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Participant Assisted Data Collection Methods in the California Healthy Homes Indoor Air Quality Study of 2011-13

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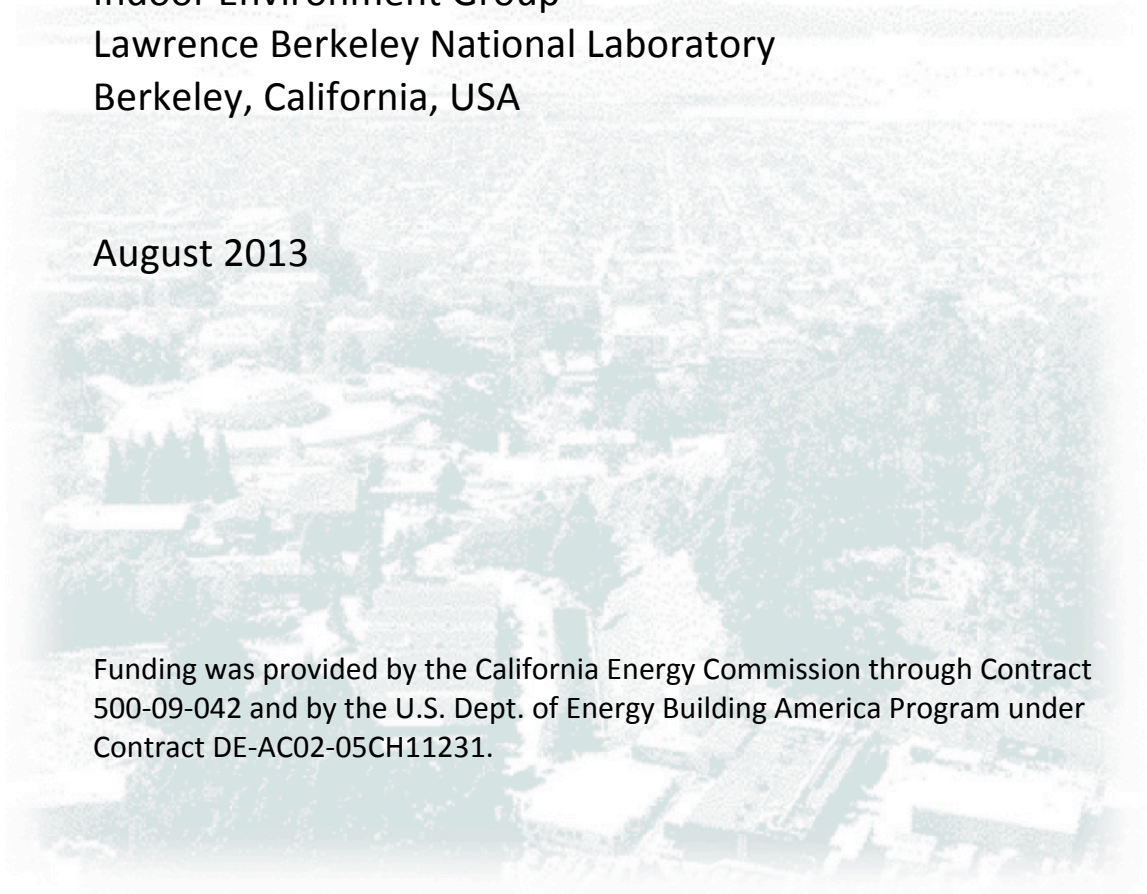


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Abstract

From November 2011 to March 2013, air quality was measured over 6-day periods in 324 residences across California using a mail-out strategy. All interactions with study participants, from recruitment, to data collection, to communication of results, were conducted with remote communication methods including conventional mail, electronic mail, telephone and text messaging. Potential participants were reached primarily by sharing study information with community groups and organizations that directed interested individuals to complete an online screening survey. Pollutant concentrations were measured with sampling equipment that was mailed to participants' homes with deployment instructions. Residence and household characteristics and activity data were collected via two phone surveys and an activity log. A comparison of responses to survey questions completed online versus over the phone indicated that a substantial fraction of participants (roughly 20%) required a researcher's assistance to respond to basic questions about appliance characteristics. Using the printed instructions and telephone assistance from researchers, roughly 90% of participants successfully deployed and returned sampling materials accurately and on schedule. The mail-out strategy employed in this study was found to be a cost-effective means for collecting residential air quality data.

1. Introduction

Air pollutant concentrations inside of homes can be substantially higher than outdoors and highly variable across homes. Since many people spend more time at home than in any other microenvironment (Klepeis et al., 2001), data on pollutant concentrations in homes are critical to understanding exposures across the population. There have been relatively few and infrequent large residential air pollutant exposure studies in the U.S. (Wallace et al., 1991; Sexton et al., 1995; Weisel et al., 2005; Johnson et al., 2009; Rodes et al., 2010), partly owing to the cost and complexity of the requisite air monitoring at many dispersed sites. Identifying lower cost data collection approaches is a priority for expanding knowledge of air pollutant exposures in U.S. homes.

Air pollutant exposure studies involving human subjects require the following steps: study design, protocol review and approval by an institutional review board, outreach and recruitment, screening and selection, deployment and retrieval of air sampling and other monitoring

equipment, characterization of the exposure environment and relevant sources, and data processing and analysis. Deploying and recovering monitoring devices and characterizing the environment typically are done by researcher(s) during visits to study homes. The cost of these study elements can be lowered by reducing or eliminating researcher visits to study homes. This can be accomplished by asking participants to pick-up and/or return monitoring equipment at a central location, by asking participants to return by mail samplers that have been deployed by researchers, or by distributing all sampling materials by mail.

The mail-out approach is potentially the most efficient and flexible, allowing sampling at geographically dispersed sites over variable durations and periods. Concerns about these alternative approaches focus on whether participants can correctly deploy samplers and whether accurate information about the environment can be obtained without a visit by a trained researcher.

Our review of the literature identified three indoor air quality studies that have used a mail-out strategy for data collection from a large sample of homes. Two of these studies were conducted in the 1980's. In the first study, nitrogen dioxide (NO₂) concentrations were sampled in 137 homes by deploying passive samplers for one-week periods, eight times throughout a year (Spengler et al., 1983). In this study, researchers visited homes to deploy and retrieve samplers for the first one-week period. During this visit, the researchers instructed participants how and where to deploy the samplers. For the seven subsequent sampling periods, participants were mailed sampling materials, along with prepaid return mailers. The authors did not comment on the success of the mail-out method, though they did note that only 9-12 of the 137 participants dropped out of the study, implying that the remaining participants successfully received and returned the seven sampling packages via mail. In the second such study, passive formaldehyde samplers were mailed to homes for one-week sampling periods (Sexton et al., 1986). Sampling was conducted in pilot, summer and winter phases involving 51, 663 and 553 homes, respectively (472 homes were included in both the summer and winter phases). This study was conducted entirely by mail, including solicitation of volunteers, placement and recovery of monitors, collection of data on occupant and housing characteristics, and communication of test results. During the pilot phase, research staff visited 47 of the homes to ensure that participants had correctly placed samplers; 44 of the 47 homes (94%) had done so. For the summer and winter phases of the study, researchers made no visits to the homes. The rate of successfully deployed and returned samplers for the pilot, summer and winter phase was 93%, 87% and 72%, respectively. The only other IAQ study we have identified that is based primarily on a mail-out strategy was not conducted until two decades later (Johnson et al., 2009). In this study, passive samplers were mailed to 104 homes for deployment both indoors and outdoors. Half of these homes were sent NO₂ and volatile organic compound (VOC) samplers for 7-day deployments and the other half were sent NO₂ and polycyclic aromatic hydrocarbons (PAH) samplers for 1 or 2 day deployments. However, instead of mailing sampling packages back to researchers, participants were instructed to deliver the package to researchers at an appointed time and place. The households invited to participate were selected from participants of two concurrent air quality studies. Of the 104 participating households, 92 (88%) completed the air sampling requirements, and 65 (63%) were fully compliant with all study expectations.

The present study used a mail-out approach to measure air pollutant concentrations in 323 homes across California. Data regarding characteristics of the homes and households were collected via two participant interviews conducted by telephone. All contact with participants, from recruitment to study completion, was conducted via traditional mail, electronic mail, phone or text messaging. To our knowledge, this represents the first residential air quality study to use

a variety of modern-day communication methods to engage study participants in the data collection process, and to reduce the burden on research staff. This paper presents a detailed description of the methods used in this study and an evaluation of the success rates of the different strategies employed. Overall, the mail-out approach to collecting residential air quality samples was found to be successful and is recommended for use in future studies.

2. Methods

2.1. Participant Recruitment and Selection

Recruitment. Recruitment materials for this study included a website, one-page flyer, and email summary (Appendix A). All recruitment materials, as well as other materials subsequently used to communicate with selected participants, received approval from the Human Subjects Committee at Lawrence Berkeley National Laboratory (LBNL). The primary strategy for recruitment of participants was to share information about the study via email and phone communication with community organizations having contact with large numbers of individuals, with a request that they share information with their membership. In most cases, these communications were “cold calls,” meaning that the researchers did not have a pre-existing relationship with the organization being contacted. While this approach allowed for contact with a large number of organizations, it also resulted in a low response rate. Organizations were generally first contacted via email, and subsequently by phone. Once contact was made, organization representatives were asked to forward the email announcement to an email distribution list, or were mailed flyers for physical distribution. Both physical and electronic announcements included a link to the project website (healthyhomes.lbl.gov/information) that provided an overview of the study and information about how to become a participant. In all, roughly 370 organizations were contacted, including roughly 100 neighborhood associations, 60 religious organizations, 50 student organizations or academic departments at 40 universities, 20 utility bill assistance programs, and 100 community-based organizations. Responses were received from roughly 20% of the organizations contacted, with neighborhood associations providing the highest proportion of participants overall and utility bill assistance programs providing the highest number of low-income participants. In the first year of the study, outreach was focused solely in Northern California. In the second year, organizations were contacted from across the state, but focus was placed on Southern California and the Central Valley. When individuals were contacted for outreach purposes, they were asked to refer others to the website or distribute flyers; no individual was contacted for the purpose of direct recruitment. We did not track the forwarding of information and no compensation was offered or awarded to anyone for sharing information about the study. Since participants were selected on a rolling basis, individuals who participated early in the sampling period were encouraged to refer friends and family to the informational website. Prior to the start of the second year of data collection, participants from the first year were emailed and encouraged to inform friends and family of the opportunity to participate.

Selection. Individuals interested in participating were directed to complete a screening survey (Appendix D) by either going to the project website or calling the research study director. Ultimately, 613 screening surveys were completed—575 through the website and 38 over the phone.

Owing to resource constraints, this study was not designed to capture a statistically representative sample of California homes with gas appliances. Rather, it was designed to preferentially collect data in homes that have one or more characteristics that are either known

or hypothesized to impact pollutant concentrations and exposures. Thus, the goal of the selection process was to identify homes with characteristics that increase the likelihood and magnitude of pollutants entering the home from gas appliance use. Towards this aim, the screening survey responses were used to give homes a “hazard score” based on a rating system designed by researchers to roughly estimate the hazard of elevated combustion pollutant concentrations in homes (Table 2.1). Points were assigned to a home based on the presence and use of any unvented gas heaters, presence and use of gas cooking appliances (which were assumed to release some fraction of their exhaust into the home), and the location and use of gas heaters or water heaters within the home (indicating the possibility of backdrafting and spillage). The point sum was increased by a multiplicative factor for those homes that were smaller, newer, or had been recently weatherized, since homes with these characteristics are expected to have higher indoor concentrations for any given rate of indoor emissions. The multiplicative factor was increased for lower income households, on the premise that they are more likely to have lower quality appliances and to continue to use appliances even after performance degrades.

Table 2.1 Algorithm for determining a “hazard score” used to evaluate the likelihood of elevated pollutant concentrations resulting from gas appliance use.

Points for gas cooking appliances based on amount of use				
	<1x / wk	1-3x / wk	4-7x / wk	>7x / wk
Cooktop	1	1.5	2	3
Oven	1	1.5	2	3
Points for primary gas heater (evaluate per appliance).				
Unvented heater ^a in living space	3			
Unvented heater in adjacent space ^b	1.5			
Vented gas heater in living space	1			
Vented gas heater in adjacent space ^b	0.5			
Points for supplementary gas heater (evaluate per appliance).				
Unvented heater in living space	2			
Unvented heater in adjacent space ^b	1			
Vented gas heater in living space	0.5			
Vented gas heater in adjacent space ^b	0			
Points for gas storage water heater per number of residents (evaluate per appliance)				
	1-2 people	3-4 people	5+ people	
Vented water heater in living space	0.5	1	1.5	
Vented water heater in adjacent space ^b	-	0.5	1	
Multiplier for other household characteristics (Sum points for categories below, add 1, then multiply by sum of points from above)				
Year home was built	< 1995	1995-2005	> 2005	
	-	0.1	0.2	
Size of home (square feet)	< 500	500-1000	1000-1500	>1500
	0.3	0.2	0.1	-
Household gross income (\$1000/year)	< 30	30-60	>60	
	0.3	0.1	-	
Weatherization renovations	No	Yes		
	-	0.2		

^a Included use of gas oven for space heating.

^b Adjacent space” includes attic, basement or attached garage.

Homes were selected for participation roughly 2 weeks in advance of the proposed sampling

week. Thus, every week, 10-20 respondents to the screening survey were contacted and invited to participate. The two primary criteria considered when selecting homes each week were geography and hazard score. We aimed to geographically cluster the homes sampled each week, to allow more efficient sampling of outdoor concentrations by using the same outdoor measurements for sites in close proximity. Within a given geographic area, priority for selection was given to homes with a higher hazard score.

2.2. Participant interactions and interviews

The first contact with participants generally occurred over the phone, two weeks prior to the planned week of sampling. The approved protocol allowed for informed consent to be obtained from individuals over the phone; this involved reading to individuals an approved script of information, answering all their questions, and ensuring that they understood and agreed to the terms (Appendix B). The information included in the script was subsequently mailed to the participants. This initial phone conversation was also used to confirm the participant's availability and schedule a phone appointment for the following week. This first phone conversation generally lasted 10 minutes.

During the second phone appointment, a researcher administered the pre-measurement interview (Appendix D) and discussed logistics for the mailing of air samplers and the week of sampling. The pre-measurement interview was designed to collect information regarding the following: home age, size and degree of air-tightness; gas appliance technology, age, location, condition and frequency of use; presence of electric cooktop, oven, water heater and/or space heating equipment (in place of gas appliances); presence of other pollutant sources inside and outside of the home; and household demographics. Since researchers would not be visiting the homes, the interview provided key information about the home and appliances that would not otherwise be obtained. This second phone conversation generally lasted no more than 30 minutes.

A week following the pre-measurement interview, sampling materials were mailed in a 9.5 inch by 12.5- or 13-inch padded envelope, enclosed in an outer 12.5 inch by 15 inch Tyvek® envelope. The participants were instructed to discard the outer envelope, and use the inner padded envelope to mail the materials back at the end of the sampling period. Participants were given the option of having the samplers delivered and returned via the US Postal Service or FedEx, depending on which option was most convenient for them. Participants were sent a reminder email or called by phone a day prior to the package arrival, and were asked to set up the samplers within one day of their receipt using the detailed instructions provided to them (Appendix C). Individuals who had trouble setting up the samplers were instructed to call one of the researchers to have the set-up process described over the phone. Participants recorded the set-up and repackaging time on the provided instruction sheet, which they included in the return mailer. Following set-up, they were asked to take two photos of the samplers at each location—one showing the samplers up close and another showing the sampler placement in the room—and transmit the photos electronically (i.e. via email or text message) to the research study director so that correct placement could be confirmed. If the study director did not receive a phone call, text message or email within two days of the package arrival, the participant was called to confirm the package had been received and the samplers set up. Once set up, the intent was for the samplers to remain in place, undisturbed for 6 days. In the second year of the study, participants were provided with a cooking log designed to assist them with tracking cooking events during the sampling period (Appendix E). The decision to include the cooking log was primarily based on repeated feedback from participants during the first year that it was difficult to recall how frequently cooking had occurred during the previous week. Participants

who received the cooking log were instructed to keep it in the kitchen and note the day, time, duration and a brief description of each cooking event. Other than tracking cooking activities, participants were asked to conduct their household activities as normal.

Near the end of the 6-days, all study participants were given an email or phone call to remind them to repackage the samplers using the provided instructions and to schedule a time for the post-measurement interview. This final phone interview was designed to characterize the activities of the home during the sampling period, including the following: frequency of use of the appliances, occupancy patterns, and use of other potential pollutant sources inside and outside of the home. Questions that might affect resident behavior were saved for the final interview. These included questions about frequency of kitchen exhaust fan use, reasons why the kitchen exhaust fan was not used (if applicable), and condition of the stovetop and oven (flame quality, operational problems etc.). Completion of the post-measurement interview marked the end of an individual's formal participation. One to six months following completion, participants were sent \$75 and a report of results from their home (Appendix E). For the majority of participants, this marked the end of their interaction with researchers. Roughly 10% of the participants contacted researchers following receipt of the report to request more specific information regarding potential pollutant sources in their home and strategies for improving their indoor air quality.

In the first year of the study, there were 29 additional homes sampled for which the majority of participant interactions were the same as described above, except that sampling materials were deployed in the home by a visiting researcher, versus being mailed to and set-up by a resident. In the second year of the study this method of deployment was eliminated, as it was decided that it did not provide enough additional information to make it worth the extra effort. The methods used when visiting homes has been previously described (Less, 2012).

2.3. Pollutant sampling instruments

Sampling was conducted in two phases from late November 2011 to mid-April 2012 and late October 2012 to mid-March 2013. During that time, 5 to 14 homes were sampled every week, with the exclusion of three to four weeks during the winter holidays. The pollutant concentration data collected from each home included time-resolved measurement of CO in the kitchen, and time-integrated measurement of formaldehyde, acetaldehyde, NO₂ and NO_x in the kitchen and bedroom. Time-integrated measurements of outdoor pollutants were made at a subset of homes. Thermistor data loggers were used to collect time-resolved measurement of environmental parameters at each sampling location and to monitor the use of furnaces. Thermocouple data loggers were used to monitor use of water heaters. A summary of the measured parameters is provided in Table 2.2

Table 2.2 Summary of pollutant and environmental monitoring instruments used in study

Parameter	Manufacturer, model	Data resolution	Location of deployment
<i>Measured at ALL homes</i>			
Aldehydes ^a	Waters, Sep-Pak XPoSure	Time integrated	Bedroom, kitchen, outdoors ^a
NO _x , NO ₂ ^a	Ogawa NO _x /NO ₂ sampler	Time integrated	Bedroom, kitchen, outdoors ^a
CO (ambient)	Lascar, USB-EL-CO300	1-minute	Kitchen
T, RH (indoors)	HOBO, U10	1-minute	Bedroom, kitchen
Furnace operation (indicated by T)	HOBO, U10	1-minute	Furnace supply register
Water heater operation (T)	HOBO, U12-014	1-minute	Water heater exhaust flue
Water heater spillage (T)	HOBO, U12-014	1-minute	Top of water heater, adjacent to draft hood
T, RH (outdoors) ^a	HOBO, U23 Pro v.2	1-minute	Outdoors

^a Outdoor sampling occurred at a subset of homes.

Participants were instructed to place the kitchen sampler assembly in a location that would not inconvenience the residents, and that was ideally at least 3 feet from the cooktop and oven, 6 feet from exterior doors and windows that were frequently opened and 2 feet from the floor and ceiling. However, in some cases, particularly in smaller kitchens, not all of the criteria were achieved. In households with children under the age of 18, participants were asked to place the second set of samplers in the bedroom of one of their children, ideally the youngest. They were given the option of locating samplers in another bedroom but in all cases participants chose to locate the samplers in the child's bedroom. In homes without children, samplers were placed in the bedroom of the head of household. The requested siting for bedroom samplers was on a surface that had not been recently lacquered, painted or refinished, that was convenient to the residents, and that was at least 6 feet from exterior doors and windows that were frequently opened and 2 feet from the floor and ceiling.

Furnace and water heater operation were monitored to help determine whether use of these appliances corresponded with changes in the CO concentration. Furnace operation was monitored by deploying a thermistor (HOBO U10) on one of the air supply registers. Water heater operation was monitored using a data logger that included an internal thermistor (HOBO U12) and attached thermocouple (Omega Engineering KMQXL-125E-6). The device was mounted on the top of the water heater so that the tip of the thermocouple was placed in the center of the exhaust flue, with the intention that the thermistor be far enough from the draft diverter to avoid large temperature increases when the appliance was venting properly. The thermocouple monitored operation of the water heater's main burner, and the thermistor placed outside the perimeter of the draft hood was intended to identify instances of spillage of hot exhaust gases. Spillage was identified by visually inspecting temperature traces to identify any instances when spikes in the exhaust temperature (measured by thermocouple) were followed by spikes in the temperature outside of the perimeter of the draft hood (measured by thermistor). Pictures of samplers set-up in the kitchen, bedroom, furnace and water heater of one home are shown in Figure 2.1.

Information regarding characteristics of the samplers and loggers deployed in each home is summarized in Table 2.2.

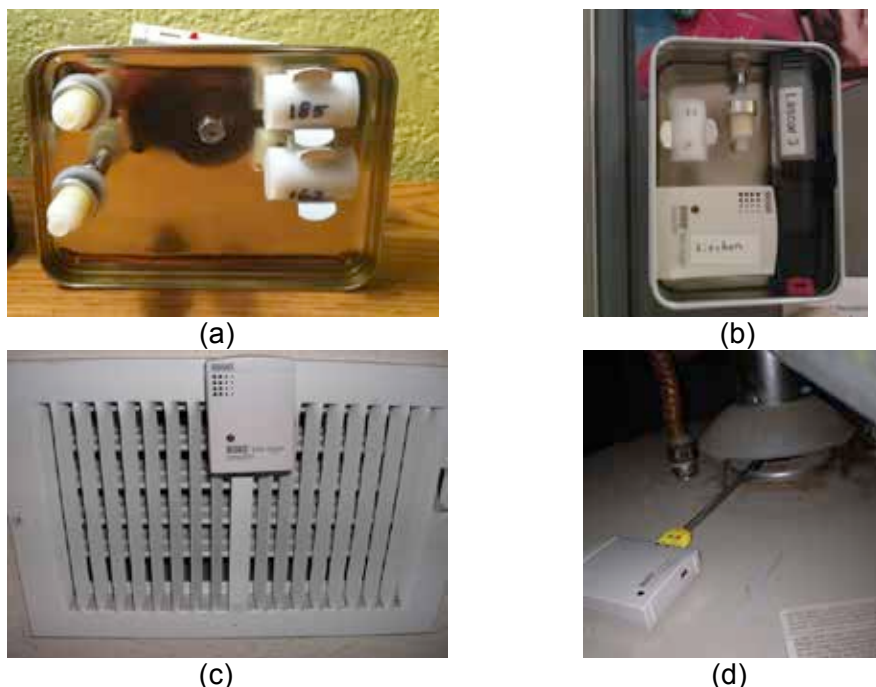


Figure 2.1 Example placement of (a) bedroom samplers (Note: temperature sensor is on the back of the tin), (b) kitchen samplers mounted on the refrigerator, (c) furnace sensor, (d) water heater sensor. Samplers/sensors were deployed and photographed by participants.

Outdoor sampling each week occurred at a minimum of one home that was considered representative of each spatial cluster of homes sampled that week. This resulted in 1 to 5 outdoor samples being collected each week. Effort was made to select homes in as few clusters as possible to minimize the number of outdoor samples needed each week. The main criteria for outdoor sampler placement were (1) a location that could easily and safely be accessed by the participant and (2) a location at which the samplers would not be at significant risk of disturbance (vandalism or exploration). As a result, outdoor sampling generally occurred at single-family homes with backyards or apartments with private balconies. Pictures of sampling packages set-up outdoors at two homes are shown in Figure 2.2. Outdoor samplers were deployed in closed tins with vent holes to provide protection from outdoor elements; thus, the samplers themselves are not visible in the pictures.



Figure 2.2 Outdoor sampler placement at two homes.

2.4 Sample Handling and Quality Assurance (QA) Procedures

Sample handling

A regular schedule for sampler preparation, deployment and processing was maintained throughout the sampling period. Prior to deployment, aldehyde cartridges were stored in a refrigerator until the morning of shipment. The NO_x samplers (which included samplers for both NO_x and NO₂) were generally assembled on the preceding Friday, and stored at room temperature in airtight bags. Packages were mailed to participants on Monday morning, and were usually received by Tuesday and rarely later than Wednesday. Participants were asked to set up the samplers as soon as possible, ideally within 24 hours, and to then repackage them six days later. Thus, participants who set up the samplers on Tuesday evening, which was most often the case, were asked to repackage them on the following Monday evening and mail them back Tuesday morning. The majority of returned packages were received at the lab on Wednesday or Thursday, though it was not uncommon to receive one or two packages on Friday. Within 24 hours of their arrival, packages were opened and their contents inventoried. Besides ensuring that all the sampling materials had been returned, the inventory also included checking that all of the airtight bags were well sealed and that the correct sensor IDs had been recorded for each home.

Following the inventory, aldehyde cartridges were stored in a freezer at -20 °C and NO_x samplers were stored in a laboratory at room temperature to await analysis. Data loggers were downloaded within a few days of arrival, and were launched for deployment at the next set of sites. NO_x and aldehyde samplers were extracted within 1 week of arrival, and were analyzed within 1 week of extraction. According to information published by the manufacturers, exposed NO_x and NO₂ samples can be stored for 2-3 weeks and extracted samples can be stored for 90 days.¹ Exposed aldehyde samplers can be stored for 2 weeks and extracted samples are stable for up to 1 month.² Aldehyde sample extracts were analyzed by high-performance liquid chromatography (HPLC) and NO_x and NO₂ extracts were analyzed by ion chromatography (IC), using procedures provided by Waters Inc. and Ogawa & Co. Inc., respectively. Formaldehyde and acetaldehyde mass values output by the HPLC were converted to concentrations using the duration of deployment and the passive sampling rates determined in validation experiments described later in this report. NO₂ and NO mass values output by the IC were converted to concentrations based on the algorithm described by Ogawa & Co. Inc., using the measured T

¹ www.ogawausa.com/pdfs/prono-noxno2so206.pdfz

² www.waters.com/webassets/cms/support/docs/wat047204.pdf

and RH and the noted sampling duration. Ogawa NO_x samplers have been validated by Singer et al. (2004). In the <10% of homes where T and RH data were not available for the kitchen or bedroom, value(s) measured in the other location at the home were used. In cases where there were no outdoor T and RH data, a value was acquired from a nearby weather station.

Quality assurance

The following procedures were used to calculate the Minimum Detection Limits (MDL) and Limits of Quantification (LOQ) for formaldehyde, acetaldehyde, NO₂ and NO_x, based on analytical methods. The MDL was calculated by taking the standard deviation of 7 samples of the same certified standard, and multiplying it by the students' t-value corresponding to a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom, according to US EPA procedure (Title 40 Code of Federal Regulations Part 136, Appendix B, revision 1.11). The LOQ was calculated as 10 times the standard deviation of the 7 analyzed standard samples. Certified standards of 100 µg/L nitrite and nitrate, and of 8.79×10^{-3} µg/L formaldehyde and acetaldehyde were used for the analysis. This analysis was performed mid-way through the data collection period. Excluding field blanks, seven aldehyde samples (outdoor) and one NO₂ sample (bedroom) were below the LOQ. The results for these samples were replaced with a value of 0.5 LOQ.

The following procedures were used to minimize and assess the frequency of contamination of the time-integrated samples. Prior to deployment, all parts of the Ogawa NO_x samplers were cleaned with deionized water and air-dried in a laboratory free of combustion sources; they were assembled and placed into sealable envelopes on the Friday before shipping out to participants. The aldehyde samplers required no assembly. They were transported to the participating homes in the individual airtight bags as shipped by the manufacturer. The seal on each airtight bag was checked upon receiving the returned samplers from the participants. The end caps on the aldehyde samplers provided a second level of protection from contamination in both directions. Contamination in the field was assessed by deploying duplicate and blank NO_x/NO₂ and aldehyde samplers at 1 to 3 homes every week, for a total of 67 blanks for each type of sampler and 57 and 64 aldehyde and NO_x/NO₂ duplicate samplers, respectively. Homes that received duplicate or blank samplers received one for each type of pollutant (i.e. NO_x/NO₂ and formaldehyde/acetaldehyde); however, no home received a set of both blank and duplicate samplers. Residents were instructed to deploy duplicate samplers in the bedroom and to keep field blanks in their airtight bags for the duration of the sampling period. Prior to mailing back the sampling package, they were instructed to open the bags of the field blanks, and remove the sampler for 10 seconds before replacing and resealing. This last step was intended to assess how commonly substantial contamination occurred in transit, due to an improperly sealed bag. The average concentration measured by the blank NO_x and NO₂ samplers was 8% greater than the LOQ. The averages measured by the blank formaldehyde and acetaldehyde samplers were 38% lower and 21% greater, respectively, than the corresponding LOQ. The average relative deviations for all pairs of NO_x, NO₂, formaldehyde and acetaldehyde duplicate samples were 3%, 7%, 5% and 5%, respectively.

The following procedures were used to assure quality in the analysis of time-integrated samples. Analytical blanks were included with every batch of samples run through the ion chromatography (IC) or high-performance liquid chromatography (HPLC) systems. For the IC analysis, a blank was included after every 5 samples to ensure that there was no carry-over contamination. Certified standards were purchased for each instrument. Target analytes were identified and measured by comparison to these standards. For the IC, a full calibration series was included with each set of samples analyzed. For the HPLC, one continuing calibration

standard was included with each set of samples analyzed. A multipoint calibration series was run every 6 months on the HPLC system. Sample extracts were saved and rerun on occasion, either to confirm unusual results or to test the error introduced by a delay in the analysis of extracts.

The following procedures were used to assure quality of data from continuous monitors. During the data collection phase, CO sensors were calibrated roughly every 2-3 weeks. The CO calibration involved exposing 6 to 15 sensors to concentrations ranging from 0 to 50 ppm in a 3.8 L chamber. The CO calibration protocol was modified between the first and second phase of the study. During the first phase, CO sensors were exposed to spans of 0, 25 and 50 ppm. The calibration spans were achieved by titrating a CO concentration of 1000 ppm with ultra zero air using a Dynacalibrator (Valco Instruments Co. Inc., Model 760). The precise span level was calculated by measuring the flow rate of each gas at the beginning and end of the exposure period. An intercept adjustment was calculated based on the loggers response at zero and a slope was calculated from a best-fit linear regression of the logger's response to the three tested spans. Since the CO loggers do not record negative values, the majority produced a 0 ppm reading when exposed to zero air, thus resulting in a 0 ppm intercept. Prior to the start of the second data collection phase, a 100 ppm CO cylinder was purchased, and CO concentration spans of 2.5 and 5 ppm were added to the sequence. It was decided to exclude the CO spans of 0 and 50 ppm from the calibration analysis in phase two, since the loggers did not record negative values and concentrations of 50 ppm were never observed in the field. Thus, CO data from phase two was adjusted with a best-fit slope and intercept calculated from the sensor readings at 2.5, 5 and 25 ppm (1 h averages of CO exceeded 25 ppm at only 3% of sites). The mean \pm one standard deviation slope and intercept calculated across loggers at the beginning and end of both sampling phases are summarized in Table 2.3. These parameters were calculated by treating the calibration span as the dependent variable and the instrument reading as the independent variable; thus, the instrument readings were adjusted by summing the product of the reading and the slope with the intercept.

Table 2.3 Calibration slope and intercept (mean \pm one standard deviation) calculated across CO loggers at the beginning and end of the two sampling phases.

Period	Month, year	Slope	Intercept (ppm)
Start 1 st phase	November, 2011	1.09 \pm 0.02	-0.02 \pm 0.05
End 1 st phase	April, 2012	1.12 \pm 0.05	-0.19 \pm 0.39
Start 2 nd phase	October, 2012	1.08 \pm 0.08	0.09 \pm 1.17
End 2 nd phase	February, 2013	1.04 \pm 0.06	1.01 \pm 1.07

The CO sensors most often produce readings that were below the span concentration to which they were exposed. However, since the calibration intercept in phase one was calculated by taking the instrument reading at zero, the resulting intercept was most often zero. During the second phase of the study, when a best-fit intercept was calculated, the values spanned a wider range, with a trend towards a positive intercept. For both phases of the study, the mean slope adjustment was above one. Data collected at each home were adjusted using an average of the slope and intercept calculated from the calibration experiment that took place immediately before and after the sampling period at that home. In some cases, only one set of calibration parameters was available for adjustment of the readings.

The following procedure was used to confirm that samples and monitors from different locations within the homes were accurately tracked. NO_x/NO₂ holders were labeled, and upon return,

were checked to ensure that residents had put samples into the bag correctly labeled for its location of deployment. The same was not done for the aldehyde samplers, due to the sampler configuration. However, the NO_x/NO₂ holders were found switched at only 4 of the 343 homes to which samplers were mailed; therefore, the switching of samplers between the bedroom and kitchen is not suspected to have been a significant source of error. The ID numbers of data loggers intended for deployment at each location in homes were recorded prior to departing the lab. Returned packages were inventoried and the records were checked to confirm that the correct ID numbers had been recorded.

The following procedure was used to characterize potential bias of NO_x and NO₂ measurements made within the outdoor enclosure box. Tests were performed on four occasions throughout the sampling period, by collocating multiple samplers outside a home in two different enclosure configurations for 6-day periods. One configuration was a relatively open dome-shaped enclosure that had been validated in past experiments (Singer et al., 2004). The second was a closed box enclosure with ~1 cm diameter holes drilled on several sides of the box and fitted with grommets. The latter configuration was used in this study because its lighter weight and smaller size made it easier to mail. The assumption was that the former configuration provided a measure of the true concentration, due to its more open design and evidence from past experiments (Singer et al., 2004). A picture of both types of outdoor enclosures is shown in Figure 2.3.



Figure 2.3 Two enclosure configurations for NO₂ / NO_x sampling: Configuration on the left has been validated in past studies. Configuration on the right was designed specifically for this study.

The first outdoor validation experiment took place on 22 November 2011, simultaneous with pollutant sampling in the first set of homes in this study. The first experiment involved collocating a pair of samplers, each in a different type of enclosure, at the front of a single family home, and deploying a third sampler in a dome enclosure at the back of the home. The results of this experiment indicated that the true NO₂ and NO_x concentrations were, respectively, 31% and 34% higher than the concentration measured by samplers in the closed box. Consequently, the number of holes in the box surface was increased from four to six, which was the largest number of holes deemed possible without overly exposing the samplers to outdoor elements. This slightly modified design was used at homes sampled from Week 3 through Week 19, and for all homes sampled in the second sampling phase. The subsequent five outdoor validation experiments were initiated on 29 November 2011, 7 February 2012, 11 April 2012, 23 October 2012 and 19 January 2013 and involved collocating three pairs of samplers in each enclosure type for six day periods outside of a single home. For the first two experiments, the three pairs were deployed in different locations along the exterior of the home, while in the final three experiments the three pairs were located together. Results from all four experiments are shown

in Table 2.4.

Table 2.4 Results from outdoor validation experiments. Each row corresponds to collocated samplers. The mean and relative standard deviation (RSD) are shown for samplers deployed simultaneously in like enclosures.

Start Date MM/DD/YY	NO ₂ (ppb)		NO _x (ppb)		NO (ppb)	
	Box	Dome	Box	Dome	Box	Dome
11/22/11	12.3	16.0 16.1	30.7	42.6 39.9	18.3	26.6 23.8
Mean (RSD)	12.3	16.1 (0.4%)	30.7	41.3 (4.6%)	18.3	25.2 (7.9%)
11/29/11	13.3 14.8 12.2	15.8 17.3 15.8	28.8 31.5 27.9	31.2 33.3 29.2	15.4 16.7 15.7	15.4 16.0 13.4
Mean (RSD)	13.4 (9.7%)	16.3 (5.3%)	29.4 (6.4%)	31.2 (6.6%)	15.9 (4.3%)	14.9 (9.1%)
2/7/12	13.9 18.2 15.1	18.7 18.8 21.7	29.6 29.5 34.1	33.4 31.8 38.4	15.7 11.3 18.9	14.7 13.0 16.7
Mean (RSD)	15.7 (14.1%)	19.7 (8.6%)	31.1 (8.5%)	34.5 (10.0%)	15.3 (24.9%)	14.8 (12.5%)
4/11/12	5.1 4.6 4.9	5.7 6.0 5.5	6.0 7.0 4.7	7.4 8.1 6.9	0.7 2.0 -0.2	1.2 1.4 1.7
Mean (RSD)	4.9 (5.2%)	5.7 (4.4%)	5.9 (19.5%)	7.5 (8.1%)	0.8 (132%)	1.4 (17.6%)
10/23/13	16.6 16.8 16.4	18.2 17.8 17.7	31.6 30.7 30.8	38.7 37.2 36.8	15.0 13.9 14.3	20.4 19.4 19.1
Mean (RSD)	16.6 (1.1%)	17.9 (1.6%)	31.0 (1.6%)	37.5 (2.6%)	14.4 (3.8%)	19.6 (3.6%)
1/19/13	19.9 23.1 21.3	27.0 24.3 25.0	67.4 68.9 65.0	75.1 72.0 71.8	47.5 45.9 43.7	48.0 47.7 46.9
Mean (RSD)	21.4 (7.5%)	25.4 (5.6%)	67.1 (3.0%)	73.0 (2.5%)	45.7 (4.2%)	47.5 (1.2%)

An attenuation factor for NO₂ measured in the box was calculated from results of the last five experiments by linearly regressing the average concentrations measured in the box against the average simultaneously measured in the domes, with the intercept of the regression forced through zero (Figure 2.4). The resulting slope of 1.18 was used to adjust the NO₂ data measured by samplers deployed in the box-enclosures with additional openings. NO₂ concentrations measured in the initial box configuration during the first two weeks of sampling (i.e. the box with less openings) were adjusted using the ratio of concentrations measured in the box and dome enclosures in the first experiment (22 November 2011). Unlike NO₂, surface deposition is not expected to be a significant sink for NO. This expectation is supported by the NO data summarized in Table 2.4. Specifically, the relative deviation between the NO measured in the dome and box for the latter five experiments ranged from 0 – 121% with a mean of 16%, which is within range of the relative standard deviation measured between samplers deployed in like containers. Thus, the NO_x concentration was adjusted by taking the sum of the measured NO concentration and the adjusted NO₂ concentration.

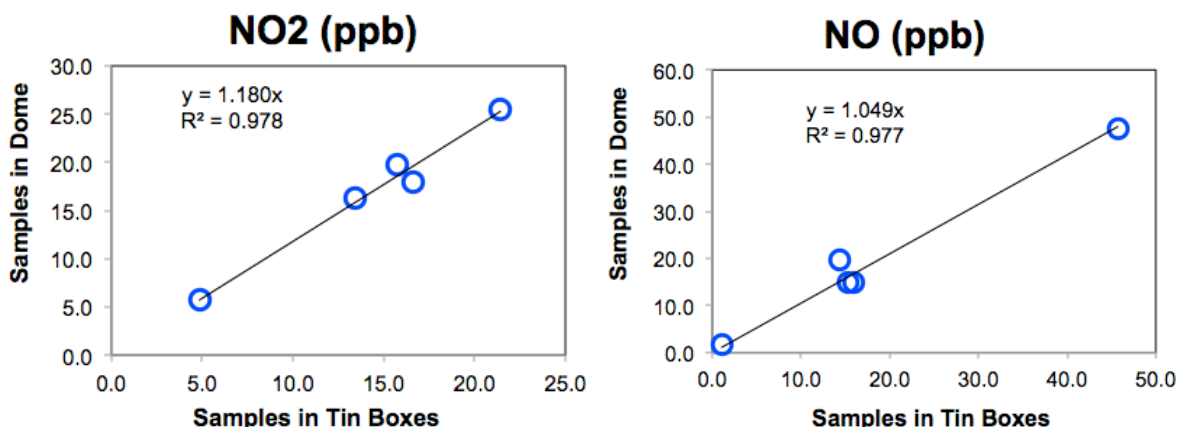


Figure 2.4 Linear regression of NO₂ and NO concentrations measured by samplers in two outdoor enclosure types. Each data point represents the average of three pairs of samplers deployed for a six-day period.

The cartridges used for aldehyde sampling are intended by the manufacturer to be used actively, not passively, as used in this study. However, a study conducted by Shinohara et al. (2004) reported that these aldehyde samplers could be used passively, and reported passive sampling rates of 1.48 and 1.23 mL/min for formaldehyde and acetaldehyde, respectively. In 2012, further testing performed at LBNL yielded passive sampling rates of 1.10 ± 0.09 and 0.86 ± 0.10 mL/min for formaldehyde and acetaldehyde, respectively (Mullen et al., submitted). These sampling rates were used to calculate formaldehyde and acetaldehyde concentrations measured in homes.

3. Results

3.1 Sample Characteristics

A total of 323 different homes were successfully sampled using the mail-out method. Of those homes, 264 were included based on screening survey answers that suggested greater potential for elevated combustion pollutant concentrations from gas appliances; these homes had a hazard score of 2.0 or greater with a mean score of 5.0 based on the scoring system shown in Table 2.1. The remaining 60 homes were selected to serve as controls, and had a mean hazard score of 0.7. These homes had either no gas appliances, had one or two vented gas appliances outside of the main living space, or had a gas appliance in the living space that was rarely used. A frequency distribution of the hazard scores is shown in Figure 3.1.

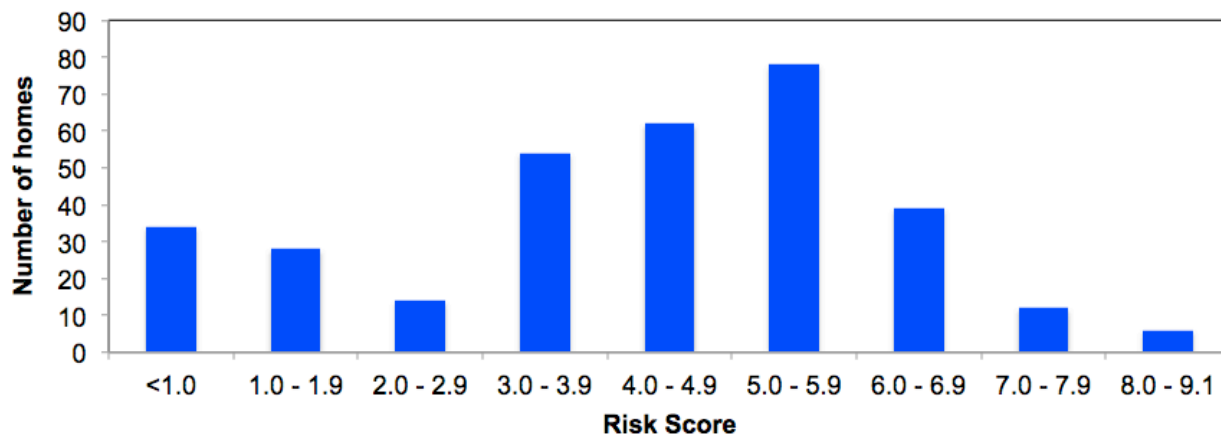


Figure 3.1 Frequency distribution of hazard scores calculated for the 323 homes sampled by mail.

Among the 323 homes, 158 were located in eight of the nine counties that comprise the San Francisco Bay Area: Alameda, Contra Costa, San Francisco, San Mateo, Santa Clara, Marin, Sonoma and Solano. There were 16 homes representing two of five counties in the Sacramento region: Sacramento and Yolo. There were 26 homes representing five of ten counties in the Central Valley: Fresno, Kern, Merced, San Joaquin and Tuolumne. There were two homes representing two of four counties on the Central Coast: Santa Cruz and San Benito. There were 85 homes representing all four of the counties making up the Los Angeles region: Los Angeles, Orange, Santa Barbara and Ventura. There were 28 homes representing both counties in the Inland Empire: Riverside and San Bernardino. Finally, there were 9 homes located in San Diego County. The sample population included both single-family (56%) and multi-family (44%) dwellings. The distribution of homes among the 25 represented counties is shown in Figure 3.2.

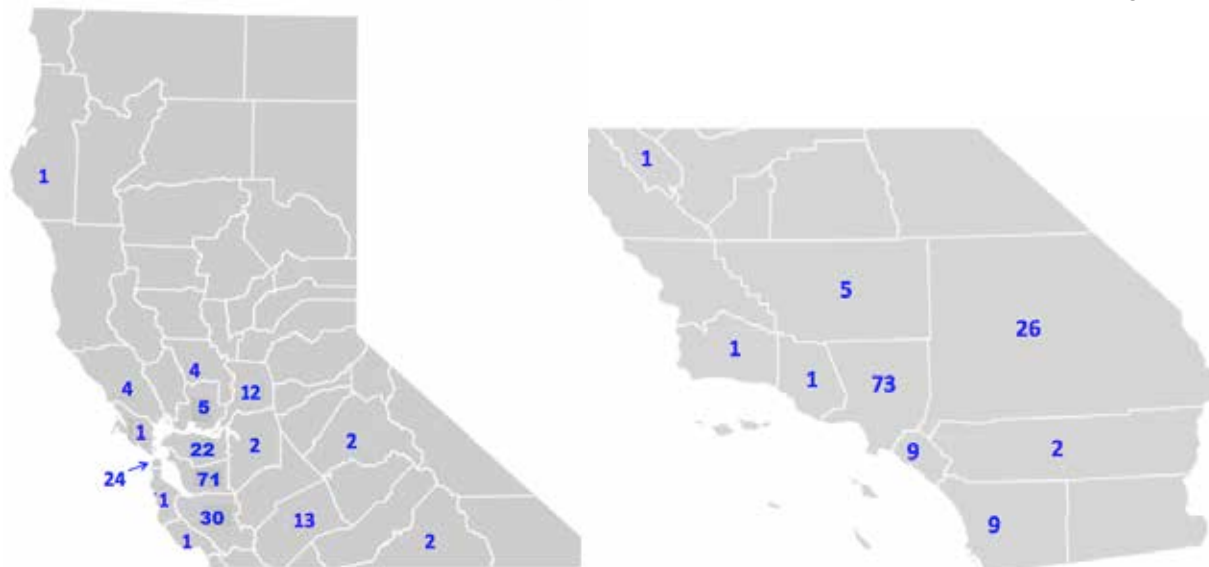


Figure 3.2 Number of homes sampled northern (left) and southern (right) California counties.

The sample population successfully overrepresented homes with frequently used unvented gas cooking appliances, which were hypothesized to increase the hazard of high pollutant concentrations. Specifically, there was at least one gas appliance in 90% of homes, and an

unvented gas cooking appliance in 82%. A gas cooktop was reportedly used more than 7 times during the week of sampling in 53% of study homes, and was used 14 times or more in 26% of study homes. Participants reported that they either did not have a kitchen exhaust fan or that they rarely or never used it in 64% of homes. A summary of the gas appliance and kitchen exhaust use characteristics of the sample population is presented in Table 3.1.

Table 3.1 Gas appliance use and kitchen exhaust characteristics of sample population

	# in study	% in study ^a
Types of appliances present		
No gas appliances	33	10%
Vented gas appliances only (i.e. furnace and/or water heater)	25	8%
Unvented gas appliances only (i.e. cooking appliances)	129	40%
Vented and unvented gas appliances	136	42%
Gas cooktop and oven usage during sampling period		
7 times or less	94	29%
More than 7 times, less than 14 times	87	27%
14 times or more	83	26%
No gas cooking	57	18%
Did not answer	2	<1%
Vented kitchen exhaust fan usage when present		
Used most of the time	76	24%
Used about half the time	41	13%
Used rarely or never	132	41%
Did not answer	1	<1%
No functional exhaust fan present	73	23%

^a Represents percentage of the total sample population.

A summary of the demographic data is presented in Table 3.2. Representation of different income brackets ranged from a low of 13% for the \$25,000 to \$50,000 bracket to a high of 25% for the \$100,000 to \$150,000 bracket. While a substantial fraction of the study sample (19%) had no resident with a college degree, the majority (53%) had at least one resident with a graduate degree. While the majority of households (51%) had only one or two occupants, the majority of participants' homes had a floor area below the average size of new homes in the Western region of the US in 2005 (National Association of Home Builders), with 26% of the homes having a floor area of less than 1000 sq. ft. and 85% having a floor area of less than 2000 sq. ft. The racial distribution of the sample was similar to that of the California population, which, according to the 2010 Census, is made up of 74% White, 7% Black, 2% American Indian or Alaskan Native, 14% Asian, and 38% Hispanic persons. (Note that because the US Census does not consider "Hispanic" as a race, individuals that report a Hispanic ethnicity are also counted within one of the race categories. Also, US Census data is tabulated per individual whereas statistics on the study population are tabulated per household). Thus, the primary difference between the ethnic distribution of the study sample and the California population is overrepresentation of the Asian/Pacific Islander and African-American populations and underrepresentation of the Hispanic/Latino population. Relative to the California population, there were lower far fewer households in this study with residents who were children or seniors.

Table 3.2 Demographics of study sample compared with demographics of the California population.

	# in study	% in study	% in CA ^a
Types of appliances present			
Home rented	147	46%	43%
Home owned	176	54%	57%
Floor Area of home (sq. ft.)			
<1000	110	34%	22%
1000-2000	143	44%	46%
>2000	47	15%	32%
Did not answer	23	7%	
Number of residents			
1 – 2	164	51%	55%
3 – 4	116	36%	
5 or more	42	13%	45% ^b
Did not answer	1	<1%	
Presence of minors and seniors			
At least one resident <18 years old	51	16%	37%
At least one resident >64 years old	20	6%	25%
All residents between 18-64 years old	252	78%	38%
Highest education level of ANYONE in household ^c			
Less than Bachelors degree	60	19%	NA
Bachelors degree	90	28%	NA
Graduate degree	172	53%	NA
Did not answer	1	<1%	
Ethnicities represented by residents ^d			
Native American	7	1%	2%
Hispanic/ Latino	36	5%	38%
Black, African-American	45	14%	7%
Asian or Pacific Islander	80	30%	14%
White, Caucasian	219	76%	74%
Combined Gross Income			
<\$25k	50	6%	22%
\$25-49k	47	13%	22%
\$50-74k	53	15%	17%
\$75-99k	36	14%	12%
\$100-150k	67	25%	14%
>\$150k	36	18%	13%
Did not answer	34	6%	

^a Home floor area data obtained from Residential Appliance Saturation Survey, 2009 (www.energy.ca.gov/appliances/rass/). Remaining data obtained from www.census.gov.

^b Percent of households with 3 or more persons in CA.

^c Educational attainment statistics were not available on a per household basis for the CA population.

^d All race/ethnic categories that partially/fully characterize an individual/household are weighted equally, therefore percentages sum to greater than 100%. However, statistics for the study population are tabulated on a per household basis, whereas CA statistics are tabulated per individual.

A summary of all known characteristics of the sample population, based on responses to the initial and exit survey, is provided in Appendix F. This summary includes both homes to which samplers were mailed (n=323) and those that were visited by a researcher (n=29).

3.2 Participant Compliance

Causes for loss of data or impaired data quality due to participants' noncompliance were divided into five categories: unresponsive/dropped out, pictures not sent or sent late, cooking log not returned, samplers set up late, samplers returned late, samplers returned unsealed.

There were 13 participants who dropped out of the study after having gone through the consent process. For seven of these cases, the participants were considered to have dropped out because they could not be reached for their initial survey appointment. While it was not uncommon for participants to miss their phone appointments, these seven individuals were not reachable after multiple attempts, and were therefore removed from the study. In two cases, participants requested to be removed from the study prior to completing the initial survey, because upon further consideration they felt participation would be inconvenient for their household. In the four remaining cases, the participants dropped out after the package had been mailed to them. In one of these four cases, the participant had to leave home for emergency travel. In two other cases, the individuals decided participation would be too burdensome, after having received and reviewed the package. In the fourth case, researchers were unable to reach the individual for three weeks after the package had been mailed. Upon finally reaching the individual and ascertaining that he had not yet set up the samplers, he was asked to mail it back unopened, since the collected data would no longer be considered reliable. The four individuals that dropped out after having received the package mailed it back without delay. For 12 of the 13 individuals that dropped out, no payment was made. In the last case, the participant received a payment of \$25, since he had already completed the initial survey and wished to continue, but was asked to send the package back, since three weeks had already transpired.

The request for pictures from each location where samplers were deployed was the most common type of participant noncompliance. The purpose of the pictures was two-fold. First, the study director reviewed the pictures at the beginning of the sampling period to ensure that samplers had been set up correctly. Second, researchers reviewed the pictures at the time of data processing and analysis in the case of an unusual or unexpected result. Over the course of the study, a few individuals declined to send pictures either because they did not have a camera, did not know how to electronically send the pictures, or did not feel comfortable sending pictures. A handful of other individuals did not provide any excuse for not sending pictures, but simply failed to do so. Individuals were reminded once to send pictures, but not prodded further. In the end, 23% of participants did not send any pictures. Pictures were sent at the end of the sampling period by 14% of participants; this did not allow researchers to provide feedback to the participants regarding placement of the samplers. In total, 63% of participants complied with the request to send pictures at the beginning of the sampling period. In most cases, the pictures provided a helpful indication of the location of the samplers and appliances in the home. There were only a few cases when the pictures provided an indication of incorrect or inappropriate placement. Specifically, on nine occasions, participants were asked to move the sampler assembly to a new location because it was either too close to the stove or oven, too close to an open window, or in an area that did not appear to have sufficient airflow. There was a tenth home for which review of the pictures following the sampling period made apparent that the participant had forgotten to remove the cap from one of the aldehyde samplers in a duplicate pair. Other than these instances, the pictures primarily provided evidence of correct sampler placement by the participants.

A hard copy of the cooking log was included in the package of every home included in the second phase of the study. The residents were asked by phone or email, days prior to the

package arrival, to track the cooking activities on the log and return it with the rest of the materials. Ultimately, of the 196 participants that were mailed cooking logs, only 16 (8%) did not return them.

Participants were asked to deploy the sampling materials within 24 hours of their arrival, and to repack the materials roughly six days later. The majority of participants followed these instructions, but a few did not. Overall, 24 of the 324 participants (7%) set up the sampling materials three or more days after the arrival of the samplers, with an average delay of roughly five days. In addition, 13 participants (4%) delayed in repacking the samplers, such that the sampling period lasted an average of roughly nine days, rather than the desired six days. Two of these homes had also set up the samplers late, which resulted in the package of samplers arriving at the lab two to three weeks after they had been mailed out by LBNL. However, in only two of these cases were the delays so significant that the data collected by time-integrated samplers were lost.

The instructions provided to the participants made clear that the time-integrated samplers should be repackaged in the same manner in which they had arrived. However, there were a few cases for which the samplers were not properly sealed. The aldehyde samplers had caps, which provided a second layer of protection. Any NO_x samplers that were sent back unsealed were discarded. Overall, there were 25 homes for which the NO_x sampler from at least one location had to be discarded because it was not properly sealed. There were 21 homes for which at least one aldehyde sampler was sent back unsealed, but in only 14 of these cases were the caps also missing, resulting in the samples being discarded.

3.3 Quality of participant survey data

Although the participant surveys differed in the types of data they collected, there were a few topical areas in which they overlapped, allowing for assessment of the quality of participant-provided data.

There were multiple questions that were similar or identical between the screening and initial surveys. A key difference was that the screening survey was primarily completed online and the initial survey was administered exclusively by telephone interview. Comparing responses to the common questions provides insight into participants' ability to provide information about their home, appliances, and kitchen exhaust system without researcher assistance.

There were 11 questions about appliance characteristics that were similar or identical between the initial and screening surveys. Table 3.3 provides a summary of the number of individuals who either provided a different response or replaced a "don't know" with an actual response during the telephone interview compared to unassisted responses online. Overall, roughly three-fourths of participants initially provided a different response to at least one of 11 questions regarding their appliance characteristics. The questions that most frequently received different responses were those regarding furnace type, kitchen exhaust fan type, and central furnace and water heater location. The question that most frequently received a "don't know" response in the online survey was whether the water heater was powered by gas or electricity. These results suggest that the more expensive telephone interview approach may have yielded more accurate information about the sites.

Table 3.3 Statistics on participants who provided different responses to questions in online, unassisted screening than those provided during the pre-monitoring “initial” survey administered by telephone interview. Individuals who answered, “don’t know” in the screening survey then provided a response in the initial survey are tabulated separately.

Question	# (%) Different Responses	# (%) Initially “Don’t know”
Primary heater type	64 (20%)	23 (7%)
Supplemental heater type	69 (21%)	14 (4%)
Location of central furnace	48 (22%)	19 (9%)
Location of wall furnace	8 (11%)	3 (4%)
Fireplace vent type	0 (0%)	6 (23%)
Water heater fuel type	7 (2%)	52 (16%)
Water heater location	70 (22%)	0 (0%)
Cooktop fuel type	12 (4%)	5 (2%)
Oven fuel type	17 (5%)	9 (3%)
Kitchen exhaust fan type	93 (29%)	11 (3%)
Kitchen range hood vent type	41 (17%)	27 (11%)

One key question that was common to both the initial survey and exit survey, both of which were conducted by telephone interview, concerned cooking frequency. In the initial survey, participants were asked to provide an estimate of the household’s cooking frequency during a typical week, whereas, in the exit survey, participants were asked to report how frequently they cooked during the previous week. A comparison between initial and exit survey responses for these questions may indicate the degree to which participants’ estimates of a “typical” cooking frequency of their households corresponds with the actual cooking frequency in a given week.

Figure 3.3 displays a regression of the number of times residents reported cooking each meal in an average week (initial survey), against the number of times they recalled cooking during the week of sampling (exit survey). Note that in both cases, residents were asked to provide the amount of cooking that occurred during a full week (i.e. 7 full days). The resulting best-fit line is defined by the equation $y = 0.53x + 6.7$ ($R^2 = 0.37$), indicating that households with infrequent cooking during the week of sampling tended to estimate a higher cooking frequency on average, whereas homes with more frequent cooking during the week of sampling tended to estimate a lower cooking frequency on average. The cooking frequencies reported in the exit and initial survey tended to be most similar for households that reported cooking roughly 14 times per week. However, it should be noted that the overall correlation between responses from these two surveys is low. Differences between the two responses may be partly due to week-to-week variability around the average value predicted by residents. However, it may also be an indication that a person is better able to report how frequently their household cooked during a defined period of time, rather than estimating their household’s average cooking frequency over an undefined period of time.

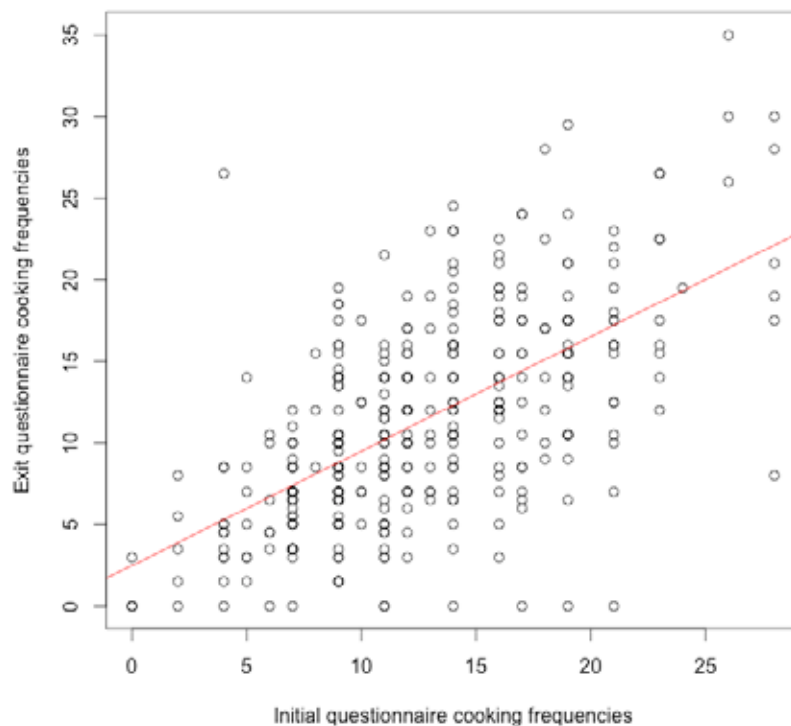


Figure 3.3 Regression of the cooking frequency during a typical week estimated by the participants, against the cooking frequency during the week of sampling reported by the participants. Regression line has equation $y = 0.70x + 2.5$ and $R^2 = 0.37$.

4. Conclusions

The recruitment methods used in this study required minimal resources, and although they yielded a low response rate, allowed for cost-effectively contacting a large number of organizations and groups. In the end, the goal of oversampling homes with appliance characteristics that increased hazard of elevated pollutant concentrations, particularly frequent use of unvented gas cooking appliances, was successfully met. The goal of oversampling households with demographic characteristics hypothesized to put them at greater risk was not met; however, the ultimately selected sample population was characterized by demographics that were close to that of the total California population. The resulting group of study homes is not assumed to be representative of the California population; translating results of the study to the California population will require consideration of the distribution of the study population characteristics across California.

There was a high rate of compliance among study participants, which has been similarly observed by other indoor air quality studies utilizing mail-out strategies. Specifically, more than 95% of participants completed the study, more than 90% returned the cooking log, and roughly 90% set-up and returned the air sampling materials on time and according to instruction. The largest source of participant noncompliance was the sending of pictures of the air samplers following set-up (47%); however, this had been communicated to participants as more of a request than a strict requirement. A comparison of questions common to the screening survey completed online and the telephone interviews indicates that a substantial fraction of participants (roughly 20%) had difficulty answering basic questions about their appliance

characteristics without the aid of a researcher. In addition, a low correlation was observed between participants' estimates of their households' typical cooking frequency and report of their households' cooking frequency during the week of sampling. Overall, results of this study provide evidence that the data necessary to conduct a large-scale indoor air quality study can be effectively collected remotely by communicating with study participants using a variety of methods (conventional mail, electronic mail, phone and text messaging).

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Appendix A: Recruitment materials

Study recruitment was primarily carried out by reaching out to community groups. This was done by first sharing information about the study with representative of community groups via email or phone, and then asking them to share that information with their group membership by sending it out via email list-serves, posting it on their website, or making hard copies available for visitors to their office. If they agreed, then recruitment materials were provided to them either by electronic or traditional mail. Recruitment materials included a flyer, a project information sheet, and a brief, one-paragraph description. The flyer was designed to be simple and aesthetically pleasing, and was either physically mailed, sent as an attachment to an email, or included in the body of an email to community group representatives. The content of the project information sheet was included on the project website and sent as an attachment to community group representatives who requested more information. The brief, one-paragraph description was provided for posting on the website of one organization.

Of the three recruitment materials, the project flyer was used most extensively when reaching out to organizations. The content of the project information sheet was also critical, in that it was the primary source of detailed information provided on the project website. Both the flyer and the information sheet were modified mid-way through the project. The flyer was edited to reduce the number of words and increase readability. The project information sheet was edited to clarify the duration of the air-sampling period, and to incorporate information about an intervention component of the study that was added in the second year. The brief, one paragraph-description was used only once, in which case it was posted on a website viewed by Lawrence Berkeley National Lab employees and affiliates.

A.1 Flyer used in first year

Would you like to participate? California Healthy Homes Indoor Air Quality Study

Participants will receive

- Information about air quality in their homes
- \$75 for participating

Participants will need to

- Complete a screening survey and two interviews over the telephone. Each interview will take 10-30 minutes.
- Help us measure air quality in your home in one of the following two ways: EITHER...
 - o Set up a small package of air monitoring devices that we will send you in the mail and that you will send back to us after one week of sampling, OR...
 - o Allow our research team to visit the home to set up and later pick-up the monitors.

To participate in this study, you must:

- Have a home in California.
- Have a smoke-free home.
- Be at least 18 years old.
- Be able to complete an interview about your home in English.

The goal of this study is to improve our understanding of indoor air quality in California homes, with a focus on homes that have natural gas appliances. The study includes collection of air quality samples and other measurements in the homes, and collection of information about the appliances and other factors that can affect air quality in homes.

Selection will be based on characteristics of the building, household and appliances.

If you would like to participate, please complete the web-based form at this link: healthyhomes.lbl.gov/survey or call us at 510-517-2357.

If you have any further questions about this study, please visit the FAQ page on our project website, or contact us by phone or email: healthyhomes.lbl.gov/information, 510-517-2357, Nmullen@lbl.gov

The deadline to sign up is March 9, 2012

A.2 Flyer used in second year

Would you like to participate? California Healthy Homes Indoor Air Quality Study

You will receive:

- Information about the air quality in your home
- \$75

You will need to:

- Complete a screening survey and two interviews over the telephone. Each interview will take 10-30 minutes.
- Help us measure air quality in your home by EITHER...
 - o Setting up small air monitoring devices that we will send you in the mail and that you will send back to us after one week of sampling, OR...
 - o Allowing our research team to visit your home to set up and later pick-up the monitors.

To qualify, you must:

- Live in California in a smoke-free home.
- Be at least 18 years old.
- Be able to answer questions about your home in English.

The goal of this study is to learn more about indoor air quality in California homes, with a focus on homes with natural gas appliances. We are collecting information on air pollution levels, household appliance types and other factors that can affect air quality in homes.

Selection is based on characteristics of the building, household and appliances.

If you would like to participate,

Please complete the web-based form at this link: healthyhomes.lbl.gov/survey or call us at 510-517-2357.

If you have any questions about this study:

Please visit the information page on our website, or contact us by phone or email: healthyhomes.lbl.gov/information, 510-517-2357, Nmullen@lbl.gov

Deadline to sign up is February 15, 2013!

A.3 Information sheet used in first year



California Healthy Homes Indoor Air Quality Study

PROJECT INFORMATION

1. What is the goal of this study?

The goal of this study is to collect information about indoor air quality in homes in California, and to better understand what factors affect indoor air quality. To achieve this goal, we plan to monitor indoor air quality parameters for one-week periods in homes in California, and to have the residents of these homes complete a survey about their household activities and appliance characteristics. We will primarily be studying homes that have natural gas appliances.

2. What exactly will I have to do?

If your home is selected for this project, you will be asked to participate based on one of two methods: (1) Have the air pollutant samplers mailed to your home, (2) Have a researcher visit your home.

These are the steps involved with participating, if the pollutant samplers are mailed to your home:

- A small package of air quality samplers will be mailed to your home, and someone in your home will be required to receive the package and set-up the samplers. Detailed instructions on how to set-up the samplers will be provided and a researcher will be available by phone to answer any questions that arise. The set-up process should take less than 30 minutes, and may be completed in as little as 10 minutes.
- At the end of the scheduled one-week sampling period, the samplers will need to be retrieved, sealed in an airtight bag and mailed back. All the packaging materials will be provided and postage would be prepaid.
- An English-speaking member of your household will need to provide information about the home and appliances through two telephone interviews, each taking 10-30 minutes. One interview will happen about 1-2 weeks before the sampling period; the other will happen at the end of the sampling period.

These are the steps involved with participating, if a researcher visits your home:

- One or two research staff will visit your home to set-up the air quality samplers and conduct a brief home inspection. Samplers will operate silently and most operate on battery power. There is one device that must be plugged in. The inspection will include measuring the size of your home, inspecting the appliances, taking some pictures of the appliances and reading your gas meter. We may also measure the ventilation rate of your home by releasing tiny amounts of a safe, odor-free chemical, and then measuring the level of that chemical in the air of your home. In all, the visit is expected to take about 60-90 minutes.
- At the end of the 1-week period, the researcher(s) will return to pick-up the air quality samplers, and read your gas meter again. This second visit will take about 30 minutes.
- An English-speaking member of your household would need to provide information about the home and appliances through two interviews, each taking 10-30 minutes. One interview will take place over the telephone about 1-2 weeks before the sampling period; the other will take place in person at the end of the sampling period at the time that the researchers make their second visit.

At some homes, a combination of these two approaches will be used, where a researcher will visit the home to set-up the samplers and will leave a prepaid envelope, so that the resident can mail the sampling package back. A payment of \$75 will be mailed to participants after they have completed the study as planned. The payment will be reduced by \$25 for a delay of more than a week in returning the air samplers or completing the exit interview, unless the delay is out of the participant's control.

3. Will I need to be home on certain days?

If researchers visit your home, the visits will be scheduled sometime between 8:00 am and 8:00 pm on a Tuesday and again on the following Monday. If the air samplers are mailed to your home, then you will be asked to set-up the air samplers on a Tuesday and then repackage them on the following Monday. If this schedule does not work for you, other arrangements may be possible.

4. How will Lawrence Berkeley National Lab select the study participants?

To be eligible to participate in this study, your home must meet the following criteria: (1) Located in California, (2) Smoke-free home, (3) At least one adult resident that is willing and able to carryout the requirements of the study (see question #2 for a description of the requirements). Among the homes that are eligible, priority will be given to selecting homes that have natural gas appliances and other characteristics we think are likely to affect the indoor air quality, such as being small in size and having old appliances.

5. How will you use information you collect from me and from my home?

The information that is collected about your home will only be used for the purpose of better understanding indoor air quality in California homes. Any information about your home used in reports will be kept anonymous. Information on your home or your contact information will not be released to anyone outside of the research staff for this study, and will not be used for any purpose other than for the study. With your permission, we may use your home address to find out information about your building from publicly available records, for example its age and size. If you have any further questions or concerns about how the information collected in this study will be used, please do not hesitate to contact us.

A.4 Information sheet used in second year



California Healthy Homes Indoor Air Quality Study

PROJECT INFORMATION

1. What is the goal of this study?

The goal of this study is to collect information about indoor air quality in homes in California, and to better understand what factors affect indoor air quality. To achieve this goal, we plan to monitor indoor air quality parameters for one-week periods in homes in California, and to have the residents of these homes complete a survey about their household activities and appliance characteristics. We will primarily be studying homes that have natural gas appliances.

2. What exactly will I have to do?

If your home is selected for this project, you will be asked to participate based on one of two methods: (1) Have the air pollutant samplers mailed to your home, (2) Have a researcher visit your home.

These are the steps involved with participating, if the pollutant samplers are mailed to your home:

- A small package of air quality samplers will be mailed to your home, and someone in your home will be required to receive the package and set-up the samplers. Detailed instructions on how to set-up the samplers will be provided and a researcher will be available by phone to answer any questions that arise. The set-up process should take less than 30 minutes, and may be completed in as little as 10 minutes.
- At the end of the scheduled 6-day sampling period, the samplers will need to be retrieved, sealed in an airtight bag and mailed back. All the packaging materials will be provided and postage would be prepaid.
- An English-speaking member of your household will need to provide information about the home and appliances through two telephone interviews, each taking 10-30 minutes. One interview will happen about 1-2 weeks before the sampling period; the other will happen at the end of the sampling period.

These are the steps involved with participating, if a researcher visits your home:

- One or two research staff will visit your home to set-up the air quality samplers and conduct a brief home inspection. Samplers will operate silently and most operate on battery power. There is one device that must be plugged in. The inspection will include measuring the size of your home, inspecting the appliances, taking some pictures of the appliances and reading your gas meter. We may also measure the ventilation rate of your home by releasing tiny amounts of a safe, odor-free chemical, and then measuring the level of that chemical in the air of your home. In all, the visit is expected to take about 60-90 minutes.
- At the end of the 6-day period, the researcher(s) will return to pick-up the air quality samplers, and read your gas meter again. This second visit will take about 30 minutes.
- An English-speaking member of your household would need to provide information about the home and appliances through two interviews, each taking 10-30 minutes. One interview will take place over the telephone about 1-2 weeks before the sampling period; the other will take place in person at the end of the sampling period at the time that the researchers make their second visit.

At some homes, a combination of these two approaches will be used, where a researcher will visit the home to set-up the samplers and will leave a prepaid envelope, so that the resident can mail the sampling package back. A payment of \$75 will be mailed to participants after they have completed the study as planned. The payment will be reduced by \$25 for a delay of more than a week in returning the air samplers or completing the exit interview, unless the delay is out of the participant's control. Some individuals will be invited to participate in a second week of air sampling, if their home meets certain criteria. A \$75 payment will be provided for each week of participation

3. Will I need to be home on certain days?

If researchers visit your home, the visits will be scheduled sometime between 8:00 am and 8:00 pm on a Tuesday and again on the following Monday. If the air samplers are mailed to your home, then you will be asked to set-up the air samplers on a Tuesday and then repackage them on the following Monday. If this schedule does not work for you, other arrangements may be possible.

4. How will Lawrence Berkeley National Lab select the study participants?

To be eligible to participate in this study, your home must meet the following criteria: (1) Located in California, (2) Smoke-free home, (3) At least one adult resident that is willing and able to carryout the requirements of the study (see question #2 for a description of the requirements). Among the homes that are eligible, priority will be given to selecting homes that have natural gas appliances and other characteristics we think are likely to affect the indoor air quality, such as being small in size and having old appliances.

5. How will you use information you collect from me and from my home?

The information that is collected about your home will only be used for the purpose of better understanding indoor air quality in California homes. Any information about your home used in reports will be kept anonymous. Information on your home or your contact information will not be released to anyone outside of the research staff for this study, and will not be used for any purpose other than for the study. With your permission, we may use your home address to find out information about your building from publicly available records, for example its age and size. If you have any further questions or concerns about how the information collected in this study will be used, please do not hesitate to contact us.

2.1 Brief study description posted on "Today at Berkeley Lab" webpage

Researchers with the Indoor Environment Group in EETD are seeking participants for an indoor air quality study. All non-smoking California homes are eligible. Participants must complete two phone interviews (10-30 minutes each), and set up a small package of air samplers in their home for six days. Participants will receive information about their indoor air quality and \$75. Study organizers are seeking a geographically and demographically diverse sample from all of California, so staff are invited to share with others they know around the state. Contact Nasim Mullen for more information.

Appendix B. Consent Materials

Since in-person contact was never made with participants, the consent of an individual to participate was obtained over the phone. This was achieved by having a researcher read a consent script to each participant over the phone, which incorporated pauses to allow for questions. Participants were subsequently mailed a hard copy of the information that had been read to them.

The consent script is divided into sections. Some sections were read to all participants and others were read to only a subset of participants. The decision of which sections were read to a given individual depended on whether researchers intended to mail the air samplers to the home or visit the home to deploy the air samplers. A third section was included in the consent script to allow for the air samplers to be deployed in a home by researchers, but then subsequently mailed back by the participants. Ultimately, this third approach was never used, but the information was left within the consent script.

Mid-way through the study, the consent script was modified to clarify that future publications would not reveal the *exact* location of the home (word “exact” was added because we intended to publish the cities where homes were located), and to provide a more accurate estimate for the time required to complete the participant surveys.

The information mailed to participants following the reading of the consent script did not include every section of the script, but contained only those sections that had been read to the participant. Thus, there are three versions of the documentation mailed to homes, which are referred to as the consent documentation sheet for mail-out, visit, and intervention homes. Only the mail-out consent documentation sheet is included here.

B.1 Consent script used in first year

Introduction

Hello, is (*name of individual who completed screening form*) available? ... Hi! My name is (*researcher name*), and I am calling about the Healthy Homes Indoor Air Quality Study. You (or *name of individual*) previously expressed interest in participating in the study and completed a screening survey. If you are still interested, we would like to invite you to participate. Do you have 10 minutes available for us to talk about the study now?

Yes → Great! *Continue with script*

No → *Arrange a time*

The first step is for you to formally consent or agree to participate. To make sure that you understand what you are agreeing to do, I will read you a short description of the study and give you a chance to ask any questions. If you chose to continue, all of this information also will be sent to you by mail. Can we start now with the study description?

Yes → Great! *Continue with script*

No → *Arrange a time*

Beginning of consent script

You are invited to participate in a research study being conducted by Dr. Brett Singer of Lawrence Berkeley National Laboratory. The goal of the study is to improve understanding of indoor air quality in homes with natural gas appliances. To advance this goal we are measuring pollutant levels and collecting information about the homes of volunteer participants. The study is supported by the California Energy Commission and by the U.S. Department of Energy. We invite you to participate because you expressed interest and you meet the study requirements.

Do you have any questions so far?

Yes → *Answer questions*

No → Okay. Then let's continue.

Description of Study Protocol

If you agree to be in this study, the following will happen:

(Read one of the next three paragraphs based on sampling approach planned for the home).

(Mail only method)

- In about one week, you will be called by me or by another member of the research team. We will ask you questions about your home, appliances, and household. After the interview, we will discuss arrangements for placing air quality sampling devices in your home. The entire phone conversation should take 30 minutes or less.
- A week after the phone interview, a small package of air quality samplers will be mailed to your home. The package will include instructions for setting up the samplers and we will help you by telephone as needed. The package will also include instructions and materials to send the samplers back to us at the end of the week. The set-up was designed to take 30 minutes or less. Samplers will operate silently and do not need to be plugged into the wall. The air quality samplers will remain in your home for one week.
- At the end of the sampling period, we will call to ask you questions about your household activities that could affect indoor air quality during the week. This should take about 10-20 minutes. At that

time we will guide you through collection and packaging of samplers. We will ask you to put the package of sampling materials in the mail or drop them off at a FedEx pickup location within the next day. Once the samplers have been mailed, your participation in the study will be complete.

(Deployed by researcher, returned by mail method)

- In about one week, you will be called by me or by another member of the research team. We will ask you questions about your home, appliances, and household. After the interview, the researcher will discuss arrangements for placing air quality sampling devices in your home. The entire phone conversation should take 30 minutes or less.
- A week after the phone interview, a collection of air quality samplers will be brought to your home by one or two researchers. The researchers will set-up the samplers and will conduct a brief home inspection. Samplers will operate silently and most operate on battery power. There is one device that must be plugged in. The inspection will include measuring the size of your home, inspecting the appliances, taking some pictures of the appliances and reading your gas meter. We may also measure the ventilation rate of your home by releasing tiny amounts of a safe, odor-free chemical, and then measuring the level of that chemical in the air of your home. In all, the visit is expected to take about 40-60 minutes. The air quality samplers will remain in your home for one week.
- At the end of the sampling period, we will call to ask you questions about your household activities that could affect indoor air quality during the week. This should take about 10-20 minutes. At that time we will guide you through collection and packaging of samplers. We will ask you to put the package of sampling materials in the mail or drop them off at a FedEx pickup location within the next day. Once the samplers have been mailed, your participation in the study will be complete.

(Visit only method)

- In about one week, you will be called by me or by another member of the research team. We will ask you questions about your home, appliances, and household. After the interview, the researcher will discuss arrangements for placing air quality sampling devices in your home. The entire phone conversation should take 30 minutes or less.
- A week after the phone interview, a collection of air quality samplers will be brought to your home by one or two researchers. The researchers will set-up the samplers and will conduct a brief home inspection. Samplers will operate silently and most operate on battery power. There is one device that must be plugged in. The inspection will include measuring the size of your home, inspecting the appliances, taking some pictures of the appliances and reading your gas meter. We may also measure the ventilation rate of your home by releasing tiny amounts of a safe, odor-free chemical, and then measuring the level of that chemical in the air of your home. In all, the visit is expected to take about 40-60 minutes. The air quality samplers will remain in your home for one week.
- At the end of the one-week sampling period, a researcher will visit your home to repackage the samplers and materials, and to ask you a few final questions. The final interview will take 10-20 minutes. The entire visit will take about 40-60 minutes. Once the researcher has finished this final visit, your participation in the study will be complete.

Do you have any questions so far?

Yes → *Answer questions*

No → Okay, then let's continue.

Statement of Benefits (No Risks) and Option to Cease Participation

There are no significant risks associated with involvement in this study. Participation should take about 2-3 hours of your time, in total.

Your records will be kept as confidential as possible. All information collected about your home will be identified by a code. When results of the research are presented, no information will be included that would reveal your identity or the location of your home. Your name and address will be kept in a separate, password-protected file and used only to contact you about the study.

The study is not designed to improve the air quality in your home but we will let you know if we identify any dangerous conditions and we will share the results of the pollutant measurements in your home. Results of the study should benefit society by advancing efforts to improve air quality in California homes.

You may stop participating in this study at any time. If you wish to stop, simply contact Nasim Mullen at (510) 517-2357 or nmullen@lbl.gov. It will be your decision if information collected about your home up to that point is included or excluded from study results. If you decide to stop participating after the samplers have been mailed or delivered to your home, we ask that you return them to us, by either mailing them back or allowing a researcher to come and pick them up. Payment of \$75 will be mailed to you after you complete the study as planned. Payment will be reduced by \$25 for a delay of more than a week in returning the air samplers or completing the exit interview, unless the delay is out of your control.

Do you have any questions so far?

Yes → *Answer questions*

No → Okay, then let's continue.

Any further questions you have about taking part in this study can be asked now, or can be directed to Dr. Brett Singer at 510-486-4779 or bcsinger@lbl.gov.

Any questions about your rights as a research subject can be directed to the Human Subjects Committee of Lawrence Berkeley National Lab (510-486-5507) or to the Committee for the Protection of Human Subjects of the University of California at Berkeley (510-642-7461). Would you like their phone numbers now? If not, they will be included when we send you a copy of this information in the mail.

Consent and Scheduling

Have you understood everything that has been described to you and have your questions been answered to your satisfaction?

_____ Yes

_____ No

Would you like to participate in this study?

_____ Yes

_____ No

If yes: Great! We would like to begin sampling the air quality in your home in 2-weeks. Will you be in town that week?

Yes → *Continue with script*

No→ Okay. Perhaps we can schedule to work in your home at a later date. Are there any weeks over the next 2 months that will *not* work for you? (*Allow for response*) We will call you back after we have a chance to review the schedule.

(Read one of the next three paragraphs based on the sampling approach that will be used for the home).

(Mail only method)

Our plan is to mail the samplers to you so that they arrive on (*insert date*). A researcher will call you the next day. You can try to set-up the samplers by yourself using the instructions included in the package, but we ask that you wait to do so until shortly before the time that the call is scheduled. If you need help, we can provide it at that time. If you have already completed the set-up, you can confirm that the samplers are in place. We then will call you at the end of the one-week sampling period, on (*insert date of last day of sampling*). At this time we will ask you the final set of questions and help if you have any questions about packaging the samplers for return. We will ask you to mail the samplers back to us within one day. Does that schedule work for you?

-No→ *Consult about alternative dates*

-Yes→ Great. What time on (*insert date for start of sampling*) will you be available for a phone call? How about on (*insert date for end of sampling*)?

(Deployed by researcher, returned by mail method)

Our plan is to come to your home to set-up the air quality samplers and conduct a brief inspection on (*insert date for start of sampling*). This visit will involve one or two researchers and will take 40-60 minutes. We will then need you to repackage the samplers and mail them back to us on (*insert date for end of sampling*). We will also call you on that day to ask you the final set of questions and help if you have any questions about packaging the samplers for return. Does that schedule work for you?

-No→ *Consult about alternative dates*

-Yes→ Great. What time on (*insert date for start of sampling*) will you be available for the visit? What time on (*insert date for end of sampling*) will you be available for a phone call?

(Visit only method)

Our plan is to come to your home to set up the air quality samplers and conduct a brief inspection on (*insert date for start of sampling*), and then return on (*insert date for end of sampling*) to pick up the samplers and ask you a few final questions. Both visits will involve one or two researchers and will take 40-60 minutes. Does that schedule work for you?

-No→ *Consult about alternative dates*

-Yes→ Great. What time on (*insert date for start of sampling*) will you be available for a visit? How about on (*insert date for end of sampling*)?

Can you please confirm that your address is _____?

If home will be visited, do you have any pets that you keep inside of your home that could be dangerous for the visiting researcher? Are there any other potential hazards in your home that we should be aware of?

In one week, I would like to call you again to go through the first interview. As I mentioned, this phone conversation will take 20 to 30 minutes.

Are you available for a 30-minute phone conversation on (*insert date*) for the first set of questions?

-No→ *See if the individual is available on the day before or after the suggested date*

-Yes→ Great. What time on (*insert date for start of sampling*) will you be available for our next phone conversation?

Thank you for your time (*name of resident*). If any questions come to your mind, feel free to call me at (*researcher phone number*) or email me at (*researcher email*). Otherwise, I look forward to talking to you on (*date scheduled for first interview*) at (*time scheduled for first interview*). Good bye.

B.2 Consent script used in second year

Introduction

Hello, is (*name of individual who completed screening form*) available? ... Hi! My name is (*researcher name*), and I am calling about the Healthy Homes Indoor Air Quality Study. You (or *name of individual*) previously expressed interest in participating in the study and completed a screening survey. If you are still interested, we would like to invite you to participate. Do you have 10 minutes available for us to talk about the study now?

Yes → Great! *Continue with script*

No → *Arrange a time*

The first step is for you to formally consent or agree to participate. To make sure that you understand what you are agreeing to do, I will read you a short description of the study and give you a chance to ask any questions. If you chose to continue, all of this information also will be sent to you by mail. Can we start now with the study description?

Yes → Great! *Continue with script*

No → *Arrange a time*

Beginning of consent script

You are invited to participate in a research study being conducted by Dr. Brett Singer of Lawrence Berkeley National Laboratory. The goal of the study is to improve understanding of indoor air quality in homes with natural gas appliances. To advance this goal we are measuring pollutant levels and collecting information about the homes of volunteer participants. The study is supported by the California Energy Commission and by the U.S. Department of Energy. We invite you to participate because you expressed interest and you meet the study requirements.

Do you have any questions so far?

Yes → *Answer questions*

No → Okay. Then let's continue.

Description of Study Protocol

If you agree to be in this study, the following will happen:

(Read one of the next three paragraphs based on sampling approach planned for the home).

(Mail only method)

- In about one week, you will be called by me or by another member of the research team. We will ask you questions about your home, appliances, and household. After the interview, we will discuss arrangements for placing air quality sampling devices in your home. The entire phone conversation should take 30 minutes or less.
- A week after the phone interview, a small package of air quality samplers will be mailed to your home. The package will include instructions for setting up the samplers and we will help you by telephone as needed. The package will also include instructions and materials to send the samplers back to us at the end of the week. The set-up was designed to take 30 minutes or less. Samplers will operate silently and do not need to be plugged into the wall. The air quality samplers will remain in your home for 6 days.
- At the end of the sampling period, we will call to ask you questions about your household activities that could affect indoor air quality during the week. This should take about 10-20 minutes. At that

time we will guide you through collection and packaging of samplers. We will ask you to put the package of sampling materials in the mail or drop them off at a FedEx pickup location within the next day. Once the samplers have been mailed, your participation in the study will be complete.

(Deployed by researcher, returned by mail method)

- In about one week, you will be called by me or by another member of the research team. We will ask you questions about your home, appliances, and household. After the interview, the researcher will discuss arrangements for placing air quality sampling devices in your home. The entire phone conversation should take 30 minutes or less.
- A week after the phone interview, a collection of air quality samplers will be brought to your home by one or two researchers. The researchers will set-up the samplers and will conduct a brief home inspection. Samplers will operate silently and most operate on battery power. There is one device that must be plugged in. The inspection will include measuring the size of your home, inspecting the appliances, taking some pictures of the appliances and reading your gas meter. We may also measure the ventilation rate of your home by releasing tiny amounts of a safe, odor-free chemical, and then measuring the level of that chemical in the air of your home. In all, the visit is expected to take about 40-60 minutes. The air quality samplers will remain in your home for 6 days.
- At the end of the sampling period, we will call to ask you questions about your household activities that could affect indoor air quality during the week. This should take about 10-20 minutes. At that time we will guide you through collection and packaging of samplers. We will ask you to put the package of sampling materials in the mail or drop them off at a FedEx pickup location within the next day. Once the samplers have been mailed, your participation in the study will be complete.

(Visit only method)

- In about one week, you will be called by me or by another member of the research team. We will ask you questions about your home, appliances, and household. After the interview, the researcher will discuss arrangements for placing air quality sampling devices in your home. The entire phone conversation should take 30 minutes or less.
- A week after the phone interview, a collection of air quality samplers will be brought to your home by one or two researchers. The researchers will set-up the samplers and will conduct a brief home inspection. Samplers will operate silently and most operate on battery power. There are 2 or 3 devices that must be plugged in. The inspection will include measuring the size of your home, inspecting the appliances, taking some pictures of the appliances and reading your gas meter. We may also measure the ventilation rate of your home by releasing tiny amounts of a safe, odor-free chemical, and then measuring the level of that chemical in the air of your home. In all, the visit is expected to take about 40-60 minutes. The air quality samplers will remain in your home for 6 days.
- At the end of the sampling period, a researcher will visit your home to repackage the samplers and materials, and to ask you a few final questions. The final interview will take about 10 minutes. The entire visit will take about 40-60 minutes. Once the researcher has finished this final visit, your participation in the study will be complete.

Do you have any questions so far?

Yes → Answer questions

No → Okay, then let's continue.

Statement of Benefits (No Risks) and Option to Cease Participation

There are no significant risks associated with involvement in this study. Participation should take about 2-3 hours of your time, in total.

Your records will be kept as confidential as possible. All information collected about your home will be identified by a code. When research results are presented, no information will be included that would reveal your identity or the exact location of your home. Your name and address will be kept in a separate, password-protected file and used only to contact you about the study.

The study is not designed to improve the air quality in your home but we will let you know if we identify any dangerous conditions and we will share the results of the pollutant measurements in your home. Results of the study should benefit society by advancing efforts to improve air quality in California homes.

You may stop participating in this study at any time. If you wish to stop, simply contact Nasim Mullen at (510) 517-2357 or nmullen@lbl.gov. It will be your decision if information collected about your home up to that point is included or excluded from study results. If you decide to stop participating after the samplers have been mailed or delivered to your home, we ask that you return them to us, by either mailing them back or allowing a researcher to come and pick them up.

Payment of \$75 will be mailed to you after you complete the study as planned. Payment will be reduced by \$25 for a delay of more than a week in returning the air samplers or completing the exit interview, unless the delay is out of your control. Lawrence Berkeley National Lab employees are eligible to participate, but will not receive any financial compensation.

Do you have any questions so far?

Yes → *Answer questions*

No → Okay, then let's continue.

Any further questions you have about taking part in this study can be asked now, or can be directed to Dr. Brett Singer at 510-486-4779 or bcsinger@lbl.gov.

Any questions about your rights as a research subject can be directed to the Human Subjects Committee of Lawrence Berkeley National Lab (510-486-5507) or to the Committee for the Protection of Human Subjects of the University of California at Berkeley (510-642-7461). Would you like their phone numbers now? If not, they will be included when we send you a copy of this information in the mail.

Consent and Scheduling

Have you understood everything that has been described to you and have your questions been answered to your satisfaction?

_____ Yes
 _____ No

Would you like to participate in this study?

_____ Yes
 _____ No

If yes: Great! We would like to begin sampling the air quality in your home in 2-weeks. Will you be in town that week?

Yes → *Continue with script*

No → Okay. Perhaps we can schedule to work in your home at a later date. Are there any weeks over the next 2 months that will *not* work for you? (*Allow for response*) We will call you back after we have a chance to review the schedule.

(Read one of the next three paragraphs based on the sampling approach that will be used for the home).

(Mail only method)

Our plan is to mail the samplers to you so that they arrive on (*insert sampling start date*). A researcher will call you the next day. You can try to set-up the samplers by yourself using the instructions included in the package, but we ask that you wait to do so until shortly before the time that the call is scheduled. If you need help, we can provide it at that time. If you have already completed the set-up, you can confirm that the samplers are in place. We then will call you at the end of the one-week sampling period, on (*insert sampling end date*). At this time we will ask you the final set of questions and help if you have any questions about packaging the samplers for return. We will ask you to mail the samplers back to us within one day. Does that schedule work for you?

-No → *Consult about alternative dates*

-Yes → Great. What time on (*insert sampling start date*) will you be available for a phone call?

How about on (*insert sampling end date*)?

(Deployed by researcher, returned by mail method)

Our plan is to come to your home to set-up the air quality samplers and conduct a brief inspection on (*insert date for start of sampling*). This visit will involve one or two researchers and will take 40-60 minutes. We will then need you to repackage the samplers and mail them back to us on (*insert date for end of sampling*). We will also call you on that day to ask you the final set of questions and help if you have any questions about packaging the samplers for return. Does that schedule work for you?

-No → *Consult about alternative dates*

-Yes → Great. What time on (*insert date for start of sampling*) will you be available for the visit?

What time on (*insert date for end of sampling*) will you be available for a phone call?

(Visit only method and two-week sampling method)

Our plan is to come to your home to set up the air quality samplers and conduct a brief inspection on (*insert date for start of sampling*), and then return on (*insert date for end of sampling*) to pick up the samplers and ask you a few final questions. Both visits will involve one or two researchers and will take 40-60 minutes. Does that schedule work for you?

-No → *Consult about alternative dates*

-Yes → Great. What time on (*insert date for start of sampling*) will you be available for a visit?

How about on (*insert date for end of sampling*)?

Can you please confirm that your address is _____?

If home will be visited, do you have any pets that you keep inside of your home that could be dangerous for the visiting researcher? Are there any other potential hazards in your home that we should be aware of?

In one week, I would like to call you again to go through the first interview. As I mentioned, this phone conversation will take 20 to 30 minutes.

Are you available for a 30-minute phone conversation on (*Monday, November 28th or Tuesday, November 29th*) for the first set of questions?

-No → *See if the individual is available on the day before or after the suggested date*

-Yes → Great. What time on (*Tuesday, December 13th*) will you be available for a visit?

Thank you for your time (*name of resident*). If any questions come to your mind, feel free to call me at (*researcher phone number*) or email me at (*researcher email*). Otherwise, I look forward to talking to you on (*date scheduled for first interview*) at (*time scheduled for first interview*). Good bye.

B.3 Consent documentation sheet for mail-out homes (includes second year changes)**California Healthy Homes Indoor Air Quality Study**

This document is a hard copy of the consent form that was read to you over the phone on _____. It is being provided to you for your records.

You are invited to participate in a research study being conducted by Dr. Brett Singer of Lawrence Berkeley National Laboratory. The goal of the study is to improve understanding of indoor air quality in homes with natural gas appliances. To advance this goal we are measuring pollutant levels and collecting information about the homes of volunteer participants. The study is supported by the California Energy Commission and by the U.S. Department of Energy. We invite you to participate because you expressed interest and you meet the study requirements.

PROCEDURES

If you agree to be in this study, the following will happen.

- In about one week, you will be called by me or by another member of the research team. We will ask you questions about your home, appliances, and household. During this call, we will discuss arrangements for placing air quality sampling devices in your home. The entire phone conversation should take 30 minutes or less.
- A week after the phone interview, a small package of air quality samplers will be mailed to your home. The package will include instructions for setting up the samplers and we will help you by telephone as needed. The package will also include instructions and materials to send the samplers back to us at the end of the week. The set-up was designed to take 30 minutes or less. Samplers will operate silently and do not need to be plugged into the wall. The air quality samplers will remain in your home for 6 days.
- At the end of the sampling period, we will call to ask you questions about your household activities that could affect indoor air quality during the week. This should take about 10-20 minutes. At that time we will guide you through collection and packaging of samplers. We will ask you to put the package of sampling materials in the mail or drop them off at a FedEx pickup location within the next day. We can help you find a FedEx location if you choose that option. Either way, we will provide you with pre-paid padded envelopes that are already addressed to our lab, so that the package can be mailed at no charge to you. Once the samplers have been mailed, your participation in the study will be complete.

There are no significant risks associated with involvement in this study. Participation should take about 2-3 hours of your time, in total.

Your records will be kept as confidential as possible. All information collected about your home will be identified by a code. When research results are presented, no information will be included that would reveal your identity or the exact location of your home. Your name and address will be kept in a separate, password-protected file and used only to contact you about the study.

The study is not designed to improve the air quality in your home but we will let you know if we identify any dangerous conditions and we will share the results of the pollutant measurements in your home. Results of the study should benefit society by advancing efforts to improve air quality in California homes.

You may stop participating in this study at any time. If you wish to stop, simply contact Nasim Mullen at (510) 517-2357 or nmullen@lbl.gov. It will be your decision if information collected about your home up to that point is included or excluded from study results. If you decide to stop participating after the samplers have been mailed or delivered to your home, we ask that you return them to us, by either mailing them back or allowing a researcher to come and pick them up. Payment of \$75 will be mailed to you after you complete the study as planned. Payment will be reduced by \$25 for a delay of more than a week in returning the air samplers or completing the exit interview, unless the delay is out of your control.

QUESTIONS

Any further questions you have about taking part in this study can be asked now, or can be directed to Dr. Brett Singer at 510-486-4779 or bcsinger@lbl.gov. Any questions about your rights as a research subject can be directed to the Human Subjects Committee of Lawrence Berkeley National Lab (510-486-5507).

Appendix C: Instructions for sampler deployment

Included with each package mailed to residents were a minimum of three and a maximum of five sets of instructions. Four sets were prepared for each possible location of instrument deployment, which consisted of the bedroom, kitchen, outdoors, and furnace and/or water heater. A fifth set of instructions was prepared to provide the participant with an initial orientation to the package, and is referred to as the master instruction sheet.

Roughly 40% of homes were provided with either duplicate or field blank nitrogen dioxide and formaldehyde air samplers. The duplicate samplers were included with the bedroom materials and the blank samplers were included with the kitchen materials. Thus, two versions of the bedroom and kitchen instructions were prepared; one set for homes that were asked to deploy duplicate or blank samplers and one set for homes that were not. The versions provided in this report include instructions for the duplicate and blank samples.

Instructions for deployment of temperature sensors on the furnace and water heater were provided in a single set. For homes that had only one of these two appliances, the instructions corresponding to the alternate appliances were deleted from the set sent to that home. The version provided in this report includes instructions for sensor deployment on both the water heater and furnace.

Participants were given the option of receiving and returning the package either by Fed-Ex or US Postal Service. The text in the master instruction sheet differed slightly depending on whether the participant preferred to use Fed-Ex or US Postal Service. Specifically, the nearest shipping drop off locations to the home were provided for participants using Fed-Ex, but not for those using the US Postal Service. In addition, the master instruction sheet varied from home-to-home depending on the number of locations that sampling materials would be deployed. The version included in this report would be sent to a participant who chose to use Fed-Ex and who would be deploying sampling materials in all four possible locations.

C.1 Master Instruction Sheet

Hello **[Participants Name]**,

This package contains the air samplers for your home. Inside this package, you will see **2** metal containers, **4** envelopes and **1** prepaid FedEx shipping label. If any of the envelopes or containers shown in the pictures below are missing, please call Nasim Mullen (510-517-2357) as soon as possible.



Air samplers for the *KITCHEN*

Air samplers for *BEDROOM*

Air samplers for *OUTDOORS*

Sensors for *FURNACE* and *WATER HEATER*



Containers for mounting air samplers in your home (Note: Lid of indoor container is for bedroom and base is for kitchen)



Padded manila envelope with prepaid FedEx shipping label

Instructions for setting up the samplers in each location are inside the envelopes. **Please open one envelope at a time and complete the setup before opening the next envelope.** This will help avoid mixing up samplers for different locations.

The instructions for each location ask you to take 2 pictures of the samplers: One picture close up, and one further away that shows where the samplers are in the room. If it is possible to take

these pictures digitally, please send them to Nasim Mullen by email (Nmullen@lbl.gov) or text messaging (510-517-2357).

When you complete the setup at all locations, please put the envelopes, instructions and pre-paid return mailer in a safe place.

The samplers should require no maintenance during the week. Please conduct all of your normal activities.

After 6 days, follow the instructions in each envelope for repacking the samplers. Please put all of the envelopes in the return mailer(s) and send them back as soon as possible. A researcher will call you to see if you have any questions about preparing or mailing the package.

Please text Nasim Mullen at 510-517-2357 or email her at Nmullen@lbl.gov, when the package has been put in a FedEx drop box.

Here are FedEx drop off locations close to your home:

[Enter at least 3 addresses here]

After the samplers have been received in our laboratory and the exit survey has been completed over the phone, we will mail you \$75 as a token of our appreciation.

Thank you for participating in the Healthy Homes Indoor Air Quality Study!

If you have any questions at any time please call Nasim Mullen at 510-517-2357

C.2 Kitchen Instructions with Field Blanks

INSTRUCTIONS: Setting up air quality samplers in your **KITCHEN**

Here is what is included in this package:



Formaldehyde sampler inside airtight bag



Formaldehyde sampler BLANK inside airtight bag



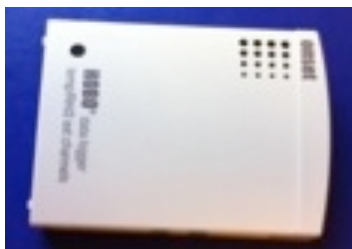
Nitrogen dioxide sampler inside airtight bag



Nitrogen dioxide sampler BLANK inside airtight bag



Carbon monoxide logger



Temperature sensor



Kitchen container

SET-UP INSTRUCTIONS

1. Take the tin labeled “KITCHEN” on one side and “BEDROOM” on the other side. Separate the two pieces from each other. Put the lid (BEDROOM container) aside. Follow the instructions below to set up the KITCHEN container.
2. Find the bag labeled “Formaldehyde (Kitchen)” (blue dot), and cut top along dotted line. Take the formaldehyde sampler out from the bag, and remove the caps from both ends, as shown below. Put caps into the airtight bag for safekeeping.



3. Push the narrow end of the formaldehyde sampler into the metal holder, as shown below.



4. Remove nitrogen dioxide sampler labeled “Kitchen” from its airtight bag (red dot). Push it into the white clip, as shown below.



5. Find the temperature sensor labeled “kitchen” and, using the magnet on the back, attach it to the open space inside the container, as shown below.



6. Put the container in the location selected when you spoke with a researcher on the phone. Specifically: *On the refrigerator, in a location that will be out of your way, and that is not too close to the cooktop and/or oven.*
7. Please take two pictures of the samplers: One picture close up, and one further away showing where the samplers are in the kitchen. If possible, please email pictures to Nasim Mullen (Nmullen@lbl.gov).
8. Below is an example picture of the sampling package on a refrigerator.



9. Keep the nitrogen dioxide *and* formaldehyde BLANKs (yellow dot) inside of their airtight bags. Do not open them.
10. Write the day and time that the samplers were removed from their airtight bags in the space below. It is very important to record the time that you set up the samplers.

DAY or DATE:

TIME:

11. Put the now empty airtight bags and the nitrogen dioxide and formaldehyde BLANKs back inside the manila envelope. Place the envelope inside the prepaid mailer, and place the mailer in a location where you will be able to find it when preparing to mail back the samplers in one week.
12. Carry out your household activities as usual.

PACKING INSTRUCTIONS

1. Collect the container with samplers in the kitchen. Get the manila envelope marked KITCHEN samplers.
2. Remove the temperature sensor and put it in the manila envelope.
3. Remove the formaldehyde sampler from the metal holder. Find the caps inside the airtight bag (blue dot). Replace caps on both ends of each formaldehyde sampler. Caps should be on tightly.
4. Put the now recapped formaldehyde sampler into its airtight bag and close the bag tightly by pinching the seal like a Ziploc bag.
5. Remove the nitrogen dioxide sampler from the white clip. Place it in its airtight bag (red dot). Close the bag tightly by pinching the seal like a Ziploc bag.
6. Write the day and time that the samplers were sealed in their airtight bags in the space below. It is very important to record the time that you packaged the samplers.

DAY or DATE:**TIME:**

7. Open up the nitrogen dioxide **blank** (yellow dot). Pull the sampler out of the bag for about 10 seconds, and then put the sampler back in the bag and close it tightly by pinching the seal like a Ziploc bag.
8. Next, *cut* the bag for the formaldehyde sampler **blank** (yellow dot) *along the dotted line*. Pull formaldehyde sampler **blank** out from the bag and remove both caps. Hold the sampler in open air for about 10 seconds, and then replace the caps. Put the sampler back in the bag and close it tightly by pinching the seal like a Ziploc bag.
9. Place the 4 sealed airtight bags with the samplers into the manila envelope.
10. Put the manila envelope into the return mailer.
11. After you have also repackaged the bedroom air samplers, close the two containers up, so that they become one container. Put the closed container into the return mailer.
12. Put these instructions in the return mailer.

If you have any questions at any time please call Nasim Mullen at 510-517-2357

C.3 Bedroom Instructions with Duplicates

INSTRUCTIONS: Setting up air quality samplers in your ***BEDROOM***

Here is what is included in this package:



2 Formaldehyde samplers
inside airtight bags



2 Nitrogen dioxide samplers
inside airtight bags



Temperature Sensor



Bedroom Container



L-Bracket

SET-UP INSTRUCTIONS

13. Take the tin labeled “KITCHEN” on one side and “BEDROOM” on the other side. Separate the two pieces from each other. Put the bottom (KITCHEN container) aside. Follow the instructions below to set up the BEDROOM container.
14. Find one of the bags labeled “Formaldehyde (Bedroom)” (orange dot), and cut top along dotted line. Take the formaldehyde sampler out of the bag, and remove caps from both ends, as shown below. Put caps into the airtight bag for safekeeping.



15. Push narrow end of the sampler into one of the metal holders, as shown below.



16. Repeat steps 2 and 3 for the second formaldehyde sampler.
17. Remove one of the nitrogen dioxide samplers from its airtight bag (green dot), and push it into the white clip, as shown below.



18. Repeat step 5 for the second nitrogen dioxide sampler.
19. Write the day and time that the samplers were removed from their airtight bags in the space below. It is very important to record the time that you set up the samplers.

DAY or DATE:

TIME:

20. Attach the L-bracket to the magnet on the back of the bedroom container, so that it acts as a stand for the container (see picture below).



21. Find the temperature sensor labeled "Bedroom" and attach it to the back of the bedroom container on the magnet, as shown below.



22. Put the container in the location discussed with a researcher on the phone. Specifically: **In your child's bedroom (or laundry room), on a table or dresser that has not been recently polished or painted or attached to a metallic surface using the magnet.**
23. Please take two pictures of the samplers: One picture close up, and one further away showing where the samplers are located within the room. If possible, email the pictures to Nasim Mullen (Nmullen@lbl.gov)

24. Below is an example of the bedroom sampling package set-up on a flat surface.



25. Put the now empty airtight bags and these instructions inside of the manila envelope. Place the envelope inside the prepaid mailer, and place the mailer in a location where you will be able to find it when preparing to mail back the samplers in one week.

26. Carryout your household activities as usual.

PACKING INSTRUCTIONS

13. Collect the container with samplers from the bedroom. Get the manila envelope marked BEDROOM samplers.
14. Remove the temperature sensor from the bedroom container, and place it into the manila envelope.
15. Remove the formaldehyde samplers from the metal holders. Take the caps out of the airtight bags (orange dot). Replace caps on both ends of each formaldehyde sampler. Caps should be on tightly.
16. Replace the now recapped formaldehyde samplers in their own airtight bag (orange dot) and close the bags tightly by pinching the seal like a Ziploc bag.
17. Remove the nitrogen dioxide samplers from the white clips. Place each of the nitrogen dioxide samplers in their own airtight bags (green dot). Close the bags tightly by pinching the seal like a Ziploc bag.
18. Place the 4 sealed airtight bags with the samplers into the manila envelope labeled BEDROOM samplers.
19. Write the day and time that the samplers were sealed in their airtight bags in the space below. It is very important to record the time that you packaged the samplers.

DAY or DATE:

TIME:

20. Put the manila envelope into the return mailer.
21. Combine the bedroom container with the kitchen container, so they form one closed container. Place the closed container inside of the return mailer.
22. Put these instructions into the return mailer.

If you have any questions at any time please call Nasim Mullen at 510-517-2357

C.4 Outdoor Instructions

INSTRUCTIONS: Setting up air quality samplers **OUTSIDE** your home

Here is what is included in the package:



Container with temperature sensor



Nitrogen dioxide sampler inside airtight bag



Formaldehyde sampler inside airtight bag



2 Releasable Ties
(For hanging container and holding it closed)

SET-UP INSTRUCTIONS:

27. Remove the lid of the outdoor container.
28. Remove the nitrogen dioxide sampler from the airtight bag (purple dot). Push the sampler into the white clip, as shown below.



29. Find the bags labeled "Formaldehyde (Outside)" (pink dot), and cut top along dotted line. Take the formaldehyde sampler out of the bag, and remove caps from both ends, as shown below. Put caps into the airtight bag for safekeeping.



30. Push the narrow uncapped end of the sampler into the metal holder on the side of the container, as shown below.



31. Write the day and time that the samplers were removed from their airtight bags in the space below. It is very important to record the time that you set up the samplers.

DAY or DATE:

TIME:

32. Put the lid back on the outdoor container.

33. Take a releasable tie and tighten it around the width of the container, as shown below. (*If you have trouble clasping the tie, please refer to the instructions on the next page. If you still have trouble, skip this step.*)



34. Put the container outside in a location where it will be secure and ideally has some protection from the elements (e.g. under a covered patio). It will also be ideal if it is not too close to the wall of the home, but it's okay to hang it from a doorknob if that is the best location.
35. Please take two pictures of the outdoor sampler: One picture close up, and one further away showing some of the surroundings. If possible, email the pictures to Nasim Mullen (Nmullen@lbl.gov)
36. There are many different ways that the releasable tie or magnet can be used to set-up the container. Pictures with different examples are shown below.



37. Put the now empty airtight bags and these instructions into the manila envelope. Place the envelope inside the prepaid mailer, and place the mailer in a location where you will be able to find it when repackaging the samplers next week.

Instructions for clasp the releasable tie

1. Thread the narrow end of the tie through the eyehole at the other end, as shown below.



2. Once you have the right sized loop, push a narrow segment of the tie into the notched end of the eyehole, as shown below.



PACKING INSTRUCTIONS

23. Remove the container from its outdoor location and find the return mailer and manila envelope labeled "OUTSIDE".
24. Release the tie from around the outdoor container and remove the lid. If you can't release it by hand, feel free to cut it with scissors.
25. Pull the formaldehyde sampler out of the metal holder. Locate the caps from inside of the airtight bag (pink dot). Replace caps on both ends of each formaldehyde sampler. Caps should be on tightly.
26. Place the now recapped formaldehyde sampler inside of its airtight bag. Close the bag tightly by pinching the seal like a Ziploc bag.
27. Remove the nitrogen dioxide sampler from the white clip, and put it in its original airtight bag (purple dot). Close the bag tightly by pinching the seal like a Ziploc bag.
28. Write the day and time that the samplers were sealed in their airtight bags in the space below. It is very important to record the time that you packaged the samplers.

DAY or DATE:

TIME:

29. Place the sealed airtight bags into the same manila envelope
30. Place the manila envelope into the return mailer.
31. Replace the lid on the outdoor container and put it into the return mailer.
32. Put these instructions into the return mailer.

If you have any questions at any time please call Nasim Mullen at 510-517-2357

C.5 Water Heater and Furnace Instructions

INSTRUCTIONS:
Setting up sensors on the WATER HEATER and FURNACE

Here is what is included in this package:



Temperature logger
(bigger)



Thermocouple
tip



Temperature sensor
(smaller)

SET-UP INSTRUCTIONS

Furnace

- 38. Put this temperature sensor near a vent where warm air is supplied by your furnace, as discussed when you last spoke with a researcher on the phone. Specifically: *Put the sensor on one of the vents where warm air is supplied to the room.*
- 39. Please take two pictures of the temperature sensor: One picture close up, and one further away showing where the heater is located in the room.
- 40. Below are pictures of the temperature sensor placed on different types of furnace supply vents. You can make sure this is a warm air *supply* vent, by turning on the furnace and feeling for warm air.

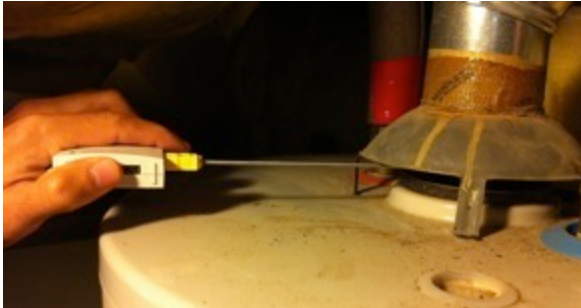


Water Heater

1. Remove the thermocouple from its clear plastic case. **Make sure not to jam the tip of the thermocouple, or it will no longer work**
2. Insert the thermocouple into the logger as shown in the picture below. Make sure that the red and blue dots line up.



3. **The water heater and especially the metal exhaust cone above the water heater may be hot.** Wait for a time when the water heater burner is off to install the temperature logger and thermocouple. The best time is when the hot water has not been used in a while. The burner makes a loud whooshing noise when on. If you hear this noise check again after about 20 minutes.
4. When the water heater burner is *OFF*, hold the logger and position the thermocouple under the water heater exhaust cone, as shown below. **Do not touch the exhaust cone and NEVER put your hand underneath it even when the burner is off.**



5. Once the thermocouple is under the exhaust cone, carefully set the logger on top of the water heater tank. The magnet at the edge should help hold it in place. A picture is shown below for two different water heaters.



6. Put the thermocouple protective case back into the manila envelope, and put the manila envelope in the return mailer. Put the return mailer in a place where you will find it in 1-week.
7. Please take two pictures of the thermocouple and data logger: One picture close up, and one further away showing the full water heater tank.
8. Continue your household activities as usual for 1-week.

PACKING INSTRUCTIONS

1. Carefully rotate the logger on its side to pull the magnet away from the water heater surface, as shown below.



2. Carefully pull the thermocouple away from beneath the exhaust cone.
3. Remove the thermocouple from the temperature logger and put the thermocouple back into the plastic protective case.
4. Place the logger and thermocouple back into the manila envelope that they came in.
5. Remove the temperature sensor from the furnace supply and place it back in the manila envelope with the thermocouple.
6. Put the manila envelope in the return mailer.

Appendix D: Participant Surveys

Each study participant completed three surveys as part of their participation. The first survey was intended for screening purposes, and was completed by individuals interested in participating in the study. This survey was designed to be both brief and broad, and could be completed either online or over the phone. The second survey was administered over the phone prior to data collection at the participant's home, and was intended to collect a broad base of specific information about the home, appliances, and household activities and demographics. This second survey was referred to as the "initial" survey, and required 15-25 minutes to complete. The third survey was administered over the phone at the end of the sampling period, and was intended to collect information about specific activities that occurred in the home during the week of sampling, as well as a few general questions saved for the end to prevent biasing participants (e.g. questions about kitchen exhaust fan use). This third survey is referred to as the "exit" survey, and required 5-10 minutes to complete.

All three surveys were modified between the first and second year of the study. In the case of the screening survey, one question was added asking if the individual intended to make any changes to the home in the coming months that might affect indoor air quality, and another asking how the individual had heard about the study (the latter question was added two months prior to the end of the study). In the case of the initial and exit surveys, questions that were deemed to have minimal usefulness were removed, questions found to be confusing were modified, and one question was added. Specifically, in the initial survey, questions A.13, A.15, H.9, K.1, O.15 were modified, questions A.16, A.18, A.19, A.20, A.22, B.4, B.5, B.6, N1.3, N1.4, O.2 were removed, and question A.22 was added. In the exit survey, question 11 was modified, questions 1, 2, 12, and 16-20 were removed, and question 1x was added. Both versions of the initial and exit surveys are included below, whereas only the modified screening survey is included.

D.1 Screening Survey

California Healthy Homes Indoor Air Quality Study Screening Survey (Telephone script; adapted for web site.)

Upon learning that the call is related to the Exposure Study:

Thank you for calling about our study.

Do you understand that this is a study about indoor air quality in California homes, that in this study we will gather information through air sampling in the homes and by asking questions about the homes, and that once you have completed your participation in the study you will receive \$75 payment? _____ Yes _____ No

If not, note the items mentioned on the announcement and website.

If you are interested in participating, the first step is a quick screening survey. I will ask you a few questions about your home and appliances. The purpose is to confirm your eligibility and to provide the information needed to characterize your home for selection. The information may be used to characterize the groups of people who responded with interest in this study. This will be done anonymously and only in groups; no individuals will be identified. You may stop the screening survey at any time. If you are eligible and interested, I will ask for your contact information at the end of this call. This information will be used only to contact you about this study or about follow-ups to this study. It will not be shared with anyone.

Do you have any questions before we start the screening survey?

Answer any questions.

May we proceed with the screening survey? _____ Yes _____ No → Go to “thank you”.

1. Are you 18 years or older?
_____ Yes _____ No → The study requires involvement of an adult resident of the home. Is there someone available who is 18 or older?
2. Is this home located in California?
_____ Yes _____ No → Not eligible, go to “thank you”.
3. Is smoking prohibited in the home?
_____ Yes _____ No → Not eligible, go to “thank you”.
4. Which fuel is used to power your cooktop?
 - a. Natural gas
 - b. Propane
 - c. Electricity
 - d. Don't know
 - e. Don't have one
5. Which fuel is used to power your oven?
 - a. Natural gas
 - b. Propane
 - c. Electricity

- d. Don't know
e. Don't have one
6. Which fuel is used to power your water heater?
a. Natural Gas
b. Propane
c. Electricity
d. Don't know
e. Don't have one
7. On average, how often do you use your cooktop, including for activities like boiling water?
 Less than once per week
 1 to 3 times per week
 4 to 7 times per week
 More than 7 times per week (meaning, more than once per day)
8. On average, how often do you use your oven?
 Less than once per week
 1 to 3 times per week
 4 to 7 times per week
 More than 7 times per week
9. Is there a range hood or other exhaust fan in your kitchen, and if so, which kind?
 Range hood
 Exhaust fan on ceiling or wall above cooktop
 Exhaust fan in kitchen but not above cooktop
 Downdraft exhaust
 No range hood or exhaust fan
 I don't know
10. If there is an exhaust fan, does it work (is it operational)?
 Yes
 No
 I don't know
11. If you have a range hood, does it blow air outside or back into the kitchen?
 Outside
 Back into the kitchen
 I don't have a range hood
 I don't know
12. How often is a range hood or other kitchen exhaust fan used when cooking occurs on the *cooktop* in your home?
 Always or often used with cooktop
 Used as needed with cooktop
 Rarely or never used with cooktop
 Exhaust fan is broken
 No kitchen exhaust fan
13. How often is a range hood or other kitchen exhaust fan used when the *oven* is used in your home?
 Always or often used with oven

- Used as needed with oven
- Rarely or never used with oven
- Exhaust fan is broken
- No kitchen exhaust fan

14. Where is your water heater located?

- Outside
- Basement or garage under living space
- Side-attached garage
- Closet in main living area
- Laundry room
- Attic
- Other location in the main living area

15. Which of the following types of heaters is used as the main source of heat in your home?

- Gas powered forced-air furnace
- Wall furnace
- Floor furnace
- Cooking oven or stove
- Gas fireplace or room heater
- Wood or pellet stove or fireplace
- Heat pump or electric forced air furnace
- Baseboard electric
- Electric space heater
- Other. Please describe:
- Don't know

16. Where is your main heater located?

- Outside
- Basement or garage under living space
- Side-attached garage
- Closet in main living area
- Laundry room
- Other location in the main living area
- Don't know

17. Do you use any other heaters in addition to your primary heater? Please indicate which of the following are used. These will be referred to as supplemental heaters

- Gas powered forced-air furnace
- Wall furnace
- Floor furnace
- Cooking oven or stove
- Gas fireplace or room heater
- Wood or pellet stove or fireplace
- Heat pump or electric forced air furnace
- Baseboard electric
- Electric space heater
- Other. Please describe:
- No supplemental heater used
- Don't know

18. How often is your *supplemental heater* used in January and February. If you don't know for sure, please feel free to estimate:

- Few times or more each day
 Few times each week but not every day
 Less than a few times each week
 I don't recall

19. [*If gas fireplace is present*] Is your gas fireplace vented or is it "vent-free"?

- Vented
 Vent-free
 Don't know

20. To your knowledge, has the home or building been renovated by a contractor to reduce air leakage. Common air sealing measures include weather-stripping on doors and windows, caulking to seal cracks, addition of insulation, and sealing of heating ducts.

- Yes
 No
 Don't know

If yes, was this done as part of a government Weatherization program?

- Yes
 No
 Don't know

21. Do you plan to make any changes to your home in the next 3 months that might affect your indoor air quality, such as adding an air cleaner or exhaust system to your home? (Homes that answer yes to this question may have the opportunity to participate in 2 weeks of sampling)

- Yes
 No
 Don't know- I am making changes to my home, but I am not sure if the changes will affect the air quality

If yes, will this be done as part of a government program?

- Yes
 No
 Don't know

22. To your knowledge, was your home designed and/or constructed to be any of the following (check all that apply):

- Passive House
 Net-Zero Energy home
 Green certified home
 None of these
 I don't know

The next questions are about the building and about your household. We are asking these questions to help us select a sample of homes that captures the diversity of California.

23. In what kind of building do you live?

- Single, detached house
 Townhouse or Side-by-Side Duplex
 Apartment building with 2-4 units

- Apartment building with 5 or more units
 Mobile home

24. In what year was the building constructed? If you are unsure it is okay to make your best guess and to note that you are “unsure”.

- Before 1980
 Between 1980 and 1994
 Between 1995 and 2005
 2006 or newer
 Unsure
 I have no idea

25. Do you own or rent your home?

- Own
 Rent
 Other

26. How large is the floor area of your home in the units of square feet (sq. ft.)? If you are unsure it is okay to make your best guess or to let me know that you are “unsure”.

- Less than 500
 500 to 1000
 1000 to 1500
 1500 to 2000
 Greater than 2000
 Unsure
 I have no idea

27. How many people live in your home?

- 1-2
 3-4
 5 or more
 I would rather not say

28. What is the combined annual income of all members of your household? If you are unsure, please feel free to make your best guess and also note that you are “unsure”.

- Less than \$30,000
 Between \$30,000 and \$60,000
 More than \$60,000
 Unsure
 I would rather not say

If you are still interested in participating there are just a few last questions to confirm your eligibility.

29. Are you willing to complete two telephone surveys that will take between 10-30 minutes each?

- Yes No → Not eligible, go to “thank you”.

30. If you are selected to participate, how would you like to receive samplers? (Would you prefer to have us send samplers to you in the mail OR visit your home to deliver and pick up the samplers OR are you fine with either option?)

- Only interested in samplers sent by mail
 Only interested if research team visits home to set up sampler

_____ Interested in either approach

31. *(If interested in sampler by mail)*: Are you willing to return to us a small package of monitoring devices that we will send to you in the mail? (If you choose to set-up the samplers yourself, we will provide detailed instructions and will help you by phone.)
 _____ Yes _____ No → Not eligible for this option, go to next question or “thank you”.
32. *(If interested in sampler by mail)*: If air samplers are mailed to your house, they should be set up on Tuesday and repackaged on Monday. Would you have 30 minutes of time on a Monday and Tuesday to do this?
 _____ Yes. I have time on Mondays and Tuesdays.
 _____ No. I would like to participate, but on different days.
 _____ I don’t know
33. *(If interested in researcher visit)*: Is the head of the household willing to have researchers visit the home to set-up and later retrieve the air sampling devices?
 _____ Yes _____ No → Not eligible for this option, go to “thank you”.
34. *(If interested in researcher visit)*: If researchers visit, they will set up samplers on a Tuesday and pick them up on a Monday. Could you be home for 90 minutes from 8:00am to 8:00pm on a Monday and Tuesday for these visits?
 _____ Yes. The researchers can visit my home on a Monday and Tuesday.
 _____ No. I would need the researchers to visit on different days.
 _____ I don’t know.
35. How did you hear about this study? (Answering is optional)

Thank you for calling (visiting our website) and taking the time to respond.

Your home is eligible for participation in this study. If you would like to have your home added to the list of potential study homes please provide your contact info below. Homes from the eligible list will be selected based on geographic location and appliance and household characteristics. We will notify you no later than March 16, 2012, to let you know whether or not you have been selected to participate in this study.

If you are interested in continuing, please provide the following information.

Name: _____

Street address of home: _____

Daytime telephone: _____

Type: home office cell

Evening telephone: _____

Type: home office cell

Preferred email _____

Back-up email (optional): _____

Preferred mode of contact: Telephone Email

D.2 Initial Survey—Year 1

{INITIAL GREETING}

Hello, is *(insert name of resident contact)* home?Hi *(insert name of resident)*, this is *(insert name of researcher)* from Lawrence Berkeley National Lab. Is now a good time to do the 20-30 minute phone interview we had scheduled to do today?

Yes→Great! Then let's begin.

No→Okay... *schedule another time, ideally on the same day, to call back.***A. GENERAL HOME CHARACTERISTICS**

{INTRODUCTION}

I am going to ask you questions about your household, about the physical characteristics of your home, about the appliances in your home, and about how you use appliances, exhaust fans and windows. These questions will help us analyze the measurements we make in your home to better understand the air quality in other homes and households with similar characteristics. You are welcome to say that you don't know or that you decline to answer in response to any of the questions that you are asked.

A.1 Do you rent or own your home? Own Rent

A.2 How many years have you lived in this home? _____

A.3 In what kind of building do you live?

Single, detached house

Townhouse or Side-by-Side Duplex

Apartment building with 2 to 4 units

Apartment building with 5 or more units

Mobile home

Other (Please describe): _____

A.4 In what year was this building constructed? _____

{Record exact year if known or ask about these ranges.}

If you don't know the exact year, was it...

Before 1950

1950 to 1979

1980 to 1995

1996 to 2005

2006 or newer

Don't know

A.5 *If the home is a house, townhouse or side-by-side duplex...*

Not Applicable

A.5.1 How many stories are there in your home?

- 1 story
- 1 ½ story split level
- 2 stories
- 2 ½ story split level
- 3 stories
- more than 3 stories

A.5.2 Does the home have a garage, and if so, where is it located?

- Attached at side with interior door
- Under part of house with interior door
- Under part of house with no interior door
- Garage not attached, or attached at side without interior door
- No garage

A.5.3 *If there is an attached garage...*

Is the garage used regularly for vehicle parking?

Yes No

A.6 *If home is in a building with multiple units...*

Not Applicable

A.6.1 On what story of the building is your home located? _____

A.6.2 How many stories in the building? _____

A.6.3 How many sides of your apartment are on outside walls? _____

A.6.4 Is there a garage in the building? _____

(removed question A.6.4.1)

A.7 What is the floor area of your home, in square feet? If you are unsure, please feel free to estimate and note that you are unsure.

- Exact if known: _____
- Less than 500
- 500 – 750
- 751 – 1000
- 1001 – 1250
- 1251 – 1500
- 1501 – 2000
- 2001 – 2500
- 2501 – 3000
- More than 3000
- Unsure
- No idea

A.8 How many bedrooms are in the home?

- 1 2 3 4 5 >5

A.9 How many bathrooms are in the home? [*Toilet only is ½ bath*]

- 1 1.5 2 2.5 3 >3

A.10 How many bathroom exhaust fans in the home, including those that don't work?

- None present 1 2 3 >3

A.11 Do you have any bathroom fans that don't work well or don't work at all?

- Don't work well. How many? _____
- Don't work at all. How many? _____
- All present work well
- Not applicable; no fans present

A.12 Which *best* describes how the kitchen is connected to other parts of the home?

- The kitchen is very open: At least one side of the kitchen is open to a large area of the home.
- The kitchen is mostly open: There is a large doorway or pass-through open to large areas of the home.
- The kitchen is a separate room with doors that can be closed.

A.12.1 If a separate room, are doors to the kitchen usually kept closed or open?

- Open Closed

A.13 To your knowledge, has the home or building been renovated within the past 5 years to reduce air leakage, for example, is there new caulking or weatherstripping, was their specific air sealing done to the walls, attic, basement or ducts?

- Yes No Don't know

A.13.1 *If yes*, was a contractor involved in the renovations?

- Yes No Don't know

A.13.2 *If yes*, was it done through a government sponsored Weatherization program?

- Yes No Don't know

A.14 Does your home use propane as a fuel for your furnace, hot water heater or another appliance?

- No propane
 All combustion appliances use propane
 Some combustion appliances use propane
 Don't know

A.15 Does your home have air-conditioning?

- Yes No

A.15.1 *If yes*, how often do you use it in the middle of the summer?

- Every day Few times per week Other (explain)

A.16 Do you have a service contract with a heating and air-conditioning company?

- Yes
 No
 I don't know

A.17 Have any of the following changes been made to your home in the last year?

A.17.1 New vinyl flooring: Yes No

A.17.2 New carpet: Yes No

A.17.3 New furniture: Yes No

A.17.4 New cabinets: Yes No

A.17.5 New paint: Yes No

Only ask questions A.18- A.20 for "High Performance" homes (determined from screening survey).

A.18 Have you achieved or pursued any building certifications for your home? If so, which of the following apply?

- LEED for Homes
 Green Point Rated New Home
 Green Point Rated Existing Home
 Certified Green Home - NAHB National Green Building Program
 Environments for Living by MASCO
 Earth Advantage certified home
 EPA Indoor Air Plus
 Living Building Challenge
 Passive House
 EarthCraft
 Energy Star for Homes
 Deep Energy Retrofit
 ACI Thousand Home Challenge
 Other; Please Describe:
 No building certifications achieved or pursued

A.19 Were healthy building material goals incorporated into your home's design and construction, possibly as part of a green home certification?

- Yes No I don't know

A.19.1 If yes, which of the following is the most appropriate designation?

- Living Building Challenge Red List chemical/material avoidance
- EPA Indoor Air Quality Plus certification
- U.S. Green Building Council's LEED or other green building rating system's healthy materials credits
- Tried to avoid VOC's and toxins in paints and other materials
- Not sure

A.20 Was your home tested for air tightness using a blower door test? This may have been done by your contractor, energy auditor, or HVAC technician as part of a green building, Energy Star or Passive House program.

- Yes No I don't know

A.20.1 If yes, do you know the result of the blower door test?

- Yes, it is:
 I do not know the result, but you may contact my contractor/builder for this information at:
 I do not know, and please do not contact my building/contractor.

A.21 Were you given a guide by your builder or contractor describing how to operate your home, including equipment and warranty information?

- Yes No I don't know

B. GENERAL INDOOR AIR QUALITY

The next few questions are about your general indoor air quality and respiratory health.

B.1 How often do you smell cooking or smoking fumes from neighboring homes?

- Never
- Rarely (once per month or less)
- Somewhat often (a few times per month)
- Very often (several times per week or more)

B.2 Is there anything outside of your home that you think might affect your indoor air quality, such as a bus stop, busy road or factory?

- No
- Yes. Please describe: _____

B.3 Does anyone in your household have asthma or another medical condition that affects breathing?

- Yes No

The next few questions address features of your home and actions that you take to manage indoor air quality.

B.4 Which features of your home most contribute to good indoor air quality? List up to five.

B.5 Are there any features of your home that contribute to bad indoor air quality? If so, list up to five.

B.6 What actions do you take to improve or manage indoor air quality in your home? List up to five.

(3 questions removed regarding perceived “stuffiness” in home or presence of lingering odors)

The next two questions ask about dampness and mold in your home environment. Dampness or mold may result from leaks, flooding, or condensation on windows or walls.

B.7 Signs of dampness or moisture may include water stains, peeling paint, or rotten wood. In the past 12 months, have there been any signs of continual or repeated dampness or moisture in your home?

Yes No Don't know

B.7.1 *If yes*, in what parts of your home?

- Main bathroom
- Second bathroom
- Basement or garage
- Bedroom
- Other location: _____
- Decline to state

B.8 In the past 12 months, has anyone SEEN mold or SMELLED moldy or musty odors inside your home? Do not include mold on food [*small amount of mold in shower (such as on tile grout, shower curtain or shower doors) counts as "No"*].

Yes No Don't know

B.8.1 *If yes*, in what parts of your home?

- Main bathroom
- Second bathroom
- Basement or garage
- Bedroom
- Other location: _____
- Decline to state

C. HEATING CHARACTERISTICS

The next set of questions is about how you heat your home.

C.1 Which of the following types of heater is used as the main source of heat in your home? In the questions that follow, this will be referred to as your primary heater.

Heating System	Primary
Forced-air furnace (Blows warm air from several locations) – § D	—
Wall furnace – § E	—
Floor furnace – § F	—
Oven or stove – § G	—
Gas fireplace (gas fireplace does not burn wood) – § H	—
Vent-free blue flame wall heater – § I	—
Portable space heater – § J	—
Heat Pump	—
Baseboard electric	—
Hot water radiator	—
Wood fireplace or wood stove	—
Other. Please describe: _____	—

C.2 Do you use any other heaters in addition to your primary heater? Please indicate which of the following are used, in order of the frequency that they are used. These will be referred to as supplemental heaters.

Heating System	Supplemental
Forced-air furnace (Blows warm air from several locations) – § D	—
Wall furnace – § E	—
Floor furnace – § F	—
Oven or stove – § G	—
Gas fireplace (gas fireplace does not burn wood) – § H	—
Vent-free blue flame wall heater – § I	—
Portable space heater – § J	—
Heat Pump	—
Baseboard electric	—
Hot water radiator	—
Wood fireplace or wood stove	—
Other. Please describe: _____	—

If primary heater was marked with a § for follow-up....

C.1.1 How often is your primary heater used during the middle of winter?
 Every day Few times per week Other (explain)

C.2.1 *If relevant...* how often is your first supplemental heater used during the middle of winter?
 Every day Few times per week Other (explain)

C.2.2 *If relevant...* how often is your second supplemental heater used during the middle of winter?

Every day Few times per week Other (explain)

C.2.3 *If relevant...* how often is your third supplemental heater used during the middle of winter?

Every day Few times per week Other (explain)

D. CENTRAL FORCED AIR FURNACE *(Repeat for each forced air furnace.)*

D.1 Interviewer indicates here if this is primary or supplemental heater:

Primary Supplemental

D.2 Is this furnace powered by natural gas, electricity or propane?

Gas Electricity Propane Don't know

If not sure, provide the following guidance:

If you are not sure, one way to tell is if your gas bill goes up a lot in the winter compared to the summer. If the gas bill goes up a lot, the furnace is probably gas.

[If powered by electricity, skip to next section]

D.3 Where is this furnace located?

- Attic or roof
- Crawl space, basement, or garage under living space
- Side-attached garage
- Closet in main living area
- Don't know

D.4 Approximately how many years old is this furnace? If you are unsure, please feel free to estimate and note that you are unsure.

- 0-5
- 6-10
- 11-15
- 16+
- Unsure
- Don't know

D.5 If you don't know, has it been replaced since you moved in?

Yes No Don't recall

D.6 Has this furnace been checked or serviced by a professional in the past 3 years?

Yes No Not sure about 3; but not during the past ___ years

D.7 How often do you change your furnace filter?

- Every 1-3 months
- Every 3-6 months
- Every 6-12 months
- Less than once a year
- Never
- I don't know

E. WALL FURNACE*Repeat for each wall furnace.***E.1** Interviewer indicates here if this is primary or supplemental heater: Primary Supplemental**E.2** Is this furnace powered by natural gas, electricity or propane? Gas Electricity Propane Don't know**E.3** *If single family home or townhouse with more than one story...*

On which story is this furnace located?

 1st floor 2nd floor 3rd floor Not applicable**E.4** Is this a tall furnace set into the wall or a short, wide furnace that sits next to the wall? Tall – set into wall Short, wide – next to wall**E.5** In which room is the furnace located? _____**E.6** Approximately how many years old is this furnace? If you are unsure, please feel free to estimate and note that you are unsure. 0-5 6-10 11-15 16+ Unsure No idea**E.6.1** If you can't estimate, has it been replaced since you moved in? Yes No Don't recall**E.7** Has this furnace been checked or serviced by a professional in the past 3 years? Yes No Not sure about 3; but not during the past _____ years**E.8** *If wall furnace is gas or propane...*

Does this furnace have a pilot burner? A pilot burner is a small flame that always burns and is used to light the main burner when the furnace turns on.

 Yes No Don't know Not applicable**E.9** Are there now or have there been in the past, any black deposits on the wall just above the furnace? Yes No Don't know**E.10** In the past 3 years, have there been any periods when your furnace has not operated properly? Yes No Not sure**E.10.1** *If yes...briefly describe the problem:* _____.

F. FLOOR FURNACE*Repeat for each floor furnace.***F.1** Interviewer indicates here if this is primary or supplemental heater: Primary Supplemental**F.2** Approximately how many years old is this furnace? If you are unsure, please feel free to estimate and note that you are unsure. 0-5
 6-10
 11-15
 16+
 Unsure
 No idea**F.2.1** If you can't estimate, has it been replaced since you moved in? Yes No Don't recall**F.3** Has this furnace been checked or serviced by a professional in the past 3 years? Yes No Not sure about 3; but not during the past _____ years**F.4** In which room is the furnace located? _____**F.4.1** *[If single family home or townhouse with more than one story]* On which story is this furnace located? 1st floor 2nd floor 3rd floor Not applicable**F.5** In the past 3 years, have there been any periods when your furnace has not operated properly? Yes No Not sure**F.5.1** *If yes...*briefly describe the problem: _____.

G. OVEN AND STOVE USED FOR HEATING

G.1 Interviewer indicates here if this is primary or supplemental heater:
 Primary Supplemental

G.2 Which of your cooking appliances do you use most often for heat?
 Stovetop
 Oven
 Both

G.3 Why do you use your stove and/or oven for heat?
 Other heater broken
 Other heater doesn't provide enough heat
 Just to heat the kitchen
 Other, explain: _____

H. GAS FIREPLACE*Repeat for each gas fireplace.***H.1** Interviewer indicates here if this is primary or supplemental heater: Primary Supplemental**H.2** Is this gas fireplace powered by natural gas or propane? Gas Propane Don't know**H.3** Is this gas fireplace controlled by a thermostat? Yes No**H.4** If you live in a house or townhouse with more than one story, on which story is this gas fireplace located? 1st floor 2nd floor 3rd floor**H.5** In which room is the fireplace located? _____**H.6** Is this gas fireplace set into the wall or does it sit in the room? Inside wall Out in room**H.7** Approximately how many years old is this gas fireplace? If you are unsure, please feel free to estimate and note that you are unsure. 0-5 6-10 11-15 16+ Unsure No idea**H.8** Has this furnace been checked or serviced by a professional in the past 3 years? Yes No Not sure about 3; but not during the past _____ years**H.9** Is this fireplace vented or vent-free? Vent-free Vented**H.10** Did you buy this furnace? If so, do you recall how and where you bought it? Not applicable; did not buy it Internet from retailer Internet from private seller Store outside of California Store inside of California**H.11** In the past 3 years, have there been periods when your furnace has not operated properly? Yes No Not sure**H.11.1** If yes...briefly describe the problem: _____.

I. VENT-FREE BLUE FLAME WALL HEATER

Repeat for each wall heater. (These are uncommon in CA.)

I.1 Interviewer indicates here if this is primary or supplemental heater:

Primary Supplemental

I.2 If you live in a house or townhouse with more than one story, on which story is this gas fireplace located? 1st floor 2nd floor 3rd floor

I.3 In which room is the furnace located? _____

I.4 Approximately how many years old is this wall heater? If you are unsure, please feel free to estimate and note that you are unsure.

0-5

6-10

11-15

16+

Unsure

No idea

I.5 Has this wall heater been checked or serviced by a professional in the past 3 years?

Yes No Not sure about 3; but not during the past _____ years

I.6 Did you buy this furnace? If so, do you recall how and where you bought it?

Not applicable; did not buy it

Internet, from retailer

From private seller outside of California

From private seller inside of California

Store outside of California

Store inside of California

I.7 In the past 3 years, have there been any periods when your furnace has not operated properly?

Yes No Not sure

I.7.1 *If yes...*briefly describe the problem: _____.

J. PORTABLE SPACE HEATER*Repeat for each space heater.***J.1** Interviewer indicates here if this is primary or supplemental heater: Primary Supplemental**J.2** Is this PORTABLE heating appliance powered by natural gas, propane or kerosene?

- Electricity
- Propane
- Kerosene
- Don't know
- Other

J.3 Approximately how many years old is this portable heater? If you are unsure, please feel free to estimate and note that you are unsure.

- 0-5
- 6-10
- 11-15
- 16+
- Unsure
- No idea

J.4 If this is used for supplementary heat, why do you use it?

- Other heater broken
- Other heater doesn't provide enough heat
- Other, explain: _____

J.5 [If heater is propane or kerosene] Did you buy this heater? If so, do you recall how and where you bought it?

- Not applicable; did not buy it
- Internet, from retailer
- From private seller outside of California
- From private seller inside of California
- Store outside of California
- Store inside of California

J.6 In the past 3 years, have there been any periods when your furnace has not operated properly? Yes No Not sure**J.6.1** If yes...briefly describe the problem: _____.

K. WATER HEATER CHARACTERISTICS

K.1 Please note all of the following types of water heaters that you use in your home. A storage water heater is the most common type; it has a large tank that stores heated water. On-demand or “tankless” water heaters heat water as needed.

- Storage water heater
- On-demand water heater that serves much or all of the home → *Skip to §L*
- Solar water heating system (may be combined with storage water heater)
- Other (describe)

K.2 Is this water heater powered by natural gas, electricity or propane?

[If not sure, can ask if there is a large exhaust duct atop the water heater]

- Natural gas
- Propane
- Electric → *Skip to §L*

K.3 Do you have more than one storage water heater?

- Yes No *[If yes, repeat all of the following questions for each.]*

K.4 Does this water heater provide most of the hot water for your home?

- Yes (primary) No (supplemental)

K.5 Where is this water heater located?

- Outside
- Basement or garage under living space
- Side-attached garage
- Closet in main living area
- Laundry room
- Other location in main living area

K.6 Approximately how old is this water heater? If you are unsure, please feel free to estimate and note that you are unsure.

- 0-5
- 6-10
- 11-15
- 16+
- Unsure
- No idea

K.6.1 If you can't estimate, has it been replaced since you moved in? Yes No

K.7 Has this WATER HEATER been checked or serviced by a professional in the past 3 years?

- Yes No Not sure about 3; but not during the past _____ years

K.8 Is this water heater a “power vent” water heater? One way to tell is that a power vent water heater has a noisy fan or blower on top. power vent water heater *not* power vented

L. CLOTHES DRYER CHARACTERISTICS

L.1 Do you have a clothes dryer in your residence?

- Yes No

L.2 If yes, is this dryer powered by natural gas, electricity or propane?

Gas Electricity Propane Don't know

[If dryer is electric, skip to §M]

L.3 Approximately how old is this dryer? If you are unsure, please feel free to estimate and note that you are unsure.

0-5
 6-10
 11-15
 16+
 Unsure
 No idea

L.4 Where is this dryer located?

Basement or garage under living space
 Side-attached garage
 Closet or laundry room in main living area
 Is the door to this room typically open, or does the door have louvered openings?
 Typically open or louvered openings Not open
 Other location in main living area

L.5 Is this dryer vented to the outdoors? In other words, is there an exhaust duct that directs air from the dryer to the outside of the house?

Yes No Don't know

M. KITCHEN APPLIANCE CHARACTERISTICS

The next few questions are about **appliances in your kitchen**. The questions may be easier to answer if you are in the kitchen, looking at the appliances.

M.1 Are your COOKTOP and OVEN part of the same appliance – a cooking range – or separate?

Together Separate

M.2 Is the COOKTOP powered by natural gas, electricity or propane?

Natural Gas Electricity Propane

If the cooktop is natural gas or propane, please ask questions M.2.1-M.2.3 below.

M.2.1 Do the cooktop burners have a pilot light, electronic ignition or light by match? Electronic ignition uses a small spark to light the flame. If the COOKTOP makes a clicking sound when you turn the knob to start the flame, it is electronic ignition.

Electronic Pilot Match light

M.2.2 Are the burners sealed or open? Open burners have openings around the burner, such that food can fall through.

Sealed Open

M.2.3 How many burners are on the cooktop? (Central griddle or grill counts as 1 burner)

1 2 4 5 6

M.3 Approximately how old is the cooktop? If you are unsure, please feel free to estimate and note that you are unsure.

0-5
 6-10
 11-15
 16+
 Unsure
 No idea

M.3.1 If you can't estimate, has it been replaced since you moved in? Yes No

M.4 When cooking, do you more often use the front or back burners, or do you use all the burners equally?

Front burners Back burners Use both equally I don't know

M.5 If separate from the cooktop, is the OVEN powered by natural gas, electricity or propane?

Natural Gas Electricity Propane

If the oven is natural gas or propane, please ask questions M.4.1 and M.4.2 below.

M.5.1 Does the oven burner have a pilot light, electronic ignition or do you light it by match?

Electronic Pilot Match light

M.5.2 Does the oven have a broiler with controls that are separate from the rest of the oven?

Yes No Don't know

M.6 Does the oven have a self-clean setting? Yes No Don't know

M.7 Do you cook using your stove or oven more often in the winter compared to other seasons?
 Yes No

M.8 Do you have any of the following types of KITCHEN EXHAUST fans in the home? Please indicate all that apply.

- Range hood above the cooktop
- Microwave and exhaust fan combination above the cooktop
- Downdraft exhaust at the back of the cooktop
- Downdraft exhaust in the middle of the cooktop
- Exhaust fan in ceiling or wall above cooktop
- Exhasut fan in ceiling or wall not above the cooktop
- Other. Please describe:
- There is no exhaust system in the kitchen

M.9 If you have a range hood or microwave exhaust fan above the cooktop, does it exhaust to the outdoors or does it have grills or holes in the front where it blows air back into the kitchen?

- Exhaust to the outdoors
- Blows air back to the kitchen
- Doesn't work
- Don't know
- No hood

If uncertain, provide this guidance. If you can feel air being blown back out from the device through a grill or set of holes at the top, it probably does not exhaust. If you can see a duct going from the top of the hood up toward the roof or back into the wall, it exhausts. This duct may be inside a cabinet above the range hood.

M.10 How many fan settings does your range hood or microwave have?

- 1 2 3 4 Continuously variable control knob

M.11 How noisy is the lowest fan setting on your range hood?

- Quiet, barely noticeable
- Noticeable but does not interfere with conversation
- Interferes with conversation or radio or TV but can talk over it
- Loud; can't have conversation or hear radio or TV

M.12 How noisy is the highest fan setting on your range hood?

- Quiet, barely noticeable
- Noticeable but does not interfere with conversation
- Interferes with conversation or radio or TV but can talk over it
- Loud; can't have conversation or hear radio or TV

N. OTHER EXHAUST SYSTEMS CHARACTERISTICS

The next few questions are about **OTHER EXHAUST SYSTEMS** in your home.

N.1 To your knowledge, does your home have a ventilation fan that operates continuously or on a set schedule? These devices are most commonly found in very new houses, in homes that have been “air sealed” for energy efficiency and in some apartment buildings.

Yes No I don't know

N.1.1 [If yes], please describe: _____

Can give these options:

- Continuous exhaust fan
- Heat or energy recovery ventilator
- “Fresh Vent” that directs outdoor air into the heating and cooling system

N1.2 [If yes] Have you ever disabled or turned off your ventilation system?

Yes No I don't know

N1.2 [If yes] Why did you disable or turn off the ventilation system?

- Not needed
- Too noisy
- Wastes energy
- Doesn't work well
- Open window instead
- Causes a cold draft in winter
- Other (explain)

N1.3 [If answer to N.1 is “yes”, and home is a “High Performance Home”] Does your home's continuous ventilation system have any of the following?

- Thermostat
- Humidity controller (in the bathroom for example)
- Speed control (for changing from low to high speed for example)
- Motion sensor
- CO₂ sensor
- No controls that I know of
- I don't know

N1.4 [If answer to N.1 is “yes”, and home is a “High Performance Home”] Do you or a service technician perform maintenance on your home's continuous ventilation system?

Yes No I don't know

N1.4.1 [If yes] which of the following do you perform?

- Changing filters
- Cleaning filters
- Replacing heat exchanger elements (the “core”) of the ERV/HRV
- I don't know
- Other. Please describe:

N.2 In the most used full bathroom, how is the exhaust fan used? *Mark all that apply.*

- Fan operates continuously
- Always when showering or bathing
- As needed to remove steam when showering or bathing

- Used by some but not everyone when showering or bathing
- As needed to remove odors
- Not very often or never
- Fan doesn't work
- No fan in this bathroom

N.3 If your main bathroom exhaust fan is not used routinely, why not? Check all that apply.

- Don't think about it
- Not needed
- Too noisy
- Wastes energy
- Broken
- Doesn't work well
- Open window instead
- Other (explain)

O. HOUSEHOLD OCCUPANCY, ACTIVITY, and DEMOGRAPHICS

The next few questions ask about activities that could impact air quality in your home.

O.1 During a typical week, on how many days does anyone in your household use the cooktop or oven for meals or at other times? Please include using the cooktop to boil water.

	All (7)	Most (4-6)	Some (1-3)	Rarely or never (<1)
BREAKFAST	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LUNCH	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DINNER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Any other time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

O.2 How often do you cook with these other appliances inside your home?

	1+ times per day	Few times per week	<1 time per week	Never
Microwave	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Toaster oven	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Toaster	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electric wok	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electric grill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Propane grill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rice Cooker	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electric Crockpot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

O.3 Do you ever cook indoors with charcoal briquettes? Yes No

O.4 Do you ever use a power generator indoors that burns fuel? Yes No

The next few questions ask about window opening in your home.

O.5 How often do you have windows open in your house during this time of year?

- More than half the time
- Several hours per day
- Less than an hour each day
- Usually closed all day

O.6 Which windows are opened most often (indicate all that apply)?

- Bedroom
- Bathroom
- Kitchen
- Common room (living room, entryway, etc.)
- Other

We will end with a few questions about your household. This information will help us relate what we measure in your home to other homes across California.

O.7 How many people live in your home at this time? _____

O.8 How many people in your home are in each age group?

0-5 years: ___ 0 ___ 1 ___ 2 ___ 3 ___ 4 ___ 5

6-17 years: ___ 0 ___ 1 ___ 2 ___ 3 ___ 4 ___ 5

18-30 years: ___ 0 ___ 1 ___ 2 ___ 3 ___ 4 ___ 5

31-64 years: ___ 0 ___ 1 ___ 2 ___ 3 ___ 4 ___ 5

65+ years: ___ 0 ___ 1 ___ 2 ___ 3 ___ 4 ___ 5

O.9 What is the highest education level of anyone in the household?

___ Grade school

___ Some high school

___ Completed high school

___ Some college or trade school

___ Associates degree or trade school completion

___ College degree

___ Graduate degree

O.10 Please indicate all races and/or ethnicities of people living in your household.

___ American Indian, Alaska Native

___ Asian or Pacific Islander

___ Black, African American

___ Hispanic / Latino

___ White, Caucasian

___ Other; please list if you wish: _____.

___ Prefer not to answer

O.11 What is the total income for all members of your household combined?

___ Less than \$25,000

___ \$25,000 - \$49,999

___ \$50,000 - \$74,999

___ \$75,000 - \$99,999

___ \$100,000 - \$150,000

___ >\$150,000

___ Prefer not to answer

[If home is owned by residents]

O.12 If your furnace were to break, and required \$200 worth of repairs, how soon would you be able to afford these repairs?

___ Right away ___ Within a week ___ Within a month ___ Not sure

O.13 If your furnace were to break beyond repair, and cost \$1000 to replace or repair, how soon would you be able to afford to do this?

___ Right away ___ Within a week ___ Within a month ___ Not sure

[If home is rented by residents]

O.14 How reliable is your landlord at making repairs to appliances when needed?

___ HARDLY or NOT reliable:

The landlord is generally unresponsive when we request that an appliance in the home be inspected or repaired.

SOMEWHAT reliable:

The landlord responds eventually to requests to have appliances repaired, but not always right away.

VERY reliable:

The landlord can be counted on to make repairs to appliances in a timely manner when needed.

O.13 *Note the gender of the resident responding to the survey:*

Male Female Unclear from voice

O.14 Is there anything more you would like to say about your house related to this study?

O.15 This study will continue for another year after this one, and we may make some changes to this survey. Are there any changes that you recommend we make to this survey to make the questions easier to understand or to make taking the survey more convenient?

If yes, describe: _____

Thank you very much for your time and help.

D.3 Initial Survey—Year 2

{INITIAL GREETING}

Hello, is *(insert name of resident contact)* home?

Hi *(insert name of resident)*, this is *(insert name of researcher)* from Lawrence Berkeley National Lab. Is now a good time to do the 20-30 minute phone interview we had scheduled to do today?

Yes→Great! Then let's begin.

No→Okay... *schedule another time, ideally on the same day, to call back.*

A. GENERAL HOME CHARACTERISTICS

{INTRODUCTION}

I am going to ask you questions about your household, about the physical characteristics of your home, about the appliances in your home, and about how you use appliances, exhaust fans and windows. These questions will help us analyze the measurements we make in your home to better understand the air quality in other homes and households with similar characteristics. You are welcome to say that you don't know or that you decline to answer in response to any of the questions that you are asked.

A.1 Do you rent or own your home? ___Own ___Rent

A.2 How many years have you lived in this home? _____

A.3 In what kind of building do you live?

- ___ Single, detached house
- ___ Townhouse or Side-by-Side Duplex
- ___ Apartment building with 2 to 4 units
- ___ Apartment building with 5 or more units
- ___ Mobile home
- ___ Other (Please describe): _____

A.4 In what year was this building constructed? _____

{Record exact year if known or ask about these ranges.}

If you don't know the exact year, was it...

- ___ Before 1950
- ___ 1950 to 1979
- ___ 1980 to 1995
- ___ 1996 to 2005
- ___ 2006 or newer
- ___ Don't know

A.5 *If the home is a house, townhouse or side-by-side duplex...* Not Applicable**A.5.1** How many stories are there in your home?

- 1 story
- 1 ½ story split level
- 2 stories
- 2 ½ story split level
- 3 stories
- more than 3 stories

A.5.2 Does the home have a garage, and if so, where is it located?

- Attached at side with interior door
- Under part of house with interior door
- Under part of house with no interior door
- Garage not attached, or attached at side without interior door
- No garage

A.5.3 *If there is an attached garage...*

Is the garage used regularly for vehicle parking?

 Yes No**A.6** *If home is in a building with multiple units...* Not Applicable**A.6.1** On what story of the building is your home located? _____**A.6.2** How many stories in the building? _____**A.6.3** How many sides of your apartment are on outside walls? _____**A.6.4** Is there a garage in the building? _____

A.7 What is the floor area of your home, in square feet? If you are unsure, please feel free to estimate and note that you are unsure.

- Exact if known: _____
- Less than 500
- 500 – 750
- 751 – 1000
- 1001 – 1250
- 1251 – 1500
- 1501 – 2000
- 2001 – 2500
- 2501 – 3000
- More than 3000
- Unsure
- No idea

A.8 How many bedrooms are in the home?

- 1 2 3 4 5 >5

A.9 How many bathrooms are in the home? [*Toilet only is ½ bath*]

- 1 1.5 2 2.5 3 >3

A.10 How many bathroom exhaust fans in the home, including those that don't work?

- None present 1 2 3 >3

A.11 Do you have any bathroom fans that don't work well or don't work at all?

- Don't work well. How many? _____
- Don't work at all. How many? _____
- All present work well
- Not applicable; no fans present

A.12 Which *best* describes how the kitchen is connected to other parts of the home?

- The kitchen is very open: At least one side of the kitchen is open to a large area of the home.
- The kitchen is mostly open: There is a large doorway or pass-through open to large areas of the home.
- The kitchen is a separate room with doors that can be closed.

A.12.1 If a separate room, are doors to the kitchen usually kept closed or open?

- Open Closed

A.13 To your knowledge, has the home or building been renovated within the past 5 years to reduce air leakage? Yes No Don't know

A.13.1 *If yes*, select all that apply:

- Weatherstripping Caulking Windows replaced
- Air sealing to walls, attic or basement Don't know

A.13.2 *If yes*, was a contractor involved in the renovations?

___ Yes ___ No ___ Don't know

A.13.3 *If yes, was it done through a government sponsored Weatherization program?*

___ Yes ___ No ___ Don't know

A.14 Does your home use propane as a fuel for your furnace, hot water heater or another appliance?

- ___ No propane
 ___ All combustion appliances use propane
 ___ Some combustion appliances use propane
 ___ Don't know

A.15 Does your home have central air-conditioning?

___ Yes ___ No

A.15.1 *If yes, how often do you use it in the middle of the summer?*

___ Every day ___ Few times per week ___ Other (explain)

A.17 Have any of the following changes been made to your home in the last year?

A.17.1 New vinyl flooring: Yes No

A.17.2 New carpet: Yes No

A.17.3 New furniture: Yes No

A.17.4 New cabinets: Yes No

A.17.5 New paint: Yes No

A.22 Does your home have one or more installed CO detectors?

- ___ Yes
 ___ No
 ___ I don't know

A.22.1 *If yes, in which room(s) are they located (check all that apply)?*

- ___ Bedroom Bathroom
 ___ Kitchen Laundry room
 ___ Gathering room Other
 ___ Hallway Don't know

B. GENERAL INDOOR AIR QUALITY

The next few questions are about your general indoor air quality and respiratory health.

B.1 How often do you smell cooking or smoking fumes from neighboring homes?

- ___ Never
 ___ Rarely (once per month or less)
 ___ Somewhat often (a few times per month)
 ___ Very often (several times per week or more)

B.2 Is there anything outside of your home that you think might affect your indoor air quality, such as a bus stop, busy road or factory?

___ No

Yes. Please describe: _____

B.3 Does anyone in your household have asthma or another medical condition that affects breathing?

Yes No

The next two questions ask about dampness and mold in your home environment. Dampness or mold may result from leaks, flooding, or condensation on windows or walls.

B.7 Signs of dampness or moisture may include water stains, peeling paint, or rotten wood. In the past 12 months, have there been any signs of continual or repeated dampness or moisture in your home?

Yes No Don't know

B.7.1 *If yes*, in what parts of your home?

Main bathroom

Second bathroom

Basement or garage

Bedroom

Other location: _____

Decline to state

B.8 In the past 12 months, has anyone SEEN mold or SMELLED moldy or musty odors inside your home? Do not include mold on food [*small amount of mold in shower (such as on tile grout, shower curtain or shower doors) counts as "No"*].

Yes No Don't know

B.8.1 *If yes*, in what parts of your home?

Main bathroom

Second bathroom

Basement or garage

Bedroom

Other location: _____

Decline to state

C. HEATING CHARACTERISTICS

C.1 Which of the following types of heater is used as the main source of heat in your home? In the questions that follow, this will be referred to as your primary heater.

Heating System	Primary
Forced-air furnace (Blows warm air from several locations) – § D	—
Wall furnace – § E	—
Floor furnace – § F	—
Oven or stove – § G	—
Gas fireplace (gas fireplace does not burn wood) – § H	—
Vent-free blue flame wall heater – § I	—
Portable space heater – § J	—
Heat Pump	—
Baseboard electric	—
Hot water radiator	—
Wood fireplace or wood stove	—
Other. Please describe: _____	—

C.2 Do you use any other heaters in addition to your primary heater? Please indicate which of the following are used, in order of the frequency that they are used. These will be referred to as supplemental heaters.

Heating System	Supplemental
Forced-air furnace (Blows warm air from several locations) – § D	—
Wall furnace – § E	—
Floor furnace – § F	—
Oven or stove – § G	—
Gas fireplace (gas fireplace does not burn wood) – § H	—
Vent-free blue flame wall heater – § I	—
Portable space heater – § J	—
Heat Pump	—
Baseboard electric	—
Hot water radiator	—
Wood fireplace or wood stove	—
Other. Please describe: _____	—

If primary heater was marked with a § for follow-up....

C.1.1 How often is your primary heater used during the middle of winter?
 Every day Few times per week Other (explain)

C.2.1 *If relevant...* how often is your first supplemental heater used during the middle of winter?
 Every day Few times per week Other (explain)

C.2.2 *If relevant...* how often is your second supplemental heater used during the middle of winter?
 Every day Few times per week Other (explain)

C.2.3 *If relevant...* how often is your third supplemental heater used during the middle of winter?

Every day Few times per week Other (explain)

D. CENTRAL FORCED AIR FURNACE *(Repeat for each forced air furnace.)*

D.1 Interviewer indicates here if this is primary or supplemental heater:

Primary Supplemental

D.2 Is this furnace powered by natural gas, electricity or propane?

Gas Electricity Propane Don't know

If not sure, provide the following guidance:

If you are not sure, one way to tell is if your gas bill goes up a lot in the winter compared to the summer. If the gas bill goes up a lot, the furnace is probably gas.

[If powered by electricity, skip to next section]

D.3 Where is this furnace located?

- Attic or roof
- Crawl space, basement, or garage under living space
- Side-attached garage
- Closet in main living area
- Don't know

D.4 Approximately how many years old is this furnace? If you are unsure, please feel free to estimate and note that you are unsure.

- 0-5
- 6-10
- 11-15
- 16+
- Unsure
- Don't know

D.5 If you don't know, has it been replaced since you moved in?

Yes No Don't recall

D.6 Has this furnace been checked or serviced by a professional in the past 3 years?

Yes No Not sure about 3; but not during the past ___ years

D.7 How often do you change your furnace filter?

- Every 1-3 months
- Every 3-6 months
- Every 6-12 months
- Less than once a year
- Never
- I don't know

E. WALL FURNACE*Repeat for each wall furnace.***E.1** Interviewer indicates here if this is primary or supplemental heater: Primary Supplemental**E.2** Is this furnace powered by natural gas, electricity or propane? Gas Electricity Propane Don't know**E.3** *If single family home or townhouse with more than one story...*

On which story is this furnace located?

 1st floor 2nd floor 3rd floor Not applicable**E.4** Is this a tall furnace set into the wall or a short, wide furnace that sits next to the wall? Tall – set into wall Short, wide – next to wall**E.5** In which room is the furnace located? _____**E.6** Approximately how many years old is this furnace? If you are unsure, please feel free to estimate and note that you are unsure. 0-5
 6-10
 11-15
 16+
 Unsure
 No idea**E.6.1** If you can't estimate, has it been replaced since you moved in? Yes No Don't recall**E.7** Has this furnace been checked or serviced by a professional in the past 3 years? Yes No Not sure about 3; but not during the past _____ years**E.8** *If wall furnace is gas or propane...*

Does this furnace have a pilot burner? A pilot burner is a small flame that always burns and is used to light the main burner when the furnace turns on.

 Yes No Don't know Not applicable**E.9** Are there now or have there been in the past, any black deposits on the wall just above the furnace? Yes No Don't know**E.10** In the past 3 years, have there been any periods when your furnace has not operated properly? Yes No Not sure**E.10.1** *If yes...briefly describe the problem:* _____.

F. FLOOR FURNACE

Repeat for each floor furnace.

F.1 Interviewer indicates here if this is primary or supplemental heater:

Primary Supplemental

F.2 Approximately how many years old is this furnace? If you are unsure, please feel free to estimate and note that you are unsure.

- 0-5
- 6-10
- 11-15
- 16+
- Unsure
- No idea

F.2.1 If you can't estimate, has it been replaced since you moved in?

Yes No Don't recall

F.3 Has this furnace been checked or serviced by a professional in the past 3 years?

Yes No Not sure about 3; but not during the past _____ years

F.4 In which room is the furnace located? _____

F.4.1 *[If single family home or townhouse with more than one story]* On which story is this furnace located? 1st floor 2nd floor 3rd floor Not applicable

F.5 In the past 3 years, have there been any periods when your furnace has not operated properly?

Yes No Not sure

F.5.1 *If yes...briefly describe the problem:* _____.

G. OVEN AND STOVE USED FOR HEATING

G.1 Interviewer indicates here if this is primary or supplemental heater:
 Primary Supplemental

G.2 Which of your cooking appliances do you use most often for heat?
 Stovetop
 Oven
 Both

G.3 Why do you use your stove and/or oven for heat?
 Other heater broken
 Other heater doesn't provide enough heat
 Just to heat the kitchen
 Other, explain: _____

H. GAS FIREPLACE

Repeat for each gas fireplace.

H.1 Interviewer indicates here if this is primary or supplemental heater:
 Primary Supplemental

H.2 Is this gas fireplace powered by natural gas or propane?
 Gas Propane Don't know

H.3 Is this gas fireplace controlled by a thermostat?
 Yes No

H.4 If you live in a house or townhouse with more than one story, on which story is this gas fireplace located? 1st floor 2nd floor 3rd floor

H.5 In which room is the fireplace located? _____

H.6 Is this gas fireplace set into the wall or does it sit in the room?
 Inside wall Out in room

H.7 Approximately how many years old is this gas fireplace? If you are unsure, please feel free to estimate and note that you are unsure.

- 0-5
- 6-10
- 11-15
- 16+
- Unsure
- No idea

H.8 Has this furnace been checked or serviced by a professional in the past 3 years?
 Yes No Not sure about 3; but not during the past _____ years

H.9 Is this fireplace vented or vent-free?

Vent-free Vented I don't know

H.10 Did you buy this furnace? If so, do you recall how and where you bought it?

Not applicable; did not buy it
 Internet from retailer
 Internet from private seller
 Store outside of California
 Store inside of California

H.11 In the past 3 years, have there been periods when your furnace has not operated properly?

Yes No Not sure

H.11.1 *If yes...*briefly describe the problem: _____.

I. VENT-FREE BLUE FLAME WALL HEATER

Repeat for each wall heater. (These are uncommon in CA.)

I.1 Interviewer indicates here if this is primary or supplemental heater:

Primary Supplemental

I.2 If you live in a house or townhouse with more than one story, on which story is this gas fireplace located? 1st floor 2nd floor 3rd floor

I.3 In which room is the furnace located? _____

I.4 Approximately how many years old is this wall heater? If you are unsure, please feel free to estimate and note that you are unsure.

0-5
 6-10
 11-15
 16+
 Unsure
 No idea

I.5 Has this wall heater been checked or serviced by a professional in the past 3 years?

Yes No Not sure about 3; but not during the past _____ years

I.6 Did you buy this furnace? If so, do you recall how and where you bought it?

Not applicable; did not buy it
 Internet, from retailer
 From private seller outside of California
 From private seller inside of California
 Store outside of California
 Store inside of California

I.7 In the past 3 years, have there been any periods when your furnace has not operated properly?

Yes No Not sure

I.7.1 *If yes...*briefly describe the problem: _____.

J. PORTABLE SPACE HEATER*Repeat for each space heater.***J.1** Interviewer indicates here if this is primary or supplemental heater: Primary Supplemental**J.2** Is this PORTABLE heating appliance powered by natural gas, propane or kerosene? Electricity
 Propane
 Kerosene
 Don't know
 Other**J.3** Approximately how many years old is this portable heater? If you are unsure, please feel free to estimate and note that you are unsure. 0-5
 6-10
 11-15
 16+
 Unsure
 No idea**J.4** If this is used for supplementary heat, why do you use it? Other heater broken
 Other heater doesn't provide enough heat
 Other, explain: _____**J.5** [If heater is propane or kerosene] Did you buy this heater? If so, do you recall how and where you bought it? Not applicable; did not buy it
 Internet, from retailer
 From private seller outside of California
 From private seller inside of California
 Store outside of California
 Store inside of California**J.6** In the past 3 years, have there been any periods when your furnace has not operated properly? Yes No Not sure**J.6.1** If yes...briefly describe the problem: _____.**K. WATER HEATER CHARACTERISTICS**

K.1 Please note all of the following types of water heaters that you use in your home. A storage water heater is the most common type; it has a large tank that stores heated water. On-demand or “tankless” water heaters heat water as needed.

- Storage water heater
- On-demand “tankless” water heater that serves much or all of the home → *Skip to §L*
- Solar water heating system (may be combined with storage water heater)
- Other (describe)

K.2 Is this water heater powered by natural gas, electricity or propane?

[If not sure, can ask if there is a large exhaust duct atop the water heater]

- Natural gas
- Propane
- Electric → *Skip to §L*

K.3 Do you have more than one storage water heater?

- Yes No *[If yes, repeat all of the following questions for each.]*

K.4 Does this water heater provide most of the hot water for your home?

- Yes (primary) No (supplemental)

K.5 Where is this water heater located?

- Outside
- Basement or garage under living space
- Side-attached garage
- Closet in main living area
- Laundry room
- Other location in main living area

K.6 Approximately how old is this water heater? If you are unsure, please feel free to estimate and note that you are unsure.

- 0-5
- 6-10
- 11-15
- 16+
- Unsure
- No idea

K.6.1 If you can't estimate, has it been replaced since you moved in? Yes No

K.7 Has this WATER HEATER been checked or serviced by a professional in the past 3 years?

- Yes No Not sure about 3; but not during the past _____ years

K.8 Is this water heater a “power vent” water heater? One way to tell is that a power vent water heater has a noisy fan or blower on top. power vent water heater *not* power vented

L. CLOTHES DRYER CHARACTERISTICS

L.1 Do you have a clothes dryer in your residence?

- Yes No

L.2 If yes, is this dryer powered by natural gas, electricity or propane?

- Gas Electricity Propane Don't know

[If dryer is electric, skip to §M]

L.3 Approximately how old is this dryer? If you are unsure, please feel free to estimate and note that you are unsure.

- 0-5
- 6-10
- 11-15
- 16+
- Unsure
- No idea

L.4 Where is this dryer located?

- Basement or garage under living space
- Side-attached garage
- Closet or laundry room in main living area
 - Is the door to this room typically open, or does the door have louvered openings?
 - Typically open or louvered openings
 - Not open
- Other location in main living area

L.5 Is this dryer vented to the outdoors? In other words, is there an exhaust duct that directs air from the dryer to the outside of the house?

- Yes
- No
- Don't know

M. KITCHEN APPLIANCE CHARACTERISTICS

The next few questions are about appliances in your kitchen. The questions may be easier to answer if you are in the kitchen, looking at the appliances.

M.1 Are your COOKTOP and OVEN part of the same appliance – a cooking range – or separate?

Together Separate

M.2 Is the COOKTOP powered by natural gas, electricity or propane?

Natural Gas Electricity Propane

If the cooktop is natural gas or propane, please ask questions M.2.1-M.2.3 below.

M.2.1 Do the cooktop burners have a pilot light, electronic ignition or light by match? Electronic ignition uses a small spark to light the flame. If the COOKTOP makes a clicking sound when you turn the knob to start the flame, it is electronic ignition.

Electronic Pilot Match light

M.2.2 Are the burners sealed or open? Open burners have openings around the burner, such that food can fall through.

Sealed Open

M.2.3 How many burners are on the cooktop? (Central griddle or grill counts as 1 burner)

1 2 4 5 6

M.3 Approximately how old is the cooktop? If you are unsure, please feel free to estimate and note that you are unsure.

0-5
 6-10
 11-15
 16+
 Unsure
 No idea

M.3.1 If you can't estimate, has it been replaced since you moved in? Yes No

M.4 When cooking, do you more often use the front or back burners, or do you use all the burners equally?

Front burners Back burners Use both equally I don't know

M.5 If separate from the cooktop, is the OVEN powered by natural gas, electricity or propane?

Natural Gas Electricity Propane

If the oven is natural gas or propane, please ask questions M.4.1 and M.4.2 below.

M.5.1 Does the oven burner have a pilot light, electronic ignition or do you light it by match?

Electronic Pilot Match light

M.5.2 Does the oven have a broiler with controls that are separate from the rest of the oven?

Yes No Don't know

M.6 Does the oven have a self-clean setting? Yes No Don't know

M.7 Do you cook using your stove or oven more often in the winter compared to other seasons?

Yes No

M.8 Do you have any of the following types of KITCHEN EXHAUST fans in the home? Please indicate all that apply.

- Range hood above the cooktop
- Microwave and exhaust fan combination above the cooktop
- Downdraft exhaust at the back of the cooktop
- Downdraft exhaust in the middle of the cooktop
- Exhaust fan in ceiling or wall above cooktop
- Exhaust fan in ceiling or wall not above the cooktop
- Other. Please describe:
- There is no exhaust system in the kitchen

M.9 If you have a range hood or microwave exhaust fan above the cooktop, does it exhaust to the outdoors or does it have grills or holes in the front where it blows air back into the kitchen?

- Exhaust to the outdoors
- Blows air back to the kitchen
- Doesn't work
- Don't know
- No hood

If uncertain, provide this guidance. If you can feel air being blown back out from the device through a grill or set of holes at the top, it probably does not exhaust. If you can see a duct going from the top of the hood up toward the roof or back into the wall, it exhausts. This duct may be inside a cabinet above the range hood.

M.10 How many fan settings does your range hood or microwave have?

1 2 3 4 Continuously variable control knob

M.11 How noisy is the lowest fan setting on your range hood?

- Quiet, barely noticeable
- Noticeable but does not interfere with conversation
- Interferes with conversation or radio or TV but can talk over it
- Loud; can't have conversation or hear radio or TV

M.12 How noisy is the highest fan setting on your range hood?

- Quiet, barely noticeable
- Noticeable but does not interfere with conversation
- Interferes with conversation or radio or TV but can talk over it
- Loud; can't have conversation or hear radio or TV

N. OTHER EXHAUST SYSTEMS CHARACTERISTICS

The next few questions are about OTHER EXHAUST SYSTEMS in your home.

N.1 To your knowledge, does your home have a ventilation fan that operates continuously or on a set schedule? These devices are most commonly found in very new houses, in homes that have been “air sealed” for energy efficiency and in some apartment buildings.

Yes No I don't know

N.1.1 *[If yes]*, please describe: _____

Can give these options:

- Continuous exhaust fan
- Heat or energy recovery ventilator
- “Fresh Vent” that directs outdoor air into the heating and cooling system

N1.2 *[If yes]* Have you ever disabled or turned off your ventilation system?

Yes No I don't know

N1.2 *[If yes]* Why did you disable or turn off the ventilation system?

- Not needed
- Too noisy
- Wastes energy
- Doesn't work well
- Open window instead
- Causes a cold draft in winter
- Other (explain)

N.2 In the most used full bathroom, how is the exhaust fan used? *Mark all that apply.*

- Fan operates continuously
- Always when showering or bathing
- As needed to remove steam when showering or bathing
- Used by some but not everyone when showering or bathing
- As needed to remove odors
- Not very often or never
- Fan doesn't work
- No fan in this bathroom

N.3 If your main bathroom exhaust fan is not used routinely, why not? Check all that apply.

- Don't think about it
- Not needed
- Too noisy
- Wastes energy
- Broken
- Doesn't work well
- Open window instead
- Other (explain)

O. HOUSEHOLD OCCUPANCY, ACTIVITY, and DEMOGRAPHICS

The next few questions ask about activities that could impact air quality in your home.

O.1 During a typical week, on how many days does anyone in your household use the cooktop or oven for meals or at other times? Please include using the cooktop to boil water.

	All (7)	Most (4-6)	Some (1-3)	Rarely or never (<1)
BREAKFAST	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LUNCH	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DINNER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Any other time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

O.3 Do you ever cook indoors with charcoal briquettes? Yes No

O.4 Do you ever use a power generator indoors that burns fuel? Yes No

The next few questions ask about window opening in your home.

O.5 How often do you have windows open in your house during this time of year?

- More than half the time
- Several hours per day
- Less than an hour each day
- Usually closed all day

O.6 Which windows are opened most often (indicate all that apply)?

- Bedroom
- Bathroom
- Kitchen
- Common room (living room, entryway, etc.)
- Other

We will end with a few questions about your household. This information will help us relate what we measure in your home to other homes across California.

O.7 How many people live in your home at this time? _____

O.8 How many people in your home are in each age group?

0-5 years:	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
6-17 years:	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
18-30 years:	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
31-64 years:	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
65+ years:	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

O.9 What is the highest education level of anyone in the household?

- Grade school
- Some high school
- Completed high school
- Some college or trade school
- Associates degree or trade school completion
- College degree
- Graduate degree

O.10 Please indicate all races and/or ethnicities of people living in your household.

- American Indian, Alaska Native
- Asian or Pacific Islander
- Black, African American
- Hispanic / Latino
- White, Caucasian
- Other; please list if you wish: _____.
- Prefer not to answer

O.11 What is the total income for all members of your household combined?

- Less than \$25,000
- \$25,000 - \$49,999
- \$50,000 - \$74,999
- \$75,000 - \$99,999
- \$100,000 - \$150,000
- >\$150,000
- Prefer not to answer

[If home is owned by residents]

O.12 If your furnace were to break, and required \$200 worth of repairs, how soon would you be able to afford these repairs?

- Right away Within a week Within a month Not sure

O.13 If your furnace were to break beyond repair, and cost \$1000 to replace or repair, how soon would you be able to afford to do this?

- Right away Within a week Within a month Not sure

[If home is rented by residents]

O.14 How reliable is your landlord at making repairs to appliances when needed?

HARDLY or NOT reliable:

The landlord is generally unresponsive when we request that an appliance in the home be inspected or repaired.

SOMEWHAT reliable:

The landlord responds eventually to requests to have appliances repaired, but not always right away.

VERY reliable:

The landlord can be counted on to make repairs to appliances in a timely manner when needed.

O.15 *Note the gender of the resident responding to the survey:*

Male *Female* *Unclear from voice*

O.16 Is there anything more you would like to say about your house related to this study?

O.15 We may conduct studies like this again in the future. Are there any changes that you recommend we make to this survey to make the questions easier to understand or to make taking the survey more convenient?

If yes, describe: _____

Thank you very much for your time and help.

D.4 Exit Survey—Year 1

1. During the past week (WEEKDAYS), was anyone in the home during the following periods? Please count anyone in the home even if they don't live there. Answer "usually" if 3 or more days; "sometimes" if 1-2 days.

After breakfast and before lunch	<input type="checkbox"/> Usually	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
During lunch	<input type="checkbox"/> Usually	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
After lunch until dinner	<input type="checkbox"/> Usually	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
During dinner	<input type="checkbox"/> Usually	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
After dinner until bedtime	<input type="checkbox"/> Usually	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely

(removed two time categories)

2. During the past WEEKEND, was anyone in the home during the following periods? Please count anyone in the home even if they don't live there.

After breakfast and before lunch	<input type="checkbox"/> Saturday	<input type="checkbox"/> Sunday
During lunch	<input type="checkbox"/> Saturday	<input type="checkbox"/> Sunday
After lunch until dinner	<input type="checkbox"/> Saturday	<input type="checkbox"/> Sunday
During dinner	<input type="checkbox"/> Saturday	<input type="checkbox"/> Sunday
After dinner until bedtime	<input type="checkbox"/> Saturday	<input type="checkbox"/> Sunday

(Changed options from "usually" "sometimes" and "rarely" to "Saturday" and "Sunday."
Also, removed two time categories)

3. During the past week, were any of the following used to heat your home? Check all that apply.

- Central forced-air furnace
- Wall furnace
- Floor furnace
- Gas oven or stove
- Electric oven or stove
- Gas fireplace
- Wood fireplace
- Wood stove
- Heat Pump
- Baseboard electric
- Portable electric space heater
- Portable space heater that burns fuel
- Other. Please describe:

Please can you tell me a bit more about how you used these heating devices?

4. MOST used heater: _____

4.a How often was it used? Every day 4-6 days 1-3 days

4.b When was it used? *Check all that apply.*

Weekday morning Weekday afternoon Weekday evening
 Weekend morning Weekend afternoon Weekend evening
 Overnight

5. SECOND most used heater: _____

5.a How often was it used? Every day 4-6 days 1-3 days

5.b When was it used? *Check all that apply.*

Weekday morning Weekday afternoon Weekday evening
 Weekend morning Weekend afternoon Weekend evening
 Overnight

6. THIRD most used heater: _____

6.a How often was it used? Every day 4-6 days 1-3 day

6.b When was it used? *Check all that apply.*

Weekday morning Weekday afternoon Weekday evening
 Weekend morning Weekend afternoon Weekend evening
 Overnight

The next few questions ask how often you opened your windows over the past week.

7. On how many nights did you leave any windows open OVERNIGHT?

All Most (4-6) Some (1-3) None

7.a Typically how many windows were open? _____

8. On how many days did you open any windows in the MORNING?

All Most (4-6) Some (1-3) None

8.a Typically how many windows were open? _____

9. On how many days did you leave any windows open during the DAY?

All Most (4-6) Some (1-3) None

9.a Typically how many windows were open? _____

10. On how many days did you have any windows open during the EVENING?

All Most (4-6) Some (1-3) None

10.a Typically how many windows were open? _____

(deleted question: "During the past week, what was the weather during the middle of the DAY/Night?")

11. During the past week, on how many days did anyone in the household use the COOKTOP to cook during the following times:

BREAKFAST	<input type="checkbox"/> 7	<input type="checkbox"/> 5-6	<input type="checkbox"/> 3- 4	<input type="checkbox"/> 1-2	<input type="checkbox"/> <1
LUNCH	<input type="checkbox"/> 7	<input type="checkbox"/> 5-6	<input type="checkbox"/> 3- 4	<input type="checkbox"/> 1-2	<input type="checkbox"/> <1
DINNER	<input type="checkbox"/> 7	<input type="checkbox"/> 5-6	<input type="checkbox"/> 3- 4	<input type="checkbox"/> 1-2	<input type="checkbox"/> <1
Any other time	<input type="checkbox"/> 7	<input type="checkbox"/> 5-6	<input type="checkbox"/> 3- 4	<input type="checkbox"/> 1-2	<input type="checkbox"/> <1

12. During the past week, on how many days did anyone in household use the OVEN to cook during the following times:

BREAKFAST	<input type="checkbox"/> 7	<input type="checkbox"/> 5-6	<input type="checkbox"/> 3- 4	<input type="checkbox"/> 1-2	<input type="checkbox"/> <1
LUNCH	<input type="checkbox"/> 7	<input type="checkbox"/> 5-6	<input type="checkbox"/> 3- 4	<input type="checkbox"/> 1-2	<input type="checkbox"/> <1
DINNER	<input type="checkbox"/> 7	<input type="checkbox"/> 5-6	<input type="checkbox"/> 3- 4	<input type="checkbox"/> 1-2	<input type="checkbox"/> <1
Any other time	<input type="checkbox"/> 7	<input type="checkbox"/> 5-6	<input type="checkbox"/> 3- 4	<input type="checkbox"/> 1-2	<input type="checkbox"/> <1

13. Did you use the self-cleaning cycle of your oven during the past week? Yes No
 13.a (If yes) Do you remember when? _____

14. During the past week, how often did any smoking, candle or incense use occur in the home?
 More than 3 times per DAY
 1 to 3 times per DAY
 3 to 6 times over the course of the WEEK
 1 to 2 times over the WEEK
 None

15. How many loads of laundry did you dry in your dryer during the past week?
 >10 6-10 1-5 None

16. Did anyone in your home use the cooktop or oven to cook in the past 24 h? Yes No
 16.1 [If yes] How many times?

17. Please tell me about the FIRST cooking event. Approximately what time did it occur?
 Before 9:00 am
 9:00 am – 11:00 am
 11:00 am – 2:00 pm
 2:00 pm – 5:00 pm
 5:00 pm – 8:00 pm
 After 8:00 pm
 Not applicable

17.a Was the oven used? Yes No

17.b If oven used...What was the oven temperature setting?
 Not used
 <300 °F
 300-400 °F

>400 °F

17.c *If oven used...* How many minutes was the oven used?

<30 30-60 60-90 >90

17.d How many cooktop burners were used?

1 2 3 4

17.e *If relevant...* How many minutes was the first burner used?

<10 10-30 30-60 >60

17.f *If relevant...* How many minutes was the second burner used?

<10 10-30 30-60 >60

17.g *If relevant...* How many minutes was the third burner used?

<10 10-30 30-60 >60

17.h *If relevant...* How many minutes was the fourth burner used?

<10 10-30 30-60 >60

17.i Did you use the exhaust fan during cooking?

For entire time Part of time Not at all

17.j Did you open any windows specifically to remove cooking fumes, smoke or odors?

For entire time Part of time Not at all

18. Please tell me about the SECOND cooking event. Approximately what time did it occur?

- Before 9:00 am
- 9:00 am – 11:00 am
- 11:00 am – 2:00 pm
- 2:00 pm – 5:00 pm
- 5:00 pm – 8:00 pm
- After 8:00 pm
- Not applicable

18.a Was the oven used? Yes No

18.b *If oven used...*What was the oven temperature setting?

- Not used
- <300 °F
- 300-400 °F
- >400 °F

18.c *If oven used...*How many minutes was the oven used?

- <30
- 30-60
- 60-90
- >90

18.d How many cooktop burners were used?

- 1
- 2
- 3
- 4

18.e *If relevant...*How many minutes was the first burner used?

- <10
- 10-30
- 30-60
- >60

18.f *If relevant...*How many minutes was the second burner used?

- <10
- 10-30
- 30-60
- >60

18.g *If relevant...*How many minutes was the third burner used?

- <10
- 10-30
- 30-60
- >60

18.h *If relevant...*How many minutes was the fourth burner used?

- <10
- 10-30
- 30-60
- >60

18.i Did you use the exhaust fan during cooking?

- For entire time
- Part of time
- Not at all

18.j Did you open any windows specifically to remove cooking fumes, smoke or odors?

- For entire time
- Part of time
- Not at all

19. Please tell me about the THIRD cooking event. Approximately what time did it occur?

- Before 9:00 am
- 9:00 am – 11:00 am
- 11:00 am – 2:00 pm
- 2:00 pm – 5:00 pm
- 5:00 pm – 8:00 pm
- After 8:00 pm
- Not applicable

19.a Was the oven used? Yes No

19.b *If oven used...*What was the oven temperature setting?

- Not used
- <300 °F
- 300-400 °F
- >400 °F

19.c *If oven used...*How many minutes was the oven used?

- <30
- 30-60
- 60-90
- >90

19.d How many cooktop burners were used?

- 1
- 2
- 3
- 4

19.e *If relevant...*How many minutes was the first burner used?

- <10
- 10-30
- 30-60
- >60

19.f *If relevant...*How many minutes was the second burner used?

- <10
- 10-30
- 30-60
- >60

19.g *If relevant...*How many minutes was the third burner used?

- <10
- 10-30
- 30-60
- >60

19.h *If relevant...*How many minutes was the fourth burner used?

- <10
- 10-30
- 30-60
- >60

19.i Did you use the exhaust fan during cooking?

- For entire time
- Part of time
- Not at all

19.j Did you open any windows specifically to remove cooking fumes, smoke or odors?

- For entire time
- Part of time
- Not at all

20. Please tell me about the FOURTH cooking event. Approximately what time did it occur?

- Before 9:00 am
- 9:00 am – 11:00 am
- 11:00 am – 2:00 pm
- 2:00 pm – 5:00 pm
- 5:00 pm – 8:00 pm
- After 8:00 pm
- Not applicable

20.a Was the oven used? Yes No

20.b *If oven used...*What was the oven temperature setting?

- Not used
- <300 °F
- 300-400 °F
- >400 °F

20.c *If oven used...*How many minutes was the oven used?

- <30
- 30-60
- 60-90
- >90

20.d How many cooktop burners were used?

- 1
- 2
- 3
- 4

20.e *If relevant...*How many minutes was the first burner used?

- <10
- 10-30
- 30-60
- >60

20.f *If relevant...*How many minutes was the second burner used?

- <10
- 10-30
- 30-60
- >60

20.g *If relevant...*How many minutes was the third burner used?

- <10
- 10-30
- 30-60
- >60

20.h *If relevant...*How many minutes was the fourth burner used?

- <10
- 10-30
- 30-60
- >60

20.i Did you use the exhaust fan during cooking?

- For entire time
- Part of time
- Not at all

20.j Did you open any windows specifically to remove cooking fumes, smoke or odors?

- For entire time
- Part of time
- Not at all

21. If you have a kitchen exhaust fan or range hood, how often is it used?
- Most times (75% or more) when cooktop or oven is used
 - Most times when cooktop is used but not when oven is used
 - About half the time
 - Infrequently; only when needed
 - Never
22. When the range hood is used, which fan speed is most commonly selected?
- Lowest setting
 - Medium setting
 - Highest setting
 - Only one speed available
 - Varies or changes depending on what is being cooked
 - Don't know or prefer not to say
23. If you use your range hood sometimes or only when needed, do you use it for any of the following reasons? Check all that apply.
- Remove smoke
 - Remove heat
 - Remove odors
 - Remove steam / moisture
 - During oven cleaning
 - Other (explain)
24. If your range hood is not used routinely, why not? Check all that apply.
- Don't think about it
 - Not needed
 - Too noisy
 - Wastes energy
 - Broken
 - Doesn't work well
 - Open window instead
 - Other (explain)
25. How often do you clean the grease screens?
- Each week
 - Each month
 - As needed
 - Never
 - No grease screens
26. Does your kitchen exhaust fan have a carbon/charcoal filter?
- Yes No I don't know
- 26.a [If yes] Does this filter need to be periodically replaced?
- Yes No I don't know

Have you ever had any of the following problem with any of the cooktop burners?

27. Burners slow to ignite or won't ignite? Yes No

27.a *If yes, How many burners?* 1 2 3 4 4+

28. Burners can't be turned down from the highest setting? Yes No

28.a *If yes, How many burners?* 1 2 3 4 4+

29. Other. Please describe: _____.

30. *If yes to any of the questions above, How was this issue resolved?*

- Hasn't been resolved
- Was serviced by a professional
- Was serviced by a resident
- Appliance was replaced
- Issue resolved itself

Have you ever had any of the following problem with the oven or broiler burners?

31. Burners slow to ignite or won't ignite? Yes No

32. Thermostat doesn't work properly? Yes No

33. Use is accompanied with a burning smell? Yes No

34. Other. Please describe: _____.

35. *If yes to any of the questions above, How was this issue resolved?*

- Hasn't been resolved
- Was serviced by a professional
- Was serviced by a resident (including cleaning)
- Appliance was replaced
- Issue resolved itself

Please describe the quality of each cooktop flame; check all that apply:

How does the flame look *without* a pot?

36. Left Front: Mostly blue OR Lots of orange; Steady OR Wobbly
 37. Left Rear: Mostly blue OR Lots of orange; Steady OR Wobbly
 38. Right Front: Mostly blue OR Lots of orange; Steady OR Wobbly
 39. Right Rear: Mostly blue OR Lots of orange; Steady OR Wobbly

40. How would you rate the air quality in your home over the past week?

- Very good
 Acceptable
 Barely acceptable
 Not acceptable

41. Over the past week, how often did you smell cigarette smoke from other nearby homes or apartments, or from the hallways?

- Never
 A few days
 Every day
 Don't know [Don't read]

42. Over the past week, how much of the time did you smell other odors (for example, cooking) nearby homes or apartments, or from the hallways?

- Never
 A few times
 Every day
 Don't know [Don't read]

43. Were there any pollution events that occurred outdoors over the last week that may have affected the air quality inside of your home (for example, outdoor fires, fireworks or construction etc.)

- No
 Yes. Please describe:

44. Is there anything more you would like to say about your house related to this study?

45. Do you have any questions? _____

46. This study will continue for another year after this one, and we may make some changes to this survey. Are there any changes that you recommend we make to this survey to make the questions easier to understand or to make taking the survey more convenient?. *If yes, describe:*

Thank you very much for your time and help. After we receive the samplers back in our lab, we will begin processing the \$75 payment. You should receive it within 1 month. If you do not receive it, please get in touch with us.

D.5 Exit Survey—Year 2**EXIT INTERVIEW: QUESTIONS ABOUT WEEK OF SAMPLING**

1x. During the past week, was there any time that no one was at home for more than a 24 hour period?

Yes

No

I don't know

X.1 *If yes, on what day(s):*

Mon. Tues. Wed. Thurs. Fri. Sat. Sun.

3. During the past week, were any of the following used to heat your home? Check all that apply.

Central forced-air furnace

Wall furnace

Floor furnace

Gas oven or stove

Electric oven or stove

Gas fireplace

Wood fireplace

Wood stove

Heat Pump

Baseboard electric

Portable electric space heater

Portable space heater that burns fuel

Other. Please describe:

Please can you tell me a bit more about how you used these heating devices?

(Use codes from initial survey: D- Forced-air furnace, E- Wall furnace, F- Floor furnace, G- Oven or stove, H- Gas fireplace, I- Vent-free gas wall heater, J- Portable space heater, K- Other electric, L- Wood fireplace or wood stove)

4. MOST used heater: _____

4.a How often was it used? Every day 4-6 days 1-3 days

4.b When was it used? *Check all that apply.*

Weekday morning Weekday afternoon Weekday evening

Weekend morning Weekend afternoon Weekend evening

Overnight

5. SECOND most used heater: _____

5.a How often was it used? Every day 4-6 days 1-3 days

5.b When was it used? *Check all that apply.*

Weekday morning Weekday afternoon Weekday evening

Weekend morning Weekend afternoon Weekend evening

Overnight

6. THIRD most used heater: _____

6.a How often was it used? Every day 4-6 days 1-3 day

6.b When was it used? *Check all that apply.*

Weekday morning Weekday afternoon Weekday evening

Weekend morning Weekend afternoon Weekend evening

Overnight

The next few questions ask how often you opened your windows over the past week.

The next few questions ask how often you opened your windows over the past week.

7. On how many nights did you leave any windows open OVERNIGHT?

All Most (4-6) Some (1-3) None

7.a Typically how many windows were open? _____

8. On how many days did you open any windows in the MORNING?

All Most (4-6) Some (1-3) None

8.a Typically how many windows were open? _____

9. On how many days did you leave any windows open during the DAY?

All Most (4-6) Some (1-3) None

9.a Typically how many windows were open? _____

10. On how many days did you have any windows open during the EVENING?

All Most (4-6) Some (1-3) None

10.a Typically how many windows were open? _____

11. During the past week, on how many days did anyone in the household use the COOKTOP or OVEN to cook during the following times:

BREAKFAST	<input type="checkbox"/> 7	<input type="checkbox"/> 5-6	<input type="checkbox"/> 3- 4	<input type="checkbox"/> 1-2	<input type="checkbox"/> <1
LUNCH	<input type="checkbox"/> 7	<input type="checkbox"/> 5-6	<input type="checkbox"/> 3- 4	<input type="checkbox"/> 1-2	<input type="checkbox"/> <1
DINNER	<input type="checkbox"/> 7	<input type="checkbox"/> 5-6	<input type="checkbox"/> 3- 4	<input type="checkbox"/> 1-2	<input type="checkbox"/> <1
Any other time	<input type="checkbox"/> 7	<input type="checkbox"/> 5-6	<input type="checkbox"/> 3- 4	<input type="checkbox"/> 1-2	<input type="checkbox"/> <1

13. Did you use the self-cleaning cycle of your oven during the past week? Yes No

13.a (If yes) Do you remember when? _____

14. During the past week, how often did any smoking, candle or incense use occur in the home?

More than 3 times per DAY

1 to 3 times per DAY

3 to 6 times over the course of the WEEK

1 to 2 times over the WEEK

None

15. How many loads of laundry did you dry in your dryer during the past week?
 >10 6-10 1-5 None
21. If you have a kitchen exhaust fan or range hood, how often is it used?
 Most times (75% or more) when cooktop or oven is used
 Most times when cooktop is used but not when oven is used
 About half the time
 Infrequently; only when needed
 Never
22. When the range hood is used, which fan speed is most commonly selected?
 Lowest setting
 Medium setting
 Highest setting
 Only one speed available
 Varies or changes depending on what is being cooked
 Don't know or prefer not to say
23. If you use your range hood sometimes or only when needed, do you use it for any of the following reasons? Check all that apply.
 Remove smoke
 Remove heat
 Remove odors
 Remove steam / moisture
 During oven cleaning
 Other (explain)
24. If your range hood is not used routinely, why not? Check all that apply.
 Don't think about it
 Not needed
 Too noisy
 Wastes energy
 Broken
 Doesn't work well
 Open window instead
 Other (explain)
25. How often do you clean the grease screens?
 Each week
 Each month
 As needed
 Never
 No grease screens
26. Does your kitchen exhaust fan have a carbon/charcoal filter?
 Yes No I don't know
- 26.a [If yes] Does this filter need to be periodically replaced?
 Yes No I don't know

Have you ever had any of the following problem with any of the cooktop burners?

27. Burners slow to ignite or won't ignite? Yes No
 27.a If yes, How many burners? 1 2 3 4 4+
28. Burners can't be turned down from the highest setting? Yes No
 28.a If yes, How many burners? 1 2 3 4 4+
29. Other. Please describe: _____.
30. If yes to any of the questions above, How was this issue resolved?
 Hasn't been resolved
 Was serviced by a professional
 Was serviced by a resident
 Appliance was replaced
 Issue resolved itself

Have you ever had any of the following problem with the oven or broiler burners?

31. Burners slow to ignite or won't ignite? Yes No
 32. Thermostat doesn't work properly? Yes No
 33. Use is accompanied with a burning smell? Yes No
 34. Other. Please describe: _____.
35. If yes to any of the questions above, How was this issue resolved?
 Hasn't been resolved
 Was serviced by a professional
 Was serviced by a resident (including cleaning)
 Appliance was replaced
 Issue resolved itself

Please describe the quality of each cooktop flame; check all that apply:

How does the flame look *without* a pot?

36. Left Front: Mostly blue OR Lots of orange; Steady OR Wobbly
 37. Left Rear: Mostly blue OR Lots of orange; Steady OR Wobbly
 38. Right Front: Mostly blue OR Lots of orange; Steady OR Wobbly
 39. Right Rear: Mostly blue OR Lots of orange; Steady OR Wobbly

40. How would you rate the air quality in your home over the past week?

- Very good
 Acceptable
 Barely acceptable
 Not acceptable

41. Over the past week, how often did you smell cigarette smoke from other nearby homes or apartments, or from the hallways?

- Never
 A few days
 Every day
 Don't know [Don't read]

42. Over the past week, how much of the time did you smell other odors (for example, cooking) nearby homes or apartments, or from the hallways?

- Never
 A few times
 Every day
 Don't know [Don't read]

43. Were there any pollution events that occurred outdoors over the last week that may have affected the air quality inside of your home (for example, outdoor fires, fireworks or construction etc.)

- No
 Yes. Please describe:

44. Is there anything more you would like to say about your house related to this study?

45. Do you have any questions? _____

46. This study will continue for another year after this one, and we may make some changes to this survey. Are there any changes that you recommend we make to this survey to make the questions easier to understand or to make taking the survey more convenient?. *If yes, describe:*

Thank you very much for your time and help. After we receive the samplers back in our lab, we will begin processing the \$75 payment. You should receive it within 1 month. If you do not receive it, please get in touch with us.

Appendix E. Other Materials

Other materials shared with the participants of the study included a cooking log and final report form. The cooking log was provided with the air sampling materials mailed to the home and was intended to assist the residents with keeping track of when they used the stove and oven during the week of sampling. The cooking log was not provided in the first year of study, because it was thought to be too burdensome for the participants, and instead, participants were asked to estimate the number of times the stove and oven were used during the week at the time of the exit survey. However, a number of participants expressed that it was difficult to remember their cooking activities from the previous six days, and would have preferred being told to keep track of cooking activities at the beginning of the week. Thus, the cooking log was created mid-way through the study, based on this participant feedback.

The final report form was designed to share with participants the concentrations of pollutants measured in their home, and to provide context for these results. No changes were made to the report form after its development in the first year of the study.

E.1 Cooking Log

Fill in a row of the boxes each time you use the **STOVE** or **OVEN**. (Site ID #XXXX)

Example:

TUESDAY

Which burner?	When?	How long?	What was cooked?
<input checked="" type="checkbox"/> Stove <input checked="" type="checkbox"/> Oven	9:00 am	5 min 15 min	Boiled water on stove Rolls in oven
<input checked="" type="checkbox"/> Stove <input type="checkbox"/> Oven	12:00 pm	10 min	Reheated soup
<input checked="" type="checkbox"/> Stove <input type="checkbox"/> Oven	3:40 pm	5 min	Boiled water
<input checked="" type="checkbox"/> Stove <input checked="" type="checkbox"/> Oven	5:00 pm	30 mins 10 mins	Noodles & sauce on stove Garlic bread in oven
<input type="checkbox"/> Stove <input checked="" type="checkbox"/> Oven	9:15 pm	15 mins	Frozen pizza
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			

TUESDAY

Which burner?	When?	How long?	What was cooked?
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			

WEDNESDAY

Which burner?	When?	How long?	What was cooked?
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			

THURSDAY

Which burner?	When?	How long?	What was cooked?
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			

FRIDAY

Which burner?	When?	How long?	What was cooked?
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			

SATURDAY

Which burner?	When?	How long?	What was cooked?
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			

SUNDAY

Which burner?	When?	How long?	What was cooked?
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			
<input type="checkbox"/> Stove <input type="checkbox"/> Oven			

MONDAY

	Which burner?	When?	How long?	What was cooked?
5.	Stove			
6.	Oven			

<input style="width: 100%; height: 15px;" type="checkbox"/> Stove <input style="width: 100%; height: 15px;" type="checkbox"/> Oven				
---	--	--	--	--

<input style="width: 100%; height: 15px;" type="checkbox"/> Stove <input style="width: 100%; height: 15px;" type="checkbox"/> Oven				
---	--	--	--	--

<input style="width: 100%; height: 15px;" type="checkbox"/> Stove <input style="width: 100%; height: 15px;" type="checkbox"/> Oven				
---	--	--	--	--

<input style="width: 100%; height: 15px;" type="checkbox"/> Stove <input style="width: 100%; height: 15px;" type="checkbox"/> Oven				
---	--	--	--	--

<input style="width: 100%; height: 15px;" type="checkbox"/> Stove <input style="width: 100%; height: 15px;" type="checkbox"/> Oven				
---	--	--	--	--

<input style="width: 100%; height: 15px;" type="checkbox"/> Stove <input style="width: 100%; height: 15px;" type="checkbox"/> Oven				
---	--	--	--	--

<input style="width: 100%; height: 15px;" type="checkbox"/> Stove <input style="width: 100%; height: 15px;" type="checkbox"/> Oven				
---	--	--	--	--

<input style="width: 100%; height: 15px;" type="checkbox"/> Stove <input style="width: 100%; height: 15px;" type="checkbox"/> Oven				
---	--	--	--	--

<input style="width: 100%; height: 15px;" type="checkbox"/> Stove <input style="width: 100%; height: 15px;" type="checkbox"/> Oven				
---	--	--	--	--

E.2 Final Report Form

[Date]

Dear [Participant Name]

Thank you again for participating in the Healthy Homes Study. The indoor air quality measurements in your home are provided on the following pages. This first page presents background information intended to help you interpret the results.

The U.S. Environmental Protection Agency (EPA) and the California EPA each set air pollutant standards. The standards are designed to protect the health of the general population including groups of people that may be more sensitive to air pollution.

Standards are set for a concentration – an amount of pollutant in a volume of air – that should not be exceeded over some period of time. In this report, we present air pollutant concentrations, or levels, as parts per million (ppm) or parts per billion (ppb). A level of 100 ppb means that there are 100 molecules of pollutant for every 1 billion molecules of air.

Health problems can result from acute, short-term exposure to very high levels or from chronic, long-term exposure to lower levels of pollutants. Short-term pollutant standards can be for 1 hour, 8 hour, or 24 hour periods. Long-term air pollutant standards are often set for a period of 1 year or longer.

U.S. and California standards are generally similar but are not the same in all cases. This is because there is no specific level that is safe for everyone, and the process of choosing a level to protect public health involves both science and policy considerations.

The background information in this report is intended only as an introduction to air pollutant hazards and standards. Additional information can be obtained via these sites:

U.S. EPA Indoor Environments Division: <http://www.epa.gov/iaq/>

California Air Resources Board: <http://www.arb.ca.gov/research/indoor/indoor.htm>

California Dept. of Public Health: <http://www.cal-iaq.org/>

Listed on the following pages are U.S. and California standards and the concentrations of pollutants that were measured in your home.

Sincerely,

Dr. Brett C. Singer

Dr. Nasim Mullen

The Healthy Homes Project Team

Carbon Monoxide (CO)

Carbon Monoxide (CO) is an odorless, colorless gas that is formed during the burning of fuels including natural gas. When combustion is complete, CO is entirely converted to carbon dioxide. Under many conditions, small amounts of CO may be emitted in the combustion products. CO can be toxic to humans and animals. The U.S. EPA and California EPA each set standards for carbon monoxide levels that should not be exceeded over 1-hour and 8-hour periods.

The device sent to your home recorded a CO reading every minute. From this, we calculated the highest 1-hour and 8-hour average levels in your kitchen. The table below presents the levels in your kitchen and also outdoors in your area during the same time period. The outdoor level was measured and reported by the government agency that is responsible for monitoring air quality in your area.

	Highest 1-hour	Highest 8-hour
U.S. Standard	35 ppm	9 ppm
California Standard	20 ppm	9 ppm
Outdoors in your area		Not reported
CO in your Kitchen		

How to use this information

[Select one of three responses provided at end of this document]

Nitrogen Dioxide (NO₂ – pronounced “N-Oh-2”)

Nitrogen Dioxide (NO₂) is formed during combustion. Outdoors it gives “smog” its characteristic brown tint. It irritates the lungs and respiratory tract. The U.S. EPA and California EPA each set NO₂ standards for 1-hour and annual periods. Our samplers collected NO₂ throughout the time they were set up in your home. We measured the total amount of NO₂ collected to calculate the average level over the sampling period. This measurement should be compared to the annual rather than the 1-hour standard because it is more representative of long-term than of peak conditions. The concentrations in your home over a full year may be lower or higher than the value measured during the study.

The table below presents the levels measured in your home and also outdoors in your area during the same time period. The outdoor level was measured with one of our samplers placed outside in your area over roughly the same period as the sample in your home.

U.S. Annual Standard	53 ppb
California Annual Standard	30 ppb
Outdoors in your area*	
NO₂ in your Kitchen	
NO₂ in your Bedroom	

How to use this information?

If concentrations in your home are much higher than outdoors, there is a major source of NO₂ in your home. The most common source in California homes is a natural gas stove. If you have a gas stove, you should use a kitchen exhaust fan or range hood that exhausts to outdoors every time you use your stove. If you don't have an exhaust fan or range hood, you can open windows when cooking to increase ventilation. Vent-free fireplaces and heaters also emit NO₂ but these are uncommon in California.

Formaldehyde

Formaldehyde is a colorless gas that has a pungent, irritating odor at levels that are much higher than those seen in homes. Most people cannot smell it at levels common in homes. Formaldehyde is emitted from many different materials found in homes. It is also produced during combustion and from some cooking. It can be toxic to humans and animals when encountered in high concentrations. Standards for formaldehyde have a somewhat different form than those for CO and NO₂. The California EPA sets acute and chronic "reference exposure levels" (RELs) as the concentration to which sensitive subgroups can be exposed without noticeable harm. The 8-hour and chronic RELs are both set at 7 ppb.

The table below presents the concentrations measured in your home and also outdoors in your area during the same time period. The outdoor level was measured with one of our samplers placed outside in your area over roughly the same period as your home sample.

California 8-h Reference Exposure Level	7 ppb
California Chronic Reference Exposure Level	7 ppb
Outdoors in your area*	
Formaldehyde in your Kitchen	
Formaldehyde in your Bedroom	

How to use this information?

Unfortunately, it is very common for homes to have formaldehyde concentrations higher than the reference exposure levels noted above. In a recent study of new homes in California, almost all of the homes had formaldehyde concentrations higher than 7 ppb. Usually, the largest source of formaldehyde in homes is emissions from composite wood products. These materials are often built into the home and cannot easily be removed. Cooking burners, cooking of food and chemical reactions involving some air fresheners and cleaning products can add formaldehyde. If you are concerned about the level in your home, one action you can take is to avoid sealing the house without any ventilation for long periods of time and using kitchen exhaust when cooking. Since formaldehyde levels outdoors are usually much lower, daily ventilation can help reduce concentrations indoors.

CO Interpretations:

[Response for homes with few or no CO concentration spikes that would indicate indoor source(s), i.e. no more than one spike above 7 ppm.]

The measured concentrations were low and suggest that there are no regular sources of CO in your home. Still, California law requires that all homes have working carbon monoxide alarms. We recommend that you install an alarm in your home as soon as possible. Having this alarm will ensure that you are alerted if CO levels increase in the future.

[Response for homes with at least one concentration spike above 10 ppm or at least 2 spikes above 7 ppm, and no exceedances of 1-h or 8-h standard levels.]

The measured concentrations were below standards but they suggest that there may be a source of carbon monoxide in your home. California law requires that all homes have working carbon monoxide alarms. We recommend that you install an alarm in your home as soon as possible. Having this alarm will ensure that you are alerted if CO levels increase in the future.

[Response for homes with: 1-h mean \geq 10 ppm]

The measured concentrations were at a level that result only when there is a substantial source of CO in your home. A common source of CO in the home is exhaust from a gas stove, gas oven, or any other gas appliance being used in the home without proper venting. If you have a venting range hood, we recommend that you use it each time you operate any cooking burner. CO can also come from an idling vehicle in an attached garage, smoking, incense, or any other combustion process occurring in the home. California law requires that all homes have working carbon monoxide alarms. We recommend that you install an alarm in your home as soon as possible. . If the concentration exceeded one or more of the air quality standards, we strongly recommend that you contact PG&E at 1-800-PGE-5000 and tell them that you are concerned about a source of CO in your home.

Appendix F: Summary sample characteristics based on survey results

Each study participant provided responses to three surveys. The first survey was primarily used for participant screening and selection. The second (i.e. initial) survey was designed to collect general information regarding home, appliance and household characteristics. The third (i.e. exit) survey was designed to collect information about activities that occurred in the home during the week of sampling. Questions regarding kitchen exhaust use and cooking appliance functionality were saved for the exit survey, so as to not influence resident behavior prior to sampling.

The tables below present a summary of responses to the initial and exit survey questions, and thus, provide a characterization of the study sample. The results include both those homes to which samplers were mailed (323), as well as those that were visited by a researcher (29).

INITIAL SURVEY QUESTIONS

Total sample of 352 includes homes to which samplers were mailed (323) and that were visited by a researcher (29).

Table 1. Rent/Own status of respondent homes (A.1)

Status	Number	Percent
Rent	150	42.6%
Own	202	57.4%
Total	352	100%

Table 2. Respondent years lived at current home (A.2)

Years Lived	Number	Percent
0-4 years ¹	192	54.5%
5-9 years	59	16.8%
10-14 years	43	12.2%
15-19 years	20	5.7%
20-24 years	12	3.4%
25-29 years	9	2.6%
30-34 years	10	2.8%
35-39 years	4	1.1%
40 years +	3	0.9%
Total	352	100%

¹Interval includes half-year period (i.e. 0-4 years includes 4.5 years)

Table 3. Type of building in which the respondent resides (A.3)

Type of Home	Number	Percent
Single, detached house	209	59.4%
Townhouse or side-by-side duplex	32	9.1%
Apartment building, 2-4 units	42	11.9%
Apartment building, 5 or more units	69	19.6%
Mobile home	0	--
Other	0	--
Total	352	100%

Table 4. Year building was built (A.4)

Years Built	Number	Percent
Before 1950	147	41.8%
1950-1979	77	21.9%
1980-1995	33	9.4%
1996-2005	27	7.7%
2006 or newer	35	9.9%
Don't know	33	9.4%
Declined to state/blank	0	--
Total	352	100%

Table 5. Number of stories in residence's house or apartment building (A.5, A.6)

Type of Home Stories	House		Apartment (building with multiple units)			
	Number	Percent	Number	Percent	Floor of apt	Number
1	139	57.7%	14	12.6%	1	37
1.5	12	5.0%	0	--	2	53
2	76	31.5%	62	55.9%	3	13
2.5	2	0.8%	0	--	4	2
3	12	5.0%	25	22.5%	5	0
3.5	0	--	0	--	6	0
4	0	--	5	4.5%	7	1
4.5	0	--	0	--	>7	0
5	0	--	3	2.7%	1-2	3
>5	0	--	2	1.8%	2-3	2
Total	241	100%	111	100%	Total	111

Table 6. Garage location and usage in residence's house (A.5)

Garage Location	Number	Percent	Regularly Used ¹	Percent
Attached at side with interior door	58	24.1%	30/58	51.7%
Under part of house with interior door	47	19.5%	31/47	66.0%
Under part of house with no interior door	16	6.6%	--	--
Garage not attached, or attached at side without interior door	69	28.6%	--	--
No garage	51	21.2%	--	--
Total	241	100%	61/105	58.1%

¹ only if garage is attached to house with interior door

Table 7. Floor area of residence's house or apartment complex (A.7)

Floor area	Number	Percent
Less than 500	14	4.0%
500-750	39	11.1%
751-1000	59	16.8%
1001-1250	49	13.9%
1251-1500	46	13.1%
1501-2000	63	17.9%
2001-2500	30	8.5%
2501-3000	12	3.4%
>3000	16	4.5%
Unsure/Don't know	24	6.8%
Total	352	100%

Table 8. Number of bedrooms in residence's home (A.8)

Bedrooms	Number	Percent
1	73	20.7%
2	88	25.0%
3	116	33.0%
4	63	17.9%
5	8	2.3%
6	2	0.6%
7	2	0.6%
Total	352	100%

Table 9. Number of bathrooms and bathroom fans in residences' homes (A.9, A.10)

Number of bathrooms	Number of bathroom fans						% Homes without bath fans
	0	1	2	3	4+	Total	
1	79	71	0	0	0	150	52.7%
1.5	3	8	6	0	0	17	17.6%
2	28	22	61	1	0	112	25.0%
2.5	2	4	7	15	1	29	6.9%
3	4	2	5	21	0	32	12.5%
4	0	0	0	2	8	10	--
5+	0	1	0	0	1	2	--
Total	116	108	79	39	10	352	33.0%
% with broken fan	--	3.7%	5.1%	0.0%	0.0%	2.3%	

Table 10. Kitchen connection to rest of respondent's residence (A.12)

Kitchen Design	Number	Percent
The kitchen is very open: At least one side of the kitchen is open to a large area of the home	165	46.9%
The kitchen is mostly open: There is a large doorway or pass-through open to large areas of the home	107	30.4%
The kitchen is a separate room with doors that can be closed	70	19.9%
	7	2.0%
Don't know	3	0.9%
Total	352	100%

Table 11. Air Conditioning use in respondent's home (A.15)

AC Use	Number	Percent
No air conditioning	215	61.1%
Everyday	62	17.6%
Few times per week	30	8.5%
Few times per month or summer	15	4.3%
Rarely	15	4.3%
Never	11	3.1%
Don't know	4	1.1%
Total	352	100%

Table 12. Structural and content changes to respondent's home, in the last year (A.17)

Changes	Number (n=323)	Percent
New vinyl floor	14	4.3%
New carpet	42	13.0%
New furniture	76	23.5%
New cabinets	25	7.7%
New paint	99	30.7%

Table 13. Cooking or smoking fumes from neighboring homes smelt by respondent (B.1)

Frequency	Number	Percent
Never	182	56.3%
Rarely (once per month)	68	21.1%
Somewhat often (a few times per month)	46	14.2%
Very often (several times per week or more)	27	8.4%
Total	323	100%

Table 14. Existence of asthmatic or other breathing conditions in household (B.3)

	Number (n=323)	Percent
Household with some medical condition pertaining to breathing	97	30.0%

Table 15. Signs and places of dampness, moisture, and mold in respondent's residence (B.7, B.8)

Places of condition ¹	Dampness and Moisture		Mold	
	Number	Percent	Number	Percent
All rooms	2	0.6%	4	1.2%
Attic/Crawl space	1	0.3%	3	0.9%
Basement	4	1.2%	3	0.9%
Bedroom	16	5.0%	15	4.6%
Closet	0	--	0	--
Family rooms	4	1.2%	3	0.9%
Kitchen/Dining	10	3.1%	8	2.5%
Hallway	2	0.6%	0	--
Laundry room	3	0.9%	0	--
Main bathroom	29	9.0%	33	10.2%
Outside/Porch/Garage	3	0.9%	4	1.2%
Other	5	1.5%	1	0.3%
No signs of such condition	244	75.5%	249	77.1%
Total	323	100%	323	100%

¹Certain homes listed more than one place for dampness and moisture, however; only the main place is taken into consideration in this table

>>Home heating system

*Electrical Radiators, Electrical Radiant systems, Electrical Fireplaces, Hot Water Radiator, Baseboard Electric, Wood Fireplace, and Heat Pump were not included in all heater characteristic analysis. Furnaces powered by electricity were also excluded in characteristic sampling.

**Oven or stove also not included in characteristic analysis due to avoidance of redundant data collection.

Table 16. Primary and Secondary¹ heater type (C.1, C.2)

Type of heater	As Main source		As Secondary source	
	Number	Percent	Number	Percent
Central Furnace	201	62.2%	15	4.6%
Wall furnace	56	17.3%	18	5.6%
Floor furnace	10	3.1%	0	--
Oven or stove	1	0.3%	2	0.6%
Gas fireplace (does not burn wood)	7	2.2%	19	5.9%
Heat pump	3	0.9%	1	0.3%
Portable space heater	30	9.3%	75	23.2%
Baseboard electric	1	0.3%	4	1.2%
Hot water radiator	5	1.5%	2	0.6%
Wood fireplace or wood stove	2	0.6%	20	6.2%
Radiant heat	0	--	1	0.3%
Other electrical furnaces ²	4	1.2%	1	0.3%
Ethanol fireplaces	0	--	0	--
No heater	3	0.9%	165	51.1%
Total	323	100%	323	100%

¹Third heating systems not included in table

²Other Electrical Furnaces include Electrical Fireplaces, Electrical Radiators, and Electrical heat radiated from heat panels on ceiling

Table 17. Primary and secondary heater usage frequency (C.1, C.2)

Usage frequency	Main source		Secondary source	
	Number	Percent	Number	Percent
Every day	221	68.4%	43	13.3%
Few times per week	63	19.5%	51	15.8%
Few times per month or winter	19	5.9%	20	6.2%
Rare	8	2.5%	15	4.6%
Never	4	1.2%	16	4.9%
Don't work	0	--	2	0.6%
Don't know	5	1.5%	11	3.4%
No heater	3	0.9%	165	51.1%
Total	323	100%	323	100%

Table 18. Characteristics of different types of heaters, primary and supplemental heaters**, in respondents' homes – Fuel Type* (D.2, E.2, H.2, J.2)

Fuel	Forced Air ¹		Wall		Radiant		Fireplaces ²		Portable		Total	
	P	S	P	S	P	S	P	S	P	S	P	S
Electric	5	--	6	3	1	--	--	--	32	82	44	85
Gas	203	16	52	15	5	1	10	21	--	--	270	53
Alcohol	--	--	--	--	--	--	--	2	--	--	0	2
Solar	1	--	--	--	1	--	--	--	--	--	2	0
DK	4	1	--	--	--	--	--	2	--	--	3	3
Total	213	17	58	18	7	1	10	23+2	32	82	320	143
Gas %	95	94	90	83	71	100	100	84	--	--	84	37

*Floor furnaces (all gas), Heat Pumps (all Electric), Hot Water Radiator (all gas), Baseboard electrics (all Electric), Oven, and other Electrical furnaces not included in statistics

**Third Heaters not included in statistics (2 Wood Fireplaces, 2 Wall Furnaces, 2 Portable Space Heaters, 2 Gas Fireplaces, and 1 Floor Furnace)

¹Includes Forced Furnaces and Gravity Central

²Includes Ethanol and Gas fueled fireplaces, but not Wood fireplaces

Table 19. Characteristics of different types of heaters in respondents' homes – Age* (D.4, E.6, F.2, H.7, J.3)

Age	Forced Air ¹		Wall		Floor		Radian t		Fireplace ²		Portabl e		Total	
	P	S	P	S	P	S	P	S	P	S	P	S	P	S
0-5 yrs	46	2	7	5	--	--	3	--	4	8+1	20	45	80	61
6-10 yrs	44	2	2	--	--	--	--	--	3	4	4	13	53	19
11-15 yrs	25	1	5	--	--	--	--	--	1	2	2	2	33	5
16+ yrs	40	3	22	5	8	--	--	--	1	3	--	1	71	12
NS/DK	53	9	16	5	2	--	3	1	1	6+1	6	21	81	43
NA*	5	--	6	3	--	--	1	--	--	--	--	--	12	3
Total	213	17	58	18	10	--	7	1	10	23+2	32	82	330	143

*Other than portable space heaters, does not include *Electric* heaters, Hot Water Radiators, Wood Fireplaces, and Oven

¹Includes Forced Furnaces and Gravity Central

²Includes two Ethanol and 23 Gas fueled fireplaces, but not Wood fireplaces

Table 20a. Characteristics of different types of heaters in respondents' homes
– Location* (D.3, E.5, F.4, H.5)

Location	Forced Air ¹		Wall		Floor		Radiant		Fireplaces ²		Total Heater Homes	
	P	S	P	S	P	S	P	S	P	S	P	S
Attic or roof	38	3	--	--	--	--	--	--	--	--	38	3
Basement/ Garage Under	--	--	--	1	--	--	--	--	--	--	0	1
Bathroom	--	--	--	1	--	--	--	--	--	--	0	1
Bedroom	--	--	3	2	--	--	--	--	--	--	3	2
Closet	50	1	--	--	--	--	--	--	--	--	50	1
Crawl Space	64	3	--	--	--	--	--	--	--	--	64	3
Dining room	1	--	2	3	4	--	--	--	--	--	7	3
Family room	--	--	39	7	4	--	--	--	7	14	50	21
Hallway	3	1	6	--	1	--	--	--	--	--	10	1
Kitchen	1	--	--	--	1	--	--	--	--	--	2	0
Outside	6	3	--	--	--	--	--	--	--	--	6	3
Side Garage	10	--	--	--	--	--	--	--	--	--	10	0
DK	24	4	--	1	--	--	--	1	--	5	24	11
NA*	5	--	6	3	--	--	1	--	--	--	12	3
Total	202	15	56	18	10	--	1	1	7	19	276	53

*Not Applicable to *Electric* heaters, and table does not include Hot Water Radiators and Hydronic systems, Wood Fireplaces, and Oven

¹Includes Forced Furnaces and Gravity Central

²Includes only gas fueled fireplaces

Table 20b. Floor Location of certain heaters in single detached houses or townhouses (E.3, F.4.1, H.4)

House Floor	Wall Furnace		Floor		Fireplaces ¹	
	P	S	P	S	P	S
1	19	6	9	--	1	14
2	--	2	--	--	1	0
DK	--	1	--	--	--	3
NA (Electric and/or Apt. complex)	37	9	1	--	5	2
Total	56	18	10	--	7	19

¹Includes only gas fueled fireplaces

Table 21. Characteristics of different types of heaters in respondents' homes
– Maintenance and services* (D.6, E.7, F.3, H.8)

	Forced Air		Wall		Floor		Fireplaces	
	P	S	P	S	P	S	P	S
Has been checked or serviced in the past 3 yrs	83	4	23	6	4	--	1	3
Never in the past 3 yrs	80	5	22	7	5	--	6	9
Don't know/Not sure	34	6	5	2	1	--	--	7
NA	4	--	6	3	--	--	--	--
Total	201	15	56	18	10	--	7	19

Table 22. Forced Air furnace filter change frequency (D.7)

Change Frequency	Main source (n=202)		Secondary source (n=15)	
	Number	Percent	Number	Percent
Every 1- 3 months	32	15.8%	2	13.3%
Every 3 – 6 months	25	12.3%	1	6.7%
Every 6 – 12 months	55	27.2%	2	13.3%
Less than once a year	23	11.4%	1	6.7%
Never	27	13.4%	1	6.7%
Don't know	35	17.3%	4	26.7%
NA	5	2.4%	4	26.7%

Table 22b. Gas Wall furnace features and structure (E.4, E.8, E.9)

Structural features of Gas Wall Furnace	Main source (n=50)		Secondary source (n=15)	
	Number	Percent	Number	Percent
Tall furnace set into the wall	37	74%	7	46.7%
Short, wide furnace that sits next to the wall	13	26%	6	40.0%
DK	--	--	2	13.3%
Has pilot burner	46	92%	10	66.7%
Does not have pilot burner	2	4.0%	1	6.7%
DK	2	4.0%	4	26.7%
There are now or there have been in the past, black deposits on the wall just above	3	6.0%	1	6.7%
There are no black deposits	46	92%	10	66.7%
DK	1	1.9%	4	26.7%

Table 22c. Gas Fireplace features and structure (H.3, H.6, H.9)

Structural features of gas fireplaces	Main source (n=7)		Secondary source (n=17)	
	Number	Percent	Number	Percent
Fireplace set into the wall	3	43%	13	76%
Fireplace sit in the room	4	57%	--	--
DK	--	--	4	23.5%
Controlled using thermostat	5	71%	3	17.6%
Not controlled by thermostat	2	29%	9	53.0%
DK	--	--	5	29.4%
Fireplace is vented	5	71%	13	76.5%
DK	2	29%	4	23.5%

Table 23. Water heaters and their fuel type (K.1, K.2)

	Don't know/ Don't have	Storage (Including Flash)		On- demand	Solar water heating system		Other water heaters		Total Homes with Water Heaters	
	N	N	%	N	N	%	N	%		
Electric	--	13	4.8%	--	2	10.0%	--	--	15	4.3%
Gas	--	255	93.8%	--	14	70.0%	2	100%	271	77.0%
Propane	--	--	--	--	1	5.0%	--	--	1	0.3%
DK	5	4	1.5%	--	3	15.0%	--	--	7	2.0%
Total	29	272	100%	29	20	100%	2	100%	294/352	83.6%

¹Two homes were unable to identify water heater type, and therefore not included in table

Table 24. Location of residences' water heaters* (K.5)

Location	Storage ²		Solar		Total Heater Homes	
	N	%	N	%	N	%
Attic or roof	--	--	4	20.0%	4	1.1%
Basement/ Garage Under	78	28.5%	8	40.0%	86	24.4%
Closet	27	9.9%	1	5.0%	28	8.0%
Laundry room	23	8.4%	1	5.0%	24	6.8%
Hallway	2	0.7%	--	--	2	0.6%
Kitchen	7	2.6%	--	--	7	2.0%
Outside	68	24.8%	3	15.0%	71	20.1%
Side Garage	39	14.2%	1	5.0%	40	11.4%
Other Location in living space	14	5.1%	--	--	14	4.0%
DK	3	1.1%	--	--	3	0.9%
NA ¹	13	4.7%	2	10.0%	15	4.3%
Total	274	100%	20	100%	294/352	83.6%

¹Not Applicable to homes with electric fueled water heaters

² Combined Boiler and Flash heaters together with Storage heater, since all fueled by gas

* Does not include homes without water heaters, homes who do not know of an existence of a water heater in residence or with on demand water heaters

Table 25. Age of residences' water heaters* (K.6)

Age	Storage ²		Solar		N	Total %
	N	%	N	%		
0-5 yrs	63	23.0%	11	55.0%	74	21.0%
6-10 yrs	46	16.8%	3	15.0%	49	13.9%
11-15 yrs	21	7.7%	--	--	21	6.0%
16+ yrs	20	7.3%	1	5.0%	21	6.0%
NS/DK	43	15.7%	--	--	43	12.2%
NA ¹	81	29.6%	5	25.0%	86	24.4%
Total	274	100%	20	100%	294/352	83.5%

¹Not Applicable to homes with electric fueled water heaters or heaters located outside

² Combined Boiler and Flash heaters together with Storage heater, since all fueled by gas

* Does not include homes without water heaters, homes who do not know of an existence of a water heater in residence or with on demand water heaters

Table 26. Number of water heaters in residences' homes (K.3)

	Number	Percent
More than one heater	34	9.7%
Only one heater	239	67.9%
Don't know	6	1.7%
Not Applicable ¹	73	20.7%
Total	352	100%

¹Not Applicable to homes without water heaters, homes who do not know of an existence of a water heater in residence, homes with electric fueled water heaters or homes with on demand water heaters

Table 27. Service checks of residences' water heaters (K.7)

	Number	Percent
Has been checked or serviced in the past 3 years	81	23.0%
Never in the past 3 years	132	37.5%
Don't know/Not sure	66	18.8%
Not Applicable ¹	73	20.7%
Total	352	100%

¹Not Applicable to homes without water heaters, homes who do not know of an existence of a water heater in residence, homes with electric fueled water heaters or homes with on demand water heaters

Table 28. Access to clothes dryer in residence (L.1)

	Number	Percent
Have cloths dryer in residence	241	68.5%
Do not have access to cloths dryer	111	31.5%
Total	352	100%

Table D.29. Clothes dryer fuel types (L.2)

	Number (n=241)	Percent
Electric	79	32.8%
Gas	140	58.1%
Propane	1	0.4%
Don't know	21	8.7%

Table 30. Age of residences' clothes dryer (L.3)

Age	Number	Percent	Percent Applicable (n=162)
0-5 years	68	19.3%	41.8%
6-10 years	47	13.4%	29.0%
11-15 years	21	6.0%	13.0%
16+ years	16	4.5%	10.0%
Don't know	10	2.8%	6.2%
Not applicable ¹	190	54.0%	--
Total	352	100%	100%

¹Homes with electric fueled clothes dryer or with no dryers

Table 31. Location of residences' clothes dryer (L.4)

Location	Number	Percent	% Applicable (n=162)	
Basement or garage under living space	23	6.5%	14.2%	
Bedroom	3	0.9%	1.9%	
Closet or laundry room in main living area	Door open	46	13.1%	28.4%
	Door close	46	13.1%	28.4%
Crawl	1	0.3%	0.6%	
Family room	1	0.3%	0.6%	
Hallway	5	1.4%	3.1%	
Kitchen	8	2.3%	4.9%	
Outside	7	1.4%	3.1%	
Side Garage	19	5.4%	11.7%	
Other Location in main living space	2	1.1%	2.5%	
Don't know	1	0.3%	0.6%	
NA	190	54.0%	--	
Total	352	100%	100%	

Table 32. Ventilation of clothes dryer (L.5)

	Number	Percent
Dryer vented to the outdoors	140	87.3%
Dryer has no exhaust duct that directs air from dryer to the outside	5	4.2%
Don't know	12	8.5%
Total ¹	157	100%

¹Not Applicable to Homes with dryers located outside, homes with Electrical dryers, or homes without dryer in residence

>> **Cooking Appliances**

Table 33. Cooktop and oven characteristic (M.1)

	Number	Percent
Cooktop and oven are of the same appliance	283	80.4%
Cooktop and oven are separate	67	19.0%
Does not have Stove and Oven	2	0.6%
Total	352	100%

Table 34. Cooktop and oven fuel type (M.2, M.5)

Fuel type	Cooktop		Oven	
	Number	Percent	Number	Percent
Electric	64	18.2%	101	28.7%
Gas	285	81.0%	247	70.2%
Propane	1	0.3%	1	0.3%
Don't know	--	--	1	0.3%
NA	2	0.6%	2	0.6%
Total	352	100%	352	100%

Table 35. Cooktop and oven burners light (M.2, M.5)

Burner light method	Cooktop			Oven		
	Number	Percent	Percent Applicable (n=286)	Number	Percent	Percent Applicable (n=249)
Electronic	228	64.8%	79.7%	174	49.4%	69.9%
Match Light	11	3.1%	3.8%	4	1.1%	1.6%
Pilot	46	13.1%	16.1%	55	15.6%	22.1%
Don't know	1	0.3%	0.3%	16	4.5%	6.4%
Not Applicable¹	66	18.8%		103	29.3%	--
Total	352	100%	100%	352	100%	100%

¹Homes without stove or oven, with electric cooktop or oven are excluded

Table 36. Cooktop burner count and habitual usage of front and back burners* (M.2, M.4)

Number of burners	Back burners		Front burners		Both front and back		Total	
3	0	--	1	100.0%	0	--	1	100%
4	15	6.8%	156	70.6%	50	22.6%	221	100%
5	1	1.9%	38	73.1%	13	25.0%	52	100%
6+	0	--	7	58.3%	5	41.7%	12	100%
Total	16	5.6%	202	70.6%	68	23.8%	286	100%

*Homes without stove or oven, with electric cooktop or oven are excluded

Table 37. More Cooktop burner characteristic* (M.2)

	Number	Percent Applicable
Cooktop burner sealed	76	26.6%
Cooktop burner open	203	71.0%
Don't know	7	2.4%
Total	286	100%

*Homes without stove or oven, with electric cooktop or oven are excluded

Table 38. Age of stovetop (M.3)

Age	Number	Percent Applicable
0-5 years	127	36.3%
6-10 years	75	21.4%
11-15 years	46	13.1%
16+ years	62	17.7%
Blank	40	11.4%
Total	350	100%

Table 39. Oven characteristics - self-cleaning setting (M.6)

	Number	Percent Applicable
Oven has self-cleaning setting	166	47.4%
Oven does not have self-clean	152	43.4%
Don't know	32	9.1%
Total	350	100%

Table 40. Oven characteristics – Broiler with separate controls* (M.5)

	Number	Percent
Broiler with separate controls	47	18.9%
Broiler without separate controls	182	73.1%
Don't know	20	8.0%
Total	249	100%

*Homes with electric oven are excluded; unknown Fuel type and propane are included

Table 41. Cooking in winter with oven or stove compared to other seasons (M.7)

	Number	Percent
Residences cook more in winter	126	35.8%
Residences do not cook more in winter	220	62.5%
Don't Know	5	1.4%
Not Applicable	1	0.3%
Total	352	100%

Table 42. Residences' kitchen exhaust system (M.8, M.9)

	Kitchen Exhaust fans	Number	Percent
Range hood above the cooktop	Exhaust out ¹	146	41.5%
	Blows air back	35	9.9%
	DK/Doesn't Work	11	3.1%
Microwave and exhaust fan combination above the cooktop	Exhaust out	32	9.1%
	Blows air back	12	3.4%
	DK/Doesn't Work	5	1.4%
Exhaust fan in the ceiling or wall above cooktop	Exhaust out	14	4.0%
	Blows air back	2	0.6%
	DK/Doesn't Work	7	2.0%
Exhaust fan in ceiling or wall not above cooktop		2	0.6%
Downdraft exhaust at the back of the cooktop		6	1.7%
Downdraft exhaust in the middle of the cooktop		5	1.4%
There is no exhaust system in the kitchen		70	19.9%
There are more than two exhaust fans		2	0.6%
There is a hole in the ceiling above cooktop		3	0.9%
	Total	352	100%

¹Home without Stove and Oven does have an exhaust system, included in this table

Table 43. Weekly cooktop or oven use frequency (number of days per week) (O.1)

Meal	All (7)	Most (4-6)	Some (1-3)	Rare or Never (<1)	NA/DK
Breakfast	104 29.5%	67 19.0%	128 36.4%	53 ¹ 15.1%	--
Lunch	36 10.2%	34 10.0%	171 ¹ 48.6%	111 31.5%	--
Dinner	128 36.4%	169 48.0%	49 13.9%	6 ¹ 1.7%	--
Other	28 8.0%	25 7.1%	111 31.5%	181 ¹ 51.4%	7

¹Home without Stove and Oven uses an Electric Dehydrator; all 352 accounted for in table

Table 44. Frequency of window openings in residences' homes (O.5)

Open times	Number	Percent
More than half the time	78	22.2%
Several hours per day	91	25.9%
Less than an hour each day	61	17.3%
Usually closed all day	121	34.4%
Don't know	1	0.3%
Total	352	100%

Table 45. Number of total residents in household (O.7)

Number of residents	Number of households	Percent
1	63	17.9%
2	117	33.2%
3	67	19.0%
4	59	16.8%
5	30	8.5%
6	8	2.3%
7	5	1.4%
8	1	0.3%
9	1	0.3%
Prefer not to say	1	0.3%
Total	352	100%

Table 44. Number of residents in households by age (O.8)

Number residents	0-5 yrs		6-17 yrs		18-30 yrs		31-64 yrs		65+ yrs	
1	25	16.1%	21	13.6%	25	16.1%	38	24.5%	18	11.6%
2	2	1.3%	6	3.9%	13	8.4%	83	53.6%	6	3.9%
3	1	0.7%	2	1.3%	5	3.2%	7	4.5%	0	--
4	2	1.3%	3	1.9%	5	3.2%	1	0.7%	3	1.9%
5	0	--	0	--	2	1.4%	0	--	0	--
6	0	--	0	--	1	0.7%	0	--	0	--
7	0	--	0	--	0	--	0	--	0	--
Total	155	100%	155	100%	155	100%	155	100%	155	100%

Table 45. Highest education level in household (O.9)

Education Level	Number	Percent
Secondary School	11	3.1%
Some College	33	9.4%
Associate Degree	16	4.5%
College Degree	103	29.3%
Graduate Degree	188	53.4%
Prefer not to say	1	0.3%
Total	352	100%

Table 46. Races and/or ethnicity of people living in respondent's household (O.10)

Ethnicity	Number	Percent of all homes
All White	162	46.0%
All Asian	40	11.4%
All Black	25	7.1%
All Hispanic/Latino	18	5.1%
All American Indian, Alaskan Native	2	0.6%
Multi-ethnicity Household	94	26.7%
White, Caucasian	245	69.6%
Asian/Pacific Islander	82	23.3%
Black, African American	45	12.8%
Hispanic/Latino	38	10.8%
American Indian, Alaskan Native	8	2.3%
Prefer not to answer	11	3.1%

Table 47. Income for all members of respondent's household (O.11)

Income	Number	Percent
Less than \$25,000	50	14.2%
\$25,000 - \$49,999	51	14.5%
\$50,000 - \$74,999	55	15.6%
\$75,000 - \$99,999	39	11.1%
\$100,000 - \$150,000	72	20.5%
>\$150,000	43	12.2%
Prefer not to answer	42	11.9%
Total	352	100%

Table 48. Earliest time to afford repairs for broken furnace – Owned homes (O.12, O.13)

Earliest possible time	If \$200 required for repair		If \$1000 required for repair	
	Number	% Applicable	Number	% Applicable
Right away	173	85.6	143	70.8
Within a week	6	3.0	13	6.4
Within a month	11	5.4	23	11.4
Not sure	12	5.9	23	11.4
Total	202	100%	202	100%
Not Applicable	150		150	

Table 49. Landlord reliability at making repairs to appliances when needed – Rented homes (O.14)

Landlord reliability	Number	% Applicable
Hardly or not reliable	14	9.3%
Somewhat reliable	58	38.7%
Very reliable	71	47.3%
Don't Know/No Landlord	7	4.7%
Total	150	100%
Not Applicable	202	

Table 50. Gender for respondents to Healthy Homes project initial questionnaire (O.15)

	Number	Percent
Female	224	63.6%
Male	113	32.1%
Left Blank	15	4.3%

EXIT SURVEY QUESTIONS
(Total 352 subjects)

Table 51. Residence weekday occupancy during different periods of day (Q1) – Y1 data only

	Usually		Sometimes		Rarely		No Response/ Don't Know		Total	
	N	%	N	%	N	%	N	%	N	%
After breakfast/ before lunch	78	50.3%	40	25.8%	32	20.6%	5	3.2%	155	100%
During lunch	67	43.2%	46	29.7%	36	23.2%	6	3.9%	155	100%
After lunch/ until dinner	62	40.0%	48	31.0%	40	25.8%	5	3.2%	155	100%
During dinner	128	82.6%	20	12.9%	4	2.6%	3	1.9%	155	100%
After dinner/ until bedtime	139	89.7%	11	7.1%	2	1.3%	3	1.9%	155	100%

Table 52. Residence weekend occupancy (Q2) – Y1 data only

	Neither		Saturday		Sunday		Both		No / Don't know		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
After breakfast/ before lunch	12	7.7%	2	14.2%	12	7.7%	10	68.4%	3	1.9%	15	100%
During lunch	18	11.6%	1	10.3%	20	12.9%	96	61.9%	5	3.2%	15	100%
After lunch/ until dinner	26	16.8%	2	13.5%	14	9.0%	89	57.4%	5	3.2%	15	100%
During dinner	15	9.7%	1	7.1%	22	14.2%	10	67.1%	3	1.9%	15	100%
After dinner/ until bedtime	9	5.8%	7	4.5%	18	11.6%	11	76.1%	3	1.9%	15	100%

Table 53. Residence sampling week no occupancy beyond 24 hours (QX) – Y2 data only

	Number	Percent
Yes, during the week of sampling there was a period of 24 hours or more when no one was at home	13	6.6%
No, during the week of sampling there was not a period of 24 hours or more when no one was at home	183	92.9%
Don't know	1	0.5%
Total	197	100%

Table 54. Heaters used during week of sampling (Q3, Q4, Q5)

Heaters	Most used heater			Second heater used		
	Number	Percent	Percent of n=278	Number	Percent	Percent of n=33
Central/Forced-air	172	48.9%	61.9%	3	0.9%	9.1%
Wall furnace	46	13.1%	16.5%	5	1.4%	15.2%
Floor furnace	7	2.0%	2.5%	0	--	--
Gas oven or stove	1	0.3%	0.4%	1	0.3%	3.0%
Gas fireplace	5	1.4%	1.8%	2	0.6%	6.1%
Wood/Ethanol fireplace	2	0.6%	0.7%	7	2.0%	21.2%
Heat pump	6	1.7%	2.2%	0	--	--
Portable space heaters	26	7.4%	9.4%	13	3.7%	39.4%
Other electrical heaters	2	0.6%	0.7%	1	0.3%	3.0%
Hot water radiators	5	1.4%	1.8%	0	--	--
Radiant heating	6	1.7%	2.2%	1	0.3%	3.0%
Did not use heater/No heater	74	21.0%	--	319	90.6%	--
Total	352	100%	100%	352	100%	100%

Table 55. Heater frequency of use during week of sampling (Q4, Q5)

Days	Most used heater			Second heater used		
	Number	Percent	Percent of n=278	Number	Percent	Percent of n=33
Every day	160	45.5%	57.6%	11	3.1%	33.3%
4-6 days	55	15.6%	19.8%	7	2.0%	21.2%
1-3 days	58	16.5%	20.9%	12	3.4%	36.4%
Don't know	5	1.4%	1.8%	3	0.9%	9.1%
Not Applicable	74	21.0%	--	319	90.6%	--
Total	352	100%	100%	352	100%	100%

Table 56. Most used heater period of usage on weekdays and weekends (Q4)

	Weekday Usage			Weekend Usage		
	Number	Percent	Percent of n=278	Number	Percent	Percent of n=278
Used for one period of day	92	26.1%	33.1%	79	22.4%	28.4%
Used for two periods of day	136	38.6%	48.9%	121	34.4%	43.5%
Used for Morning, Afternoon, and Evening	28	8.0%	10.1%	34	9.7%	12.2%
Not used	9	2.6%	3.2%	31	9.1%	11.5%
Don't know	13	3.7%	4.7%	13	3.4%	4.3%
Used during Mornings	95	27.0%	34.2%	81	23.0%	29.1%
Used during Afternoon	20	5.7%	7.2%	24	6.8%	8.6%
Used during Evenings	119	33.8%	42.8%	108	30.7%	38.8%
Not Applicable	74	21.0%	--	74	21.0%	--

Table 56b. Second used heater period of usage on weekdays and weekends (Q5)

	Weekday Usage			Weekend Usage		
	Number	Percent	Percent of n=33	Number	Percent	Percent of n=33
Used for one period of day	18	5.1%	54.5%	11	3.1%	33.3%
Used for two periods of day	5	1.4%	15.2%	7	2.0%	21.2%
Used for Morning, Afternoon, and Evening	1	0.3%	3.0%	1	0.3%	3.0%
Not used during weekday	5	1.4%	15.2%	10	2.8%	30.3%
Don't know	4	1.1%	12.1%	4	1.1%	12.1%
Used during Mornings	4	1.1%	12.1%	4	1.1%	12.1%
Used during Afternoon	1	0.3%	3.0%	2	0.6%	6.1%
Used during Evenings	11	3.1%	33.3%	10	2.8%	30.3%
Not Applicable	319	90.6%	--	319	90.6%	--

Table 56c. Heater usage overnight during week of sampling (Q4, Q5)

	Most used heater			Second heater used		
	Number	Percent	Percent of n=278	Number	Percent	Percent of n=33
Overnight usage	123	34.9%	44.2%	6	1.7%	18.2%
No overnight usage	139	39.5%	50.0%	23	6.5%	69.7%
Don't know	16	4.5%	5.8%	4	1.1%	12.1%
Not Applicable	74	21.0%	--	319	90.6%	--
Total	352	100%	100%	352	100%	100%

Table 57. Windows open during week of sampling (Q7 – Q10)

<i>Number of days</i>	Overnight		Morning		Day		Evening	
	N	%	N	%	N	%	N	%
7 days	45	12.8%	67	19.0%	74	21.0%	44	12.5%
4-6 days	15	4.3%	20	5.7%	35	9.9%	26	7.4%
1-3 days	18	5.1%	48	13.6%	132	37.5%	136	38.6%
None	269	76.4%	211	59.9%	107	30.4%	241	68.5%
Don't know	5	1.4%	6	1.7%	4	1.1%	5	1.4%
Total	352	100%	352	100%	352	100%	352	100%

<i>Number of Windows Open</i>	N		%		N		%	
	N	%	N	%	N	%	N	%
1	44	12.5%	54	15.3%	83	23.6%	45	12.8%
2	27	7.7%	41	11.6%	79	22.4%	35	9.9%
3	3	0.9%	22	6.3%	44	12.5%	17	4.8%
4	2	0.6%	9	2.6%	19	5.4%	4	1.1%
5+	2	0.6%	8	2.3%	14	4.0%	5	1.4%
Don't know/ Wasn't open	274	77.8%	218	61.9%	113	32.1%	246	69.9%

Table 58a. Cooktop usage at different periods of day during week of sampling (Q11) – Y1 data only

Meals	7 days		5-6 days		3-4 days		1-2 days		<1	Total ¹
	N	%	N	%	N	%	N	%		
Breakfast	45	29.6%	2	13.2%	2	18.4%	3	20.4%	28	18.4%
Lunch	6	3.9%	7	4.6%	2	17.1%	4	28.9%	69	45.4%
Dinner	46	30.3%	4	30.3%	3	25.7%	1	10.5%	5	3.3%
Any other time	12	7.9%	5	3.3%	1	12.5%	2	15.1%	93	61.2%

¹Three homes indicated that they do not know what their cooking schedule was during week of sampling

Table 58b. Oven usage at different periods of day during week of sampling (Q12) – Y1 data only

Meals	7 days		5-6 days		3-4 days		1-2 days		<1	Total ¹
	N	%	N	%	N	%	N	%		
Breakfast	2	1.3%	1	0.7%	0	0.0%	8	5.3%	141	92.8%
Lunch	0	0.0%	0	0.0%	0	0.0%	9	5.9%	143	94.1%
Dinner	3	2.0%	8	5.3%	2	16.4%	5	34.9%	63	41.4%
Any other time	0	0.0%	0	0.0%	0	0.0%	1	12.5%	133	87.5%

¹Three homes indicated that they do not know what their cooking schedule was during week of sampling

Table 58c. Cooktop/Oven usage at different periods of day during week of sampling (Q11) – Y1 and Y2 data

Meals	7 days		5-6 days		3-4 days		1-2 days		<1		Total ¹
	N	%	N	%	N	%	N	%	N	%	
Breakfast	95	27.5%	4	12.8%	69	20.0%	69	20.0%	68	19.7%	345
Lunch	21	6.1%	1	2.9%	59	17.1%	11	32.8%	142	41.2%	345
Dinner	76	22.0%	8	25.8%	10	31.6%	55	15.9%	16	4.6%	345
Any other time	17	4.9%	7	2.0%	37	10.7%	65	18.8%	219	63.5%	345

¹Seven homes indicated that they do not know what their cooking schedule was during week of sampling

Table 59. Use of Oven's self-clean cycle during week of sampling (Q13)

	Number	Percent	Percent of n=198
Yes, the self-clean cycle was used	4	1.1%	2.0%
No, the self-clean cycle was not used	193	54.8%	97.5%
Don't know	1	0.3%	0.5%
No Oven/No self-clean function	154	43.8%	--
Total	352	100%	100%

Table 60. Frequency of candle or incense use during week of sampling (Q14)

Frequency of use	Number	Percent
More than 3 times per day	2	0.6%
1-3 times per day	11	3.1%
3-6 times over the course of the week	18	5.1%
1-2 times over the week	65	18.5%
None	248	70.5%
Don't know	8	2.3%
Total	352	100%

Table 51. Loads of laundry dried during week of sampling (Q15)

	Number	Percent	Percent of n=241
>10 loads	7	2.0%	2.9%
6-10 loads	41	11.6%	17.0%
1-5 loads	154	43.8%	63.9%
None	35	9.9%	14.5%
Don't know	4	1.1%	1.7%
No dryer in residence	111	31.5%	--
Total	352	100%	100%

Table 52. Usage frequency of kitchen exhaust fan or range hood (Q21)

Frequency	Number	Percent	Percent of n=279
Most times (75% or more) when cooktop or oven is used	44	12.5%	15.8%
Most times when cooktop is used but not when oven is used	39	11.1%	14.0%
About half the time	45	12.8%	16.1%
Infrequently; only when needed	113	32.1%	40.5%
Never	35	9.9%	12.5%
Don't know	3	0.9%	1.1%
No exhaust system	73	20.7%	--
Total	352	100%	100%

Table 53. Most common kitchen exhaust fan speed used during week of sampling (Q22)

Settings	Number	Percent	Percent of n=241
Lowest setting	57	16.2%	23.7%
Medium setting	29	8.2%	12.0%
Highest setting	75	21.3%	31.1%
Only one speed available	44	12.5%	18.3%
Varies or changes depending on what is being cooked	31	8.8%	12.9%
Don't recall	5	1.4%	2.1%
No exhaust system or did not use exhaust fan	111	31.5%	--
Total	352	100%	100%

Table 54. Reasons for using exhaust system regularly (Q23)

Reasons	Number	Percent of n=241 who used their exhaust fans
Remove smoke	111	46.1%
Remove heat	11	4.6%
Remove odors	75	31.1%
Remove steam/moisture	38	15.8%
During oven cleaning	1	0.4%
Other reasons	4	1.7%
Did not specify	80	33.2%

*Subjects were able to choose more than one answer

Table 55. Reasons that exhaust system is not used regularly (Q24)

Reasons	Number	Percent of n=193 who used their exhaust fans half the time or less
Don't think about it	31	16.1%
Not needed	92	47.7%
Too noisy	40	20.7%
Wastes energy	3	1.6%
Broken	1	0.5%
Doesn't work well	18	9.3%
Open window instead	17	8.8%
Other reasons (e.g. automatic fan)	7	3.6%
Did not specify or don't know	23	11.9%

*Subjects were able to choose more than one answer

Table 56. Frequency of cleaning grease screens of fans or range hood (Q25)

Frequency	Number	Percent
Each week	4	1.4%
Each month	13	4.7%
As needed	110	39.4%
Never (never clean or never use exhaust fan therefore do not need to clean)	104	37.3%
No grease screens	15	5.4%
Did not specify	33	11.8%
Total	279	100%

Table 57. Existence and use of carbon/charcoal filter in kitchen (Q26)

		Number	Percent
Have carbon/charcoal filter	Need to be periodically replaced	3	1.1%
	Does not need to be periodically replaced	1	0.4%
	Don't know	3	1.1%
Does not have carbon/charcoal filter		266	95.3%
Don't know		6	2.2%
Total		279	100%

Table 58. Problems with cooktop burners (Q27, Q28, Q29)

Problem	Yes	No	Percent homes with stove burner problems	Total
Slow to ignite or won't ignite	104	246	29.7%	350
Can't turn down from the highest setting	7	343	2.0%	350
Other problems ¹	13	337	3.7%	350

¹The other problems are provided uniquely by each of the 13 homes, which include burning smell, burner not turning off, lighting by match or lighter, and continuous clicking problem after ignition of burner

Table 59. Problems with oven burners (Q31, Q32, Q33)

Problem	Yes	No	Percent homes with oven burner problems	Total
Burners slow to ignite or won't ignite	20	330	5.7%	350
Thermostat does not work properly	10	340	2.9%	350
Use is accompanied by burning smell	8	342	2.3%	350
Other problems	17	333	4.9%	350

¹The other problems are provided uniquely by each of the 17 homes, which include ovens that don't heat up or don't work, ovens with control panel malfunctioning, elevated CO levels, food spills and gas leakage

Table 60. Manner in which burner ignition problems were resolved (Q30, Q35)

	Cooktop		Oven	
	Number	Percent	Number	Percent
Hasn't been resolved	60	54.1%	20	47.6%
Was serviced by a professional	9	8.1%	8	19.0%
Was serviced by a resident	13	11.7%	4	9.5%
Issue resolved itself	21	18.9%	5	11.9%
Don't know	8	7.2%	5	11.9%
Total Homes with problems	111	100%	42	100%

Table 61. Flame appearance without pot on top* (Q36, Q37, Q38, Q39)

	Mostly blue		Lots of orange		Don't know		Total
	Number	Percent	Number	Percent	Number	Percent	
Left Front	252	88.1%	9	3.1%	25	8.7%	286
Left Rear	252	88.1%	8	2.8%	26	9.1%	286
Right Front	251	87.8%	9	3.1%	26	9.1%	286
Right Rear	252	88.1%	9	3.1%	25	8.7%	286

*Applicable to only non-electrical cooking appliances, n=286

Table 62. Flame appearance with pot on top* (Q36, Q37, Q38, Q39)

	Steady		Wobbly		Blank/No response		Total
	Number	Percent	Number	Percent	Number	Percent	
Left Front	253	88.5%	7	2.4%	26	9.1%	286
Left Rear	253	88.5%	7	2.4%	26	9.1%	286
Right Front	252	88.1%	7	2.4%	27	9.4%	286
Right Rear	253	88.5%	7	2.4%	26	9.1%	286

*Applicable to only non-electrical cooking appliances, n=286

Table 63. Respondent's rating of home's air quality during week of sampling (Q40)

	Number	Percent
Very good	111	31.5%
Acceptable	219	62.2%
Barely acceptable	13	3.7%
Not acceptable	5	1.4%
No response	4	1.1%
Total	352	100%

Table 64. Smell of cigarette smoke from other nearby homes or apartments, or from hallways, during week of sampling (Q41)

	Number	Percent
Never	302	85.8%
Once or twice	1	0.3%
A few days	34	9.7%
Every day	9	2.6%
Don't know	6	1.7%
Total	352	100%

Table 65. Smell of other odor in week of sampling (Q42)

	Number	Percent
Never	294	83.5%
A few days	46	13.1%
Every day	6	1.7%
Don't know	6	1.7%
Total	352	100%