

How to Conduct a Survey of Residential Wood Combustion (2003) - OMNI

Introduction

EPA's Emissions Inventory Improvement Program funded MARAMA to prepare information on how to conduct surveys of residential wood burning. The survey is the recommended method of developing data on the amount and type of wood burned and the type of equipment used.

In 2003, MARAMA hired OMNI Consulting Services, Inc. to prepare a report and this website as an information resource for state, local and regional organizations that are planning or conducting residential wood combustion (RWC) surveys.

As part of this work, OMNI conducted a national search to identify U.S. RWC surveys and coordinated a conference call with an expert forum on the subject of RWC survey methodology. It is hoped that this work will provide information to improve RWC emissions inventories. This website contains a general discussion on survey preparation as well as specific recommendations for RWC survey contents.

Unfortunately, many RWC surveys, including some of those listed on this website, have been conducted for reasons other than emissions inventory development, and it has been difficult to derive emissions inventory values from these surveys. In addition, there are many subtleties associated with RWC that require careful survey design. Moreover, many parts of the country have never been surveyed. Included on this website is a compilation of all the identified RWC surveys conducted from 1981 to late 2003. For the surveys conducted in the last ten years contact information has been provided along with the survey sample size and survey area population.

Key Residential Wood Combustion Survey Contents

A successfully designed survey will return results that provide the necessary information to calculate an emissions inventory. The needed information is: types of appliance at each residence, how many appliances each residence has, how much fuel is burned in each appliance and residence demographics for extrapolating survey results to the entire area's population should that be necessary. This section of the report will discuss each of these topics in detail. Historically there have been some common problems with RWC surveys. These common problems include not distinguishing wood use in the different appliance types, which is important because they have different emission factors, over estimating wood use, confusion over the term "insert" and not properly addressing homes that do not have or do not use their wood burning appliance. It is hoped that the following discussion will help avoid or to mitigate these difficulties in future surveys.

Type of Appliance

Conventional (non-certified) woodstove, certified non-catalytic woodstove, certified catalytic woodstove, masonry fireplace, factory-built fireplace, advanced technology (EPA) fireplace, masonry heater, fireplace insert, pellet stove, wood burning furnace/boiler and cook stoves are the main wood burning appliance types in use in the U.S. The numerous types of appliances and subtle differences between types cause confusion in RWC surveys. Many homeowners, and some surveyors, cannot always tell the difference. If a survey questionnaire is to be mailed, drawings and a description will help homeowners know what type of appliance they have. If a survey is to be done by interview, the interviewer should understand the appliance types and be able to communicate the differences to the respondent.

Woodstoves are freestanding wood burning space heaters. Determining the type of woodstove (conventional woodstove, certified non-catalytic woodstove or certified catalytic woodstove) is not always straightforward as the EPA emission certification rules were phased in over several years. Care should also be taken when determining the woodstove type as most people in the air quality field use the term certified to denote a stove is EPA certified for low emissions, but homeowners may think certified means it was installed by a certified installer, was certified as installed correctly by the city or certified for safety by an accredited safety laboratory. Conventional woodstoves have no emissions control and have not been EPA certified for low emissions, generally these stoves were built before 1990. Catalytic woodstoves have a built in catalyst to reduce emissions and are EPA certified as low emissions. Certified non-catalytic woodstoves use design technology to lower emissions and are EPA certified as low emissions.

Conventional fireplaces, both factory built (zero-clearance) and masonry (site-built), are normally built into a wall but a small percent will be freestanding. Fireplaces are mostly for decorative use, or at most supplemental heat, they may have no doors, screen doors or non-sealing glass doors (no gasket) and they may have "heatilator" tubes or other tubular grates to aid in heating the room.

Advanced technology fireplaces (sometimes referred to as EPA fireplaces) are uncommon as few have been sold. They are actually certified woodstoves built into a wall to look like a fireplace and they are air tight with gasketed doors.

Survey Preparation

Before designing a residential wood combustion survey, familiarization with general survey procedures and survey design for area source emissions inventories is recommended. Some background information on surveying techniques is worth discussing although it is not the primary focus of this report. The primary focus of this report is on the specifics of RWC surveys in developing emissions inventories. It should be noted that the EPA has provided guidance for general survey methodology in the EIIIP Technical Report Series, Volume III, Area Sources and Area Source Method Abstracts, Chapter 24, Conducting Surveys for Area Source Inventories.

The first step in developing a RWC emissions inventory is to determine if a survey is necessary. If it is decided to conduct a survey, thorough planning is essential. Initial planning should include an evaluation of the data quality requirements and a project budget. Before starting to design the survey, the information needed to develop an emissions inventory should be identified. Typically RWC emissions inventories require: types of appliance at each residence, how many appliances each residence has, how much fuel is burned in each appliance and residence demographics for extrapolating survey results to the entire area's population. Useful demographic information includes the urban/rural distribution of a home's residential area, economic distribution of the residential area and the age of residences in the area. In addition to survey results, heating degree-day data for the survey area may be useful when extrapolating survey results.

Distribution of a Survey Questionnaire

Typically, RWC survey questionnaires have been either mailed or completed by telephone interviews. There are strong arguments for each method.

Positive aspects of mailing survey questionnaires are: (1.) mailing survey questionnaires is normally cheaper to administer than telephone surveys, (2.) survey questionnaires can use graphics to explain possible answers and (3.) they are self-administered on a homeowner's time at their own pace. Negative aspects of mailing survey questionnaires are: (1.) the survey period is longer, often much longer, (2.) addresses change, meaning that more survey questionnaires need to be sent in-order to receive the required number completed and returned, (3.) incomplete forms can be unusable, (4.) administrators cannot ask questions to clarify answers, (5.) they bias results to people with interest in the subject and (6.) in populations with lower educational and literacy levels response rates are often too small to be useful. Response rates are often as low as 3%.

A way of mitigating low response rates when mailing survey questionnaires is to mail a postcard either before or after the survey questionnaire is sent (or both) explaining why it is important that the survey questionnaire is completed and returned. Unfortunately, this doubles or triples mailing costs. Another way to increase response to a mailed survey questionnaire is to use an incentive. One possibility is to offer to donate money to a charity specified by the respondent. Another is to include the people who return completed survey questionnaires in a drawing for a prize. A third

is to offer a copy of the (non-confidential) result highlights to those who complete the questionnaire. Any of these techniques will increase the response rate.

To determine the number of survey questionnaires that should be mailed, an estimate of the expected response rate should be made and the number of survey questionnaires sent adjusted accordingly. For example, if a sample of 1,000 respondents is desired as part of a mailing survey, and the estimated response rate is 5%, 20,000 questionnaires should be mailed. Bulk mail rates can save on postage expenses. However, most researchers do not use bulk mail because people may throw out bulk mailings without opening the envelope, lowering the response rate. Also, bulk mail moves slowly, increasing the time needed to complete the project.

Telephone surveys have the distinct advantage of utilizing an interactive interviewer who can explain stove types, wood use units and make sure the survey is complete. Interviewers can also often elicit longer or more complete answers than people will give on their own and if using a computer-assisted telephone interviewing system (CATI) the results can be available minutes after completing the last interview.

CATI software makes complex or lengthy questionnaires practical by offering many logic options; CATI can skip questions, perform calculations and modify questions based on the answers to earlier questions. It can check the logical consistency of answers and can present questions or answer choices in random order.

Random sampling is easier with telephone interviews; a computer can dial random telephone numbers when there is not an actual list of telephone numbers of potential respondents.

Problems with telephone interviews are: (1.) the expense of a team of interviewers, (2.) the expense to train and supervise interviewers, (3.) biased results to women and seniors who have been shown to be more likely at home during evening hours, (4.) telemarketers have given telephone research a bad name (many people are reluctant to answer the phone to avoid telemarketers and use their answering machines to screen calls), (5.) the prime calling time is about 6-9 p.m. (a time many homeowners have planned activities) and (6.) an interviewer cannot show graphics or diagrams by phone.

Sample Size (Number of Households)

To get representative results, the sample size needs to be determined prior to surveying and an unbiased, random sampling procedure is needed. The first step in determining sample size is to define the target population. When developing a RWC emissions inventory the target population should be all households in the area for which the emissions inventory is being developed. The data quality requirements, the study budget and population characteristics should be taken into account when making a decision on the sample size. Large samples will provide better data but are more time consuming and are more costly. With very homogeneous populations a large sample size may not be worth the extra time and expense. The number of responses needed to obtain data quality requirements can be calculated using basic statistics or with on-line calculators (<http://www.surveysystem.com/sscalc.htm>). For example, in a survey area with a population of 1 million households, a survey sample of 1066 respondents (only one respondent per household) will give a result with a 95% confidence level and 3% confidence interval, if the confidence interval is

widened to 5% only 384 samples are needed. Often RWC surveys designed for emissions inventory development have a 95% confidence level and 3% confidence interval. Confidence level is how likely the value is within the confidence interval had the entire population been surveyed. The confidence interval is the range that the true value lies.

To calculate the number of survey questionnaires to be distributed, the desired number of samples should be divided by the expected response rate. (For example: 26,650 surveys would need to be mailed if a desired 1066 questionnaires are to be returned with an expected 4% return rate, $1066/0.04 = 26,650$.)

Preparation of Survey Questions

In general, it is recommended that the ultimate purpose of the survey be considered in any survey design. The information desired should be reviewed and questions should be designed to result in the data needed, in this case the development of a RWC emissions inventory. Questions should be kept simple and brief. Questions that will over complicate the survey should be avoided. It is advisable to keep in mind the audience who will receive the survey questionnaire and the language that they will understand when wording a survey questionnaire. Attention should be paid to the order of the questions to keep the survey streamlined. Questions should not be asked in a way to bias answers. Emotional buzzwords, i.e., pollution, dirty, etc. should be avoided. It is important to have an option for "none", "other", "don't know" or "not applicable." At the beginning of the survey it is helpful to confirm that the residence is in the area being surveyed and the type of residence being surveyed, this data is also included for extrapolating data (zip code and residence type) to the entire area's population. Personal questions, such as income level or educational background, are not needed for emissions inventories but if they are to be asked as part of a survey it is preferred to ask them at the end, so that the important data is obtained should the respondent become offended and discontinue the conversation.

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A pilot survey followed by a revision of questions is a valuable tool in assuring usable results. Care should be taken when mixing any results from a pilot test with the final survey as the questions may change.

Survey Participants

When collecting data by a survey, the information needs to be collected from an individual at the residence who is familiar with the information requested. For example, the data collected may not be reliable if it is from a child interviewed simply because they are the person who answered the telephone. Many of the surveys listed in Section 4 of this report gathered information on public opinion along with RWC emissions inventory data. Due to this extra data being collected (along with demographics of the person giving the opinion) special care needs to be taken to avoid bias. It has been documented that telephone surveys are often biased to women and seniors because they statistically tend to be home more often in the evenings to answer the telephone. As long as the person answering the questions is knowledgeable about wood use in the home, there is little concern of bias; the questions involved in RWC emissions inventory surveys should not require opinions.