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## **Author contributions**

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- Screened and weighted the survey data
- Analyzed the data
- Drafted the manuscript
- Revised the manuscript

Scott J. Young

- Designed the survey instrument
- Supervised the analysis and manuscript development
- Calculated the summary numbers for Appendix B
- Revised the manuscript

Jeffery B. Greenblatt

- Conceived the idea for the survey
- Supervised the development, deployment, and initial analysis of the survey
- Designed the survey instrument
- Revised the manuscript

## **Abstract**

To better understand the use of refrigeration products and ice in households, we surveyed 2694 people across the U.S. We found 2.9% of households had non-compressor refrigerators, 0.1% had hybrid products with a wine chiller compartment, and 1.6% had stand-alone icemakers. Approximately 49.2% of households used one or more ice-making appliances for producing ice. Household average ice use was 1.8 lb per day, or 0.6 lb per day if adjusted to match results of previous field-metering studies. We also present results on the characteristics of stand-alone icemakers, the distribution of personal ice use, and the variation of ice use with ice-making method. The results of this survey can help shed light on the structure of residential refrigeration energy use.

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# 1 Introduction

Most people take refrigeration products for granted. Almost all households have a refrigerator, and many households have at least one additional refrigeration appliance, such as a freezer, an icemaker inside a refrigerator or freezer, or even a wine chiller. It is due to this ubiquity and the amount of energy that each of those appliances consumes, that refrigeration is a large contributor to household energy consumption.

In order to understand how to best reduce residential energy consumption, researchers need accurate information on how many products exist and how they are used. For the most common refrigeration products, such as refrigerators, large government surveys can provide estimates of their penetration and size distribution (RECS, 2009). For many less-popular products, however, there are few or no sources of information. The same goes for many behavioral patterns. For example, the only estimates of household ice use come from reports published in the U.S. Department of Energy's rulemaking dockets (Ecotope, 2013; NEEA, 2014; AHAM, 2014).

This report presents the results of a survey aimed at filling in some of the gaps in information on refrigeration products and residential ice use. This survey follows several other surveys on refrigeration products performed by Lawrence Berkeley National Laboratory (Greenblatt et al., 2013a). The present survey was fielded in 2014 via Amazon Mechanical Turk. We asked respondents about the presence of several refrigeration appliances in their home. We also asked about the methods used to make ice, how much ice people used, and when during the year the ice was used.

This information allowed us to estimate the penetration of several refrigeration products in households and compare our estimates to other sources. We were also able to estimate the distribution of methods typically used for making ice in the households and how often people operate stand-alone icemakers. Finally, we were able to estimate quantities of personal and household ice use, and compare those results to other reports of ice production.

This report presents information that is useful for estimating refrigeration-related household energy consumption. We present most results in the main 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 Data sources

#### 2.1.1 Amazon Mechanical Turk

We conducted the present survey using Amazon Mechanical Turk (AMT). AMT is an online platform started in 2005 by Amazon.com as a crowd-sourcing tool. It allows “requesters” to post Human Intelligence Tasks (HITs) and “workers” to pick tasks they want to complete in exchange for money. Those HITs usually require human discretion and action that computers cannot provide. Roughly half of the more than 500,000 AMT users globally are from the U.S. (Paolacci et al., 2010; Amazon, 2011), providing a large, diverse subject pool, especially for U.S.-based research.

Various studies have shown that AMT users cover all demographics of the general U.S. population (Paolacci et al. 2010; Gosling et al. 2004; Ipeirotis 2010). Although they are not represented with the same distribution as the general population, applying a weight to each response has been shown to effectively improve the representativeness of the distribution (Yang et al. 2015; Greenblatt et al. 2013b).

The current survey, called RI2, is sixth in a series of surveys on refrigeration products that Lawrence Berkeley National Laboratory (LBNL) has deployed with AMT. We will present some of the results from the previous surveys, particularly those on product ownership, in comparison with the results of the present survey. Table 2.1.1 lists the surveys that we used in the comparison. Further details of their findings can be found in Greenblatt et al. (2013a).

**Table 2.1.1: AMT surveys deployed by LBNL and referred to in this report**

<b>Survey code</b>	<b>Survey topics and description</b>	<b>Deployment date</b>
RP2	Ownership of many refrigeration products, including all those considered in the present survey. Included model number check for non-compressor refrigerators.	April-May, 2012
RP3	Ownership of many refrigeration products including non-compressor refrigerators and icemakers. Did not ask for model numbers.	July-September, 2012
NV1	Restricted to owners of non-compressor refrigerators. Asked for model numbers.	July-October, 2012
RI1	Restricted to owners of stand-alone icemakers. Asked for model numbers.	July-October, 2012
RI2 (current survey)	Ownership of refrigerators, freezers, non-compressor refrigerators, hybrids and stand-alone icemakers. Asked for model numbers. Use of stand-alone icemakers by season. Personal ice use by season.	January-June, 2014

### **2.1.2 Residential Energy Consumption Survey**

The Residential Energy Consumption Survey (RECS) is published every five years by the U.S. Energy Information Administration, a branch of the U.S. Department of Energy. It asks hundreds of questions about home characteristics, appliances, and demographics, and is designed to be a representative sample of U.S. households. The most recent survey (RECS 2009) contained 12,084 households (McNary and Berry, 2012). Each sampled household was assigned a weight indicating the number of households that it represented.

We used RECS 2009 as the reference for cell weighting the respondents in the current survey. We also compared our results on product ownership to the results from RECS 2009.

## **2.2 Survey development**

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 three sections: section A had 21 questions relating to product ownership, the amount of time that icemakers are plugged in, and ice production methods used in the respondent's household. Section B had 6 questions relating to ice use by the survey respondent. Section C had 11 questions on demographics. Appendix A contains the complete survey instrument.

### **2.2.1 Inclusion of questions from RECS 2009**

We chose most of the demographic questions from RECS 2009, so that we could use RECS 2009 as a reference for weighting the present survey.

Four of the demographic questions related to the survey respondent personally:

- Gender
- Race
- Hispanic/Latino origin
- Highest education level

The remaining demographics related to the survey respondent's household:

- Zipcode (first 3 digits)
- Number of occupants by age
- Total number of occupants in household
- Annual household income
- Type of home
- Owned vs. rented home

When specifying Race, we gave respondents the option choose "Other" and specify what they meant by "Other". The most common response to this question was "Hispanic", and this correlated well with the question on Hispanic origin. Therefore, we combined the responses to these two questions so that any respondent who selected "Yes" to the question on Hispanic origin was classified as Hispanic for analysis relating to race.



Respondents who selected “No” to the question on Hispanic origin were classified based on their response to the question on Race.

We also included two questions about product ownership that coincided with RECS 2009: “How many refrigerators are plugged in at your home right now?” and “How many freezers are plugged in at your home right now?” This allowed us to confirm that our estimates of product ownership were similar to those of RECS 2009.

Greenblatt et al. (2013a) provide additional discussion of the variation between the phrasing of questions in AMT refrigeration product surveys and RECS 2009.

### **2.2.2 Allowance of null responses**

Every question in the survey had a “Don't know” or “Decline to state” option. This was important for distinguishing respondents who skipped questions from those who read the question but were either not able to provide information, or did not feel comfortable providing information. We refer to these responses as null responses in this report.

### **2.2.3 Questions to test respondents' attentiveness and honesty**

Online surveys can include respondents who provide inaccurate information either through inattentiveness or fraudulence (Baker and Le Guin, 2007). We included four questions specifically to identify these respondents. These test questions were questions that any U.S. resident should be able to answer easily. They were mildly disguised by embedding them among topical product questions, with incorrect answers that often strongly resembled those of the surrounding questions. We screened out respondents who had incorrect responses on any of these questions.

We also included questions that allowed us to perform consistency checks on the responses. For example, we asked for the number of full-time occupants living in the home as well as the number in each of several age bands (including an “unknown age” band). We then compared the sum of the age-based responses to the number of full time occupants. We screened out respondents whose results differed by more than one (to account for honest mistakes in arithmetic).

## **2.3 Survey deployment**

We deployed the survey six times. Each time the survey was restricted to participants that were at least 18 years old and resided in the U.S. The first three deployments targeted the general population and were deployed between January and March 2014. These received a total of 2283 responses. Following this, we deployed the survey three additional times targeting respondents from demographic subgroups that were underrepresented in the first three deployments. These deployments occurred between May and June, 2014 and received 1070 responses. All respondents received \$2 for completing the survey.

Table 2.3.1 shows the percentage of respondents from the demographic subgroups targeted in the final three survey deployments, both for RECS and for the current AMT survey. The table shows that the demographic subgroup surveys improved the

representation of most underrepresented subgroups but had little effect on the representation of households containing people aged 60 years and older.

**Table 2.3.1: Percentage of respondents from underrepresented demographic subgroups**

Demographic subgroup	Percentage of respondents in RECS	Percentage of respondents in current AMT survey	
		Before subgroup surveys	After subgroup surveys
Black	13.2	5.6	12.4
Hispanic	12.9	6.5	12.7
1 household member	27.5	14.1	20.3
No college education	38.3	9.5	17.1
Aged 60-69	18.8	11.6	12.7
Aged 70 or more	17.8	4.1	4.6

## 2.4 Screening

From the 3353 respondents collected through all the survey deployments, we screened out 659, leaving 2694 respondents that we included in the survey analysis. Most respondents were screened out due to evidence that they completed the survey multiple times, provided false information, or did not have their full attention on completing the survey. These are common problems for internet surveys (Baker and Le Guin, 2007), and we used the following techniques to identify these respondents.

We screened out 124 respondents that completed the survey multiple times. We identified these respondents from their unique AMT worker ID.

We removed 328 respondents using one or more of the checks for inattentiveness and fraudulence built in to the survey:

- Test question errors
- Inconsistency in agreement test questions
- Seven or more responses left blank

We removed 134 respondents because they did not provide enough evidence to estimate personal ice use. We removed 58 respondents due to evidence that they selected the same answer to every question (also known as straightlining, see MKTG Incorporated, 2015). We removed 14 respondents due to conflicts between answers in different sections of the survey. We also removed 1 respondent because their zip code was located outside of the 50 U.S. states and District of Columbia.

## 2.5 Demographic weighting

We assigned each of the 2694 respondents we used in the analysis a weight by comparing their demographic characteristics to RECS 2009. We did this to make the survey more representative of the general U.S. population. We used a cell-weighting approach very similar to the one described by Kalton and Flores-Cervantes (2003). The only difference was that we did not attempt to fill in missing demographic responses when assigning weights—we simply assigned a weight based on the available demographic responses. We have used this weighting approach for previous AMT surveys, and we have found that it improves the demographic representation more effectively than other techniques (Yang et al., 2015).

We weighted the current survey using six demographic variables in the following order:

1. Number of 20-29 year olds in the household
2. Census division
3. Number of household members
4. Race
5. Education
6. Gender

We chose the number of demographic variables used for weighting based on the maximum number that improved the demographic representation of the survey. We chose the order of variables that resulted in the demographic representation most similar to RECS 2009.

## 2.6 Calculation of proportions and confidence intervals

Most of the survey questions had a defined set of response options. For each of these questions, we calculated the weighted proportion of respondents that selected each response or combination of responses where the selection of multiple responses was allowed. We present most of the results in the main report and the results from all questions in Appendix B.

We present 95% confidence intervals for most proportions. We based confidence intervals on the standard error calculated using the normal approximation to the binomial distribution:

$$\sigma_x = \sqrt{\frac{p_x(1 - p_x)}{N}}$$

where

$\sigma_x$  = standard error for a single proportion

$p_x$  = a single proportion

$N$  = the total number of responses in the sample

We then calculated the lower and upper bounds of the confidence interval as:

$$\text{lower bound} = p_x - z\sigma_x$$

$$\text{upper bound} = p_x + z\sigma_x$$

The values  $-z$  and  $z$  are the standard scores bracketing the desired probability in the center of the standard normal distribution (Steel et al. 1996). For example, for a 95% confidence interval,  $z = 1.96$  because  $-1.96$  and  $1.96$  are the standard scores for which the standard normal cumulative distribution function equals 2.5% and 97.5%, respectively.

When reporting 95% confidence intervals in the text of this report, we use the notation 95% CI [X, Y], where CI refers to confidence interval, X indicates the lower bound of the 95% confidence interval, and Y indicates the upper bound. We omit the second and later '95% CI' when presenting more than one 95% confidence interval within a single paragraph.

For the sections on how often icemakers are plugged in and personal ice use, we combined several categorical questions to produce a single numerical value for each respondent. The weighted mean results were calculated using the formula:

$$\mu = \frac{\sum_{i=1}^N x_i w_i}{\sum_{i=1}^N w_i}$$

where

$\mu$  = weighted mean

$x_i$  = value of response  $i$

$w_i$  = weight of response  $i$

To find the 95% confidence interval of the mean for these values, we first needed to determine the weighted variance using the unbiased estimate of sample variance (Wikipedia, 2015):

$$V = \frac{\sum_{i=1}^N w_i (x_i - \mu)^2}{(V_1 - 1)}$$

where

$V$  = weighted variance

$$V_1 = \sum_{i=1}^N w_i$$

We then calculated the standard error from this as

$$\sigma = \sqrt{\frac{V}{V1}}$$

We then used this value of standard error to determine the confidence intervals as described above.

For all groups of simultaneous confidence intervals that we present, we have chosen not to adjust the individual confidence intervals for the family-wise error rate. There are many different opinions, both technical and philosophical, regarding adjustment for family-wise error rate (e.g., Rothman, 1990; Shaffer, 1995). We have chosen the simplest approach of no adjustment. As a result, all confidence intervals represent the error rate indicated for the individually estimated quantities.

### **3 Results and specific discussion**

#### **3.1 Penetration and products per household**

The term “penetration” indicates the fraction of U.S. homes that have at least one targeted product. The penetration can never be greater than 100%. In this section we also determine the mean number of products per household, of households that own at least one of each product.

##### **3.1.1 Refrigerators and stand-alone freezers**

We included questions A1 “How many refrigerators are plugged in at your home right now?” and A2 “How many freezers are plugged in at your home right now?” so we could compare our results to those from RECS 2009. Although the surveys were taken five years apart, the penetration estimated by RECS has not varied greatly with time (Yang et al., 2015). Therefore, the actual penetration in 2014 was likely similar to the estimate from RECS 2009.

Table 3.1.1 shows that the refrigerator penetration estimated from the current survey is similar to the penetrations estimated by RECS and two other AMT surveys that we deployed in 2012.

**Table 3.1.1: Penetration of refrigerators**

Survey	Household penetration (%)	95% confidence interval (%)
RI2 (current study)	99.8	[99.6, 99.9]
RECS	99.8	[99.8, 99.9]
RP2	98.6	[98.2, 99.0]
RP3	99.5	[99.3, 99.7]

Table 3.1.2 shows the mean number of refrigerators per household is also consistent across all surveys, falling between 1.2 and 1.3.

**Table 3.1.2: Number of refrigerators per household**

Number of refrigerators	Mean refrigerators per household	95% confidence interval
RI2 (current study)	1.21	[1.19, 1.22]
RECS	1.26	[1.26, 1.26]
RP2	1.27	[1.27, 1.28]
RP3	1.23	[1.22, 1.23]

Table 3.1.3 shows the estimated penetration of stand-alone freezers. The current survey result falls between RP2 and RP3, and is a little higher than RECS.

There are several possible reasons for why the current survey has a higher estimate of freezer penetration than RECS. First, due to small differences in the layout and phrasing of the freezer question, it is possible that some respondents in the current survey included freezers other than only stand-alone freezers in their responses. Second, the difference could also be related to self-selection bias. AMT participants who do not own many refrigeration products might be less likely to participate in a survey on refrigeration products and ice-making. Finally, although historical RECS data indicates that the penetration of freezers has remained relatively constant over time (Yang et al., 2015), it is possible that freezer penetration has increased between the time that RECS 2009 was collected and the date of the current survey.

**Table 3.1.3: Penetration of freezers**

Survey	Household penetration (%)	95% confidence interval (%)
RI2 (current study)	36.3	[34.4, 38.1]
RECS	30.4	[29.6, 31.3]
RP2	31.3	[29.7, 32.8]
RP3	41.4	[39.9, 43.0]

Table 3.1.4 shows the mean number of freezers per household calculated from the RI2 survey compared with other surveys. The results are consistent across all surveys at 1.1.

**Table 3.1.4: Number of freezers per household**

Survey	Mean freezers per household	95% confidence interval
RI2 (current study)	1.13	[1.11, 1.16]
RECS	1.10	[1.10, 1.10]
RP2	1.11	[1.11, 1.12]
RP3	1.13	[1.13, 1.14]

### 3.1.2 Non-compressor refrigerators

Non-compressor refrigerators use technology other than vapor compression for refrigeration. We knew from previous surveys that people often do not know the technology of their refrigerator, because the products look the same from the outside. Therefore, as well as asking respondents “How many non-compressor refrigerators are plugged in at your home?” we also asked them to provide the brand and model number, so we could verify the technology.

The weighted proportion of respondents that stated they owned a non-compressor refrigerator was 13.3%. Of these, 27.1% provided model numbers. Only 16.8% of provided model numbers corresponded with non-compressor refrigerators. We assumed that the same percentage of responses that did not provide a model number were non-compressor; therefore we recalculated the penetration to be 2.9%, 95% CI [2.2, 3.6].

Our estimate is lower than the estimate of non-compressor refrigerator penetration provided by Greenblatt et al. (2013a), which was 3.8%, 95% CI [1.5, 5.8]. This value was based on a combination of estimates from three AMT surveys, each with somewhat different phrasing, and not all of which asked for a model number. The estimate from the current survey falls within the 95% confidence interval of the previous estimate.

The phrasing of the question “How many non-compressor refrigerators are plugged in at your home right now?” also allowed us to estimate the number of products per household. The mean was 1.09, 95% CI [1.01, 1.17]. This is a little higher than the NV1 survey result of 1.02, [1.00, 1.07].

### 3.1.3 Hybrid products

Hybrid products can be either a refrigerator or freezer, with a separate compartment designed specifically for storing wine at a warmer temperature. We had no previous experience with how well these types of products are identified. Therefore, we asked respondents to provide the brand and model number, so we could verify their products.

The weighted proportion of respondents that indicated their household owned a hybrid product was 2.7%, 95% CI [2.1, 3.4]. Of these, 20.5% provided a model number. Only 3.0%

of the provided model numbers were verified as a hybrid product. We assumed that the same proportion of results that did not provide a model number were hybrid products, therefore we estimated the penetration to be 0.1%, [0.0, 0.2]. The number of products per household was estimated to be 1.05, [1.00, 1.10].

Respondents misidentified a variety of products as hybrid products. The largest proportion of the responses, 40.7%, corresponded to an ordinary refrigerator. Many refrigerators now come with an optional shelf, designed for the storage of wine, which could explain the confusion. The second largest proportion, 36.3%, referred to wine chillers. Some respondents identified either a refrigerator or freezer with a separate independent temperature-controlled compartment that could be adjusted to store wine, but could also be used for multiple other purposes. Others identified a product with a compartment for storing wine that did not have independent temperature control.

The RP2 survey also collected information on hybrid products, with an estimated penetration of 3.1%, 95% CI [1.9, 4.3] (Greenblatt et al., 2013a). The survey did not ask for a model number, so there was no way to verify the results. The question on ownership was collected as a yes or no response, rather than the number of products plugged in at the respondents home. Therefore it was not possible to estimate the number of products per household from the RP2 survey.

#### **3.1.4 Stand-alone icemakers**

A stand-alone icemaker is a product that automatically produces and harvests ice. It can be portable or non-portable, depending on whether connection to a water supply is required for operation. We wanted to determine the penetration of stand-alone icemakers and also distinguish between portable and non-portable units. Therefore, we included three questions on icemaker ownership: question A10 “How many stand-alone icemakers are plugged in at your home right now?” A11 “How many portable stand-alone icemakers are in your home, including those not plugged in?” and A12 “Is your most used stand-alone icemaker portable?” We also asked respondents a series five of questions on how often their most-used icemaker is plugged in. Finally, we asked respondents to provide the brand and model number, so we could verify their products.

We knew from previous surveys that stand-alone icemakers are relatively easy to identify, so the success rate for model number verification is often very high. This was also the case for this study—96.4% of the model numbers provided were stand-alone icemakers. Therefore, instead of using model numbers, we used consistency between the responses to the eight other questions on icemakers to verify the respondents who owned a stand-alone icemaker. We used the model numbers to verify whether the respondent’s icemaker was portable or non-portable.

The weighted proportion of all respondents that indicated they owned a stand-alone icemaker in questions A10 and A11 was 2.4%, 95% CI [1.8, 3.0]. After comparing the consistency of responses across the other stand-alone icemaker questions, we screened out several respondents, and reached a final estimated penetration of 1.6%, [1.1, 2.1]. The



screening process removed respondents who selected “Don’t know” or “No icemakers are used in my home” to more than one of the 8 questions. We also screened out any responses that indicated they owned an icemaker, but did not select it as one of the ice-making methods used in their household for question A21.

The penetration estimated by the present survey is lower than the estimate provided by Greenblatt et al. (2013a), which was 4.6%, 95% CI [1.7, 7.3]. That estimate was based on the penetrations estimated from the RP2 and RP3 surveys, 2.5% [1.9, 3.0] and 7.6% [6.8, 8.7], respectively, combined with a model number verification from the RI1 survey of 85.7% [83.5, 87.9].

Table 3.1.5 shows the mean number of stand-alone icemakers per household determined from all four AMT surveys. The results are consistent across all surveys, with the vast majority of households owning only one.

**Table 3.1.5: Mean number of stand-alone icemakers per household**

<b>Survey</b>	<b>Mean per household</b>	<b>95% confidence interval</b>
RI2 (current study)	1.00	[1.00, 1.00]
RI1	1.03	[1.00, 1.06]
RP2	1.02	[1.00, 1.10]
RP3	1.04	[1.00, 1.09]

### 3.1.5 Proportion of portable icemakers

We included question A12, “Is your most-used stand-alone icemaker portable?” to allow us to distinguish between portable and non-portable icemakers. We also asked respondents to provide a model number, which we used to verify their responses to question A12.

The weighted proportion of respondents that indicated their most-used stand-alone icemaker was portable was 78.1%, 95% CI [65.9, 90.4]. Of the 43.6 weighted responses that owned an icemaker, 72.3% provided a model number. After checking these against question A12, 98.1% of portable icemakers were correctly identified. We therefore assumed that the respondents that did not provide a model number correctly identified whether their stand-alone icemaker was portable or non-portable.

We based our estimate of classification accuracy on only the results from portable icemakers, because only four respondents with non-portable icemakers provided model numbers. This very small number may be due to the fact that non-portable icemakers are often “under-counter” or “built-in”, in which case it could be difficult for the respondent to find the model number.

Previously, the RI1 survey found that 71.9%, 95% CI [68.8, 75.0] of stand-alone icemakers were portable. This percentage is similar to the percentage found from the present survey. It should be noted that all products in RI1 were classified by their model number, and the

survey had 811 responses, so the result from RI1 could be more accurate than the result from the present survey.

### 3.2 Ice-making methods

Question A21 asked “What does your household use for making ice?” Table 3.2.1 shows the percentage of weighted survey responses that used each ice making method or combination of methods. As can be seen, manual (filling trays with water and placing in the freezer) was the most common method, followed by integrated icemaker (automatic icemaker inside a refrigerator or freezer, with or without a through-the-door dispenser).

**Table 3.2.1: Methods of ice-making in U.S. households**

<b>Ice-making method</b>	<b>Percentage of weighted response</b>	<b>Lower 95% CI (%)</b>	<b>Upper 95% CI (%)</b>
No ice used	5.6	4.8	6.5
Manual (ice cube trays)	45.2	43.3	47.1
Integrated icemaker	39.1	37.3	41.0
Manual & integrated	7.5	6.5	8.5
Stand-alone icemaker	1.1	0.7	1.5
Manual & stand-alone	0.3	0.1	0.5
Integrated & stand-alone	0.2	0.0	0.4
Manual, integrated & stand-alone	0.1	0.0	0.2

We can compare our estimate that 47% of households use an integrated icemaker with estimates of integrated icemaker penetration from other sources. RECS has not previously reported on all integrated ice makers, but it did report the percentage of households with a through-the-door icemaker to be 10% in 1993, 20% in 2001, 26% in 2005, and 33% in 2009. This trend from RECS suggests that approximately 39% of households had through-the-door icemakers in 2014.

Although we have no precise data on the percentage of integrated icemakers without through-the-door dispensers, market research data from The NPD Group indicated that it was at least 30% of integrated icemakers sold in 2007 and 2008 (The NPD Group, 2008). Data published by the U.S. Department of Energy also showed that more than half of the integrated icemakers sold since 2008 used through-the-door dispensers (DOE, 2011). If we assume based on this information that at least 10% of households have integrated icemakers without through-the-door dispensers, the total penetration of integrated icemakers could be at least 50% of households. This number is close to our estimate that 47% of households use an integrated icemaker for making ice.

### 3.3 Percentage of time stand-alone icemakers are plugged in

We asked respondents five questions about how often their most-used stand-alone icemaker was plugged in: the season(s) in which the icemaker was plugged in the most and the least (A16 and 19), and the number of days it was plugged in during the past week, during the most-used season, and during the least-used season (A15, 17, and 20).

#### 3.3.1 Calculation method

We converted the responses on the number of days plugged in per week to numerical values using the conversion shown in Table 3.3.1.

**Table 3.3.1: Number of days plugged in response options**

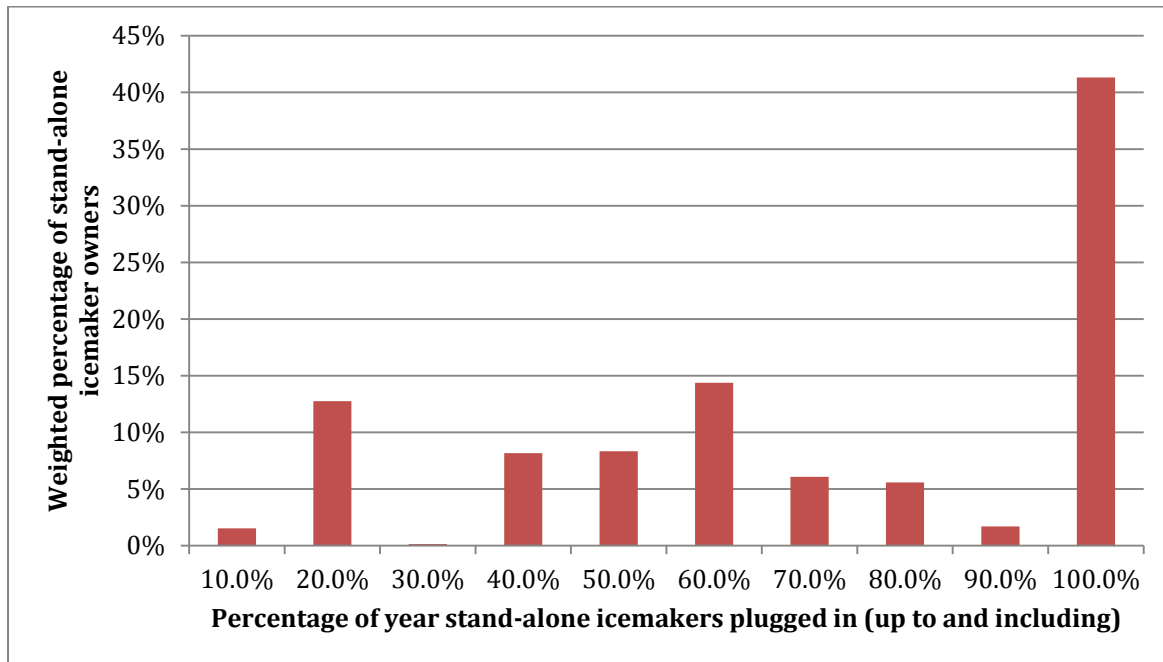
Response option	Numerical value (days)
Up to ½ a day (12 hours) per week	0.25
Between ½ and 1 day per week	0.75
Between 1 and 3 days per week	2
Between 3 and 7 days per week	5
It is plugged in continually (7 days per week)	7

We then allocated the number of days plugged in per week for the most- and least-used seasons to the season(s) that respondents indicated they used their icemakers the most and least, respectively. We assumed that the number of days per week plugged in for all other seasons was the mean of the values for most- and least-used seasons.

We determined the percentage of the year that an icemaker was plugged in by multiplying the number of days per week it was plugged in within each season by the number of weeks in that season, summing across seasons, and dividing by the average number of days in a year.

#### 3.3.2 Distribution of percentage of year that icemakers are plugged in

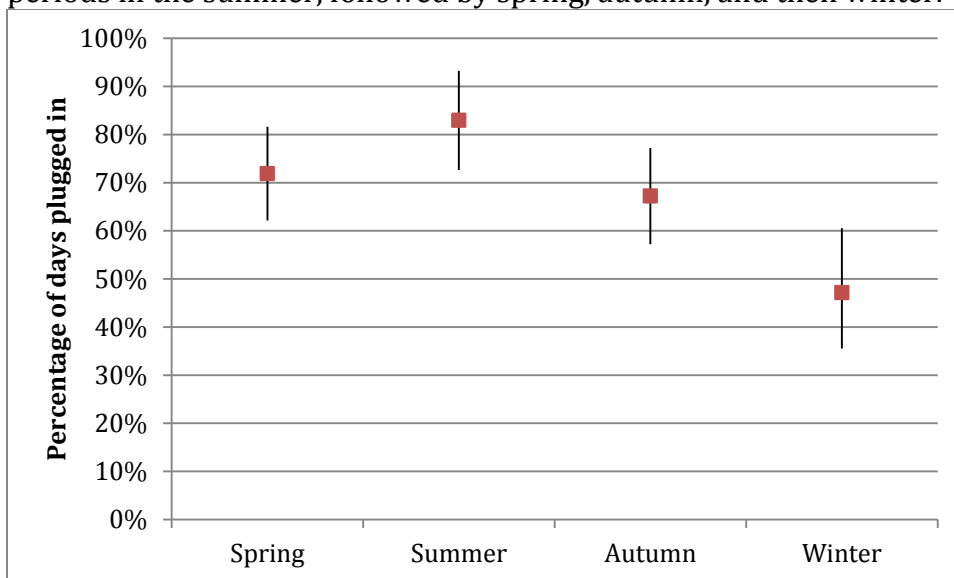
Figure 3.3.1 shows the distribution of the time plugged in as a percentage of the year in bins of 10% (the values indicate the top of the bin range) for all respondents. The distribution has three modes. A large number of respondents kept their icemaker plugged in continuously throughout the year, another group was centered at 50-60% of the year, and the final mode existed at 20% or less of the year. The overall mean was 67.6% of the year, 95% CI [58.2, 77.0], and the median was 66.8%.



**Figure 3.3.1: Distribution of percentage of year stand-alone icemakers were plugged in.**

### 3.3.3 Seasonal variation

Figure 3.3.2 shows the mean time icemakers are plugged in for each season, as a percentage of the total days in the season. Icemakers were plugged in for the longest periods in the summer, followed by spring, autumn, and then winter.



**Figure 3.3.2: Percentage of days plugged in for each season, with 95% confidence intervals**

### 3.3.4 Percentage of time plugged in by type

We also separated the results by portable or non-portable icemaker. Table 3.3.2 shows these results along with the overall mean for comparison. As expected, portable icemakers were plugged in less frequently than non-portable. The median of 100% for non-portable icemakers indicates that more than half of the respondents kept them plugged in continually.

**Table 3.3.2: Percentage of year portable and non-portable icemakers were plugged in**

Type	Mean	Median	Lower 95% CI of mean	Upper 95% CI of mean
All	67.6	66.8	58.2	77.0
Portable	61.6	54.7	50.9	72.3
Non-portable	89.1	100.0	75.5	100

### 3.4 Personal Ice Use

Section B of the survey asked respondents about the amount of ice that they used from their home(s). We instructed respondents to include ice they personally used from all of their homes, if they had more than one. This was different than the rest of the survey, which asked about the home that the respondent used the most (if they had more than one). We did this to ensure that we included all the ice people consumed, even if they lived in multiple locations for work or school for part of their time.

We asked respondents five questions about their personal ice use: the season(s) in which they used the most and least ice (B2 and 4), and the amount of ice they used per day during the past week and during the season(s) in which they used the most and least ice (B1, 3, and 5). We asked for the amount of ice in eight-ounce cups per day, and we defined an eight ounce cup as a traditional tea cup or a measuring cup.

### 3.4.1 Calculation method

We combined the responses to the five questions on personal ice use to produce an estimate of the average ice use per day for each survey respondent. We first converted the ice use per day questions to numerical values by taking the middle of each response range as shown in Table 3.4.1.

**Table 3.4.1: Numerical conversion of ice use response options**

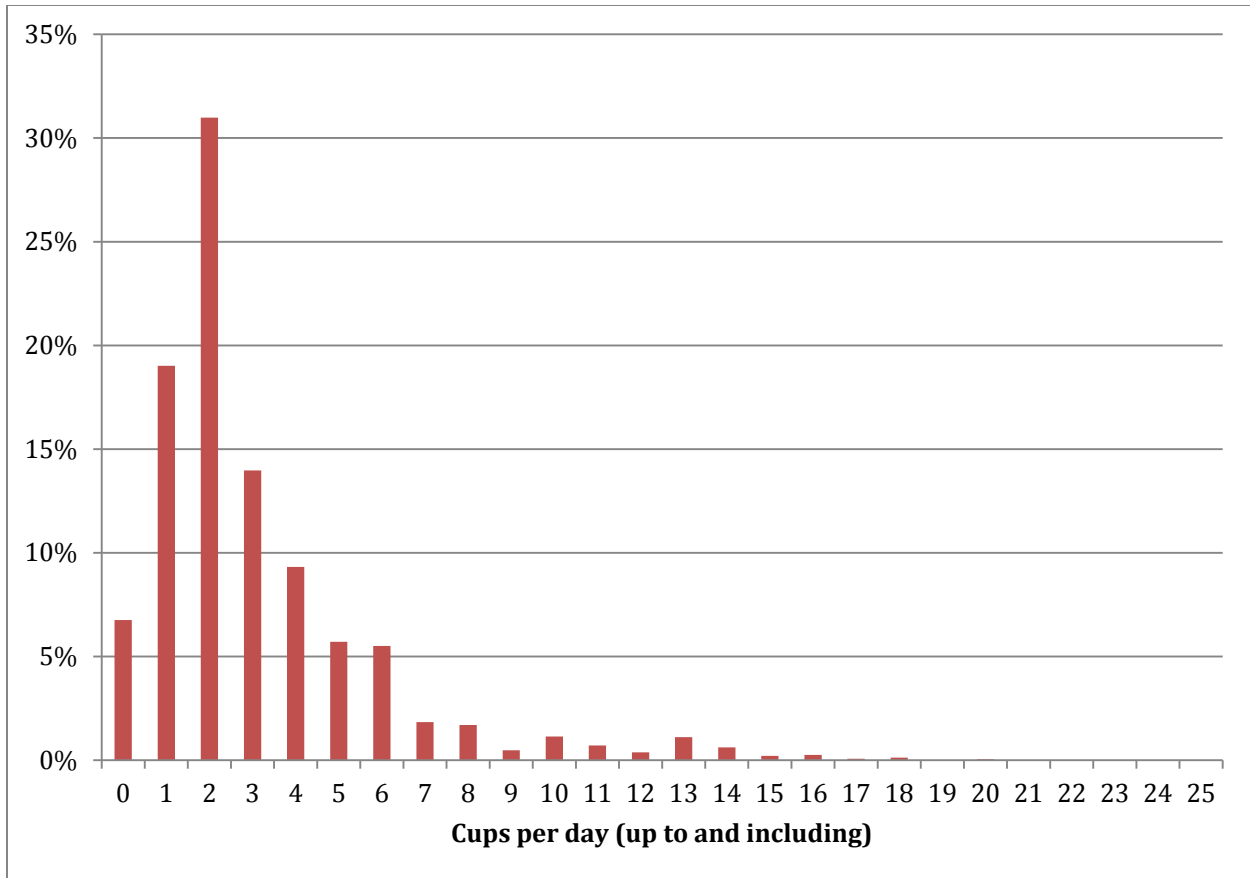
<b>Response option</b>	<b>Numerical value for number of cups per day</b>
I have not used any ice from my home	0
Up to 1 cup of ice per day	0.5
About 2 cups of ice per day	2
About 3 cups of ice per day	3
About 4 cups of ice per day	4
About 5-6 cups of ice per day	5.5
About 7-8 cups of ice per day	7.5
About 9-10 cups of ice per day	9.5
About 11-15 cups of ice per day	13
About 16-20 cups of ice per day	18
More than 20 cups of ice per day	25

We then allocated the ice use per day for the most- and least-used seasons to the season(s) that respondents indicated they used the most and least ice, respectively. We assumed that the ice use per day for all other seasons was the mean of the values for most- and least-used seasons.

We determined the annual average daily ice use by multiplying the ice use per day within each season by the number of days in that season, summing across seasons, and dividing by the average number of days in a year.

### 3.4.2 Distribution of personal ice use per day

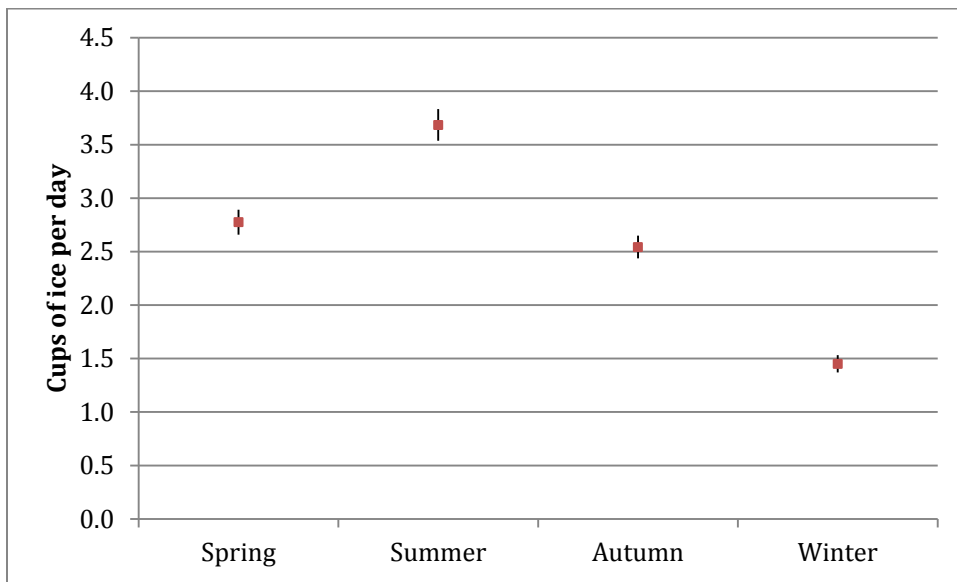
Figure 3.4.1 shows the distribution of ice use per day for all respondents. The distribution is positively skewed, with most people consuming small volumes of ice, and a long tail of greater ice consumption. The mean ice consumption was 2.62 cups per day, 95% CI [2.51, 2.73], and the median was 1.76 cups per day.



**Figure 3.4.1: Distribution of personal ice consumption**

### 3.4.3 Seasonal variation

Figure 3.4.2 shows that ice use was highest in summer, followed by spring, autumn, and then winter. This pattern is similar to the seasonal pattern seen in the percentage of time that icemakers were plugged in, but the variation between seasons was larger for personal ice use.



**Figure 3.4.2: Mean ice per day use in each season**

### 3.5 Personal ice use by ice-making method

In addition to personal ice use of all respondents, we wanted to determine whether ice use varied with the type of ice-making method(s) used by the household. In order to answer this question, we combined the responses to question A21 on ice-making methods with the responses to section B on personal ice use. This required us to assume that the methods chosen in A21 fully reflected the source of the respondent’s household ice consumption. This is not necessarily the case, however, because section A asked about the methods used in the respondent’s most-used home, while section B asked about the ice consumed from all of the respondent’s homes. We expect that the error due to this assumption is likely small, because there are likely few individuals who live in multiple homes. For example, the U.S. census bureau found only 2.5% of U.S. housing units were used as a secondary home<sup>1</sup>.

Table 3.5.1 shows results along with the percentage of survey respondents that selected each ice-making method. The results from all respondents are repeated here for easy comparison. As can be seen, there was large variation in the amount of ice used depending on method. Respondents from households that only made ice manually used the least amount of ice, less than the mean of all respondents. Households that used an integrated icemaker only, or a combination of integrated and manual ice-making, used only slightly more than all respondents. Respondents from households that used a stand-alone icemaker, especially in combination with other ice-making methods, used substantially more than all respondents.

<sup>1</sup>

[http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=AHS\\_2013\\_C01AH&prodType=table](http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=AHS_2013_C01AH&prodType=table)



The results are sensible in the context of the relative capacities of different types of icemakers. For example, portable stand-alone icemakers are capable of producing five to six times more ice than integrated icemakers. This suggests that people purchase an ice-making product that suits their requirements.

**Table 3.5.1: Mean and median personal ice use by respondents from household with a given ice-making method**

Method	Percentage of sample	Mean (cups per day)	Median	Lower 95% CI	Upper 95% CI
All respondents	100.0	2.62	1.76	2.51	2.73
Manual (ice cube trays)	45.2	2.14	1.44	2.01	2.27
Integrated	39.1	3.20	2.26	3.03	3.37
Manual & integrated	7.5	3.11	2.07	2.65	3.56
Stand-alone	1.1	6.70	5.02	4.93	8.47
Manual & stand-alone	0.3	4.93	3.01	3.31	6.54
Integrated & stand-alone	0.2	4.00	4.64	1.17	6.83
Manual, integrated & stand-alone	0.1	8.78	3.02	0.00	22.64

### 3.6 Household ice use by ice-making method

We also estimated average household ice use. We did this by combining the results on personal ice use with the responses on the number of household members in section C of the survey. In addition to the assumptions required to estimate personal ice use by ice-making method, household ice use required additional assumptions on whether a respondent’s ice consumption was representative of the consumption by other household members.

In order to express the range of potential representativeness of the respondent’s ice use for the rest of the household, we estimated household ice use using two sets of assumptions. First, we assumed that all other household members used (a) the same amount of ice as the respondent, (b) the survey mean personal ice use, or (c) the mean personal ice use of all respondents using the same ice-making method(s) as the household. Second, we assumed that children<sup>2</sup> used (a) the same amount of ice as adults, or (b) half of the ice consumed by adults. This latter assumption agrees with a field monitoring study on integrated icemaker households, which found that “children seem to contribute to fewer ice making cycles than adults” ( Ecotope, 2013).

<sup>2</sup> We assumed household members were children if they were less than 20 years old, and there were one or more household members over 20 years old.

We thus developed the following five scale-up methods:

- **Method 1:** All household members use the same amount of ice as the respondent.
- **Method 2:** All household members except the survey respondent use the mean ice use per day calculated in section 3.4.2.
- **Method 3:** All household members except the survey respondent use the mean amount of ice associated with their household’s ice-making method(s) as shown in Table 3.5.1.
- **Method 4:** Same as Method 2, except children use half as much ice as adults.
- **Method 5:** Same as Method 3, except children use half as much ice as adults.

Table 3.6.1 shows the results for Method 1 along with mean personal ice use and mean number of household members. Respondents from households that used integrated or stand-alone icemakers used more ice, and those households also had more occupants. As a result, Method 1 provided very high estimates of household ice use for households that used stand-alone icemakers. These high estimates were attenuated in the other scale-up methods we used.

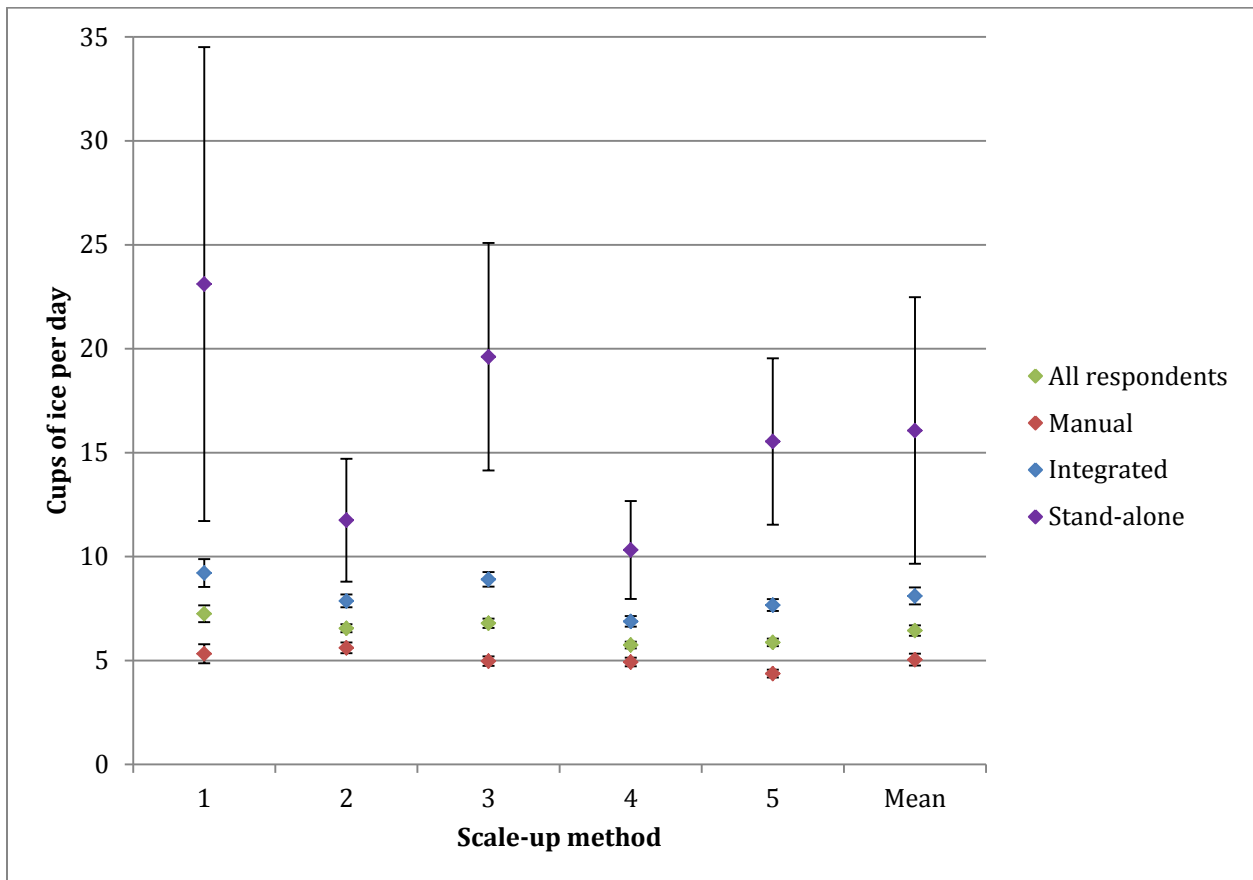
**Table 3.6.1: Results of scaling personal ice use to household ice use assuming all household members use same amount of ice**

Household ice-making method(s)	Personal ice use (cups of ice per day)	Mean number of household members	Household ice use from Method 1 (cups per day)*
All respondents	2.62	2.5	7.25
Manual (ice cube trays)	2.14	2.3	5.33
Integrated	3.20	2.8	9.21
Manual & integrated	3.11	2.8	9.32
Stand-alone	6.70	2.9	23.11
Manual & stand-alone	4.93	3.5	18.90
Integrated & stand-alone	4.00	3.7	16.05
Manual, integrated & stand-alone	8.78	2.9	33.16

\* Mean household ice use was calculated by multiplying personal ice use by number of household members, and then taking the mean. These results are not the same as multiplying mean personal ice use by mean number of household members, so multiplying the numbers shown in the table will generally not result in the household mean.

Figure 3.6.1 shows the results for all five scale-up methods for all respondents and households that use a single ice-making method. We did not plot households that used

multiple ice-making methods, because we wanted to keep the figure readable. There are several items that are notable from this figure. First, irrespective of the method, the rank order between ice-making methods remained the same—manual ice-making had the lowest average, followed by integrated icemakers and then stand-alone icemakers. Second, the assumptions used had very little effect on the estimated household ice use for households that used manual ice-making and integrated icemakers. Finally, the assumptions used had a large effect on the estimated ice use for households that used stand-alone icemakers, due to the large number of people and children in these households.



**Figure 3.6.1: Household ice use per day**

### 3.7 Comparing ice use to other studies

Although we were unable to find any peer-reviewed studies of ice production, there were three reports of estimated daily ice production from the U.S. Department of Energy’s refrigerator and freezer rulemaking proceedings. The Association of Home Appliance Manufacturers (AHAM) first provided an estimate of 1.8 lb per day, based on 3 consumer surveys and 3 field tests (AHAM, 2010). More recently, the Northwest Energy Efficiency Alliance (NEEA) commissioned Ecotope to perform a field metering study of 86 integrated icemakers in the states of Washington, Oregon, and Idaho. This study found a positively skewed distribution of ice production, with a mean of 0.76 lb per day and a median of 0.63 lb per day (Ecotope, 2013; NEEA, 2014; AHAM, 2014). Additionally, AHAM has reported a

manufacturer study of 4894 integrated icemakers with ice dispensers, using data collected during technician service calls. This study also found a positively skewed distribution of ice production, with a mean of 0.83 lb per day and a median of 0.59 lb per day (AHAM, 2014).

The reported distribution of production from other studies is similar to the positively-skewed distribution found in the present study. In order to compare the mean values, we converted our results from cups per day to pounds per day. We estimated each eight-ounce cup of ice to weigh 0.28 lb, based on the bulk density of ice cubes being approximately 33 lb per cubic foot<sup>3,4</sup>, and 8 U.S. fluid ounces being equal to 0.008355 cubic feet. For household values, we used the mean of the various methods we evaluated.

Table 3.7.1 shows personal and household ice use from the present study in pounds per day. The results reported by other studies are likely most analogous to our household results, because a single refrigerator usually serves a single household. Our result for all respondents in the survey, 1.80 lb per day, is very similar to the first estimate reported by AHAM. This value and our results for integrated icemakers, however, are much higher than the values reported from the field-metering studies.

**Table 3.7.1: Personal and household ice use in pounds of ice per day**

Ice-making method	Personal ice use		Household ice use	
	Mean	95% CI	Mean	95% CI
All respondents	0.73	[0.70, 0.76]	1.80	[1.56, 2.14]
Manual	0.60	[0.56, 0.64]	1.41	[1.17, 1.64]
Integrated	0.90	[0.85, 0.94]	2.27	[1.86, 2.77]
Stand-alone	1.88	[1.38, 2.37]	4.50	[2.23, 9.66]

There are several possible reasons for the difference between our results and those of the field-metering studies. Our study and AHAM’s first study were based largely on survey data. As a result, it is possible that survey respondents generally overestimate how much ice they use. It was also not clear whether respondents in the current survey answered based on the number of full cups of ice they used, or based on the amount of ice they would typically put into a cup (filling the rest of the volume with a drink). The shape of ice cubes is also variable, and therefore our estimate of bulk density was the mean of a range of values. In addition, as we mentioned already, it is possible that we have overestimated household ice use when scaling up from personal to the household. Finally, it is also possible that the results from the field-metering studies—which represent the production from single integrated icemakers—underestimate household ice production. RECS 2009

<sup>3</sup> <http://www.inter-bulk.com/BulkDensityList.htm>

<sup>4</sup>

<http://www.sawyerhanson.com/uploads/Brabender%20Ingredient%20bulk%20density%20table.pdf>

indicated that around 23% of households have more than one refrigerator, and it is possible that these households use icemakers in more than one refrigerator.

If we assume that the field metering studies provide a more accurate estimate of ice production than our survey, we can derive an adjustment factor for integrated icemakers and apply it to our results for all types of ice-making. We divided our estimate for household ice production by a weighted mean of the NEEA (2014) results (to account for the fact that more integrated icemakers have through-the-door dispensers). This gave us an adjustment factor of 2.99, indicating that the household survey results were 2.99 times higher than the field-metering results. We then divided our estimates for all ice-making methods by this factor. The adjusted results are shown in Table 3.7.2.

**Table 3.7.2: Personal and household ice use in pounds of ice per day, after adjustment for field-metering results**

<b>Ice-making method</b>	<b>Personal ice use</b>	<b>95% CI</b>	<b>Household ice use</b>	<b>95% CI</b>
All respondents	0.25	[0.24, 0.26]	0.60	[0.52, 0.72]
Manual	0.20	[0.19, 0.21]	0.47	[0.39, 0.55]
Integrated	0.30	[0.28, 0.32]	0.76	[0.62, 0.93]
Stand-alone	0.63	[0.46, 0.79]	1.51	[0.75, 3.23]

In comparing our results to those from the field-metering studies, there are several questions that are important to highlight. First, it is not clear how representative of the population the field metering studies were. AHAM provided no information on the households that the manufacturer data came from, and Ecotope highlighted several areas in which their sample might not have been representative. For example, they included households from three states only, and the average size of the metered households was smaller than the national average. Second, the Ecotope study took place only during the spring and summer, and AHAM did not report when the manufacturer study took place. Finally, it is not clear whether the adjustment factor we calculated for integrated icemakers should be the same as the adjustment factor used for households that use other methods to make ice.

## 4 General discussion

Although refrigeration products are ubiquitous in U.S. homes, several aspects of their use are largely unknown. This report presents the results of a survey we conducted to explore some existing gaps in knowledge. We fielded the survey on Amazon Mechanical Turk, and we analyzed data from 2694 respondents. We presented the results for most of the survey topics in this report, and the tabulated responses to all questions are in Appendix B.

We estimated the penetration and number of products per household for several refrigeration products. We found the penetration to be 99.8% for refrigerators, 36.3% for freezers, 2.9% for non-compressor refrigerators, 0.1% for hybrid products that incorporate

a wine chiller compartment, and 1.6% for stand-alone icemakers. Our result for refrigerators was similar to RECS 2009, and our estimate for freezers was 6 percentage points higher than RECS 2009. Our estimate for non-compressor refrigerators was similar to the results from previous surveys, and our results for hybrid products and stand-alone icemakers were lower than reported from earlier surveys (Greenblatt et al., 2013a).

We also asked about the methods that people use to make ice. Approximately 5.6% of households did not make ice, and 45.2% made ice manually with trays. Most of the remaining households used an icemaker integrated within a refrigerator or freezer, or a combination of manual trays and integrated icemaker. Approximately 1.6% of households used a stand-alone icemaker or a combination of methods including a stand-alone icemaker.

In addition, we estimated the characteristics and pattern of use for stand-alone icemakers. We estimated that 78.1% of stand-alone icemakers were portable, which is similar to the previous AMT survey estimate of 71.9%. We also estimated that portable units were plugged in 61.6% of the time, and non-portables were plugged in 89.1% of the time. The median for non-portables was 100%, indicating that more than half were plugged in continually. We also found that stand-alone icemakers were plugged in more often during the summer and less often in the winter.

Finally, we estimated personal and household ice use. We found that personal ice use had a positively skewed distribution, with most individuals using less than the overall average of 2.62 cups, or 0.73 lb per day. We estimated the mean household ice use to be 6.44 cups, or 1.80 lb per day. A household's method of ice production was correlated with the amount of ice use, with households that utilized manual trays using less ice than those that used integrated icemakers, and much less than those that used stand-alone icemakers. Compared to field-metering studies (Ecotope, 2013; NEEA, 2014; AHAM, 2014), our results were approximately three times higher. It is not clear which estimates are most accurate, but if we adjusted our estimates to match the field-metering studies, our adjusted estimate of average ice use would be 0.25 lb per day for individuals and 0.60 lb per day for households.

This report provides information on several aspects of refrigeration appliances and ice production for which there were previously little or no data. These results will allow for a more accurate estimate of the household energy consumed by refrigeration products.

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## Appendix A: Survey Form

# Residential Refrigeration Products and Ice-making Research Study

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The Energy Efficiency Group at Lawrence Berkeley National Laboratory would like to invite you to participate in a survey on refrigeration products and ice making in U.S. homes.

Before you proceed with this survey, please make sure that you fulfill the following qualifications:

1. You must reside in the U.S.
2. You must be at least 18 years old.

### Examples of the products surveyed:

*A REFRIGERATOR cools items such as food to a temperature below 39°F (4°C). It may include a separate freezer, icemaker or wine/beverage cooler compartment.*



*A FREEZER freezes and stores items such as food at 0°F (-18°C) or below. It may include a separate icemaker or wine/beverage cooler compartment.*



*An ICEMAKER automatically produces ice (usually in small cubes) and keeps them frozen for later use. It is often included in a refrigerator or freezer, but some icemakers are completely separate from a standard refrigerator or freezer and are called STAND-ALONE ICEMAKERS.*



*A WINE/BEVERAGE COOLER (sometimes called a wine cooler, wine chiller, beverage center or beverage cooler) is a special type of appliance used mainly for cooling liquids such as wine or beer, at 39° to 65°F (4° to 18°C). It is NOT designed for the safe preservation of food.*



### **What you need to do to complete the survey:**

- Answer questions about the refrigeration products and ice making appliances in your home
- Answer questions about your personal ice usage.
- Report the brands and model numbers of refrigeration appliances in your home. You can often find this information on the product “nameplate,” which is a small rectangular label usually located inside or on the back of the appliance. Your owner's manual may also provide you with the brand and model number.
- Answer demographic questions, such as gender and race.
- Answer all questions in the survey that are applicable to you. Skipping questions may cause your work to be rejected. If applicable, you may choose options such as “I don’t have...,” “Decline to state,” or “I don’t know.”

### **More information about participating in this survey:**

- Within 7 days of the survey being closed, we will review your responses. You will be paid \$2.00 for your completed and accepted survey.
- Your work will not be accepted and you will not be paid if you do not match the qualifications stated above or do not answer all the questions that apply to you.
- If your work is rejected, a negative rating will be applied to your Amazon Mechanical Turk (AMT) account. This could affect your overall rating and might prevent you from taking other HITs with high rating requirements.
- The data this survey collects about you and your home will be password-protected and only seen by the research team. Only data that has been grouped together with data from others will be published.
- Should you have any questions related to this survey, you may contact the study Principal Investigator, Jeffery Greenblatt at 415-814-9088, or you may contact us via e-mail: EESurvey.amz@lbl.gov.
- Any questions you have about your rights as a participant will be answered by Berkeley Lab Human Subjects Committee at 510-486-5399.
- A copy of this study information can be obtained from the following webpage:  
<http://energy.lbl.gov/fsp/>

**Participation in this research is voluntary. You have the right to not take part in this survey. If you decide to take this survey, please click “Accept HIT” at the end of this page.**

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**This Survey is broken into 3 Sections (Section A, Section B, and Section C). Make sure to respond to all questions in all sections.**

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### **Section A: Refrigeration Products**

If you live in more than one home, please restrict your responses in this section to the home you use the most.

*Please answer ALL questions in this section (Section A: Questions A1-A21).*

**A1. How many refrigerators are plugged in at your home right now?**

**DO NOT INCLUDE:**

- Stand-alone freezers
- Stand-alone icemakers
- Stand-alone wine/beverage coolers

**INCLUDE:**

- Full-size refrigerators
- Compact refrigerators
- Refrigerators with separate freezers, automatic icemakers, or wine/beverage cooler compartments

*Check the number of refrigerators*

- None
- 1
- 2
- 3
- 4
- 5 or more
- Don't know

**A2. How many freezers are plugged in at your home right now?**

**DO NOT INCLUDE:**

- Stand-alone Refrigerators
- Stand-alone icemakers
- Stand-alone wine/beverage coolers
- Freezers that are part of a refrigerator

**INCLUDE:**

- Stand-alone freezers
- Freezers with automatic icemakers or wine/beverage cooler compartments

Check the number of freezers

- None
- 1
- 2
- 3
- 4
- 5 or more
- Don't know

*Most refrigeration products use vapor compression technology to keep foods and beverages cold. But some refrigeration products are cooled with other types of technologies. One technology is called THERMOELECTRIC cooling and another is called ABSORPTION cooling. Both are quieter than regular refrigeration technology and produce little vibration. Also, absorption cooling can be powered by propane or some other fuel as well as by electricity. Common brands featuring these technologies include EdgeStar and Dometic.*

**A3. How many refrigerators are plugged in at your home right now that use THERMOELECTRIC or ABSORPTION cooling technology to provide cooling?**

**DO NOT INCLUDE:**

- Refrigerators that use vapor compression technology
- Stand-alone freezers
- Stand-alone icemakers
- Stand-alone wine/beverage coolers

**INCLUDE:**

- **Thermoelectric or absorption cooling refrigerators**

*Check the number of refrigerators with THERMOELECTRIC or ABSORPTION cooling technology.*

- None
- 1
- 2
- 3
- 4
- 5 or more
- Don't know

*If you have more than one thermoelectric or absorption cooling refrigerator in your home, please restrict your answers below to the largest-capacity unit.*

**A4. What is the brand of this thermoelectric or absorption cooling refrigerator?**

**A5. What is the full model number of this thermoelectric or absorption cooling refrigerator?**

- Model Number:
- None
- I don't know (*Please select this option if the model number could only be found at the back of your appliance and it is too heavy to move*)

*Some refrigerators or freezers have a special section or compartment specifically designed to store wine at a temperature warmer than 39°F (4°C). This is different than a wine shelf or rack that comes with some standard refrigerators that is maintained at the same temperature as the rest of the compartment.*

**A6. How many refrigerators or freezers are plugged in at your home right now that have a SPECIAL SECTION OR COMPARTMENT designed specifically for storing wine at a warmer temperature?**

**DO NOT INCLUDE:**

- Stand-alone wine/beverage coolers

**INCLUDE:**

- Refrigerators and freezers with separate wine/beverage cooler compartments

*Check the number of refrigerators and freezers with a SPECIAL SECTION OR COMPARTMENT designed specifically for storing wine at a warmer temperature.*

- None
- 1
- 2
- 3
- 4
- 5 or more
- Don't know

*Reminder: please provide an answer to ALL questions*

*If you have more than one refrigerator or freezer with a separate section for storing wine at a warmer temperature in your home, please restrict your answers below to the largest-capacity unit.*

**A7. What is the brand of this refrigerator or freezer with a separate section for storing wine at a warmer temperature?**

**A8. What is the full model number of this refrigerator or freezer with a separate section for storing wine at a warmer temperature?** The model number is critical information for our analysis. Please enter model number below or select 'None' if no refrigerator or freezer with a separate section for storing wine at a warmer temperature is used in your home.

- Model Number:
- None
- I don't know (*Please select this option if the model number could only be found at the back of your appliance and it is too heavy to move*)

**A9. Who is the current president of the U.S.?**

- Amana
- Bosch
- Danby
- Emerson
- Frigidaire
- GE
- Haier
- JennAir
- Kenmore
- Miele
- Obama
- Sanyo
- Tresanti
- Uline
- Viking
- Whirlpool
- Don't know

**A10. How many stand-alone icemakers are plugged in at your home right now?**

**DO NOT INCLUDE:**

- Refrigerators
- Freezers
- Wine/beverage coolers
- Icemakers that are part of a refrigerator, freezer or wine/beverage cooler

**INCLUDE:**

- Stand-alone icemakers

*Check the number of stand-alone icemakers*

- None
- 1
- 2
- 3

- 4
- 5 or more
- Don't know

*A **PORTABLE** icemaker is a stand-alone icemaker that is advertised as being portable. It might be small and able to fit on a countertop. It might also have a handle or wheels to make it easier to move.*

**A11. How many PORTABLE stand-alone icemakers are used in your home, INCLUDING those that are NOT plugged in right now?**

**DO NOT INCLUDE:**

- Refrigerators
- Freezers
- Wine/beverage coolers
- Ice makers that are part of a refrigerator, freezer or wine/beverage cooler
- Stand-alone icemakers that are not portable

**INCLUDE:**

- Portable stand-alone icemakers

*Check the number of portable stand-alone icemakers*

- None
- 1
- 2
- 3
- 4
- 5 or more
- Don't know

*If more than one stand-alone icemaker is used in your home, please restrict your answers below to the **most-used** unit.*

**A12. Is your most-used stand-alone icemaker portable?**

- There are no stand-alone icemakers used in my home
- Yes, this stand-alone icemaker is portable
- No, this stand-alone icemaker is not portable
- Don't know

**A13. What is the brand of your most-used stand-alone icemaker?**

**A14. What is the full model number of your most-used stand-alone icemaker? The model number is**



critical information for our analysis. Please enter model number below or select 'None' if no stand-alone icemakers are used in your home.

- Model Number:
- None
- I don't know (*Please select this option if the model number could only be found at the back of your appliance and it is too heavy to move*)

**A15. Within the past week, how much of the time has this stand-alone icemaker been plugged in? Indicate the number of days:**

- No stand-alone icemakers are used in my home
- Up to 1/2 a day (12 hours) per week
- Between 1/2 and 1 day per week
- Between 1 and 3 days per week
- Between 3 and 7 days per week
- It is plugged in continually (7 days per week)
- Don't know

**A16. Choose the time(s) of year that this stand-alone icemaker is plugged in the MOST (choose all that apply):**

- No stand-alone icemakers are used in my home
- This stand-alone icemaker is plugged in for the same amount of time in all seasons
- Spring (i.e. March, April, and May)
- Summer (i.e. June, July, and August)
- Autumn (i.e. September, October, and November)
- Winter (i.e. December, January, and February)
- Don't know

**A17. In the season(s) when this stand-alone icemaker is used the MOST, for how much of each week is the icemaker plugged in? Indicate the number of days:**

- No stand-alone icemakers are used in my home
- Up to 1/2 a day (12 hours) per week
- Between 1/2 and 1 day per week
- Between 1 and 3 days per week
- Between 3 and 7 days per week
- It is plugged in continually (7 days per week)
- Don't know

**A18. How many hours are there in a day?**

- Less than 5 hours

- At least 5 but fewer than 10 hours
- At least 10 but fewer than 20 hours
- At least 20 but fewer than 30 hours
- At least 30 but fewer than 40 hours
- More than 40 hours
- Don't know

**A19. Choose the time(s) of year that this stand-alone icemaker is plugged in the LEAST(choose all that apply):**

- No stand-alone icemakers are used in my home
- This stand-alone icemaker is plugged in for the same amount of time in all seasons
- Spring (i.e. March, April, and May)
- Summer (i.e. June, July, and August)
- Autumn (i.e. September, October, and November)
- Winter (i.e. December, January, and February)
- Don't know

**A20. In the season(s) when this stand-alone icemaker is used the LEAST, for how much of each week is the icemaker plugged in? Indicate the number of days:**

- No stand-alone icemakers are used in my home
- Up to 1/2 a day (12 hours) per week
- Between 1/2 and 1 day per week
- Between 1 and 3 days per week
- Between 3 and 7 days per week
- It is plugged in continually (7 days per week)
- Don't know

**A21. What does your household use for making ice (choose all that apply):**

- My household does not make any ice
- Manually-filled ice cube trays inside a refrigerator, freezer, or wine chiller
- Automatic icemaker inside a refrigerator, freezer, or wine chiller
- Stand-alone icemaker
- Don't know

**THIS IS THE END OF SECTION A; PLEASE PROCEED TO SECTION B.**

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## **Section B: Personal Ice Use**

***Please answer ALL questions in this section (Section B: Questions B1-B6).***

*For the following questions, we are interested in the amount of ice that is MADE IN YOUR HOME and YOU USE.*

***DO NOT INCLUDE:***

- *Ice eaten, drunk, or used by other members of your household*
- *Ice that you purchase outside of your home*
- *Ice you receive from another source*

***INCLUDE:***

- *Ice made within your home, that you personally eat, drink, or use*

*To estimate the quantity of ice you use per day, please indicate the number of 8-ounce cups. An 8-ounce cup is the size of a traditional tea cup or a measuring cup.*

*Examples:*



**If you live in more than one home, please include the ice you use from ALL of your homes for your responses in this section.**

**B1. Over the last week, how much ice from your home have you used per day? Indicate the number of 8-ounce cups:**

- I have not used any ice from my home in the past week
- Up to 1 cup of ice per day
- About 2 cups of ice per day
- About 3 cups of ice per day
- About 4 cups of ice per day
- About 5-6 cups of ice per day
- About 7-8 cups of ice per day
- About 9-10 cups of ice per day
- About 11-15 cups of ice per day
- About 16-20 cups of ice per day
- More than 20 cups of ice per day

- Don't know

**B2. Choose the times of year that you use the MOST ice from your home(choose all that apply):**

- I do not use any ice from my home
- I use the same amount of ice in all seasons
- Spring (i.e. March, April, and May)
- Summer (i.e. June, July, and August)
- Autumn (i.e. September, October, and November)
- Winter (i.e. December, January, and February)
- Don't know

**B3. In the season(s) when you use the MOST ice from your home, how much ice do you typically use per day? Indicate the number of 8-ounce cups:**

- I do not use any ice from my home
- Up to 1 cup of ice per day
- About 2 cups of ice per day
- About 3 cups of ice per day
- About 4 cups of ice per day
- About 5-6 cups of ice per day
- About 7-8 cups of ice per day
- About 9-10 cups of ice per day
- About 11-15 cups of ice per day
- About 16-20 cups of ice per day
- More than 20 cups of ice per day
- Don't know

**B4. Choose the times of year that you use the LEAST ice from your home(choose all that apply):**

- I do not use any ice from my home
- I use the same amount of ice in all seasons
- Spring (i.e. March, April, and May)
- Summer (i.e. June, July, and August)
- Autumn (i.e. September, October, and November)
- Winter (i.e. December, January, and February)
- Don't know

**B5. In the season(s) when you use the LEAST ice from your home, how much ice do you typically use per day? Indicate the number of 8-ounce cups:**

- I do not use any ice from my home
- Up to 1 cup of ice per day

- About 2 cups of ice per day
- About 3 cups of ice per day
- About 4 cups of ice per day
- About 5-6 cups of ice per day
- About 7-8 cups of ice per day
- About 9-10 cups of ice per day
- About 11-15 cups of ice per day
- About 16-20 cups of ice per day
- More than 20 cups of ice per day
- Don't know

**B6. What are ice cubes typically made from?**

- Air
- Glass
- Steel
- Water
- Oil
- Don't know

**THIS IS THE END OF SECTION B; PLEASE PROCEED TO SECTION C.**

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**Section C: Demographic Questions**

*Please answer ALL questions in this section (Section C: Questions C1-C11).*

**If you live in more than one home, please restrict your responses in this section to the home you use the most.**

**C1. What are the first three digits of the zip code where this home is located?**

- *Example: for the zip code "90210", please enter "902"*
- *Please remember to include leading zeroes: for zip code "07245", please enter "072"*

**C2. What is your gender?**

- Male
- Female
- Decline to state

**C3. Are you Hispanic or Latino?**

- Yes
- No
- Decline to state

**C4. What is your race?**

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

**C5. What is your highest education level?**

**C6. How many people live in your home for most of the year (including you)?**

**C7. Of the people you included in the total for Question C6, how many people are in the following age categories? [Make sure to respond to each of the age groups listed below]**

*Younger than 20*

*20 to 29 years old*

*30 to 39 years old*

*40 to 49 years old*

*50 to 59 years old*

*60 to 69 years old*

*70 or older*

Age unknown

**C8. 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

**C9. What material are wine bottles typically made from?**

- Fabric
- Glass
- Rubber
- Tile
- Wood
- Don't know

**C10. What type of home do you live in most of the year?**

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

**C11. Is this home owned or rented?**

- Owned or being bought by someone in your household
- Rented
- Occupied without payment of rent

Don't know/Decline to state

**If you wish, please leave any comments regarding the survey's questions, design, or structure in the comment box below:>**



## Appendix B: Results from all survey questions

### Introduction

This appendix contains simple results for all questions with a defined set of response options in the survey. For each question, we present a table containing five columns: (1) the response options, (2) the number of responses that selected each response option (or options where selection of multiple options was possible), (3) the weighted counts of respondents that selected each option (including null response), (4) the proportion of weighted response excluding null responses, and (5) the 95% confidence interval for the proportion of weighted response excluding null responses.

### Section A: Refrigeration Products

**Question A1.** How many refrigerators are plugged in at your home right now?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
None	9	6.65	0.25	0.00	0.50
1	2110	2180.69	81.00	79.00	82.99
2	507	458.76	17.04	15.13	18.95
3	57	43.88	1.63	0.99	2.27
4	6	2.00	0.07	0.00	0.21
5 or more	1	0.35	0.01	0.00	0.07
Don't know	0	0.00			
Blank	4	1.67			
Total	2694	2694.00			
Null response	4	1.67			

**Question A2.** How many freezers are plugged in at your home right now?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
None	1678	1714.47	63.75	61.30	66.19
1	875	854.40	31.77	29.40	34.14
2	124	111.05	4.13	3.12	5.14
3	12	8.43	0.31	0.03	0.60
4	1	1.18	0.04	0.00	0.15
5 or more	0	0.00	0.00	0.00	0.00
Don't know	3	3.04			
Blank	1	1.45			
Total	2694	2694.00			
Null response	4	4.49			

**Question A3.** How many refrigerators are plugged in at your home right now that use thermoelectric or absorption cooling technology to provide cooling?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
None	1888	1994.48	83.50	81.50	85.51
1	428	359.61	15.06	13.13	16.99
2	41	31.26	1.31	0.70	1.92
3	4	3.13	0.13	0.00	0.33
4	0	0.00	0.00	0.00	0.00
5 or more	0	0.00	0.00	0.00	0.00
Don't know	329	304.83			
Blank	4	0.69			
Total	2694	2694.00			
Null response	333	305.52			

**Question A4.** What is the brand of this thermoelectric or absorption cooling refrigerator? [Responses are not shown, because there were more than 40 options.]

**Question A5.** What is the full model number of this thermoelectric or absorption cooling refrigerator? [Responses are not shown, because there was not a defined set of options.]

**Question A6.** How many refrigerators or freezers are plugged in at your home right now that have a special section or compartment designed specifically for storing wine at a warmer temperature?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
None	2588	2601.46	97.07	96.21	97.93
1	87	72.05	2.69	1.86	3.51
2	7	6.49	0.24	0.00	0.49
3	0	0.00	0.00	0.00	0.00
4	0	0.00	0.00	0.00	0.00
5 or more	0	0.00	0.00	0.00	0.00
Don't know	9	5.18			
Blank	3	8.82			
Total	2694	2694.00			
Null response	12	14.00			

**Question A7.** What is the brand of this refrigerator or freezer with a separate section for storing wine at a warmer temperature? [Responses are not shown, because there were more than 40 options.]

**Question A8.** What is the full model number of this refrigerator or freezer with a separate section for storing wine at a warmer temperature? [Responses are not shown, because there was no defined set of options.]

**Question A9.** Who is the current president of the U.S.? [Question included for quality control purposes. Only responses that selected Obama were included in the survey analysis]

**Question A10.** How many stand-alone icemakers are plugged in at your home right now?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
None	2625	2642.99	98.12	97.43	98.81
1	66	45.86	1.70	1.04	2.36
2	2	4.85	0.18	0.00	0.40
3	0	0.00	0.00	0.00	0.00
4	0	0.00	0.00	0.00	0.00
5 or more	0	0.00	0.00	0.00	0.00
Don't know	0	0.00			
Blank	1	0.31			
Total	2694	2694.00			
Null response	1	0.31			

**Question A11.** How many portable stand-alone icemakers are used in your home, including those that are not plugged in right now?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
None	2638	2645.10	98.28	97.61	98.94
1	54	46.22	1.72	1.06	2.38
2	1	0.16	0.01	0.00	0.05
3	0	0.00	0.00	0.00	0.00
4	0	0.00	0.00	0.00	0.00
5 or more	0	0.00	0.00	0.00	0.00
Don't know	1	2.51			
Blank	0	0.00			
Total	2694	2694.00			
Null response	1	2.51			

**Question A12.** Is your most-used stand-alone icemaker portable?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
There are no stand-alone icemakers used in my home	1	0.20	0.47	0.00	3.01
Yes, this stand-alone icemaker is portable	36	33.92	81.54	67.14	95.94
No, this stand-alone icemaker is not portable	19	7.48	17.99	3.73	32.25
Don't know	1	0.72			
Blank	3	1.27			
Total	60	43.59			
Null response	4	1.99			

**Question A13.** What is the brand of your most-used stand-alone icemaker? [Responses are not shown, because there were more than 40 options.]

**Question A14.** What is the full model number of your most-used stand-alone icemaker? [Responses are not shown, because there was no defined set of options.]

**Question A15.** Within the past week, how much of the time has this stand-alone icemaker been plugged in?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
No stand-alone icemakers are used in my home	0	0.00	0.00	0.00	0.00
Up to 1/2 a day (12 hours) per week	11	10.11	23.21	6.34	40.07
Between 1/2 and 1 day per week	5	5.77	13.24	0.00	26.78
Between 1 and 3 days per week	6	2.98	6.83	0.00	16.91
Between 3 and 7 days per week	6	3.24	7.44	0.00	17.93
It is plugged in continually (7 days per week)	32	21.48	49.29	29.31	69.27
Don't know	0	0.00			
Blank	0	0.00			
Total	60	43.59			
Null response	0	0.00			

**Question A16.** Choose the time(s) of year that this stand-alone icemaker is plugged in the most:

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
This stand-alone icemaker is plugged in for the same amount of time in all seasons	29	19.73	45.26	24.36	66.17
Spring (i.e. March, April, and May)	0	0.00	0.00	0.00	0.00
Summer (i.e. June, July, and August)	16	15.25	35.00	14.96	55.03
Autumn (i.e. September, October, and November)	0	0.00	0.00	0.00	0.00
Winter (i.e. December, January, and February)	0	0.00	0.00	0.00	0.00
Spring, Summer	11	5.59	12.82	0.00	26.86
Summer, Autumn	1	1.72	3.96	0.00	12.14
Spring, Summer, Fall	3	1.29	2.97	0.00	10.09
No stand-alone icemakers are used in my home	0	0.00	0.00	0.00	0.00
Conflict*	0	0.00			
Don't know	0	0.00			
Blank	0	0.00			
Total	60	43.59			
Null response	0	0.00			

\*Conflict refers to a response that selected multiple options that could not be true (e.g. No stand-alone icemakers are used in my home and Summer were both selected).

**Question A17.** In the season(s) when this stand-alone icemaker is used the most, for how much of each week is the icemaker plugged in?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
No stand-alone icemakers are used in my home	0	0.00	0.00	0.00	0.00
Up to 1/2 a day (12 hours) per week	3	0.67	1.54	0.00	6.45
Between 1/2 and 1 day per week	0	0.00	0.00	0.00	0.00
Between 1 and 3 days per week	4	5.62	12.90	0.00	26.30
Between 3 and 7 days per week	10	9.70	22.26	5.64	38.89
It is plugged in continually (7 days per week)	43	27.59	63.30	44.04	82.56
Don't know	0	0.00			
Blank	0	0.00			
Total	60	43.59			
Null response	0	0.00			

**Question A18.** How many hours are there is a day? [Question included for quality control purposes. Only responses that selected "At least 20 but fewer than 30 hours" were included in the analysis]



**Question A19.** Choose the time(s) of year that this stand-alone icemaker is plugged in least:

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
This stand-alone icemaker is plugged in for the same amount of time in all seasons	28	19.52	45.00	24.34	65.65
Spring (i.e. March, April, and May)	0	0.00	0.00	0.00	0.00
Summer (i.e. June, July, and August)	0	0.00	0.00	0.00	0.00
Autumn (i.e. September, October, and November)	0	0.00	0.00	0.00	0.00
Winter (i.e. December, January, and February)	28	23.10	53.26	32.55	73.97
Spring, Summer	0	0.00	0.00	0.00	0.00
Autumn, Winter	3	0.76	1.74	0.00	7.18
No stand-alone icemakers are used in my home	0	0.00	0.00	0.00	0.00
Conflict*	0	0.00			
Don't know	0	0.00			
Blank	1	0.21			
Total	60	43.59			
Null response	1	0.21			

\*Conflict refers to a response that selected multiple options that could not be true (e.g. No stand-alone icemakers are used in my home and Summer were both selected).

**Question A20.** In the season(s) when this stand-alone icemaker is used the least, for how much of each week is the icemaker plugged in?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
No stand-alone icemakers are used in my home	0	0.00	0.00	0.00	0.00
Up to 1/2 a day (12 hours) per week	22	18.74	43.15	23.33	62.98
Between 1/2 and 1 day per week	8	4.10	9.44	0.00	21.14
Between 1 and 3 days per week	1	0.34	0.78	0.00	4.31
Between 3 and 7 days per week	3	1.59	3.67	0.00	11.19
It is plugged in continually (7 days per week)	25	18.66	42.96	23.14	62.77
Don't know	0	0.00			
Blank	1	0.15			
Total	60	43.59			
Null response	1	0.15			

**Question A21.** What does your household use for making ice?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
My household does not make any ice	170	151.25	5.66	4.43	6.88
Manually-filled ice cube trays inside a refrigerator, freezer, or wine chiller	1182	1217.92	45.55	42.91	48.18
Automatic icemaker inside a refrigerator, freezer, or wine chiller	1029	1053.75	39.41	36.82	41.99
Stand-alone icemaker	35	29.34	1.10	0.55	1.65
Trays and icemaker in fridge	222	201.90	7.55	6.15	8.95
Trays and standalone ice maker	11	9.15	0.34	0.03	0.65
Stand-alone and icemaker in fridge	13	5.88	0.22	0.00	0.47
Trays, icemaker in fridge, stand-alone	9	4.89	0.18	0.00	0.41
Conflict	10	13.25			
Don't know	3	0.77			
Blank	10	5.90			
Total	2694	2694.00			
Null response	23	19.92			

## Section B: Personal Ice Use

**Question B1.** Over the last week, how much ice from your home have you used per day?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
I have not used any ice from my home in the past week	655	641.53	23.83	21.50	26.16
Up to 1 cup of ice per day	868	864.45	32.11	29.56	34.66
About 2 cups of ice per day	487	439.51	16.33	14.30	18.35
About 3 cups of ice per day	222	246.13	9.14	7.57	10.72
About 4 cups of ice per day	184	172.71	6.42	5.08	7.76
About 5-6 cups of ice per day	119	129.91	4.83	3.65	6.00
About 7-8 cups of ice per day	51	51.64	1.92	1.17	2.67
About 9-10 cups of ice per day	55	70.88	2.63	1.76	3.51
About 11-15 cups of ice per day	28	43.85	1.63	0.94	2.32
About 16-20 cups of ice per day	12	16.34	0.61	0.18	1.03
More than 20 cups of ice per day	11	15.25	0.57	0.16	0.98
Don't know	0	0.00			
Blank	2	1.79			
Total	2694	2694.00			
Null response	2	1.79			

**Question B2.** Choose the times of year that you use the most ice from your home:

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
I use the same amount of ice in all seasons	527	564.02	20.98	18.69	23.27
Spring (i.e. March, April, and May)	3	1.02	0.04	0.00	0.15
Summer (i.e. June, July, and August)	1317	1383.39	51.45	48.65	54.26
Autumn (i.e. September, October, and November)	1	3.54	0.13	0.00	0.34
Winter (i.e. December, January, and February)	0	0.00	0.00	0.00	0.00
Spring, Summer	428	330.31	12.29	10.44	14.13
Spring, Summer, Autumn	133	130.38	4.85	3.64	6.06
Spring, Summer, Winter	1	4.45	0.17	0.00	0.39
Spring, Winter	0	0.00	0.00	0.00	0.00
Summer, Autumn	85	87.18	3.24	2.25	4.24
Summer, Winter	8	17.84	0.66	0.21	1.12
Summer, Autumn, Winter	1	0.19	0.01	0.00	0.05
Autumn, Winter	1	0.29	0.01	0.00	0.07
I do not use any ice from my home	179	165.99	6.17	4.82	7.53
Conflict*	9	5.19			
Don't know	0	0.00			
Blank	1	0.21			
Total	2694	2694.00			
Null response	10	5.39			

\*Conflict refers to a response that selected multiple options that could not be true (e.g. I do not use any ice from my home and Summer were both selected).

**Question B3.** In the season(s) when you use the most ice from your home, how much ice do you typically use per day?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
I have not used any ice from my home in the past week	192	179.96	6.69	5.32	8.05
Up to 1 cup of ice per day	527	491.71	18.27	16.15	20.38
About 2 cups of ice per day	635	600.64	22.32	20.04	24.59
About 3 cups of ice per day	399	403.29	14.98	13.03	16.94
About 4 cups of ice per day	323	328.78	12.21	10.42	14.01
About 5-6 cups of ice per day	256	275.72	10.24	8.59	11.90
About 7-8 cups of ice per day	160	173.95	6.46	5.12	7.81
About 9-10 cups of ice per day	93	115.09	4.28	3.17	5.38
About 11-15 cups of ice per day	59	65.30	2.43	1.58	3.27
About 16-20 cups of ice per day	27	28.32	1.05	0.49	1.61
More than 20 cups of ice per day	20	28.88	1.07	0.51	1.64
Don't know	2	2.14			
Blank	1	0.21			
Total	2694	2694.00			
Null response	3	2.35			

**Question B4.** Choose the times of year that you use the least ice from your home:

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
I use the same amount of ice in all seasons	524	561.99	20.92	18.64	23.21
Spring (i.e. March, April, and May)	9	16.98	0.63	0.19	1.08
Summer (i.e. June, July, and August)	0	0.00	0.00	0.00	0.00
Autumn (i.e. September, October, and November)	12	26.06	0.97	0.42	1.52
Winter (i.e. December, January, and February)	1645	1668.36	62.11	59.38	64.84
Spring, Summer	0	0.00	0.00	0.00	0.00
Spring, Autumn	5	4.52	0.17	0.00	0.40
Spring, Winter	36	33.58	1.25	0.63	1.87
Spring, Summer, Winter	0	0.00	0.00	0.00	0.00
Spring, Autumn, Winter	45	40.90	1.52	0.83	2.21
Summer, Autumn	0	0.00	0.00	0.00	0.00
Summer, Winter	0	0.00	0.00	0.00	0.00
Autumn, Winter	225	166.49	6.20	4.84	7.55
I do not use any ice from my home	184	167.22	6.23	4.87	7.58
Conflict*	6	4.57			
Don't know	1	2.02			
Blank	2	1.30			
Total	2694	2694.00			
Null response	9	7.90			

\*Conflict refers to a response that selected multiple options that could not be true (e.g. I do not use any ice from my home and Summer were both selected).

**Question B5.** In the season(s) when you use the least ice from your home, how much ice do you typically use per day?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
I have not used any ice from my home in the past week	529	475.83	17.83	15.73	19.94
Up to 1 cup of ice per day	1398	1381.61	51.78	49.03	54.52
About 2 cups of ice per day	341	342.15	12.82	10.99	14.66
About 3 cups of ice per day	147	168.24	6.31	4.97	7.64
About 4 cups of ice per day	112	115.48	4.33	3.21	5.45
About 5-6 cups of ice per day	76	87.92	3.29	2.31	4.28
About 7-8 cups of ice per day	34	41.64	1.56	0.88	2.24
About 9-10 cups of ice per day	25	30.72	1.15	0.57	1.74
About 11-15 cups of ice per day	11	22.43	0.84	0.34	1.34
About 16-20 cups of ice per day	4	2.26	0.08	0.00	0.24
More than 20 cups of ice per day	0	0.00	0.00	0.00	0.00
Don't know	17	25.71			
Blank	0	0.00			
Total	2694	2694.00			
Null response	17	25.71			

**Question B6.** What are ice cubes typically made from? [Question included for quality control purposes. Only responses that selected “water” were included in the analysis]



## Section C: Demographic Questions

**Question C1.** What are the first three digits of the zip code where this home is located?

[Responses binned by census division]

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
New England	121	130.33	4.85	3.69	6.02
Mid Atlantic	370	360.83	13.43	11.58	15.28
East North Central	392	422.21	15.72	13.75	17.69
West North Central	135	190.68	7.10	5.71	8.49
South Atlantic	606	565.88	21.06	18.86	23.27
East South Central	162	167.53	6.24	4.93	7.55
West South Central	239	301.90	11.24	9.53	12.95
Mountain North	91	92.69	3.45	2.46	4.44
Mountain South	103	53.83	2.00	1.24	2.76
Pacific	463	400.53	14.91	12.98	16.84
Don't know	12	7.58			
Blank	0	0.00			
Total	2694	2694.00			
Null response	12	7.58			

**Question C2.** What is your gender?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
Female	1184	1334.77	49.76	47.59	51.92
Male	1494	1347.73	50.24	48.08	52.41
Decline to state	16	11.50			
Blank	0	0.00			
Total	2694	2694.00			
Null response	16	11.50			

**Question C3. Are you Hispanic or Latino?**

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
Yes	339	325.31	12.10	10.69	13.51
No	2346	2362.36	87.90	86.49	89.31
Decline to state	0	0.00			
Blank	9	6.33			
Total	2694	2694.00			
Null response	9	6.33			

**Question C4. What is your race?**

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
Hispanic*	339	325.31	12.14	10.41	13.86
American Indian/Alaska Native	21	15.66	0.58	0.18	0.99
Asian	167	86.28	3.22	2.29	4.15
Black	319	343.47	12.82	11.05	14.58
Native Hawaiian or other pacific islander	4	0.90	0.03	0.00	0.13
White	1760	1871.75	69.85	67.42	72.27
2 or more races selected	67	35.35	1.32	0.72	1.92
Other	3	1.02	0.04	0.00	0.14
Decline to state	14	14.25			
Blank	0	0.00			
Total	2694	2694.00			
Null response	14	14.25			

\* These are the responses from C3, which were combined because many respondents selected "Other" then specified their race as Hispanic or Latino.

Where the specified race fitted into another category this response was incorporated elsewhere, the most common being "Hispanic" which was combined with question C3.

**Question C5. What is your highest education level?**

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
No Education*	23	25.59	0.95	0.45	1.45
High school diploma or GED	433	740.06	27.51	25.19	29.83
Some college, no degree	761	726.66	27.01	24.71	29.32
Associate Degree	273	232.39	8.64	7.18	10.10
Bachelor Degree	911	702.21	26.10	23.83	28.38
Master Degree	215	205.91	7.65	6.28	9.03
PhD or Professional Degree	72	57.28	2.13	1.38	2.88
Decline to state	6	3.90			
Blank	0	0.00			
Total	2694	2694.00			
Null response	6	3.90			

\*Combines two categories: No school, and kindergarten to grade 12 (no diploma).

**Question C6. How many people live in your home for most of the year (including you)?**

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
0*	7	12.82	0.48	0.13	0.83
1	546	737.26	27.37	25.10	29.63
2	719	843.11	31.30	28.94	33.65
3	611	427.68	15.88	14.02	17.73
4	468	371.34	13.78	12.03	15.54
5 or more	343	301.80	11.20	9.60	12.81
Don't know	0	0.00			
Blank	0	0.00			
Total	2694	2694.00			
Null response	0	0.00			

\* Counted as null response. In the analysis, the sum of people by age was used to fill in for these where possible.

**Question C7.** Of the people you included in the total for Question C6, how many people are in the following age categories? The results indicate the number of households that have at least one member from the response category.

<b>Response Category</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
Under 20	969	986.13	36.60	34.79	38.42
20-29	1586	621.07	23.05	21.46	24.64
30-39	909	1215.20	45.11	43.23	46.99
40-49	545	671.25	24.92	23.28	26.55
50-59	573	561.24	20.83	19.30	22.37
60-69	343	398.57	14.79	13.45	16.14
70+	127	177.10	6.57	34.79	38.42

**Question C8.** What is your combined annual household income?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
\$0-\$19,999	364	412.51	15.75	13.87	17.63
\$20,000-\$39,999	719	755.41	28.84	26.51	31.18
\$40,000-\$59,999	560	611.64	23.35	21.17	25.54
\$60,000-\$79,999	396	347.41	13.27	11.52	15.01
\$80,000-\$99,999	267	237.70	9.08	7.60	10.56
\$100,000 and more*	296	254.25	9.71	8.18	11.23
Don't know/Decline to state	91	74.76			
Blank	1	0.31			
Total	2694	2694.00			
Null response	92	75.07			

\* In the survey this response was separated into four options, but these were combined to make them similar to RECS.

**Question C9.** What material are wine bottles typically made from? [This question was included for quality control purposes. Only responses that selected “Glass” were included in the analysis]

**Note on questions C10 and C11:** During the first deployment of the survey there was a problem with the last two questions, in that they could not both be answered. (i.e. when the answer to C11 was selected, the answer to C10 disappeared). There are 84 responses in the final data set that were from this deployment of the survey, which may be affected by this. These results were not used during the analysis.

**Question C10.** What type of home to you live in most of the year?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
Single-family detached house (a house detached from any other house)	1517	1604.68	61.14	58.58	63.70
Single-family attached house (a house attached to one or more houses)	224	205.55	7.83	6.42	9.24
Apartment building with 2-4 units	251	222.68	8.48	7.02	9.95
Apartment building with 5 or more units	512	426.32	16.24	14.31	18.18
Mobile home	72	117.36	4.47	3.39	5.56
Dormitory	17	14.20	0.54	0.16	0.93
Something else	30	33.65	1.28	0.69	1.87
Don't know/Decline to state	12	14.95			
Blank	59	54.61			
Total	2694	2694.00			
Null response	71	69.56			

**Question C11.** Is this home owned or rented?

<b>Response categories</b>	<b>Unweighted counts</b>	<b>Weighted counts</b>	<b>Weighted proportion excluding null response (%)</b>	<b>Lower CI (%)</b>	<b>Upper CI (%)</b>
Owned or being bought by someone in your household	1407	1566.83	58.99	56.71	61.28
Rented	1235	1068.25	40.22	37.94	42.50
Occupied without payment of rent	23	20.94	0.79	0.38	1.20
Don't know/Decline to state	22	31.53			
Blank	7	6.46			
Total	2694	2694.00			
Null response	29	37.99			