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How to Collect Data on Household Energy Consumption

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Energy policy and activities should be based on accurate data about how households acquire and use energy — and such data is best acquired at the household level.

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This paper presents guidelines for administering household energy surveys.

Typically, country energy balances, national budget surveys, and microstudies have been the source of information about residential energy consumption. A dedicated nationwide household energy survey will generate more relevant data for planners, policymakers, and evaluators — but may overturn assumptions in the process.

The subsidized promotion of liquefied petroleum gas (LPG) as a charcoal substitute in Senegal, for example, was based on the assumption that subsidies alone would lead to widespread adoption of butane fuel and that as the use of butane increased, the use of charcoal would decline. But a 1987 survey indicated that although 65 percent of the households in Dakar have LPG stoves, only 2 percent use the fuel exclusively. And in the households that use both LPG and charcoal, consumption of charcoal has not changed.

In Niger, wealthy residents, because of their lifestyle and income, were considered the logical market for modern fuels. But a 1986 study indicated that they used a lot of wood because they could afford to buy it in bulk (which made it the cheapest fuel) and they suffered none of the health or other disadvantages of wood fires because their servants did all the cooking.

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ABSTRACT

Representative information on household energy is essential for organizations and individuals seeking to: (a) identify residential energy problems and trends; (b) prepare supply and demand projections; (c) engage in energy sector planning; (d) conduct market research; (e) develop effective policies and programs as part of household energy strategies; and (f) evaluate ongoing and completed projects. Without comprehensive knowledge of how households acquire and use energy, attempts to develop activities and policies which purportedly seek to improve domestic welfare and/or protect the environment can be futile and even counterproductive. In fact, recent efforts to develop household energy databases have led to the overturning of inaccurate preconceptions and false paradigms upon which past actions and policies had been based.

Typically, information relating to residential energy consumption has been dealt with through country energy balances, national budget surveys and micro-studies. Each of these has certain advantages which, however, are outweighed by their drawbacks. Instead, a dedicated, nationwide household energy survey can be the most effective means of generating relevant data for planners, policymakers and evaluators. This database, combined with the results of more specialized studies, can then be used to understand and improve on the complex systems that are part of household energy consumption.

For household energy surveying, this paper offers some lessons and caveats from recent experience concerning:

- overall survey design;
- sample design;
- questionnaire preparation;
- survey fieldwork and logistics;
- data processing and analysis; and
- costs and timing.

Finally, a quick checklist is provided to assist practitioners in the preparation of household energy survey work.

I. INTRODUCTION

The existence of reliable, disaggregated information on residential fuel consumption and supply is essential to the formulation of sound household energy strategies. Unfortunately, institutions and individuals concerned with data collection and management in many developing countries have often not considered household energy characteristics in the design of their information-gathering exercises. Thus, there is a serious need for carefully-developed and maintained databases on residential fuel demand and supply so that planners and policymakers can identify, quantify and address the key issues relating to household energy. This paper reviews some of the important methodological, theoretical and practical issues that should be considered by organizations which are planning to gather data on domestic energy use. It is based on the experiences of the joint UNDP/World Bank Energy Sector Management Assistance Program (ESMAP) in developing household energy strategies, as well as on a review of the literature and advice from practitioners in the field.[1]

Without comprehensive knowledge of how households acquire and use energy, attempts to develop policies and projects which purportedly seek to improve the welfare of households and/or protect the environment can be futile and even counterproductive. Solid information on fuel prices, quantities consumed and consumer preferences are necessary for interfuel substitution analysis and pricing policies. Knowledge of culinary practices, household decisionmaking on expenditures and stove/oven ownership are crucial in preparing the cooking efficiency component of a demand management program. Data on consumption patterns, biomass supply systems and household attitudes towards the natural resource base are essential to the development of a supply management strategy. Reliance on anecdotal evidence, unrepresentative statistics and theoretical extrapolations to create real policies will amount, at best, to random shots in the dark and, at worst, these shots might hit the wrong targets.

When policies and projects for the residential sub-sector have been implemented in the past, the subsequent development and analysis of a household energy database has led to the overturning of inaccurate preconceptions and false paradigms upon which these real actions had been based. For example, the [illegible]ed promotion of LPG as a charcoal substitute in Senegal for the last sixteen years has been based on assumptions that increased use of butane would lead to a commensurate reduction in charcoal use, and that subsidies alone would lead to widespread adoption of the fuel. However, a 1987 survey indicated that, despite the fact that 65% of households in Dakar possess some type of LPG stove, only 2% use the fuel exclusively and, of the 25% of families which use both LPG and charcoal, their consumption of the latter fuel has not changed. In Niger, it was thought that wealthy residences would be the logical market for modern fuels due to their lifestyles and income levels. However, a 1986 study revealed that they were significant consumers of wood because they could afford to buy in bulk, thus making it the cheapest fuel. Also, family members did not have to suffer the negative health and other consequences of wood fires as servants did the cooking. These are just two instances of how, in the absence of accurate information, well-intentioned prejudgments concerning household energy use have or could lead to misdirected actions and investments.

Thus, representative information on household energy plays a pivotal role for institutions which seek to: (a) identify problems and trends; (b) prepare supply and demand projections; (c) engage in energy sector planning; (d) conduct market research; (e) develop effective policies and programs; and (f) evaluate ongoing and completed projects. To create this resource, a variety of instruments can be employed. On the demand side, a set of information-gathering tools are briefly assessed and the most promising one -- the household energy survey -- is delineated in more detail. For this type of survey, key considerations are presented concerning overall design, sample selection, questionnaire design, logistics and fieldwork, and data processing. On the supply side, techniques for understanding the dynamics of commercial and traditional fuel supply will be outlined in an upcoming Energy Department paper.

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[1] This paper was prepared by Josef Leitmann (Energy Planner, ESMAP), with the assistance of Zouhair Souissi (Summer Intern, World Bank). Advice from the field was provided by Samir Amous, Doug Barnes, Michel Matly, Gordon McGranahan and Azedine Ouerghi.

II. COLLECTING DATA ON HOUSEHOLD ENERGY USE

Common Methodologies

Typically, information relating to residential energy sector consumption has been dealt with through country energy balances, national budget surveys and micro-studies. Each of these has certain advantages which, however, are outweighed by their drawbacks. Their limitations render them inadequate tools for crafting a usable household energy database. Instead, it will be suggested that a dedicated, nationwide household energy survey is the most effective means of generating relevant information for planners, policymakers and evaluators.

The choice of methodology and the scope of the data-gathering endeavor will be significantly influenced by a variety of factors. These have been summarized in the upcoming Commonwealth Science Council's Biomass Handbook and include the following:

- geographical area to be covered and ease of communication
- number of regions investigated
- number of communities/eco-systems investigated per region
- relative reliance upon secondary & primary data sources
- precision and breadth of coverage
- number of persons to be questioned per socio-economic or other category
- number of topics explored per person
- level of detail & accuracy required for each topic
- number & timing of interviews per person.

Planners should compare these trade-offs with the proposed uses of data and with their available resources in order to select the optimal methodology.

Regardless of the methodology chosen, household energy data collection can not be a one-shot affair. The institution responsible for information gathering and analysis should be involved in the creation, management and updating of a database on household energy. If external assistance will be used for household energy data gathering, then staff training in survey work and data analysis should be part of the package. Once created, the database should be accessible and easy to update, e.g. on a microcomputer with user-friendly software.

National Energy Balances

An energy balance presents quantities of each major fuel (by weight or by energy value) consumed by specific sectors (industrial, commercial, government, household) per year. A representative energy balance for Ethiopia is presented in Table 2.1 below.

TABLE 2.1: ETHIOPIA NATIONAL ENERGY BALANCE (1982)
Final Energy Consumption ('000 toe)

Sector	Biomass Fuels	Electricity	Petroleum	Total	Share (%)
Industry	30	35	102	167	2.1
Transport			349	349	4.4
Agriculture		1	31	32	0.4
Households	7,402	16	18	7,436	92.8
Commerce/Govt.	___	11	21	32	0.4
Total	7,432	63	521	8,016	100.0
Share	92.7	0.8	6.5	100.0	

SOURCE: Ethiopia: Issues and Options in the Energy Sector. Joint UNDP/World Bank ESMAP; Washington, DC, July 1984 (Report No. 4741-ET)

The advantages of using the energy balance are that: (a) it identifies the relative importance of the household sub-sector in the overall energy consumption profile; (b) it pinpoints the key fuels in the sub-sector; and (c) it is available for most countries. The limitations of using energy balances for detailed analysis regarding residential fuel use are:

- the data are almost always based on information provided by suppliers; thus, they are more reliable for commercial fuels where transactions are recorded and less so for traditional energy sources (either collected or marketed) where no regular records are kept;

- because of this supply orientation, the aggregate figures do not reflect actual demand;

- information is presented only at the global level; no disaggregation is possible to pinpoint issues and problems that might affect specific regions, income classes or types of consumers; and

- consumption of biomass, often the most important household fuel, is usually a very rough estimate based on a set of untested assumptions.

Thus, energy balances are an insufficient, if not entirely inappropriate, means for focusing on the real issues and options in household energy.

National Budget Surveys

These are large, statistically representative surveys which seek to develop data and trends on how families spend and save. They are usually conducted every 3 - 10 years, may involve several rounds with repeat visits in each round and focus on cash expenditure. These efforts have several advantages: (a) they are high-visibility efforts which receive substantial resources; (b) they are generally well-planned and statistically valid; and (c) they are nationwide. However, the energy analyst seeking to use results from these surveys faces several constraints:

- fuel consumption is rarely measured; it is usually based on recollection and is thus unreliable;

- because many expenditure categories are covered, the level of detail is unsatisfactory; often, important variables such as price, fuel availability and end-use equipment are not included;

- typically, no time series data are generated by these exercises because they are undertaken infrequently and/or do not use the same methodology, including questions, for each iteration; and

- because these surveys mostly concentrate on cash purchases, collected fuels (wood, twigs, agricultural and animal residues) are not reflected in final consumption figures.

Still, there is room for improvement whereby a household energy module can be incorporated in the family budget survey to generate useful information for planning and implementation purposes. An example of such a module, which was added to the 1987-88 Family Budget Survey in the Yemen Arab Republic, is presented in Annex 1.

Micro-surveys

These data collection exercises are aimed at understanding the social and microeconomic aspects of household energy demand in a limited geographical area. Generally, they can involve a sample of up to several hundred households, may cover several villages and could rely on re-surveying. They are attractive because: (a) micro-surveys are usually inexpensive; (b) because of their small sample size, they can be undertaken and analyzed relatively rapidly; and (c) because of their small size and limited geographical focus, they are easily managed. On the negative side,

- their specific focus is also a limitation as one can rarely extrapolate results from the sample to the national, or even regional, population;

- in practice, they often don't measure such important characteristics as efficiency of end-use devices, the natural resource stock and income or expenditure level; and

- they are one-shot affairs which don't allow for comparison of results over time, especially regarding seasonality of fuel use.

So, micro-surveys are generally not appropriate for yielding a database that will allow for understanding and addressing energy problems at the national level. If carefully designed, they can be useful for assessing the situation in a pre-defined area and, as such, may have important applications in regions which have special problems.

Additional Techniques for Gathering Specific Household Energy Information

Specialized investigatory techniques can be used to get important, detailed information on particular subjects, e.g. cooking efficiency, household decisionmaking and precise biomass fuel consumption. Laboratory and field tests should be conducted to determine theoretical and actual energy efficiencies of cookstoves and ovens. This will be essential for calculating the cost of useful energy in cooking. Sociological studies can be made to document how family decisionmaking occurs regarding inter alia purchase of fuel, cooking practices and procurement of cooking equipment. For fuel consumption, a small, representative sample of households can be chosen for intensive investigation. Surveyors can visit residences on a daily basis over a period of several weeks to determine exact amounts of fuel used through weighing, volumetric measurements and detailed questioning. For example, FAO has been undertaking countrywide wood consumption surveys since the 1950s. These attempt to measure use of all types of wood products such as woodfuel, poles, sawnwood, panel products and paper. This has resulted in estimates of wood consumption for several countries, e.g. Sudan (1958), East Africa (1960), Tanzania (1970), Thailand (1970) and Zambia (1986). All of these specialized studies are useful and usually necessary supplements to methods described above as well as the household energy surveying detailed below.

III. HOUSEHOLD ENERGY SURVEYING

A household energy survey is a means of gathering statistically representative information on residential fuel demand and use so as to help precisely define household energy issues and aid in formulating appropriate strategies. It generally involves a structured survey using a carefully designed sample, pre-tested questionnaires, fieldwork and data analysis. In contrast with the options assessed above, a survey dedicated exclusively to household energy requires considerable logistical and, sometimes, financial effort on the part of the institutions involved. Therefore, the need for such an exercise should be well-justified and its costs carefully weighed against the expected yield of information as well as its utility for policy analysis.

The objectives of a household energy survey include:

- painting a comprehensive picture of residential energy consumption;

- assessing the relations between fuel use and household socio-economic characteristics;

- identifying existing and potential problems or limitations in the use of specific fuels; and

- analyzing the impact of implemented or contemplated efforts to influence consumption in the sub-sector.

To achieve these objectives, the survey can obtain detailed information on: (a) the price, quantity, end-uses and availability of marketed fuels; (b) the quantities, end-uses, collection times and availability of gathered fuels; (c) cultural factors such as diet, cooking habits and rituals which may affect energy demand; (d) the cost, efficiencies and lifetimes of energy-using devices, e.g. cookstoves; (e) expenditure classes and the relative importance of energy in the family budget; (f) household size and its impact on per capita fuel use; and (g) changes in fuel use with geographical/ecological zone.

Overall Survey Design

To ensure that the survey is worth the effort, care should be taken in the overall design so that one does not re-invent the wheel and that the right answers are sought by asking the right people the right questions. In most countries, useful information on residential energy consumption may have already been gathered for other purposes. Such data can usually provide a starting point for identifying critical issues as well as selecting population groups and areas for in-depth research. Previous studies and surveys will help narrow the objectives and amount of information sought in the household energy survey, thus saving time and money. Interviews with those previously involved in similar tasks can also help improve survey design and implementation. For instance, preliminary research may highlight the possible seasonality of fuel consumption, migration patterns or accessibility of survey sites, and thus aid in survey timing and logistics. The services of a sociologist or anthropologist can be used to assist in understanding household consumption patterns to better design and implement a relevant survey.

After reviewing the available information and identifying gaps in the data, care must be taken in determining which information will be most useful in understanding energy problems and their solutions. While it would be difficult and, indeed, unwise to assume an advance knowledge of the outcome of the survey, one can develop a general set of expectations about how the database will be used. For example, in Morocco, a series of working papers were outlined which would then be written based on information generated by the household energy survey. Their structure was by no means fixed but they did provide useful guideposts in the important areas of sample and questionnaire design. In Indonesia, an interministerial committee on household energy was established to review the survey design process so as to guarantee that the survey would provide each ministry with information that would be useful. These are just two techniques which can be used as a check on ultimate worth of the survey.

Three important caveats should be noted at the outset. First, some key variables may be difficult to analyze in a household survey. For instance, price elasticities are difficult to measure because, in many cases, there is very small variation at the time of the survey. Second, household data may be inappropriate for analyzing macro-issues. Household surveys are for understanding patterns at the micro-level, especially the relationships between different types of household characteristics. Just because one finds, for example, a relationship between expenditure and energy use at the micro-level does not mean that the same relationship will hold at the village or national level. Macro-structural changes in energy use may be better explained by migration patterns, government policy or changes in the industrial structure of the country, rather than the characteristics of a household. Third, the level of detail which a household energy survey should achieve depends on the informational requirements and implementational capabilities of policymakers and energy planners. Thus, in designing a survey, one should not lose sight of the impact which a marginal increase in valuable information may have on feasible policy decisions. Given these overall considerations, one can proceed to the mechanics of actual household energy surveying.

Sample Design

Sample design is an important procedure which usually makes use of formal probability theory. While it may be necessary to deviate from this process for practical reasons, this can result in selection of an unrepresentative sample which may render subsequent results unreliable when extrapolated to the population as a whole. Some of the factors which may limit the application of statistical techniques include: (a) lack of a master sample or data on the overall population from which the sample is to be drawn; (b) physical inaccessibility of population sub-groups; (c) language barriers; and (d) insufficient financial or human resources. Whether or not statistically valid samples are drawn, they should be designed so that they reflect the survey's objectives, especially household characteristics which are thought to be relevant to energy consumption.

Sampling Procedures Depend on Goals and Resources. There are several types of sampling procedures which can be used in surveys including random, stratified random, matched pair, selection according to a quota, and even a total census. Generally, a random, representative sample is necessary to determine total household energy consumption for a country or a region. To draw such a sample, reliable and comprehensive data must exist on the size, location and key characteristics of the population one wants to study must exist. When this is not available, creative alternatives may be found. For example, in the 1987 Burkina Faso urban household energy survey, census listings were unreliable so the following methodology was used: (a) cities were divided into small geographic areas; (b) a random sample of these areas was chosen for the survey; (c) a household census was conducted in the chosen areas; and (d) a random sample was drawn from the listed households.

The focus of the survey can also help determine whether or not a random sample of the population is necessary. For example, if an evaluation of energy consumption with and without an improved stove is to be done but the stove has not significantly penetrated the market, then a representative sample selected randomly from the population may not have enough cases of the stove to permit adequate analysis. In a recent study of rural electrification in India, a matched pair design was chosen. Households with electricity were concentrated in the high income groups and those without electricity were mainly in low income groups. With a random sample, results would have been biased because there would be no control groups (poor households with electricity and rich households without it). Therefore, the sample selection matched households from 6 occupational groups (large farmers, medium farmers, small farmers, trade and landless laborers), and households with and without electricity were selected from each group. Finally, choice and definition of the sample unit is important. Definite samples can be drawn if a household is defined as family members living together or all people who live and eat under the same roof. Whichever definition is chosen, it should be clearly stated in the presentation of survey results.

Sample Stratification Should Be Considered. Stratification is a partition of the surveyed population so that data can be disaggregated and relevant factors can be analyzed in greater detail. Household size, geographical location and wealth are often used for stratification in energy surveys, meaning that within the sample a distinction is made between different income or expenditure levels, region and the number of people in each household. Information on income and/or expenditure may not be reliable because of respondent suspicions concerning official use of the data for taxation purposes. If this is the case, proxies can be used to categorize

households, e.g. type/size of dwelling, ownership of vehicles, number/type of appliances, neighborhood, etc. With spatial stratification, use of functional rather than administrative regions may be more appropriate when trying to link consumption patterns with ecological zones. However, it may be difficult to stray too far from official administrative divisions as many statistics are only available on this basis. Finally, it should be noted that the more a sample is stratified, the more it requires a larger sample to ensure that results obtained from the sample are generalizable to the larger population

Sample Size Should Be Calculated. When using random survey techniques, the sample size should be calculated using statistical methods which determine sampling error and confidence level. However, if resource constraints limit the sample size, then its reliability and precision should be determined by working backwards from the feasible sample. Confidence levels and sampling error should always be given to clarify the validity of published results. Simply selecting a sample based on 1% or 0.1% of the population does not guarantee that results will be representative.

Sample Design in Morocco

A household energy consumption survey has been designed in Morocco under a USAID/ESMAP project. It will involve three rounds to capture winter, spring, summer and crop-related seasonality. The objective of the survey is to provide data to analysts on fuelwood development, household energy conservation, cooking equipment, fuel prices, petroleum products and rural electrification so that a comprehensive household energy strategy can be developed.

Sampling methodology. A random stratified sample was drawn from the Statistics Department's master sample. This is a large sample which is designed to meet all household survey needs for the 1984-92 period. It is based on the 1982 census and is already divided into rural and urban areas, and five strata reflecting housing types. Sampling involved the following phases: (a) review of existing data; (b) selection of zones to be surveyed; (c) familiarization with the master sample; (d) selection of sampling procedure and estimation of the size, reliability and precision of the sample; (e) distribution of the sample in time and space; and (f) selection of the method for estimating population parameters from the sample variables.

Stratification. Stratification aimed at capturing geographical factors such as proximity to the forest, the structure of urban vs. rural demand and socio-economic factors affecting consumption. Administrative districts were not suited to this stratification so the country was divided into four survey zones according to energy, forest and climate characteristics. Each zone included several administrative provinces and the criteria used for grouping provinces into zones were: electricity consumption; rate of LPG use; forest surface; minimum temperature in winter; and rainfall recorded by the nearest meteorological station.

Sample size. Because of the selection and stratification techniques used, a sample size of 6080 households was chosen (2800 rural and 3280 urban) at a 95% confidence level. If a lesser degree of precision and stratification was desired, the sample could have been as small as 2200 households. The sample size will be the same for each round. To minimize biases, a portion of the households visited during the first round will be visited during the second, and a portion of the second will be visited during the third. The duration of the survey will be approximately three weeks in each round.

Questionnaire Design

Questionnaire design involves choosing questions that will generate reliable and usable information for policymakers, understanding the important elements of the questionnaire format, and avoiding common mistakes in structuring questions. Considerable savings in data gathering and analysis can be achieved if questionnaire is set up according to the objectives of the survey. This can be done in several ways.

To get the right answers, those who need them should be consulted prior to survey design. Key policymakers can be interviewed and informational needs of practitioners can be assessed. Then, outlines of working papers that would be generated from survey results or even a draft questionnaire can be presented to these individuals and their institutions for review. This will result in broader participation in the exercise, a more useful questionnaire and will give them a feeling of having a stake in the outcome. Some examples of data requirements that different policymakers might have are presented in Table 3.1.

TABLE 3.1: ANALYTICAL & STATISTICAL ISSUES FOR THE POLICYMAKER

Questions for the Policymaker	Data Requirements
1) What % of the population use biomass as their only fuel or primary fuel?	Total population: rural, urban Type of biomass energy used Type of use and user Frequency/quantity of use
2) Do consumers get enough biomass to meet their needs? Where are there deficits?	Minimum requirements per cap./yr. Actual consumption of biomass Regional disaggregation
3) Why are people not using or using very little of a particular fuel?	Socio-economic characteristics Prices, costs & accessibility Distribution system Fuel preferences & end-uses
4) Do people earn enough money to buy their fuel and end-use equipment?	Income classes Expenditure on energy & other Price & consumption levels Frequency of payment (daily, weekly, monthly)

SOURCE: Adapted from Commonwealth Scientific Council, Biomass Handbook, 1988

To translate policy concerns into concrete outputs, comprehensive, detailed tables can then be prepared and anticipated answers can be pre-coded prior to actual fieldwork. For example, tables can be set up for fuel end-use such as cooking, heating and lighting, occasional activities (beer brewing, crop drying, pharmacy product preparation, etc.), and other uses. Data on these occasional fuels and their uses can then be obtained through specially-designed questions in a dedicated portion of the survey questionnaire and pilot survey.

Important Elements in Questionnaire Design. Some important considerations in the design of the survey instrument are presented below:

(a) The order and wording of questions are very important; these should be assessed in a pilot test of the survey to minimize redundancy and enhance clarity.

(b) Questions should be simplified by breaking them down into their smallest components so that it is easier for respondents to make accurate estimates.

(c) The questionnaire should be designed so that it is easy for the interviewer to fill in, e.g. by using large white spaces, boxes, arrows, clear instructions and a good reference manual.

(d) The length of the questionnaire will affect the time of the interview. Depending on the culture, interviews longer than two hours per household can reduce the quality of the responses.

(e) Control questions should be included for important variables so that the accuracy of responses can be cross-checked.

(f) The appropriate language and local units of measurement should be incorporated in the questionnaire for each different area that is to be surveyed.

(g) Respondents should be asked a general concluding question where they have an opportunity to give their comments and views on topics that they think are of relevance to the survey. This can generate useful information and give the respondent an opportunity to participate in questionnaire design by answering his/her own question.

These are all elements of a good questionnaire. Some of the key items that can be covered in a household energy survey are presented in Annex 2. Care should be taken in duplicating the wording and format used in these examples as they were not designed for specific countries or regions and may not be applicable or relevant to your situation.

Some Common Mistakes. The following is a list of errors which are frequently made in the preparation of household energy survey questions. The list is not comprehensive but one should certainly avoid:

(a) asking questions that are not relevant to the issues being addressed in the survey. In many instances, highly specialized questions cannot be answered by the majority of the population. In addition, there is always the temptation to insert many superfluous questions;

(b) concentrating on obtaining too much factual information, while forgetting that, in the end, the data must be analyzed. This information gathering overkill can lead to needlessly long interviews, which affects the quality of the data collected;

(c) asking double-barreled questions. These involve asking for two or more pieces of information in the same question. For instance, "do you use electricity or kerosene for lighting?" is really two or even three questions and should be separated into its individual parts;

(d) failing to use screening techniques so that relevant questions are asked of relevant populations. To ask a person who has never used electricity or kerosene for lighting to compare them is not appropriate;

(e) not distinguishing between questions that are used for obtaining information and those that are intended to assess the respondent's opinion on certain issues. The form for asking information and opinion questions is quite different. Asking a respondent how much charcoal he now uses requires a different approach compared to asking an opinion on why charcoal is used;

(f) overemphasizing the counting of megajoules while placing less emphasis on the policy issues involved in household energy; and

(g) assuming that reliable responses will be given, especially for questions regarding budgets and income. It is often necessary to develop this information through several sets of questions, e.g. on expenditure, prices and quantities.

Several other lessons that can be learned from the process of questionnaire design are presented in the box below which summarizes experience with a survey in Bangladesh.

Bangladesh: Village Energy Survey

In Bangladesh, a survey focusing on the interrelationships between different village resources and energy patterns was undertaken in 1984, as the first phase in introducing alternative energy technologies. Important factors which were considered include: location of reserve forests in relation to the urban and rural population; ownership and/or accessibility of fuel-producing resources such as trees, agricultural land, and animals; agricultural landholding and type of crop; household or mill processing of rice and sugarcane; local practices of providing food as partial payment for wages; and seasonal migration of rural laborers and families.

Some weaknesses which were noted in the survey questionnaires were:

1. Fuel amounts consumed by the household were recorded without reference to specific end-uses; this did not allow for in-depth analysis of consumption patterns.

2. No common denominator was used in identifying and measuring traditional fuels, which made tabulation difficult.

3. Except in one sub-sample, the amount of fuel consumed was estimated by recall. Time periods used in different rounds were different, and amounts were not checked by weighing.

4. In the macro-survey, the same questionnaire was used in urban and rural areas. It would have been more accurate to design two distinct questionnaires addressing the urban and rural situations separately.

5. Although introduction of efficient stoves to save cooking fuel was considered as a policy option, the questionnaires did not include questions about existing stoves and cooking practices.

Survey Fieldwork and Logistics

It is essential that survey logistics be carefully prepared in advance so that fieldwork can proceed as smoothly as possible. A well-designed questionnaire is worthless without a dedicated, well-trained staff that can use it in the field to obtain reliable results. Some important logistical and training considerations are presented below which one should be aware of when planning fieldwork.

Logistics. Some key logistical elements of implementing a household energy survey are legal clearance, lodging/per diem, transport, availability of equipment and supplies, supervision and quality control. Depending on how the survey team is organized, these may be the responsibility of the director, an administrative assistant, a supervisor or a committee of supervisors. These responsibilities can be illustrated by the main tasks assigned to the supervisor for the Cote d'Ivoire Living Standards Survey (1986) which were:

- Contacting authorities in villages before the survey to advise them of the dates of interviews;

- Preparing the household questionnaires for a pre-selected list of dwellings;

- Helping interviewers to locate households, reviewing all non-contacts and refusals, and replacing selected households when necessary;
- Verifying that all parts of the questionnaire are properly completed before returning to the regional office;

- Coding items that are not pre-coded on the questionnaire;

- Conducting re-interviews of 25 percent of the households; and

- Reviewing the printouts of both rounds of the questionnaire to detect interviewer and data entry errors, and supervising correction of all errors in the field and in the office.

Thus, in this case, the supervisor had several logistical responsibilities, the most important of which involved quality control.

Selection and Training of Interviewers. Interviewers should be selected from the local population for their knowledge of the language, culture, transport system, etc. Often, female surveyors are preferred in household energy work because of their better rapport with women who are usually the most important users (and gatherers) of household fuels. Generally, the interviewers should not be in any position of social or political authority which would induce a strong bias in answers. Some practitioners go so far as to recommend that no official institution, especially a governmental one, should be in direct contact with the survey sample as this may cause a distortion of responses.

The quality of the interviews also depends on the education of the surveyors. Their training should be planned carefully. This can be done with audio-visual methods and practice interviews. A manual explaining the objectives of the survey, identification of the respondent, interviewing techniques, structure of the questionnaire, and the way each question should be asked and recorded should be given to and used by each interviewer. In the field, novices can be accompanied by more experienced surveyors during their first interviews. The field coordinator and supervisors should carefully monitor the work of interviewers, attend interviews, check answer sheets, hold regular review meetings, discuss problems and assess preliminary results.

At the beginning of the interview itself, the surveyor should deliver a introductory statement or letter to the head of the household which covers the objectives of the survey, its importance, confidentiality of responses and who the sponsoring institution is. Care should be taken to ensure that the right questions are asked to the right people. For example, in some households where the husband has more than one wife, there may be a number of cooking units and practices, all of which should be reflected in the survey results.

An example of a four day training period covered the following:

- Introduction to the objectives of the survey, work plan, methodology, sampling procedure, schedule of activities and logistical arrangements;

- Introduction to methods for conducting interviews, recording responses and handling interviewing problems;

- Group discussion of the questionnaire, with detailed consideration of appropriate phrases, the meaning and purpose of questions, format, etc.;

- Timed group interviews of one individual;

- Individual practice interviews conducted at the surveyor's home; and

- Individual practice interviews conducted near the office.

Lastly, it is essential to stress the importance of building good morale and an esprit de corps amongst the surveyors. The success of the survey depends on their understanding and acceptance of the procedures, and on their initiative in handling problems properly. It is necessary to build a real survey team by: (a) continually reminding them of the purpose of the survey, the importance of getting accurate information, and the link between a good database and good policies/projects; (b) involving them in formulating questions and improving the questionnaire, both during training and after the pilot test; (c) convoking regular debriefing meetings, and asking interviewers for a final written report assessing their work, overall survey organization and recommendations for improvement; and (d) informing them of preliminary results, especially if day-to-day processing is conducted in the field as soon as completed questionnaires are returned.

Data Processing and Analysis

The most common administrative problem for household surveys is the underestimation of data cleaning and analysis requirements. The results of surveys that cost tens or hundreds of thousands of dollars frequently are used only for very simple calculations of trends, if they are used at all. Once the preliminary analysis has been completed, the survey results are often abandoned and never used again. People, in many cases, seem to be satisfied that they have generated new information but are less willing to fully analyze it, and budgets usually reflect this bias. An accurate outline of what actually needs to be done to get, analyze and present good results is outlined here.

Cleaning the Data. Checking survey forms, coding, editing, keypunching and tabulating data is a time-consuming process. It can take several months just between the collection of data and its availability for analysis. Editing is a major stage in survey data processing. Its objective is to detect and correct errors so that a satisfactory quality of raw data can be obtained. Correction may cause other errors and, whenever possible, these should be documented. Where possible, editing should be done by computers which can use data entry programs. These use a set of files that store the characteristics of the questionnaire, possible variable values, skip patterns, and shape and functions of the data entry screens. As data are keyed in, they are submitted to a set of standard checks contained in the data entry files. Numeric variables are constrained to lie between minimum and maximum values, qualitative variables can only have certain valid codes, and chronological variables must contain valid dates. In this manner, improperly recorded or keyed in data can be automatically identified.

Computer Processing. Computer processing facilitates and speeds up the analysis of data, quickly calculates statistical significance, and helps establish relationships among variables. Several computer packages are available for this purpose. Two of the most common are SAS (Statistical Analysis System) and SPSS (Statistical Package for the Social Sciences). SAS and SPSS can tabulate answers by absolute, relative and cumulative frequency, and they automatically calculate values such as the mean, median, mode, standard deviation, variance, minimum, maximum, range, number of valid cases and bias. However, there are other software packages which may be more appropriate depending on the type of computer used, length of the questionnaire, number of variables and number of respondents.

For utilizing the data, computers are especially useful for conducting multiple regression analysis to test the important hypothesized relationships between a set of independent and dependent variables. Computer processing facilitates cross-tabulation of, for example, answers about stove characteristics which need to be broken down according to type of stove. It is also useful to use computer packages to analyze the statistical limits of the data by dividing response error frequency into those attributable to the enumerator, and respondent error due to bias, ignorance and memory lapse. Finally, an optical scanner can be used with a computer and

specially-designed questionnaire forms to speed data entry and tabulation. This can be a more costly option in the short-run but it may save time and money if new survey work is anticipated in the future.

Reporting the Results. Data should be presented in such a way that they can be easily used as instruments for decisionmaking. For effective use of reports, careful consideration is needed in the choice of the title and format. A survey covering different subjects and policy issues may need separate reports or working papers. A general presentation of the socio-economics of the survey area and the linkages between the survey findings and national policy should be included. Specific tables should reflect the policy issues that are important to the survey and not be just a description of the facts uncovered in the survey.

Reports should summarize the survey methodology (including sample stratification), conversion factors, technical aspects of energy data, results and findings. Use of tables, graphs, diagrams and charts should be made to clarify the data and major conclusions. The report should also provide information on the actual time spent gathering data, the period of the survey and a listing of pertinent unusual events which might affect the validity of the results. In any energy survey, certain findings are liable to be inconsistent or difficult to explain. These should be mentioned and their significance discussed. Lastly, while it is not practical or recommended that unconverted survey data be included in the report, a survey codebook should be prepared so that others can use the data, if requested.

Effective reporting requires appropriate analysis. Results reported in terms of average energy consumption by end-use and type of energy, as is done in most household energy consumption surveys, provide only a background for identifying needs and formulating broad energy policies and interventions. Information for policy analysis on prices, equity and economic growth should show whether significant differences or variations exist among households or types of energy consumers, as well as the factors influencing such differences.

Costs and Timing

The pricetag of a household energy survey will depend on a variety of factors including: sample size, dispersion of the population, degree of reliance on international expertise, wage rates, transport costs and training requirements. For a full-scale survey involving over a thousand households, costs have ranged from $17 per household in a low-income country (Indonesia) to $67 per household in a middle-income state (Yemen Arab Republic). A rapid survey using a short questionnaire which covered 500 households in five cities was undertaken in Senegal for less than $20 per household.

The amount of time that it takes to travel from overall survey design to reporting of final results can vary from several months to several years. Experience to date has shown that the timing of household energy surveys is sensitive to:

(a) the ease of securing official approval and agreement on questionnaire content, sample selection and sample size;

(b) the number of times that the population will be surveyed, e.g. summer/winter in order to capture seasonal variations;

(c) problems with computer hardware and/or software;

(d) the frequency and duration of national holidays, e.g. Ramadan, independence celebrations, which may interfere with staff and respondent availability;

(e) the competing priorities (time, resources) of the agency which undertakes the survey;

(f) the level of staff training that is required, especially for interviewers, data entry personnel and analysts; and

(g) whether a full-time coordinator is available to process paperwork, supervise overall organization and maintain a disciplined schedule.

Even if none of these factors is a problem, it is highly unlikely that the process will be completed from start to finish in the anticipated time frame.

IV. HOUSEHOLD ENERGY SURVEY CHECKLIST

The following guidelines can be used as a quick checklist during household energy survey design:

1. Clearly define the objectives of your study and focus on the information that is essential for policymaking and follow-up project design.

2. Understand the characteristics of household fuels as well as how they are acquired and used.

3. Identify and target questionnaires to appropriate sub-groups.

4. Use stratified random sampling whenever possible.

5. Coordinate with local and regional officials and leaders.

6. Rely on local surveyors who are from the culture and linguistic group of the surveyed area. Use female interviewers when and if this facilitates access.

7. Choose educated interviewers, train them well beforehand, monitor field performance carefully and maintain morale.

8. Anticipate possible responses and pre-code the questionnaires to speed up data entry and analysis.

9. Consider how to overcome possible problems with strategic, instrumental and hypothetical biases.

10. Make sure that respondents thoroughly understand the goals of the survey and the meaning of each question.

11. Take care to identify the most appropriate respondent in the household for a particular section of the questionnaire.

12. Separate consumption by end-use.

13. Convert commonly used units into standard ones by taking physical measurements, preferably by weight and moisture content (solid fuels), and volume (liquid fuels).

14. Focus on recent activities rather than distant events.

15. Break questions down into their smallest, simplest components.

16. Cross-check important answers, especially those pertaining to income, expenditure and quantities.

17. Investigate the reasons for variations in prices and quantities.

18. Examine land tenure arrangements to determine if they have a significant impact on consumption patterns.

19. Use computer analysis and statistical tests.

20. Anticipate delays and budget your resources (time, staff and money) accordingly.

ANNEX 1

ENERGY MODULE FOR NATIONAL EXPENDITURE SURVEY
(YEMEN ARAB REPUBLIC 1987 - 1988)

A. HOUSEHOLD FUEL : Price, Quantity and Availability

Fuel	Unit	Price per Unit	Quantity Used per Period	Availability
Electricity	kwh			
Battery: wet	voltage ----			
dry cell	voltage ----			
LPG	cylinder			
Kerosene	liter			
Wood	kg. equivalent			
Charcoal	kg.			
Other Biomass	kg. equivalent			

CODE FOR AVAILABILITY COLUMN

1 = much more difficult to obtain than 2 years ago
2 = more difficult
3 = no change
4 = easier to obtain

B. HOUSEHOLD FUEL : Supply

Questions on the Supply of Each Fuel	Type of Fuel				
	LPG	Kerosene	Wood	Charcoal	Other Biomass
Source of Supply 1) own village/neighborhood 2) next village/neighborhood 3) outside of local area					
Transport of Fuel from Supply Source 1) by truck 2) by car 3) by motorcycle 4) by animal 5) by handcart 6) hand-carried 7) other					
Time Required to Go to Supply Source and Return Home (specify in hours and minutes)					

C. HOUSEHOLD FUEL : End-Uses and Equipment

End Use 1	Type of Fuel						
	Electricity	Batteries	LPG	Kerosene	Wood	Charcoal	Other Biomass
Cooking							
Water Heating							
Baking							
Space Heating							
Lighting							
Other							
1: List percentage of each fuel used for each relevant end-use							
Equipment (list how many of each are used by the household)	TV Lightbulbs Fluorescent lights ____ Hot water heater Air conditioner Radio Water pump _____ Refrigerator	(same as for electricity)	Cookstove: 1 pot 2 pot Light Other (specify)	Cookstove: 1 pot 2 pot Lamp: wick___ pressurized ____ Refrigerator Other (specify)	Cookstove: open/day ____ open/metal _____ enclosed/clay ____ enclosed/metal Other (specify)	(same as wood) + waterpipe	(same as wood)

D. HOUSEHOLD FUEL: Purchased vs Collected

How is Fuel acquired? (specify percent)	Type of Fuel		
	Wood	Charcoal	Other Biomass
Purchased Collected: from home garden from own land from others' land from public land			
Total	100%	100%	100%

E. For LPG Users

How many LPG cylinders does your household currently possess?

Filled _____

Empty _____

F. Electricity Users

Where does power come from?

YGEC _____

Local generator ____.

Own generator _____

Batteries : dry _____

liquid _____

ANNEX 2

INFORMATION TO BE GATHERED BY HOUSEHOLD ENERGY SURVEYS

A. Survey Form Identification

1. Name of head of household
2. Name of respondent
3. Name of interviewer
4. Date of interview
5. Time of interview start and finish
6. Location of household (city/quarter, district, town, village)

B. Economic and Demographic Background

1. Family size
2. Length of time in dwelling; is dwelling owned or rented
3. Ethnicity
4. Composition of household (spouse/s, children, other family members, domestics, others)
5. Number of people who can read and write (is household head literate? spouse?)
6. Where does household get public information from (TV, radio, print media, extension agents)
7. Distance of household from transport network (major road, river, rail-way, coast, airstrip)
8. Occupation of head of household; of other working members
9. Family expenditures and receipt of income (daily, monthly, annual)
10. Family savings
11. Amount of money set aside by household for daily purchases
12. For farm households:
    a) size of farm (ha)
    b) main crops and times of harvest
    c) livestock: number of cows, goats, chickens, other
13. For households with trees:
    a) type of tree formation (hedges, boundary trees, woodlot, natural woodland, trees in field, trees around house)
    b) over what area (ha)?
14. For urban households: any commercial activities by household?

C. Fuel Supply and Cost

1. For purchased fuel:
    a) types (wood, charcoal, agricultural residues, dung, kerosene, LPG, etc.)
    b) cost
    c) where purchased
    d) bought by cash, credit or barter
    e) who buys
    f) average quantity purchased (per day/week/month)
    g) frequency of purchase
    h) compare cost to one year ago (higher, lower, same)
    i) means of transporting purchased fuel to household
    j) seasonal variations in price and availability
    k) seasonal variations in use
    l) amount or percentage used for cooking; for other end-uses

m) amount of fuel consumed daily
n) moisture content (for biomass)
o) preferred fuel (for each end-use) and reasons for ference
p) any difficulties in obtaining fuel

2. For gathered fuel:
   a) types
   b) distance of gathering site from household
   c) travel time (round-trip)
   d) collection time
   e) load size
   f) means of transport to household
   g) who gathers fuel
   h) who owns land and/or fuel
   i) frequency of gathering
   j) compare availability to one year ago (more, less, same)
   k) quantity consumed daily
   l) seasonal variation in availability
   m) seasonal variation in use
   n) amount or percentage used for cooking; for other end-uses
   o) moisture content
   p) any difficulties in obtaining fuel
   q) preferred fuel (for each end-use) and reasons for preference

3. For purchased electricity:
   a) average bill and kWh (monthly, quarterly)
   b) price per kWh
   c) peak hours
   d) is connection shared with another household?
   e) source of supply (utility, private producer)
   f) reliability of supply
   g) appliance stock (wattage, number, type)

4. For own-generated electricity:
   a) installed capacity (kW)
   b) average use (hours per month, year)
   c) monthly/yearly consumption of fuel; type & cost of fuel
   d) any connections to other households and/or users?
   e) rate charged to others (for connection; per kWh)

5. Perceptions
   a) is fuel affordable?
   b) how much of household budget is spent on fuel?
   c) does fuel meet household needs?
   d) if not, why not?
   e) what alternatives exist?
   f) will they be used?
   g) what are the barriers to their use?
   h) are there problems with availability, price, distance, other?
   i) what energy-using equipment will be purchased in the coming month/year?

D. Cooking End-uses

1. Stove/oven type
   a) quantity possessed

b) cost
c) lifetime
d) frequency of use
e) fuel used (and preferred fuel, if different)
f) efficiency (measured in field and in lab)
g) production source: homemade (by whom), purchased, rented, traded or gift
h) who proposes/decides/pays for new stove/oven
i) what is good about stove/oven
j) what improvements can be made (owner and interviewer views)

2. Pots and pans
a) quantity
b) material (clay, aluminum, etc.)
c) size (diameter, depth)
d) cost
e) frequency of use
f) lifetime
g) used with which stove
h) number used per meal
i) who proposes/decides/pays for new pots and pans
j) do pots/pans have lids? are lids used?
k) production: homemade (by whom), purchased, traded, gift

3. Cooking habits
a) who cooks (spouse, family member, hired cook, relative, other)
b) average number of people at each meal
c) regular dishes (breakfast, lunch, dinner, snack)
d) for major staple food:
- which stove/oven is used?
- how often is staple cooked?
- which fuel is used to cook staple?
- which stove/fuel is preferred for cooking it?
e) cooking space (multipurpose area, separate kitchen, open air)
- is there a problem with ventilation and smoke?
- is kitchen shared with other household(s)?
f) flame heat used for cooking (high, low, adjustable)
g) are prepared foods or baked goods purchased? how often?

4. Attitudes towards change (interviewer explains change and potential savings)
a) would household use an improved stove/oven?
b) what is willingness to pay for fuel-saving stove/oven?
c) would household use more efficient pots and pans?
d) what is willingness to pay?
e) which of the following fuel-saving actions does/could be done?
- tend fire more carefully
- extinguish fire immediately after cooking
- assemble all ingredients prior to cooking in order to shorten time that stove/oven is used
- use aluminum instead of clay pots
- cover pot with lid while cooking
- warm water by placing container next to stove/oven
- use fire consecutively instead of re-lighting
- soak legumes
- serve foods that take less time to cook
- cook larger amount initially and re-heat
- serve cold cooked food

- serve raw food
- serve fewer meals
- simmer food instead of cooking at full boil

E. Non-cooking End-uses

1. List end-uses (lighting, water heating for washing/bathing/other, refrigeration, air conditioning, electrical appliances, other)
   a) purpose
   b) frequency of use
   c) method
   d) time of day most used
   e) fuel used

2. For electric lighting
   a) type (incandescent, fluorescent)
   b) power (watts)
   c) number of bulbs
   d) hours used per day

3. For non-electric lighting
   a) fuel
   b) type of lighting device (candle, lantern, etc.)
   c) efficiency (test in lab and household)
   d) cost
   e) where bought
   f) lifetime

4. For electrical appliances
   a) type
   b) quantity
   c) wattage
   d) hours used per day
   e) lifetime
   f) plans to buy additional appliances

5. For space heating/cooling
   a) fuel
   b) type of equipment
   c) efficiency (tested in lab and household)
   d) cost
   e) where bought
   f) hours used per day
   g) lifetime

F. Dwelling Characteristics

1. Type of accommodation (hut, house, apartment, other)
2. Age of dwelling
3. Walls (concrete, aggregate, wood, stone, mud, poles, mud/poles, other)
4. Roof (flat, pitched, tile, zinc plate, wood, other)
5. Number of rooms
6. Floor (concrete, tiled, earth, wood, other)
7. Number of stories

8. Heating
    a) season when heating is used
    b) method used to heat dwelling
    c) fuel used for heating
9. Cooling
    a) season when cooling is needed
    b) method used to cool house (equipment, passive/architectural)
    c) fuel used for cooling

G. Transportation (optional)

1. Type (motorcycle, car, jeep, taxi, truck, bus, tractor, boat, plane, animal)
    a) fuel (kerosene, gasoline, diesel oil, fuel oil, fodder, other)
    b) cost of fuel
    c) location of fuel source
    d) engine power (cc)
    e) is vehicle borrowed, rented or owned?
    f) any plans to get another mode of transport? why?
    g) number of each type of transport

2. Consumption
    a) reference period for trip information (day/week/month/year)
    b) frequency of trip
    c) average distance covered (km)
    d) total fuel consumption (liters, kg)
    e) average load factor (passengers, cargo)

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