as a summary statistic for hours, even though the distribution of hours per fan per day is not normally distributed. We have done this because we expect that readers may want to be able to use the numbers we report to estimate total hours of operation for the country or for a division. This calculation can be done easily with the arithmetic mean, as the mean can be multiplied by (a) our estimate of the number of ceiling fans per household, and (b) the number of households with ceiling fans reported in RECS 2009. This is not as easily done with any other form of average, such as a geometric mean.

Figure 4 shows our estimated mean hours per fan per day nationally and for each division. The resulting national mean hours per fan per year is 2350, 95% CI [2270, 2440]. We also estimated the national total annual operating hours by multiplying the mean hours per fan per year by our estimated mean number of fans per household and the number of households with ceiling fans reported in RECS 2009 (i.e. 82.6×10^6 households). We estimated this number to be 5.69×10^{11} hours, [5.40×10^{11}, 5.98×10^{11}].

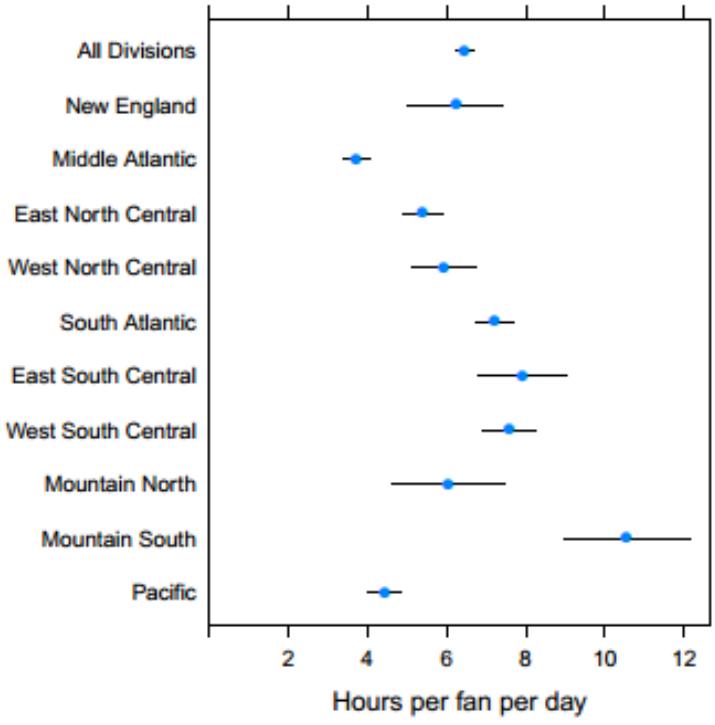

Figure 4. Mean hours of ceiling fan operation per day. This figure shows arithmetic means, and horizontal bars represent the 95% confidence interval for each mean.

3.4.5 Relation between hours and fan size

Questions 6, 10, and 13 asked respondents for the blade span of their first, second, and third most-used fans. Figure 5 shows the relation between fan size and the annual hours of operation. Fans with a span of approximately 5 feet are operated more often than smaller fans. Fans with a span of approximately 6 feet are operated less frequently than smaller fans, but there are a small number of fans with a span of 6 feet or larger. As a result, 6 foot and larger fans may be specialty fans.

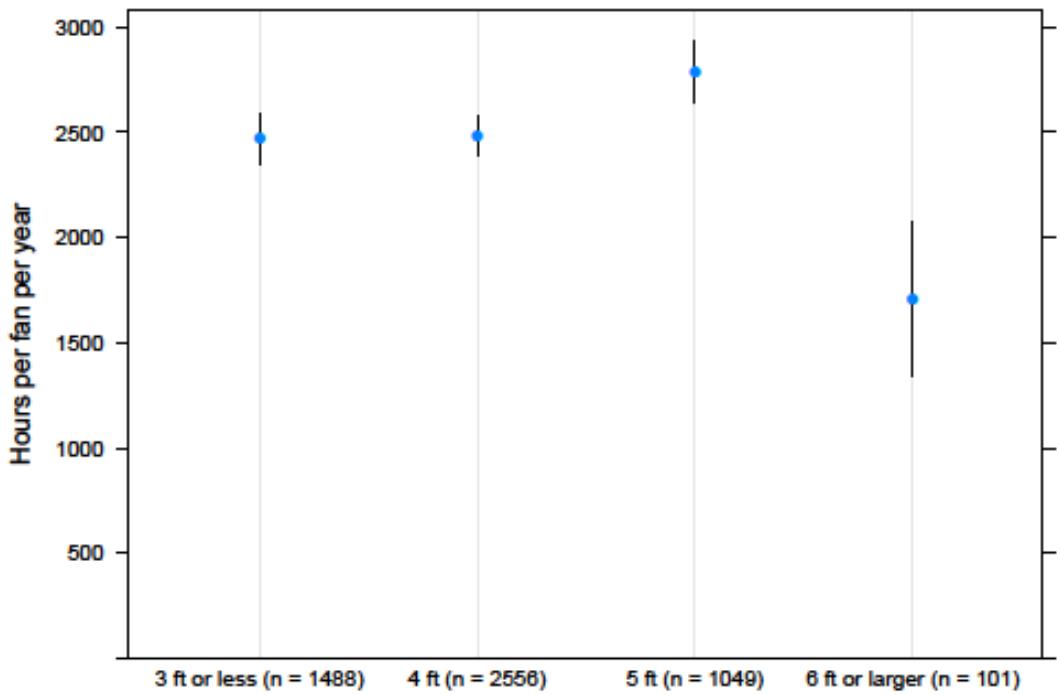

Figure 5. Mean annual hours of operation per ceiling fan for each category of fan size. Vertical bars represent the 95% confidence interval for each mean.

3.5 Hours of operation at each fan speed

3.5.1 Analysis

We used responses to questions 5, 9, and 12 to determine the proportion of time that the first, second, and third most-used fans were used at each speed. The vast majority of ceiling fans have three possible speed settings, so we asked specifically for the proportion of time at high, medium, and low speed. We also included options for respondents to indicate that their fan had only a single speed or fewer than three speeds. Although it is possible that some fans have more than three speed settings, we relied on the respondents to assess time spent at the various fan settings as time spent at high, medium, or low.

We converted the categorical responses into an estimated proportion of time for each speed using the values in Table 7. We also identified a smaller number of fans as single-speed fans, and we excluded any respondents who did not provide enough information to estimate the speed proportions of a fan. We converted blank responses to 0, because we found during the pilot survey that some respondents left speeds blank when they did not use that speed. We converted "Don't know" responses to 0.1 because that was the lowest non-zero response level. We assumed that speeds marked as "Don't know" had a small amount of use, but not enough for the respondent to remember.

We also investigated the sensitivity of the results to (a) allocating a different proportion to the "Don't know" responses (from 0.0 to 1.0), and (b) removing respondents with any "Don't know" responses in questions 5, 9, or 12. We found that excluding respondents or changing the proportion would change the calculated distribution of operating hours at each speed by less than 1.0%.

Table 7. Estimated proportion of time at each speed.

Response	**Proportion of time at selected speed**
0 - 20%	0.1
20 - 40%	0.3
40 - 60%	0.5
60 - 80%	0.7
80 - 100%	0.9
Don't know	0.1
Blank	0

For the responses corresponding to each fan, we adjusted the proportion of time spent at each speed such that the total proportion of time spent at all speeds would equal 100%. In other words, we divided the estimated proportion for each speed by the sum of the estimated proportions for all speeds for each fan. For example, if a respondent said they used a fan at low, medium, and high speeds all 50% of the time each, we estimated that they used each speed 33.3% of the time (i.e. 50% ÷ [3 × 50%] = 33.3%).

We estimated the speed proportions of any remaining ceiling fans in the household to be the same as the speed proportions for the third most-used fan. We then multiplied the

annual hours of operation for each fan by the estimated proportion of time for each speed, to get the estimated annual hours spent at each speed.

3.5.2 Results

Figure 6 shows the estimated proportion of ceiling fan hours of operation spent at each speed nationally and for each division. This figure includes only the hours for multi-speed fans. We found that single-speed fans represented 4.20% of fans, 95% CI [3.68, 4.72], and 3.08%, [2.41, 3.75], of ceiling fan operating hours nationally.

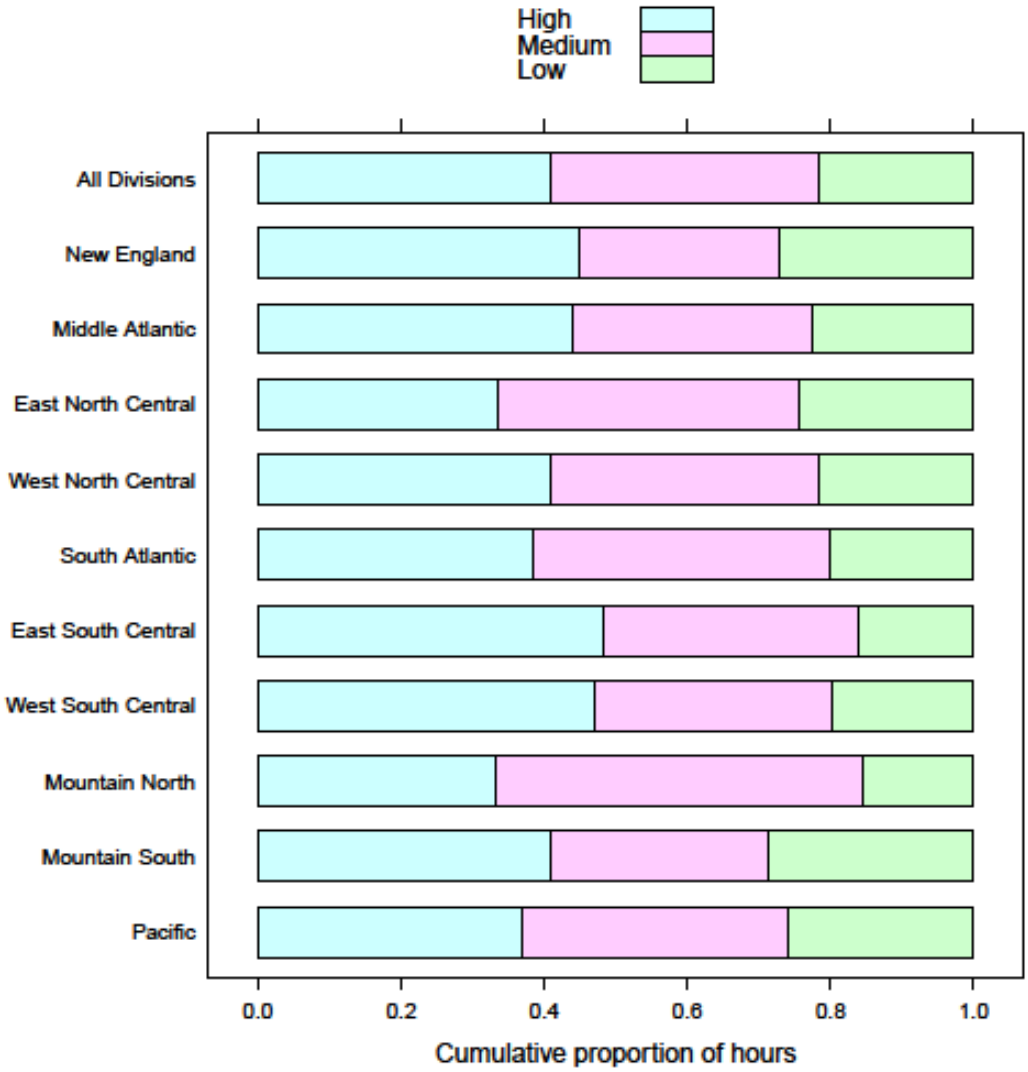

Figure 6. Estimated proportion of time that multi-speed fans are operated at each speed.

3.6 Energy consumption

3.6.1 Analysis

In order to calculate energy consumption, we needed to identify the power consumed by ceiling fans at each speed and by single-speed ceiling fans. For multiple-speed ceiling fans, we used an average for each speed from values we observed during store visits. We visited Home Depot and Lowe's stores during the period July to December 2013, and we recorded the power values on the ceiling fan packaging for all the models available in the store. Home Depot and Lowe's collectively represent 70% of ceiling fan sales (NPD Intellect, 2011), so it is likely that the selection in their stores is representative of the market. There is more uncertainty about the mean power values for low and medium speeds, because most fan packages we observed provided power for high speed only. For single-speed ceiling fans, which are no longer sold in the residential market, mean power level was estimated using expert opinion (V. Mehta, personal communication, March 14, 2013). Table 8 shows the power values that used for each speed in the energy use analysis.

Table 8. Power used to estimate energy for each fan speed.

Speed	**Watts**
Low	13
Medium	32
High	62
Single speed	100

We multiplied the annual hours that each fan spent at each speed by the power at each speed to estimate the fan's annual energy consumption at each speed. We then summed across speeds to get each fan's total annual energy consumption.

3.6.2 Results

Figure 7 shows the mean annual energy consumption per ceiling fan per year, both nationally and for each division. The distribution of ceiling fan energy consumption is positively skewed, similar to the distribution of operating hours. To estimate the national total annual energy consumed by ceiling fans, we multiplied the mean energy consumption per fan by our estimate of the number of ceiling fans per household and the number of households with ceiling fans reported in RECS 2009. We estimated this number to be 2.40×10^{10} kilowatt-hours, 95% CI [2.27×10^{10}, 2.52×10^{10}].

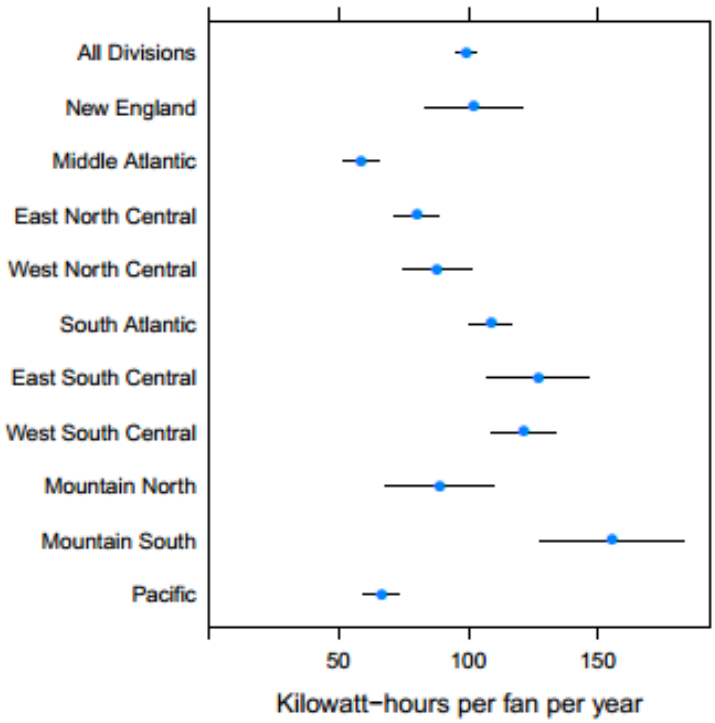

Figure 7. Mean annual energy consumption per ceiling fan per year. The means are arithmetic means, and the horizontal bars represent the 95% confidence interval for each mean.

3.6.3 Comparison with other studies

Calwell and Horowitz (2001) provided national estimates of annual ceiling fan energy consumption by relating hours of operation to cooling degree days, calibrating based on results from small studies in Canada and Florida. Table 9 compares the national mean values from their estimate and ours. In order to provide a fair comparison, we have expressed both sets of household numbers relative to all households in the nation, including households without ceiling fans.

Calwell and Horowitz's estimate of hours per fan per day is very similar to ours. They found a smaller number of hours per household per year, largely because there were fewer fans per household at that time. This can be seen in the RECS data: the percentage of houses with ceiling fans and the number of fans per household increased from 61% and 1.53, respectively, in RECS 1997 (the data used by Calwell and Horowitz) to 73% and 2.11 in RECS 2009. Calwell and Horowitz also used a larger average power than we did, resulting in an estimated annual energy consumption only slightly smaller than our estimate.

Table 9. National estimates reported in Calwell and Horowitz (2001) and our survey. Fans, hours, and energy per household are expressed relative to all households in the nation, including households without ceiling fans.

Study	**Hours per fan per day**	**Fans per household**	**Hours per household per year**	**Watts per fan**	**Kilowatt-hours per household per year**
Calwell and Horowitz 2001	6.2	1.5	3400	59	200
Current study	6.4	2.1	5000	42	210

RLW Analytics (2002) provided estimates of hours and energy per ceiling fan for California. These estimates came from the field monitoring they performed. They focused on the fans used most frequently in each home (See page 13 of RLW Analytics, 2002). In order to provide a similar comparison, we have compared their estimates with the estimates calculated for our California survey respondents, using only the three most-used fans in each respondent's household.

Table 10 shows the estimates from RLW Analytics (2002) and our survey. Our estimates have substantially higher hours and kilowatt-hours per fan. It is possible that the estimates from RLW are lower than typical use. A report by Davis Energy Group, prepared for Pacific Gas and Electric Company, indicated that the monitoring for the RLW Analytics study occurred during the time of the California energy crises (Davis Energy Group, 2004). As a result, it is possible that homeowners were operating electric appliances less than normally at the time.

Table 10. Mean energy, hours, and power reported in RLW Analytics study and our survey.

Study	**Kilowatt-hours per fan**	**Hours per fan**	**Watts per fan**
RLW Analytics 2002	32.8	897	36.6
Current study	73.4	1734	42.3

3.7 Impact of ceiling fans on air conditioning usage

Although fans are often advertised as a way to reduce the cost of air conditioning, it is an open question whether, in practice, people operate their air conditioner differently when their ceiling fan is running. We asked two questions about air conditioning in the survey. Question 16 asked respondents whether they have air conditioning in their home. We found the proportion of all respondents with air conditioning to be 87.5%, 95% CI [86.2, 88.7]. This proportion is very similar to the proportion reported in RECS 2009, 87.1%, [86.4, 87.8].

Question 17 asked the respondents with air conditioning whether they adjust their thermostat when their ceiling fan is running. Table 11 provides the proportions and confidence intervals for all respondents. Over 70% of respondents did not adjust their thermostat when their ceiling fan was operating. This proportion varied between divisions, with a low of 57.2%, 95% CI [46.5, 67.9] in the Mountain South division, and a high of 87.7%, [78.0, 97.4] in the Mountain North division.

Table 11. Air conditioning thermostat adjustment due to ceiling fans for all respondents who operate air conditioning with ceiling fan (n=1915). Confidence intervals in this table were Bonferroni-corrected to represent 95% confidence across all proportions.

		95% Confidence Interval	
Thermostat adjustment	**Percentage**	**Lower**	**Upper**
Thermostat is set warmer by more than 3 degrees	6.43	4.98	7.87
Thermostat is set warmer by 3 degrees or less	17.54	15.3	19.78
No adjustment to thermostat is made	70.22	67.53	72.91
Thermostat is set cooler by 3 degrees or less	4.02	2.86	5.17
Thermostat is set cooler by more than 3 degrees	1.79	1.01	2.57

RLW Analytics (2002) also asked California householders whether they adjusted the air conditioning thermostat when ceiling fans were operating. Of the 34 participants they surveyed, 77%, 95% CI [62, 91], did not adjust the thermostat when their ceiling fan was operating. This proportion was similar to proportion we found for our California participants, 76.4%, [69.4, 83.5], (n=138).

3.8 Operation of fan with no one in room

In question 24, we asked respondents how often ceiling fans in their home were run when no one is in the room. Figure 8 provides the results for this question, for all respondents and for each division. In addition to showing the percentage of respondents who reported each response, we also report the mean proportion of time that fans operate with no one in the room. We calculated the mean proportion by multiplying the percentage of respondents choosing each response by the mean proportion associated with each response (e.g., "Almost always (90-100% of the time)" corresponds to a mean proportion of 95%), and summing the resulting products across all responses.

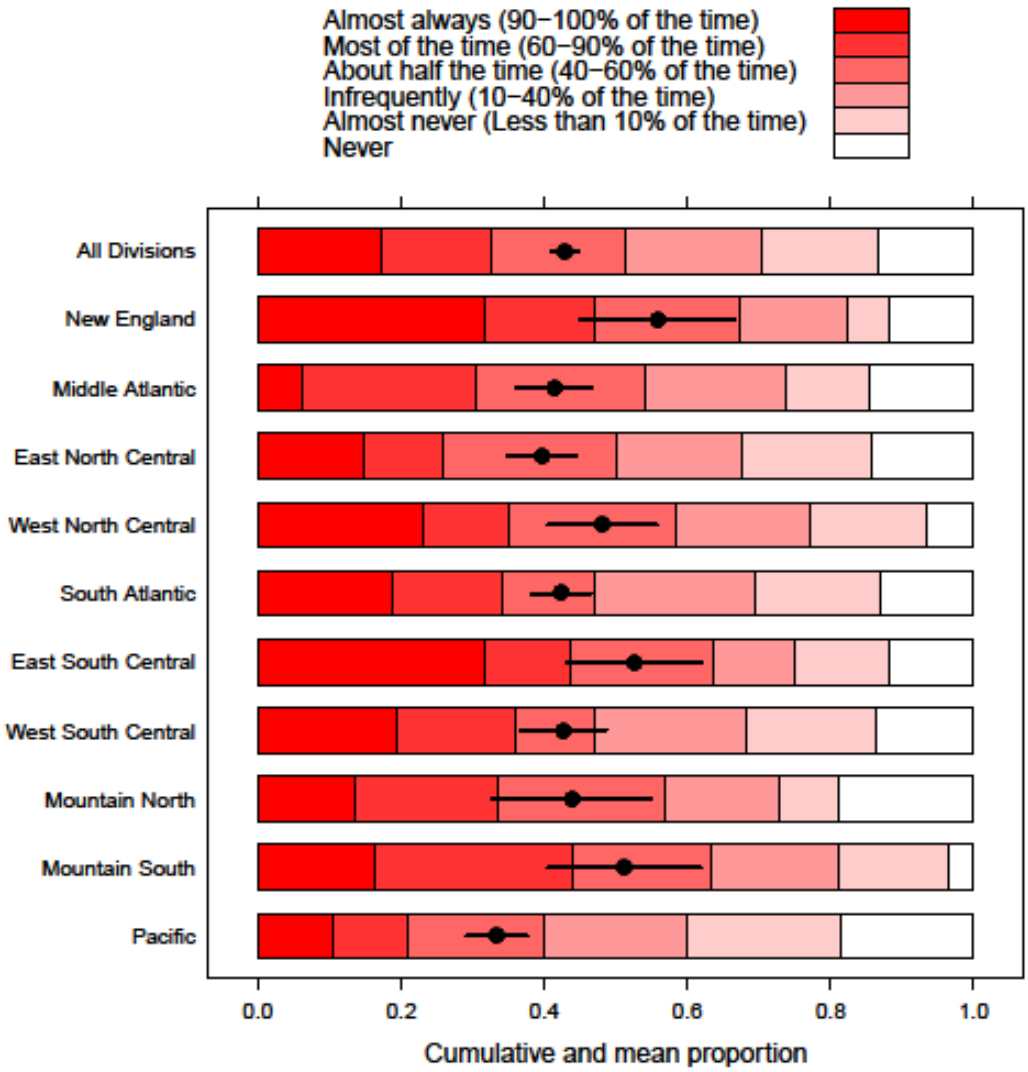

Figure 8. Operation of fans with no one in the room. Stacked bars represent the fraction of respondents who chose each response. Solid circles and horizontal bars represent the mean proportion and 95% confidence interval calculated from all responses.

3.9 Operation of fan overnight

For each respondent, we calculated the proportion of fans outside of the bedroom that are sometimes run overnight. We did this by dividing the number of fans outside the bedroom operated overnight reported in question 22 by the number of fans outside the bedroom reported in question 2. Across all participants (and 3805 fans), the proportion of fans run overnight was 35.1%, 95% CI [33.6, 36.7]. This proportion varied between divisions, with a low of 28.3%, [24.4, 32.2], in the East North Central division (518 fans), and a high of 49.6%, [43.6, 55.6] in the West North Central division (266 fans).

For fans that are sometimes run overnight, question 23 asked respondents the frequency with which fans outside of the bedroom were operated overnight during the hottest three months of the year. Figure 9 provides the results for this question, nationally and for each division. We have shown the percentage of respondents who reported each response, as well as the mean proportion. We calculated the mean proportion by multiplying the percentage of respondents choosing each response by the mean proportion associated with each response, and summing the resulting products across all responses.

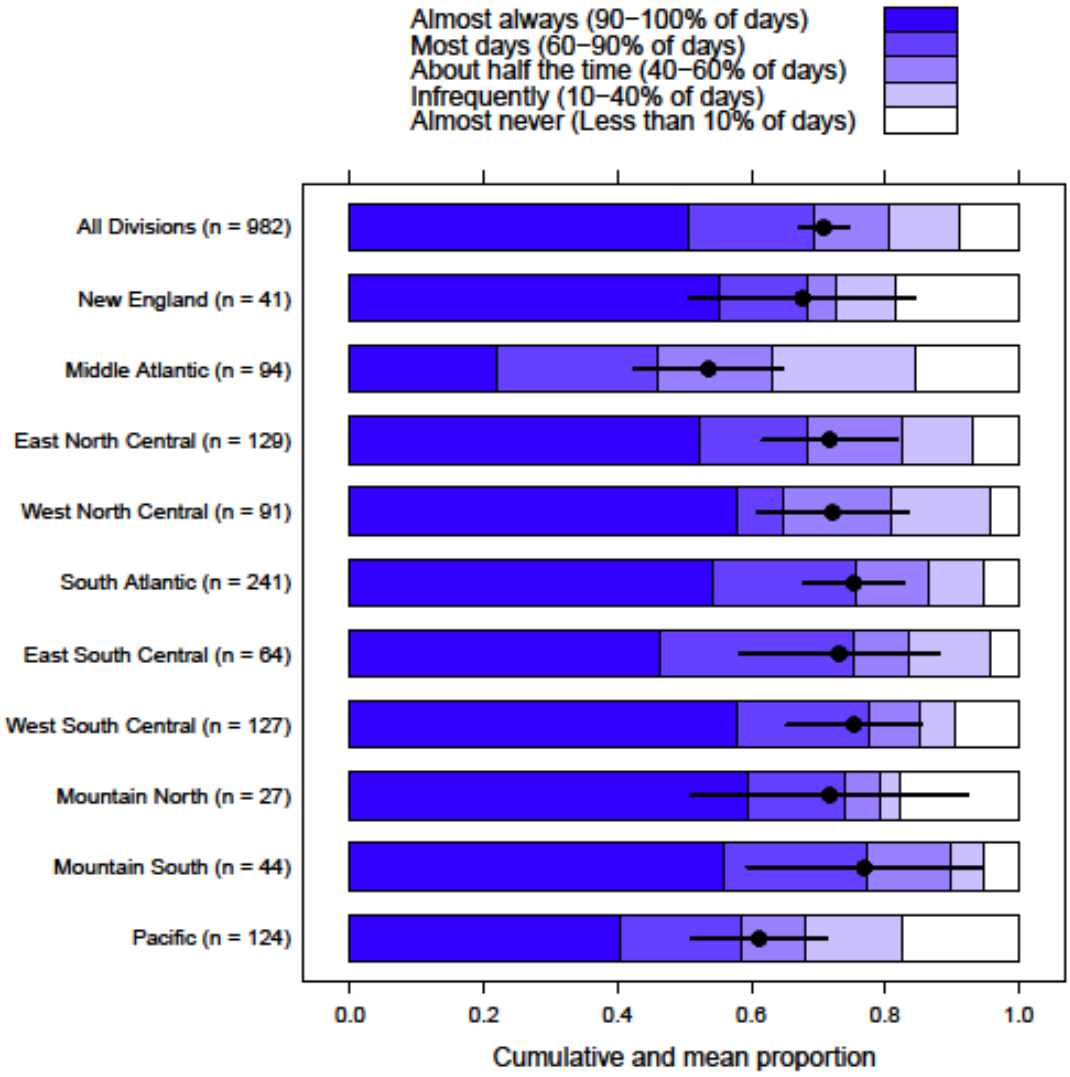

Figure 9. Overnight operation of ceiling fans outside the bedroom during the three hottest months of the year. Stacked bars represent the fraction of respondents who chose each response. Solid circles and horizontal bars represent the mean proportion and 95% confidence interval calculated from all responses.

3.10 Ceiling fan controls

In question 21, we asked respondents about the type of control they primarily used to switch the settings of the ceiling fans in their home. We allowed respondents to choose only one type of control for this question. Table 12 provides the proportions and confidence intervals for all respondents. Over half of respondents primarily use a pull chain to control their fan(s).

Table 12. Proportions of respondents who primarily use each type of control for their ceiling fan(s). Confidence intervals in this table were Bonferroni-corrected to represent 95% confidence across all proportions.

		95% Confidence Interval	
Control type	**Percentage**	**Lower**	**Upper**
Pull chain/chord	57.57	55.04	60.10
Wall switch (on-off only)	23.16	21.00	25.32
Wall control (on-off and variable speed control)	10.81	9.22	12.40
Remote control (battery operated)	7.40	6.06	8.74
Other	1.07	0.54	1.59

3.11 Proportion of fans with light kits

We calculated the proportion of ceiling fans with light kits using the numbers for fans and light kits reported in question 2. Figure 10 shows the resulting proportions of ceiling fans with light kits, expressed as a proportion of the total number of ceiling fans, for all respondents and each division.

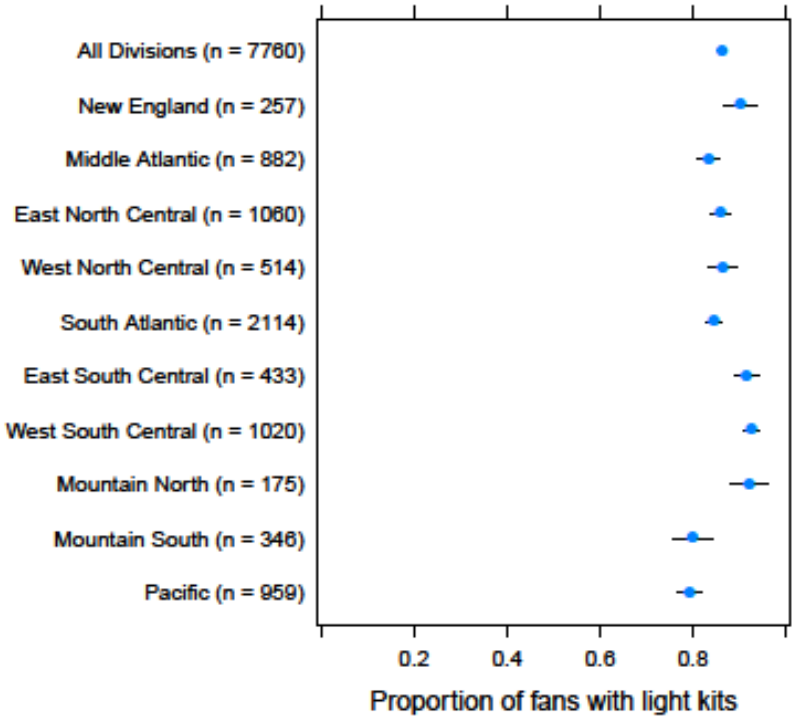

Figure 10. Proportion of ceiling fans with light kits.

Figure 11 shows the proportion of ceiling fans with light kits calculated for each room, expressed as a proportion of the number of fans. We tried to prevent any confusion between ceiling fans and ventilation or exhaust fans, as might be expected for fans in bathrooms and kitchens. To do this, we included the following text at the start of the survey:

> For the purposes of this survey, ventilation fans such as the ventilation fans sometimes found in bathrooms or in the attic of a house are NOT considered to be ceiling fans. Fans enclosed inside the ceiling, such as whole-house fans, are also NOT considered to be ceiling fans.

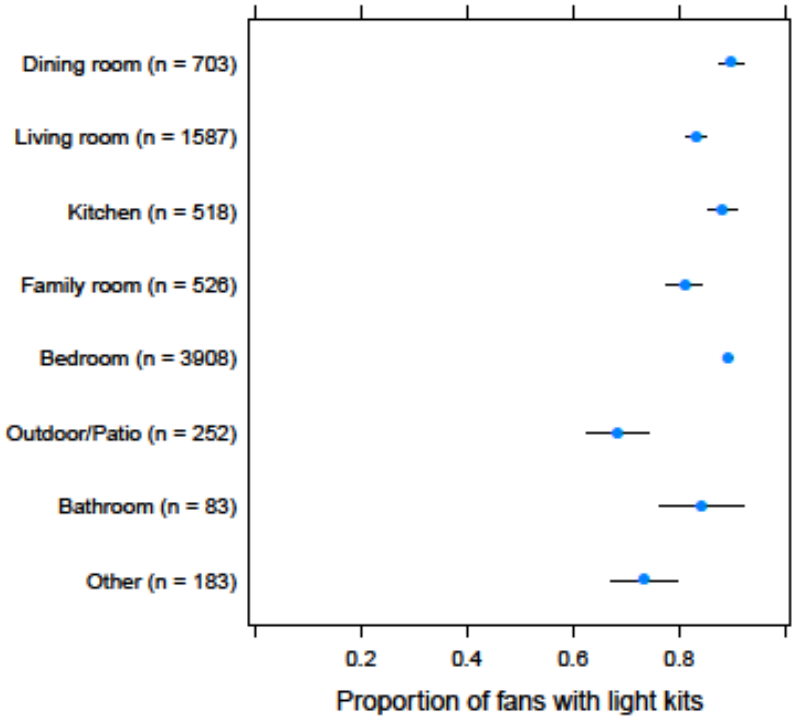

Figure 11. Proportion of fans with light kits, reported by room.

3.12 Light sockets

In question 26, we asked respondents about the type of light sockets in their most-used ceiling fan that includes lights. Figure 12 illustrates the proportion of total light kits corresponding to each type of light socket, nationally and for each division. Respondents were able to select multiple socket types in this question, and we included all light kits with a combination of socket types in a single response category.

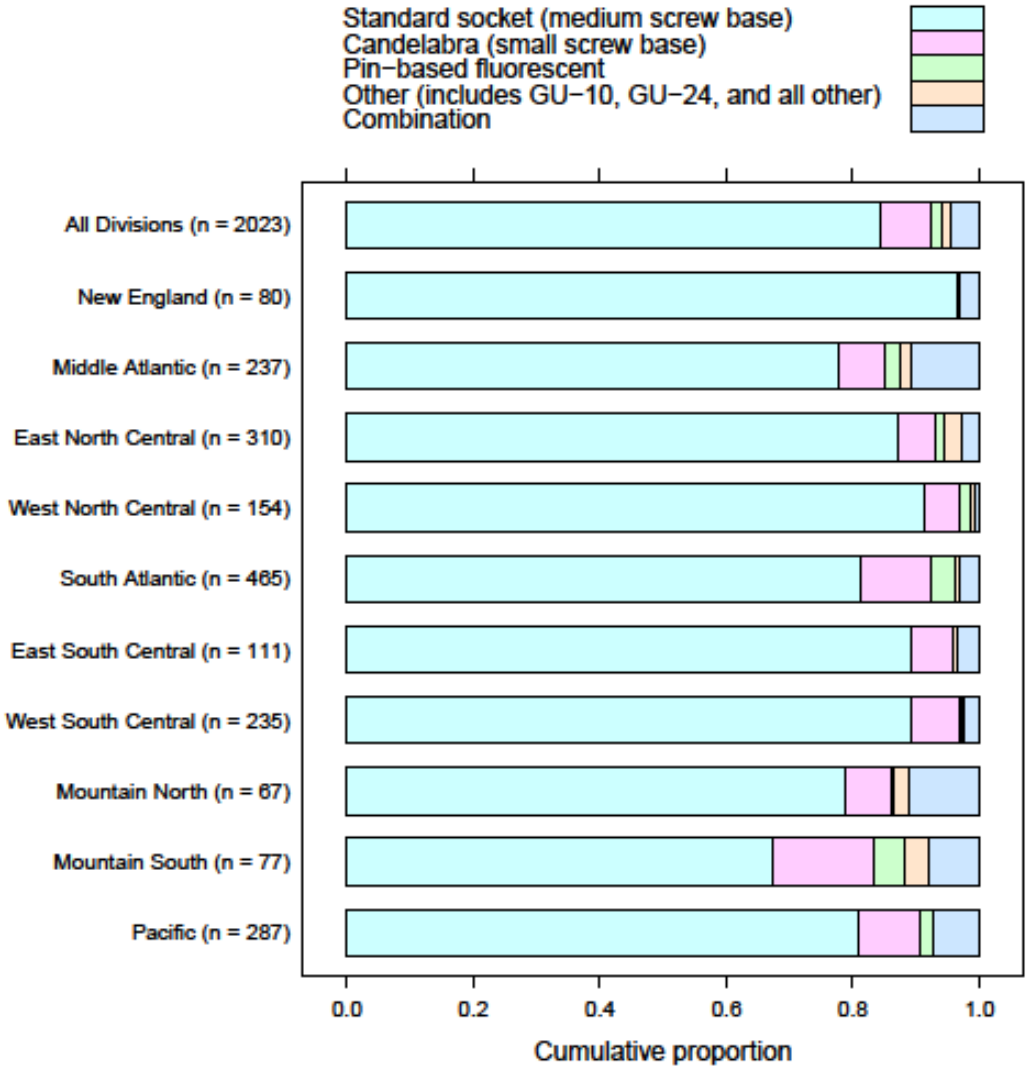

Figure 12. Proportion of light kits with each socket type.

3.13 Light bulbs

Question 27 asked respondents about the type of light bulbs in their most-used ceiling fan that includes lights. Figure 13 illustrates the proportion of total light kits corresponding to each type of light bulb, nationally and for each division. Respondents were able to select multiple bulb types in this question, and we included all light kits with a combination of light bulb types in a single response category.

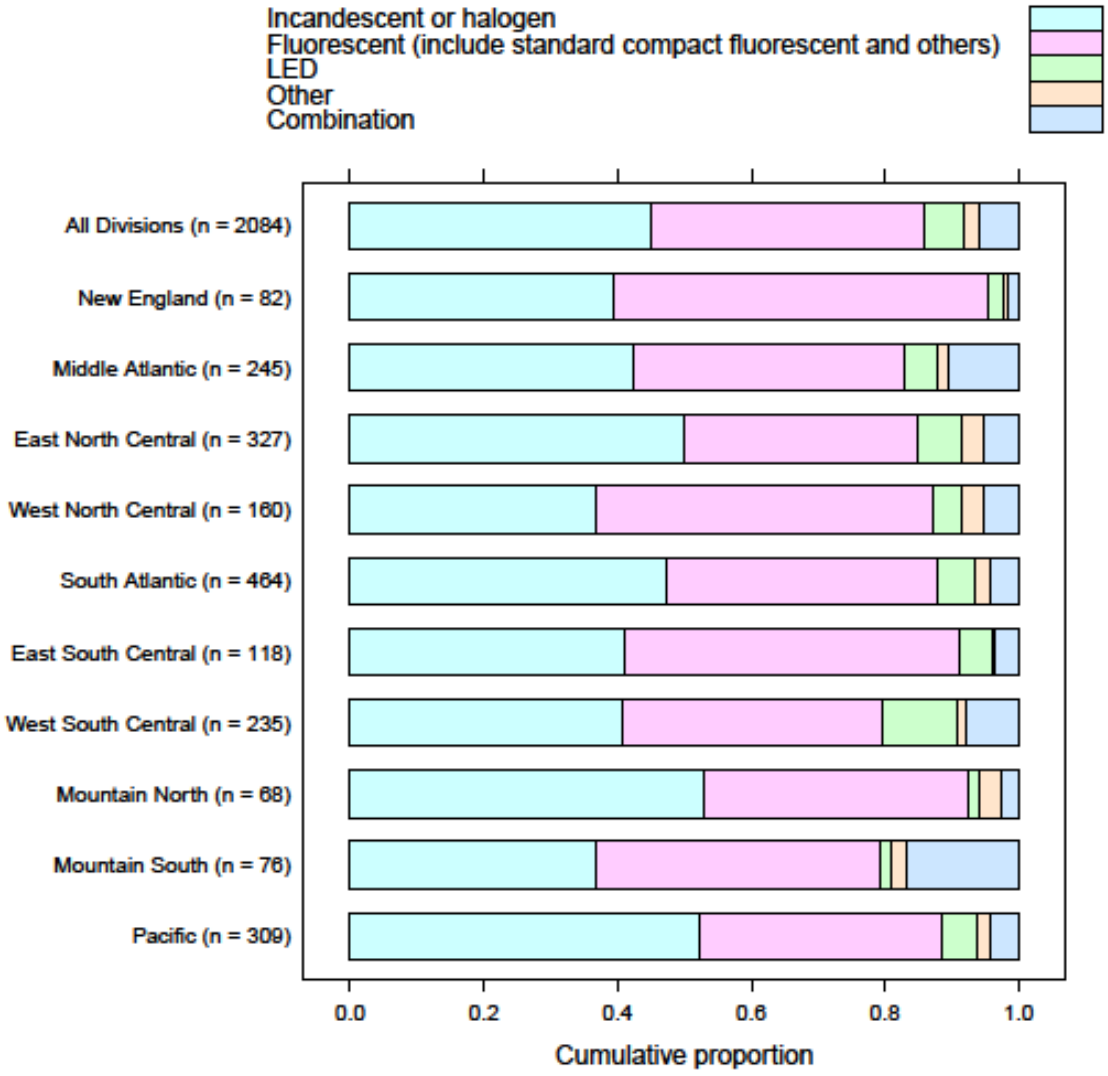

Figure 13. Proportion of light kits with each bulb type.

3.14 Light controls

Questions 28 and 29 asked respondents about the controls used for their most-used ceiling fan that has lights. Figure 14 shows the proportion of total light kits corresponding to each type of control, nationally and for each division.

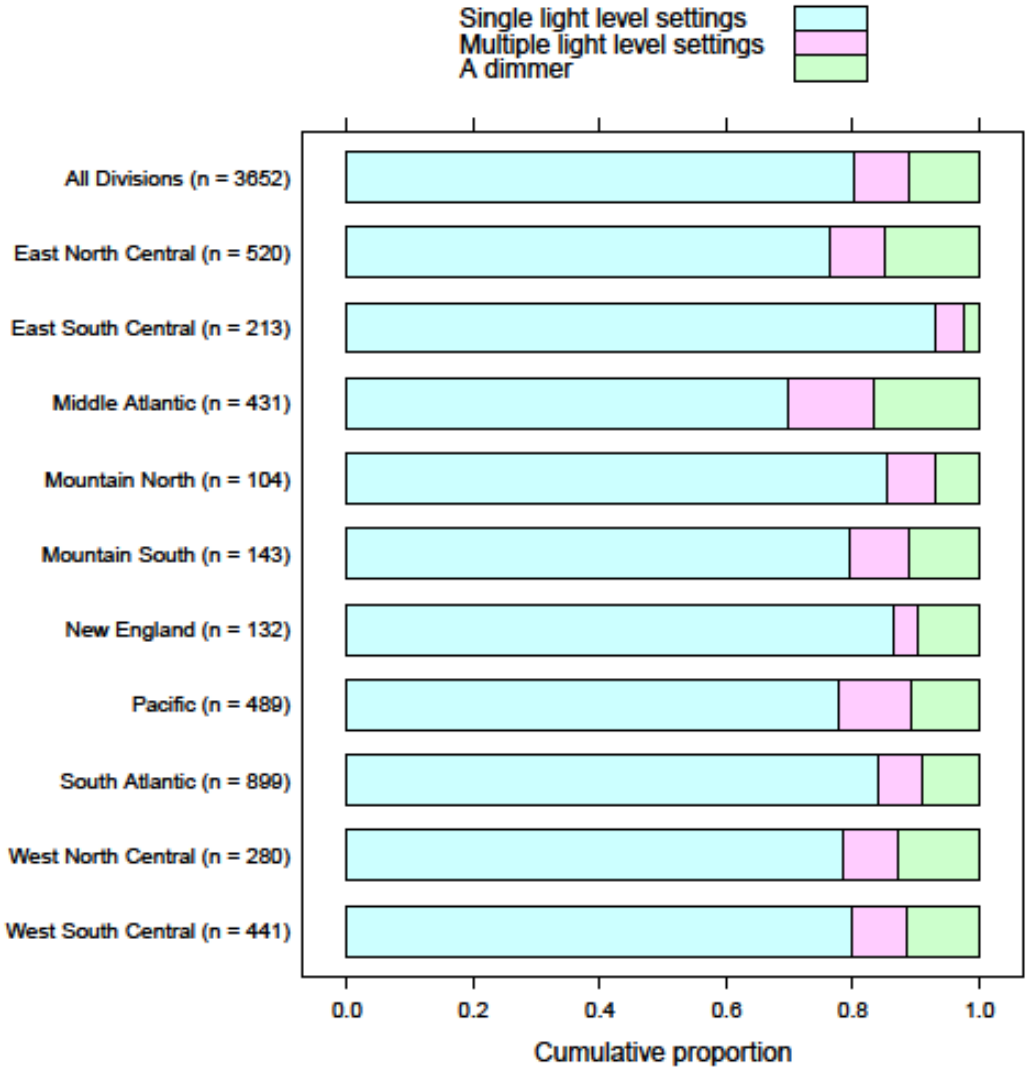

Figure 14. Proportion of light kits with each control type.

Table 13 shows the proportion of light kits with controls allowing for dimming or multiple light settings that respondents reported actually using to adjust the light level (i.e., not just turning the light kit on and off).

Table 13. Proportion of light kits with controls to adjust the light level that are actually used to adjust the light level.

		95% Confidence Interval	
Control type	**Percentage**	**Lower**	**Upper**
Dimmer (n = 441)	81.5	77.9	85.1
Multiple light level settings (n = 267)	73.7	68.4	79.0

4 General discussion

This report provides an overview of a survey conducted to explore residential ceiling fan use in the U.S. We deployed the survey on Amazon Mechanical Turk, and we have analyzed responses from 2550 respondents. We have presented the detailed results for several topics in this report, and the tabulated responses to all questions are in Appendix B.

This survey has allowed for detailed estimates of hours of operation and energy consumption for ceiling fans nationally and in each RECS division. We found that the distribution of hours of operation per fan per day is bimodal, and it can be approximated with the combination of a positively-skewed distribution and delta function. Knowledge of this distribution can be useful for understanding how much of the population could be affected by efforts to reduce energy consumption.

We found that the average fan in the U.S. consumes approximately 99 kWh per year. Fans in the Mountain South division have the highest hours and energy consumption, with an average energy consumption of 155 kWh per fan. Fans in the Middle Atlantic division have the lowest energy consumption, with 59 kWh per fan.

When compared with other studies, we found that our estimate of operating hours per ceiling fan per day was similar to the hours per fan per day estimated by Calwell and Horowitz (2001). On the other hand, our estimates of hours and energy use for California are much higher than the estimates from the metering study by RLW Analytics (2002). One possible reason for this difference is that RLW Analytics monitored ceiling fan operation during the California electricity crises, a time when households reduced their energy use.

We have also estimated the proportion of hours spent at each fan speed. We find that high speed is the most popular speed nationally, accounting for over 40% of fan operating hours. Low is the least popular speed, accounting for less than 25% of hours.

Our results for air conditioning are similar to the results from other surveys. Most of our respondents had air conditioning, and the proportion of households is similar to the proportion found in RECS 2009. In addition, we find that 70% of households do not adjust their air conditioner thermostat when the ceiling fan is running. The proportion we found is similar to the proportion found by RLW Analytics when they asked households in California (RLW Analytics, 2002).

We found that fans are operated for a considerable amount of time when no one is in the room. This includes operation overnight in rooms other than the bedroom. These results suggest that a considerable amount of energy consumption from fans might be due to operation when the fans are not providing any cooling benefit to people. As a

result, there could be potential for increased education or design/control options to reduce energy.

We found that approximately 86% of ceiling fans have light kits, and most of those light kits use standard sockets with either incandescent or fluorescent bulbs. Approximately 20% of lights have adjustable light settings, and over 70% of lights with adjustable settings are adjusted.

Overall, this survey provides information on a number of topics that are important for understanding ceiling fan use. Many of these topics have not been researched previously. These results may be useful for estimating present energy consumption and identifying options for reducing future energy consumption from ceiling fans.

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6 Appendix A: Survey form

This appendix contains the survey form deployed on Amazon Mechanical Turk to sample the general population. The survey was also deployed several times to sample additional respondents from several demographic sub-groups (see Methods for more details). In these cases, we changed only the header on the first page of the survey. All other parts of the survey form were the same for all deployments.

Ceiling Fan Usage Survey

Qualifications: U.S. residents at least 18 years old.

You must have at least one ceiling fan at your primary residence to take this survey!

NOTE: You will NOT GET PAID If you do not qualify for this survey or If you do not answer all questions that you are NOT asked to skip. Also, due to the size of our research study, we may take up to 21 DAYS to pay you.

Ceiling fans are nonportable devices suspended from the ceiling that circulate air via the rotation of fan blades. Portable fans or any fans not attached to the ceiling are NOT considered to be ceiling fans. For the purposes of this survey, ventilation fans such as the ventilation fans sometimes found in bathrooms or in the attic of a house are NOT considered to be ceiling fans. Fans enclosed inside the ceiling, such as whole-house fans, are also NOT considered to be ceiling fans.

General Questions

If you live in more than one home that has a ceiling fan, please restrict your responses to the home you use the most.

We are trying to better understand how, how often and for how long people use ceiling fans both inside their homes and outdoors.

1. How many ceiling fans (both indoor and outdoor) are there in your home?

○ None ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ Don't know

If you answered "None" to the above question, YOU CANNOT PROCEED WITH THE SURVEY! PLEASE STOP AND EXIT.

2. Please indicate the locations and numbers of ceiling fans in your primary residence by filling out the table below

Please insert numbers only

Room	Enter the total number of fans in these rooms	How many of the fans in these rooms include lights?
Dining Room(s)		
Living Room(s)		
Kitchen(s)		
Family room(s)		
Bedroom(s)		
Outdoor/Patio		
Bathroom(s)		
Other		

3. For each of the following months, how frequently are one or more ceiling fans in use in your home?

Month	Frequency of ceiling fan use
January	○ Every day ○ Most days ○ Half the days ○ A few days ○ Never ○ Don't know
February	○ Every day ○ Most days ○ Half the days ○ A few days ○ Never ○ Don't know
March	○ Every day ○ Most days ○ Half the days ○ A few days ○ Never ○ Don't know
April	○ Every day ○ Most days ○ Half the days ○ A few days ○ Never ○ Don't know
May	○ Every day ○ Most days ○ Half the days ○ A few days ○ Never ○ Don't know

June	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
July	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
August	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
September	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
October	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
November	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
December	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know

The following 3 questions are about the most-used ceiling fan in your home.

4. For the most-used ceiling fan in your home, on days when the fan is in use, approximately how many hours a day is it in use?

During the month that it is used the most:

[ ] **hours/day**

During a month when usage is relatively low (but the fan is still used somewhat):

[ ] **hours/day**

5. For the most-used ceiling fan in your home, when it is in use, what percentage of the time is it in use at each of the following speeds (please fill in a percentage for all speeds):

High speed	○ 0 - 20% ○ 20 - 40% ○ 40 - 60% ○ 60 - 80% ○ 80 - 100% ○ Fan doesn't have a high speed ○ Fan only has one speed ○ Don't know

Medium speed	○ 0 - 20% ○ 20 - 40% ○ 40 - 60% ○ 60 - 80% ○ 80 - 100% ○ Fan doesn't have a medium speed ○ Fan only has one speed ○ Don't know

Low speed	○ 0 - 20% ○ 20 - 40% ○ 40 - 60% ○ 60 - 80% ○ 80 - 100% ○ Fan doesn't have a low speed ○ Fan only has one speed ○ Don't know

6. Approximately what is the blade span of the most-used ceiling fan in your home? (The blade span is the diameter of the circle swept by the rotating fan blades.)

○ 3 ft or less
○ 4 ft
○ 5 ft
○ 6 ft or larger
○ Don't know

7. What is the approximate age, in years, of the most-used ceiling fan in your home?

○ 2 or less ○ 2-4 ○ 4-6 ○ 6-8 ○ 8-10 ○ 10-12 ○ 12-14 ○ 14-16 ○ 16-18 ○ 18-20 ○ More than 20 ○ Don't know

The following 3 questions are about the second most-used ceiling fan in your home. **If you only have one ceiling fan in your home, please skip to Question 15.**

8. For the second most-used ceiling fan in your home, how much use does this fan get compared to the most used fan?

(Choose the closest answer.)

- ○ The same amount
- ○ Almost as much (70-90%)
- ○ About half as much
- ○ About 1/3 as much
- ○ Far less (10%)
- ○ Not used
- ○ Don't know

9. For the second most-used ceiling fan in your home, when it is in use, what percentage of the time is it in use at each of the following speeds (please fill in a percentage for all speeds):

High speed	○ 0 - 20% ○ 20 - 40% ○ 40 - 60% ○ 60 - 80% ○ 80 - 100% ○ Fan doesn't have a high speed ○ Fan only has one speed ○ Don't know
Medium speed	○ 0 - 20% ○ 20 - 40% ○ 40 - 60% ○ 60 - 80% ○ 80 - 100% ○ Fan doesn't have a medium speed ○ Fan only has one speed ○ Don't know
Low speed	○ 0 - 20% ○ 20 - 40% ○ 40 - 60% ○ 60 - 80% ○ 80 - 100% ○ Fan doesn't have a low speed ○ Fan only has one speed ○ Don't know

10. Approximately what is the blade span of the second most-used ceiling fan in your home? (The blade span is the diameter of the circle swept by the rotating fan blades.)

- ○ 3 ft or less
- ○ 4 ft
- ○ 5 ft
- ○ 6 ft or larger
- ○ Don't know

The following 3 questions are about the third most-used ceiling fan in your home. **If you have two ceiling fans in your home or less, please skip to Question 14.**

11. For the third most-used ceiling fan in your home, how much use does this fan get compared to the most used fan? (Choose the closest answer.)

- ○ The same amount
- ○ Almost as much (70-90%)
- ○ About half as much
- ○ About 1/3 as much
- ○ Far less (10%)
- ○ Not used
- ○ Don't know

12. For the third most-used ceiling fan in your home, when it is in use, what percentage of the time it is in use at each of the following speeds (please fill in a percentage for all speeds):

High speed	○ 0 - 20% ○ 20 - 40% ○ 40 - 60% ○ 60 - 80% ○ 80 - 100% ○ Fan doesn't have a high speed ○ Fan only has one speed ○ Don't know

Medium speed	○ 0 - 20% ○ 20 - 40% ○ 40 - 60% ○ 60 - 80% ○ 80 - 100% ○ Fan doesn't have a medium speed ○ Fan only has one speed ○ Don't know

Low speed	○ 0 - 20% ○ 20 - 40% ○ 40 - 60% ○ 60 - 80% ○ 80 - 100% ○ Fan doesn't have a low speed ○ Fan only has one speed ○ Don't know

13. Approximately what is the blade span of the third most-used ceiling fan in your home? (The blade span is the diameter of the circle swept by the rotating fan blades.)

- ○ 3 ft or less
- ○ 4 ft
- ○ 5 ft
- ○ 6 ft or larger
- ○ Don't know

We are looking to understand how the people in your household use ceiling fans and how they are combined to create a comfortable temperature in your home.

14. For the following times of year, when at least one ceiling fan is in use, how many ceiling fans in total, are typically in use at the same time?

Time of year	Typical number of ceiling fans in use
During warmer months	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ No fan ever used ○ Don't know
During colder months	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ No fan ever used ○ Don't know
During months with intermediate temperature	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ No fan ever used ○ Don't know

15. How many hours are there in a day?

- ○ 6
- ○ 12
- ○ 18
- ○ 24
- ○ 36
- ○ 48
- ○ Don't know

16. Is there air conditioning in your home, and if so, is it ever run it at the same time as any of the ceiling fans?

- ○ No air conditioning in home
- ○ Home has air conditioning, but ceiling fans and AC are never run at the same time
- ○ Home has air conditioning, and ceiling fans and AC are infrequently run at the same time
- ○ Home has air conditioning, and ceiling fans and AC are sometimes run at the same time
- ○ Home has air conditioning, and ceiling fans and AC are frequently run at the same time
- ○ Home has air conditioning, and ceiling fans and AC are always run at the same time
- ○ Don't know

If you answered "No air conditioning in home" or "Home has air conditioning, but ceiling fans and AC are never run at the same time" to the above question, please skip to Question 18.

17. When ceiling fans and air conditioning are running at the same time, do you (or anyone else in your home) adjust the thermostat settings?

- ○ No adjustment to thermostat is made
- ○ Thermostat is set warmer by 3 degrees or less
- ○ Thermostat is set cooler by 3 degrees or less
- ○ Thermostat is set warmer by more than 3 degrees
- ○ Thermostat is set cooler by more than 3 degrees
- ○ Don't know

18. Many fans are capable of pushing air upwards (instead of down) by rotating in the opposite direction. How many of the ceiling fans in your home are ever run in reverse mode?

If you answered "None" or "Not aware of reverse mode" or "Don't know" to the above question, please skip to Question 21.

19. For each of the following months, how often are the ceiling fans in your home run in reverse mode?

Month	Frequency of ceiling fan use (in reverse mode ONLY)					
January	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
February	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
March	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
April	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
May	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
June	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
July	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
August	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
September	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
October	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
November	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
December	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know

20. On those days that ceiling fans are run in reverse mode, how many hours a day are they run in reverse mode?

hours/day

21. How do you primarily switch the settings of the ceiling fans in your home (for example, to turn ceiling fans on or off, or to change the speed setting)?

- ○ Pull chain/chord
- ○ Wall switch (on-off only)
- ○ Wall control (on-off and variable speed control)
- ○ Remote control (battery operated)
- ○ Other

○ Don’t know

22. How many of the ceiling fans in your home are sometimes run overnight?

Number of ceiling fans located in bedrooms that are sometimes run overnight

○ None ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ Don't know

Number of ceiling fans NOT located in bedrooms that are sometimes run overnight

○ None ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ Don't know

If you answered “None” or “Don’t know” to both parts of the above question, please skip to Question 24.

23. For those ceiling fans that are sometimes run overnight, on days when ceiling fans are in use during the hottest 3 months out of the year, how frequently are they run overnight?

For ceiling fans located in bedrooms

○ Almost always (90-100% of days)
○ Most days (60-90% of days)
○ About half the time (40-60% of days)
○ Infrequently (10-40% of days)
○ Almost never (Less than 10% of days)
○ Don't know

For ceiling fans NOT located in bedrooms

○ Almost always (90-100% of days)
○ Most days (60-90% of days)
○ About half the time (40-60% of days)
○ Infrequently (10-40% of days)
○ Almost never (Less than 10% of days)
○ Don't know

24. Are the ceiling fans in your home ever run when no one is in the room, and if so, what percentage of the time?

○ Never
○ Almost never (Less than 10% of the time)
○ Infrequently (10-40% of the time)
○ About half the time (40-60% of the time)
○ Most of the time (60-90% of the time)
○ Almost always (90-100% of the time)
○ Don't know

We are trying to better understand the use and characteristics of ceiling fan lights. **Please answer the following 5 questions only if you have ceiling fans that include lights.**

25. For those ceiling fans with lights attached, are the lights typically used at the same time as the ceiling fan?

○ Yes, they are typically used together

- ○ They are sometimes used together, sometimes independently
- ○ No, they are typically used independently. They are used the same way normal overhead lights are used.
- ○ Yes, they are typically used together, except overnight
- ○ Don't know

26. For your most-used ceiling fan that includes lights, what kind of light sockets does it have (you can check more than one box if more than one kind is used)?

- ☐ Standard socket (medium screw base)
- ☐ Pin-based fluorescent
- ☐ Candelabra (small screw base)
- ☐ Other (includes GU-10, GU-24, and all other)
- ☐ Don't know

27. For your most-used ceiling fan that includes lights, what kind of light bulbs are you using in it (you can check more than one box if more than one kind is used)?

- ☐ Incandescent or halogen
- ☐ Fluorescent (include standard compact fluorescent and others)
- ☐ LED
- ☐ Other
- ☐ Don't know

28. For your most-used ceiling fan that has lights:

The light on my ceiling fan is 'on-off' only	○ Yes ○ No ○ Don't know
The lighting on my ceiling fan has…	○ A dimmer settings ○ Single light level ○ Multiple light level settings ○ Don't know
If your light kit has a dimmer or multiple light level settings, do you use it or them to adjust light output other than just turning the device on and off?	○ Yes ○ No ○ Not applicable ○ Don't know

29. For your second-most-used ceiling fan that has lights (if applicable):

The light on my ceiling fan is 'on-off' only	○ Yes ○ No ○ Don't know
The lighting on my ceiling fan has…	○ A dimmer settings ○ Single light level ○ Multiple light level settings ○ Don't know
If your light kit has a dimmer or multiple light level settings, do you use it or them to adjust light output other than just turning the device on and off?	○ Yes ○ No ○ Not applicable ○ Don't know

In the following 2 questions, we are trying to understand the typical usage of outdoor fans. **If you indicated in question 2 that you do NOT have any outdoor ceiling fans, please skip to Question 32.**

30. For each of the following months, how frequently are the outdoor ceiling fan(s) in your home actively used?

Month	Frequency of ceiling fan use (outdoor ceiling fans ONLY)					
January	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
February	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
March	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
April	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
May	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
June	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
July	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
August	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
September	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
October	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
November	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know
December	○ Every day	○ Most days	○ Half the days	○ A few days	○ Never	○ Don't know

31. On days when the outdoor ceiling fan(s) are in use, approximately how many hours a day are they in use?

[ ] **hours/day**

32. Right now, as you take this survey, how many ceiling fans are currently on in your home?

○ None ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ Don't know

If you answered "None" or "Don't know" to the above question, please skip to Question 34.

33. Right now, as you take this survey, for the most-used fan that is currently on, what speed is it set to?

- ○ Low
- ○ Medium
- ○ High
- ○ Other
- ○ Single speed
- ○ Don't know

Demographics:

We want to make sure that our survey reflects the make-up of the US population, so we need to ask you a few questions about you and your household.

34. What is your five-digit ZIP code? [ ]

35. What is your gender?

- ○ Male
- ○ Female
- ○ Decline to state

36. Are you Hispanic or Latino?

- ○ Yes
- ○ No
- ○ Decline to state

37. What is your race?

- ○ American Indian/Alaska Native
- ○ Asian
- ○ Black/African-American
- ○ Native Hawaiian/Other Pacific Islander
- ○ White or Caucasian
- ○ Two or more races
- ○ Other
- ○ Decline to state

38. What is your highest education level?

39. How many people live in your home for most of the year (including you)?

Number of people

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ Don't know/Decline to state ○ Doesn't apply

40. Of the people you included in the total for Question 39, how many people are in the following age categories (please fill in the number of people for all applicable categories)

Younger than 20

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ Don't know/Decline to state ○ Doesn't apply

20 to 29 years old

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ Don't know/Decline to state ○ Doesn't apply

30 to 39 years old

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ Don't know/Decline to state ○ Doesn't apply

40 to 49 years old

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ Don't know/Decline to state ○ Doesn't apply

50 to 59 years old

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ Don't know/Decline to state ○ Doesn't apply

60 to 69 years old

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ Don't know/Decline to state ○ Doesn't apply

70 or older

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ Don’t know/Decline to state ○ Doesn’t apply

Age unknown or prefer not to say

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 or more ○ Don’t know/Decline to state ○ Doesn't apply

41. What is your combined annual household income?

○ $0-$19,999 per year
○ $20,000-$39,999 per year
○ $40,000-$59,999 per year
○ $60,000-$79,999 per year
○ $80,000-$99,999 per year
○ $100,000-$119,999 per year
○ $120,000-$149,999 per year
○ $150,000-$199,999 per year
○ $200,000 or more per year
○ Don’t know/Decline to state

42. What type of home do you live in most of the year?

○ a Single-family detached house (a house detached from any other house)
○ a Single-family attached house (a house attached to one or more houses)
○ an Apartment building with 2-4 units
○ an Apartment building 5 or more units
○ a Mobile home
○ a Dormitory
○ Something else
○ Don't know

43. Is this home owned or rented?

○ Owned or being bought by someone in your household
○ Rented
○ Occupied without payment of rent
○ Don't know

Due to the size of our research study, we may take up to 21 DAYS to pay you.

Appendix B: Tabulation of all survey questions

Introduction

This appendix contains simple results for all questions in the survey. For each question, we report (a) the question and any sub-questions, (b) the weighted counts of the respondents we analyzed for that question, and (c) the weighted percentage of respondents who chose each response level. For many questions, we report the counts and weighted percentages with and without "Don't know" and blank responses. For others, we report only the values including "Don't know" and blank responses.

For some questions with multiple parts, we have combined the parts together into a two-dimensional table. In these cases, the response levels are shown along one axis of the table, and the multiple parts of the question are shown along the the other axis.

Question 1

How many ceiling fans (both indoor and outdoor) are there in your home?

	All responses	Known responses
Total weighted count	2550	2550
Percentage for each response		
1	26.7	26.7
2	24.0	24.0
3	16.0	16.0
4	14.3	14.3
5	9.3	9.3
6	5.6	5.6
7	1.6	1.6
8	0.8	0.8
9	0.7	0.7
10 or more	0.8	0.8
Don't know	0.0	0.0
Blank	0.0	0.0

Question 2

Please indicate the locations and numbers of ceiling fans in your primary residence by filling out the table below

Sub-question 1: Enter the total number of fans in these rooms

Sub-question 2: How many of the fans in these rooms include lights?

Total weighted count in each row: 2550

Room	Device	0	1	2	3	4	5	6	7
Dining room	Fan	75.0	24.7	0.3	0.0	0.0	0.0	0.0	0.0
Dining room	Light	77.3	22.4	0.1	0.1	0.0	0.1	0.0	0.0
Living room	Fan	41.2	56.2	2.3	0.3	0.0	0.0	0.0	0.0
Living room	Light	51.2	46.3	2.2	0.3	0.1	0.0	0.0	0.0
Kitchen	Fan	80.1	19.0	0.9	0.0	0.0	0.0	0.0	0.0
Kitchen	Light	81.9	17.5	0.6	0.0	0.0	0.0	0.0	0.0
Family room	Fan	79.7	18.6	1.5	0.1	0.0	0.0	0.0	0.0
Family room	Light	83.4	15.3	1.2	0.2	0.0	0.0	0.0	0.0
Bedroom	Fan	27.3	29.4	22.5	15.3	4.3	0.9	0.1	0.2
Bedroom	Light	35.0	26.1	19.9	14.2	3.6	1.0	0.1	0.2
Outdoor/Patio	Fan	93.1	4.9	1.7	0.1	0.1	0.0	0.0	0.0
Outdoor/Patio	Light	95.0	3.8	1.2	0.1	0.0	0.0	0.0	0.0
Bathroom	Fan	97.9	1.4	0.3	0.3	0.0	0.0	0.0	0.0
Bathroom	Light	98.2	1.3	0.2	0.3	0.0	0.0	0.0	0.0
Other	Fan	92.1	7.0	0.8	0.0	0.1	0.0	0.0	0.0
Other	Light	93.9	5.4	0.6	0.0	0.0	0.0	0.0	0.0

Question 3

For each of the following months, how frequently are one or more ceiling fans in use in your home?

Total weighted count in each row: 2550

Month	Every day	Most days	Half the days	A few days	Never	Don't know	Blank
January	19.6	10.1	5.6	23.5	39.1	0.6	1.5
February	20.0	10.4	5.3	23.9	38.0	0.6	1.8
March	22.6	11.4	9.4	27.9	26.3	0.6	1.9
April	26.4	15.4	17.4	26.2	12.4	0.8	1.4
May	35.5	22.3	18.2	17.8	4.4	0.3	1.5
June	57.1	24.6	8.6	7.6	1.6	0.2	0.3
July	69.9	18.7	4.6	5.4	0.9	0.1	0.3
August	69.7	17.9	5.4	5.3	1.0	0.3	0.3
September	45.2	27.4	13.1	10.5	3.0	0.2	0.5
October	26.4	18.7	18.6	20.6	13.7	0.5	1.4
November	20.6	10.1	10.1	25.7	31.3	0.9	1.3
December	19.3	9.6	6.3	22.4	39.3	0.9	2.0

Question 4

For the most-used ceiling fan in your home, on days when the fan is in use, approximately how many hours a day is it in use?

Sub-question 1: During the month that it is used the most:

Sub-question 2: During a month when usage is relatively low (but the fan is still used somewhat):

Total weighted count in each column: 2550

Hours	Month when used most	Month when usage is low
0	0.3	0.6
1	0.4	15.3
2	2.7	15.4
3	2.8	9.9
4	3.9	11.2
5	3.3	5.4

6	4.9	8.4
7	2.2	1.6
8	12.3	11.7
9	0.9	0.3
10	4.9	3.2
11	0.2	0.2
12	12.2	6.2
13	0.4	0.0
14	1.2	0.2
15	2.8	0.7
16	4.5	0.9
17	0.2	0.0
18	1.9	0.5
19	0.1	0.0
20	2.0	0.5
21	0.0	0.0
22	0.3	0.2
23	0.1	0.1
24	35.6	7.6

Question 5

For the most-used ceiling fan in your home, when it is in use, what percentage of the time is it in use at each of the following speeds (please fill in a percentage for all speeds):

Responses from all respondents

Total weighted count in each column: 2550

Response	High speed	Medium speed	Low speed
0 - 20%	35.3	28.4	58.0
20 - 40%	12.0	17.7	14.5
40 - 60%	7.5	18.4	7.5
60 - 80%	12.9	14.4	5.6
80 - 100%	25.7	13.3	7.3
Fan doesn't have [this] speed	0.3	1.4	0.3
Fan only has one speed	4.6	4.5	4.5
Don't know	0.6	0.5	0.9
Blank	1.0	1.4	1.3

Responses from respondents with multi-speed fans

Total weighted count in each column: 2429

Response	High speed	Medium speed	Low speed
0 - 20%	37.1	29.8	60.9
20 - 40%	12.6	18.6	15.3
40 - 60%	7.9	19.3	7.9
60 - 80%	13.6	15.1	5.9
80 - 100%	26.9	14.0	7.6
Fan doesn't have [this] speed	0.3	1.3	0.1
Fan only has one speed	0.0	0.0	0.0
Don't know	0.6	0.5	1.0
Blank	1.0	1.4	1.3

Question 6

Approximately what is the blade span of the most-used ceiling fan in your home? (The blade span is the diameter of the circle swept by the rotating fan blades.)

	All responses	Known responses
Total weighted count	2550	2318
Percentage for each response		
3 ft or less	25.0	27.5
4 ft	44.1	48.5
5 ft	19.7	21.7
6 ft or larger	2.0	2.3
Don't know	8.9	0.0
Blank	0.1	0.0

Question 7

What is the approximate age, in years, of the most-used ceiling fan in your home?

	All responses	Known responses
Total weighted count	2550	2205
Percentage for each response		
2 or less	8.5	9.8
2 to 4	16.0	18.5
4 to 6	17.5	20.2
6 to 8	13.6	15.8
8 to 10	9.3	10.7
10 to 12	8.7	10.0
12 to 14	2.8	3.2
14 to 16	2.5	2.9
16 to 18	1.7	2.0
18 to 20	2.1	2.4
More than 20	3.7	4.3
Don't know	12.9	0.0
Blank	0.6	0.0

Question 8

For the second most-used ceiling fan in your home, how much use does this fan get compared to the most used fan? (Choose the closest answer.)

	All responses	Known responses
Total weighted count	1868	1868
Percentage for each response		
The same amount	25.1	25.1
Almost as much (70-90%)	35.4	35.4
About half as much	19.5	19.5
About 1/3 as much	10.3	10.3
Far less (10%)	8.8	8.8
Not used	0.9	0.9
Don't know	0.0	0.0
Blank	0.0	0.0

Question 9

For the second most-used ceiling fan in your home, when it is in use, what percentage of the time is it in use at each of the following speeds (please fill in a percentage for all speeds):

Responses from all respondents

Total weighted count in each column: 1868

Response	High speed	Medium speed	Low speed
0 - 20%	40.1	28.7	53.6
20 - 40%	11.3	21.6	16.7
40 - 60%	9.3	16.9	8.3
60 - 80%	10.6	12.3	5.2
80 - 100%	22.6	13.9	9.4
Fan doesn't have [this] speed	0.1	1.0	0.4
Fan only has one speed	3.5	3.5	3.4
Don't know	0.4	0.5	0.7
Blank	2.2	1.5	2.3

Responses from respondents with multi-speed fans

Total weighted count in each column: 1799

Response	High speed	Medium speed	Low speed
0 - 20%	41.6	29.8	55.7
20 - 40%	11.8	22.5	17.3
40 - 60%	9.7	17.6	8.6
60 - 80%	11.0	12.8	5.4
80 - 100%	23.4	14.5	9.8
Fan doesn't have [this] speed	0.0	0.8	0.2
Fan only has one speed	0.0	0.0	0.0
Don't know	0.4	0.5	0.7
Blank	2.2	1.6	2.3

Question 10

Approximately what is the blade span of the second most-used ceiling fan in your home? (The blade span is the diameter of the circle swept by the rotating fan blades.)

	All responses	Known responses
Total weighted count	1868	1702
Percentage for each response		
3 ft or less	26.4	29.0
4 ft	46.1	50.6
5 ft	17.3	19.0
6 ft or larger	1.2	1.3
Don't know	8.9	0.0
Blank	0.0	0.0

Question 11

For the third most-used ceiling fan in your home, how much use does this fan get compared to the most used fan? (Choose the closest answer.)

	All responses	Known responses
Total weighted count	1255	1255
Percentage for each response		
The same amount	18.1	18.1
Almost as much (70-90%)	20.3	20.3
About half as much	18.6	18.6
About 1/3 as much	17.4	17.4
Far less (10%)	23.4	23.4
Not used	2.2	2.2
Don't know	0.0	0.0
Blank	0.0	0.0

Question 12

For the third most-used ceiling fan in your home, when it is in use, what percentage of the time it is in use at each of the following speeds (please fill in a percentage for all speeds):

Responses from all respondents

Total weighted count in each column: 1255

Response	High speed	Medium speed	Low speed
0 - 20%	42.2	34.9	54.3
20 - 40%	10.3	19.4	12.6
40 - 60%	9.8	16.1	9.3
60 - 80%	7.9	9.2	5.2
80 - 100%	22.6	13.1	10.2
Fan doesn't have [this] speed	0.2	0.6	0.7
Fan only has one speed	4.1	3.9	3.9
Don't know	0.3	0.5	0.6
Blank	2.6	2.4	3.2

Responses from respondents with multi-speed fans

Total weighted count in each column: 1202

Response	High speed	Medium speed	Low speed
0 - 20%	44.1	36.4	56.7
20 - 40%	10.8	20.3	13.2
40 - 60%	10.2	16.9	9.7
60 - 80%	8.2	9.6	5.5
80 - 100%	23.6	13.7	10.6
Fan doesn't have [this] speed	0.0	0.2	0.3
Fan only has one speed	0.0	0.0	0.0
Don't know	0.3	0.5	0.6
Blank	2.7	2.5	3.3

Question 13

Approximately what is the blade span of the third most-used ceiling fan in your home? (The blade span is the diameter of the circle swept by the rotating fan blades.)

	All responses	Known responses
Total weighted count	1255	1130
Percentage for each response		
3 ft or less	30.4	33.8
4 ft	42.7	47.5
5 ft	14.7	16.3
6 ft or larger	2.2	2.4
Don't know	9.7	0.0
Blank	0.3	0.0

Question 14

For the following times of year, when at least one ceiling fan is in use, how many ceiling fans in total, are typically in use at the same time?

Sub-question 1: During warmer months

Sub-question 2: During colder months

Sub-question 3: During months with intermediate temperature

	Warmer		Colder		Intermediate	
	All responses	Known responses	All responses	Known responses	All responses	Known responses
Total weighted count	1868	1839	1868	1815	1868	1823
Percentage for each response						
No fan ever used	0.2	0.2	27.2	28.0	3.0	3.1
1	8.2	8.3	37.5	38.6	29.0	29.7
2	40.2	40.9	21.4	22.0	38.1	39.1
3	24.9	25.3	5.5	5.6	15.9	16.3
4	14.2	14.4	2.9	3.0	7.0	7.2
5	5.1	5.2	1.6	1.7	1.9	1.9
6	2.6	2.6	0.5	0.5	0.8	0.9
7	1.0	1.1	0.1	0.1	1.1	1.1
8	0.9	0.9	0.2	0.2	0.2	0.2
9	0.2	0.2	0.0	0.0	0.1	0.1
10 or more	0.9	0.9	0.4	0.4	0.4	0.4
Don't know	0.4	0.0	1.5	0.0	1.0	0.0
Blank	1.2	0.0	1.4	0.0	1.4	0.0

Question 15

How many hours are there in a day?

This question was the test of respondents' attention and honesty. We included only the respondents who answered this question correctly.

Question 16

Is there air conditioning in your home, and if so, is it ever run it at the same time as any of the ceiling fans?

	All responses	Known responses
Total weighted count	2550	2549
Percentage for each response		
No air conditioning in home	12.5	12.5
Home has air conditioning, but ceiling fans and AC are never run at the same time	5.3	5.3
Home has air conditioning, and ceiling fans and AC are infrequently run at the same time	5.7	5.7
Home has air conditioning, and ceiling fans and AC are sometimes run at the same time	19.1	19.1
Home has air conditioning, and ceiling fans and AC are frequently run at the same time	38.1	38.2
Home has air conditioning, and ceiling fans and AC are always run at the same time	19.2	19.3
Don't know	0.0	0.0
Blank	0.0	0.0

Question 17

When ceiling fans and air conditioning are running at the same time, do you (or anyone else in your home) adjust the thermostat settings?

	All responses	Known responses
Total weighted count	2096	2002
Percentage for each response		
No adjustment to thermostat is made	67.1	70.2
Thermostat is set warmer by 3 degrees or less	16.8	17.5
Thermostat is set cooler by 3 degrees or less	3.8	4.0
Thermostat is set warmer by more than 3 degrees	6.1	6.4
Thermostat is set cooler by more than 3 degrees	1.7	1.8
Don't know	1.9	0.0
Blank	2.6	0.0

Question 18

Many fans are capable of pushing air upwards (instead of down) by rotating in the opposite direction. How many of the ceiling fans in your home are ever run in reverse mode?

	All responses	Known responses
Total weighted count	2550	2436
Percentage for each response		
Not aware of reverse mode	12.5	13.1
None	43.8	45.9
1	13.1	13.8
2	10.3	10.8
3	5.9	6.1
4	4.5	4.8
5	2.8	2.9
6	1.2	1.3
7	0.6	0.6
8	0.2	0.2
9	0.1	0.1
10 or more	0.3	0.3
Don't know	3.6	0.0
Blank	0.8	0.0

Question 19

For each of the following months, how often are the ceiling fans in your home run in reverse mode?

Total weighted count in each row: 998

Month	Every day	Most days	Half the days	A few days	Never	Don't know	Blank
January	20.9	9.9	4.8	20.5	38.1	3.0	2.7
February	20.2	9.9	5.5	22.3	38.7	3.0	0.3
March	11.2	7.6	6.9	20.4	49.9	3.1	0.9
April	4.8	2.7	7.6	17.8	62.4	3.1	1.8
May	3.3	3.8	2.5	13.1	72.5	2.9	1.7
June	4.5	3.7	2.2	9.1	75.0	3.2	2.3
July	5.5	3.2	2.6	7.5	75.9	3.0	2.2
August	5.4	3.1	4.0	6.2	75.5	3.1	2.7
September	4.0	4.1	4.5	12.4	69.0	3.1	2.9
October	4.9	5.2	7.4	22.0	55.5	3.1	2.0
November	13.9	9.5	7.0	21.4	44.6	3.1	0.6
December	20.4	8.8	5.7	23.2	37.9	3.0	0.9

Question 20

On those days that ceiling fans are run in reverse mode, how many hours a day are they run in reverse mode?

	All responses	Known responses
Total weighted count	998	945
Percentage for each response		
0	20.3	21.4
1	5.3	5.6
2	6.0	6.3
3	4.4	4.7
4	6.9	7.2
5	4.3	4.5
6	6.8	7.1
7	1.3	1.4
8	7.4	7.8
9	0.0	0.0
10	3.9	4.2
11	0.2	0.2
12	7.0	7.4
14	0.3	0.3
15	0.7	0.7
16	1.5	1.6
18	1.5	1.6
20	0.6	0.6
22	0.1	0.1
24	16.3	17.2
Blank	5.3	0.0

Question 21

How do you primarily switch the settings of the ceiling fans in your home (for example, to turn ceiling fans on or off, or to change the speed setting)?

	All responses	Known responses
Total weighted count	2550	2527
Percentage for each response		
Pull chain/chord	60.2	60.7
Wall switch (on-off only)	21.7	21.8
Wall control (on-off and variable speed control)	9.4	9.5
Remote control (battery operated)	6.3	6.4
Other	1.6	1.6
Don't know	0.3	0.0
Blank	0.6	0.0

Question 22

How many of the ceiling fans in your home are sometimes run overnight?

Sub-question 1: Number of ceiling fans located in bedrooms that are sometimes run overnight

Sub-question 2: Number of ceiling fans NOT located in bedrooms that are sometimes run overnight

	Bedrooms		NOT bedrooms	
	All responses	Known responses	All responses	Known responses
Total weighted count	2550	2536	2550	2527
Percentage for each response				
None	28.1	28.2	59.0	59.6
1	38.6	38.8	30.6	30.9
2	20.2	20.3	7.4	7.5
3	8.5	8.5	1.1	1.1
4	2.8	2.8	0.6	0.6
5	0.5	0.5	0.2	0.2
6	0.4	0.4	0.3	0.3
7	0.2	0.2	0.0	0.0
8	0.1	0.1	0.0	0.0
9	0.1	0.1	0.0	0.0
10 or more	0.0	0.0	0.0	0.0
Don't know	0.1	0.0	0.3	0.0
Blank	0.5	0.0	0.6	0.0

Question 23

For those ceiling fans that are sometimes run overnight, on days when ceiling fans are in use at all, how frequently are they run overnight?

Sub-question 1: For ceiling fans located in bedrooms

Sub-question 2: For ceiling fans NOT located in bedrooms

	Bedrooms		NOT bedrooms	
	All responses	Known responses	All responses	Known responses
Total weighted count	1820	1708	1022	979
Percentage for each response				
Almost always (90-100% of days)	66.7	71.1	48.4	50.5
Most days (60-90% of days)	15.0	16.0	18.2	18.9
About half the time (40-60% of days)	6.1	6.5	10.7	11.2
Infrequently (10-40% of days)	4.6	4.9	10.0	10.5
Almost never (Less than 10% of days)	1.4	1.5	8.5	8.9
Don't know	1.4	0.0	3.4	0.0
Blank	4.8	0.0	0.8	0.0

Question 24

Are the ceiling fans in your home ever run when no one is in the room, and if so, what percentage of the time?

	All responses	Known responses
Total weighted count	2550	2534
Percentage for each response		
Almost always (90-100% of the time)	17.3	17.4
Most of the time (60-90% of the time)	15.3	15.3
About half the time (40-60% of the time)	18.5	18.6
Infrequently (10-40% of the time)	18.9	19.1
Almost never (Less than 10% of the time)	16.2	16.3
Never	13.2	13.3
Don't know	0.3	0.0
Blank	0.3	0.0

Question 25

For those ceiling fans with lights attached, are the lights typically used at the same time as the ceiling fan?

	All responses	Known responses
Total weighted count	2268	2257
Percentage for each response		
Yes, they are typically used together	15.4	15.5
Yes, they are typically used together, except overnight	4.9	4.9
They are sometimes used together, sometimes independently	43.8	44.0
No, they are typically used independently. They are used the same way normal overhead lights are used.	35.4	35.5
Don't know	0.3	0.0
Blank	0.2	0.0

Question 26

For your most-used ceiling fan that includes lights, what kind of light sockets does it have (you can check more than one box if more than one kind is used)?

	All responses	Known responses
Total weighted count	2268	2029
Percentage for each response		
Standard socket (medium screw base)	75.3	84.2
Pin-based fluorescent	1.7	1.9
Candelabra (small screw base)	7.3	8.2
Other (includes GU-10, GU-24, and all other)	1.1	1.3
Combination	4.1	4.5
Don't know	9.9	0.0
Blank	0.6	0.0

Question 27

For your most-used ceiling fan that includes lights, what kind of light bulbs are you using in it (you can check more than one box if more than one kind is used)?

	All responses	Known responses
Total weighted count	2268	2072
Percentage for each response		
Incandescent or halogen	41.1	45.0
Fluorescent (include standard compact fluorescent and others)	37.4	41.0
LED	5.4	6.0
Other	2.0	2.2
Combination	5.4	5.9
Don't know	8.1	0.0
Blank	0.6	0.0

Question 28

For your most-used ceiling fan that has lights:

Sub-question 1: The light on my ceiling fan is 'on-off' only

	All responses	Known responses
Total weighted count	2268	2237
Percentage for each response		
Yes	80.8	81.9
No	17.8	18.1
Don't know	0.8	0.0
Blank	0.6	0.0

Sub-question 2: The lighting on my ceiling fan has:

	All responses	Known responses
Total weighted count	2268	2099
Percentage for each response		
Single light level settings	72.9	78.8
Multiple light level settings	8.1	8.7
A dimmer	11.6	12.5
Don't know	3.0	0.0
Blank	4.5	0.0

Sub-question 3: If your light kit has a dimmer or multiple light level settings, do you use it or them to adjust light output other than just turning the device on and off?

	All responses	Known responses
Total weighted count	2268	2071
Percentage for each response		
Yes	15.5	17.0
No	8.9	9.8
Not applicable	66.9	73.2
Don't know	1.5	0.0
Blank	7.2	0.0

Question 29

For your second-most-used ceiling fan that has lights (if applicable):

Sub-question 1: The light on my ceiling fan is 'on-off' only

	All responses	Known responses
Total weighted count	1658	1619
Percentage for each response		
Yes	81.2	83.1
No	16.5	16.9
Don't know	0.9	0.0
Blank	1.4	0.0

Sub-question 2: The lighting on my ceiling fan has:

	All responses	Known responses
Total weighted count	1658	1537
Percentage for each response		
Single light level settings	76.4	82.4
Multiple light level settings	7.7	8.4
A dimmer	8.6	9.3
Don't know	2.5	0.0
Blank	4.8	0.0

Sub-question 3: If your light kit has a dimmer or multiple light level settings, do you use it or them to adjust light output other than just turning the device on and off?

	All responses	Known responses
Total weighted count	1658	1515
Percentage for each response		
Yes	12.2	13.3
No	8.4	9.1
Not applicable	70.9	77.5
Don't know	1.7	0.0
Blank	7.0	0.0

Question 30

For each of the following months, how frequently are the outdoor ceiling fan(s) in your home actively used?

Total weighted count in each row: 175

Month	Every day	Most days	Half the days	A few days	Never	Don't know	Blank
January	4.7	2.0	3.7	8.0	80.0	0.5	1.1
February	4.8	2.1	3.6	10.8	76.2	0.5	2.0
March	6.6	2.1	4.5	17.4	67.8	0.5	1.1
April	8.7	4.2	5.3	27.4	52.5	0.5	1.4
May	11.0	5.4	15.8	37.2	30.0	0.1	0.5
June	18.4	16.2	11.3	43.7	10.1	0.1	0.3
July	21.3	15.8	11.7	42.4	8.5	0.1	0.2
August	23.8	13.4	10.5	40.9	10.9	0.1	0.4
September	12.7	15.4	12.1	34.9	24.8	0.1	0.0
October	6.3	6.6	10.3	28.4	47.1	0.2	1.1
November	5.4	2.9	6.4	13.8	70.2	0.2	1.1
December	4.5	2.6	6.0	9.5	74.9	0.2	2.4

Question 31

On days when the outdoor ceiling fan(s) are in use, approximately how many hours a day are they in use?

	All responses	Known responses
Total weighted count	175	174
Percentage for each response		
0	5.4	5.5
1	12.0	12.1
2	27.5	27.7
3	13.1	13.2
4	14.3	14.4
5	4.3	4.3
6	2.5	2.6
7	0.1	0.1
8	2.7	2.7
9	0.2	0.2
10	5.0	5.1
12	1.9	1.9
13	1.1	1.1
15	0.2	0.2
16	1.4	1.4
18	1.0	1.0
20	0.0	0.0
24	6.4	6.5
Blank	0.8	0.0

Question 32

Right now, as you take this survey, how many ceiling fans are currently on in your home?

	All responses	Known responses
Total weighted count	2550	2484
Percentage for each response		
None	20.8	21.3
1	34.1	35.0
2	21.2	21.8
3	11.6	11.9
4	4.7	4.8
5	2.5	2.5
6	1.5	1.6
7	0.4	0.4
8	0.2	0.2
9	0.4	0.4
10 or more	0.1	0.1
Don't know	0.6	0.0
Blank	2.0	0.0

Question 33

Right now, as you take this survey, for the most-used fan that is currently on, what speed is it set to?

	All responses	Known responses
Total weighted count	1953	1943
Percentage for each response		
Low	15.8	15.9
Medium	42.7	43.0
High	36.3	36.5
Other	0.6	0.6
Single speed	4.0	4.0
Don't know	0.4	0.0
Blank	0.2	0.0

Question 34

What is your five-digit ZIP code?

We used this question to find the RECS division of each respondent. The distribution of RECS divisions is reported in the Results.

Question 35

What is your gender?

	All responses	Known responses
Total weighted count	2550	2533
Percentage for each response		
Female	59.3	59.7
Male	40.1	40.3
Decline to state	0.2	0.0
Blank	0.5	0.0

Question 36

Are you Hispanic or Latino?

	All responses	Known responses
Total weighted count	2550	2522
Percentage for each response		
Yes	10.6	10.8
No	88.3	89.2
Decline to state	1.0	0.0
Blank	0.1	0.0

Question 37

What is your race?

	All responses	Known responses
Total weighted count	2550	2489
Percentage for each response		
American Indian/Alaska Native	0.3	0.3
Asian	2.8	2.9
Black/African-American	11.5	11.8
Native Hawaiian/Other Pacific Islander	0.1	0.1
White or Caucasian	76.9	78.8
Two or more races	3.3	3.4
Other	2.7	2.7
Decline to state	2.1	0.0
Blank	0.3	0.0

Question 38

What is your highest education level?

	All responses	Known responses
Total weighted count	2550	2528
Percentage for each response		
No schooling completed	0.1	0.1
Kindergarten to grade 12 (No Diploma)	0.9	0.9
High school diploma or GED	26.3	26.5
Some college, no degree	26.2	26.4
Associate's degree (for example: AA, AS)	8.6	8.7
Bachelor's degree (for example: BA, BS)	25.6	25.8
Master's degree (for example: MA, MS, MBA)	9.3	9.3
Professional degree (for example: MD, JD)	1.5	1.5
Doctorate degree (for example: PhD, EdD)	0.7	0.7
Decline to state	0.3	0.0
Blank	0.6	0.0

Question 39

How many people live in your home for most of the year (including you)?

	All responses	Known responses
Total weighted count	2550	2550
Percentage for each response		
1	24.4	24.4
2	32.7	32.7
3	16.3	16.3
4	14.8	14.8
5	7.8	7.8
6	2.8	2.8
7	0.9	0.9
8	0.3	0.3
9	0.0	0.0
Blank	0.0	0.0

Question 40

Of the people you included in the total for Question 39, how many people are in the following age categories (please fill in the number of people for all applicable categories)

Age category	Total weighted count of known responses	Percentage of households with at least one person in the category
Younger than 20	2545	37.7
20 to 29	2543	24.3
30 to 39	2544	42.7
40 to 49	2540	26.1
50 to 59	2542	25.8
60 to 69	2542	17.7
70 or older	2540	5.9

Question 41

What is your combined annual household income?

	All responses	Known responses
Total weighted count	2550	2395
Percentage for each response		
$0-$19,999	14.3	15.2
$20,000-$39,999	24.4	26.0
$40,000-$59,999	21.5	22.8
$60,000-$79,999	14.4	15.3
$80,000-$99,999	8.1	8.6
$100,000-$119,999	5.2	5.6
$120,000-$149,999	3.0	3.2
$150,000-$199,999	1.8	1.9
$200,000 or more	1.2	1.3
Don't know/Decline to state	6.1	0.0
Blank	0.0	0.0

Question 42

What type of home do you live in most of the year?

	All responses	Known responses
Total weighted count	2550	2538
Percentage for each response		
a Single-family detached house (a house detached from any other house)	65.3	65.7
a Single-family attached house (a house attached to one or more houses)	7.0	7.0
an Apartment building with 2-4 units	5.8	5.8
an Apartment building 5 or more units	14.5	14.6
a Mobile home	4.3	4.3
a Dormitory	0.4	0.4
Something else	2.2	2.2
Don't know	0.2	0.0
Blank	0.3	0.0

Question 43

Is this home owned or rented?

	All responses	Known responses
Total weighted count	2550	2545
Percentage for each response		
Owned or being bought by someone in your household	61.9	62.1
Rented	37.0	37.0
Occupied without payment of rent	0.9	0.9
Don't know	0.0	0.0
Blank	0.2	0.0