CHAPTER 4
RESEARCH DESIGN

4.1 INTRODUCTION
Some part of the research design like sampling frame, sampling method and sample size, data analysis, etc., are already discussed in the previous chapter. However, being an empirical research the questionnaire design is the most crucial part of the research design in the present case. In this research study, it was decided to obtain the required information from the households, through a researcher administered personal interview using a structured questionnaire. It has been said that, our society is no longer an “industrial society” but an “information society.” That is, our major problems and tasks no longer mainly center on the production of the goods and services necessary for survival and comfort. Our “society,” thus, requires a prompt and accurate flow of information on preferences, needs, and behavior. It is in response to this critical need for information on the part of the government, business, and social institutions that so much reliance is placed on surveys (Scheuren, 2004). Surveys can be classified in many ways. One dimension is by size and type of sample. Surveys also can be used to study either human or non-human populations (e.g., animate or inanimate objects -- animals, soils, housing, etc.). While many of the principles are the same for all surveys, the focus here will be on methods for surveying individuals.

Many surveys study all persons living in a defined area, but others might focus on special population groups—children, physicians, community leaders, the unemployed, or users of a particular product or service. Surveys may also be conducted with national, state, or local samples.

Surveys can be classified by their method of data collection. Mail, telephone interview, and in-person interview surveys are the most common. Extracting data from samples of medical and other records is also frequently done. In newer methods of data collection, information is entered directly into computers either by a trained interviewer or, increasingly, by the respondent.
Mail surveys can be relatively low in cost. As with any other survey, problems exist in their use when insufficient attention is given to getting high levels of cooperation. Mail surveys can be most effective when directed at particular groups, such as subscribers to a specialized magazine or members of a professional association.

- Telephone interviews are an efficient method of collecting some types of data and are being increasingly used. They lend themselves particularly well to situations where timeliness is a factor and the length of the survey is limited.

- In-person interviews in a respondent’s home or office are much more expensive than mail or telephone surveys. They may be necessary, however, especially when complex information is to be collected.

Surveys can be further classified by their content. Some surveys focus on opinions and attitudes (such as a pre-election survey of voters), while others are concerned with factual characteristics or behaviors (such as people’s health, housing, consumer spending, or transportation habits). Questions may be open-ended (“Why do you feel that way?”) or closed (“Do you approve or disapprove?”). Survey takers may ask respondents to rate a political candidate or a product on some type of scale, or they may ask for a ranking of various alternatives.

The manner in which a question is asked can greatly affect the results of a survey. For example, an NBC (National Broadcasting Company)/Wall Street Journal poll asked two very similar questions with very different results: (1) Do you favor cutting programs such as social security, medicare, medicaid, and farm subsidies to reduce the budget deficit? The results: 23% favor; 66% oppose; 11% no opinion. (2) Do you favor cutting government entitlements to reduce the budget deficit? The results: 61% favor; 25% oppose; 14% no opinion (Scheuren, 2004). Thus, during surveys questions must be framed tactfully to extract maximum information which are reliable.

4.2 STEPS FOLLOWED IN DESIGNING THE QUESTIONNAIRE
A questionnaire is a formalized set of questions aimed at eliciting information regarding facts, level of knowledge, attitudes, needs and motivations. As suggested by Krishnaswamy et al., in
their book titled "Management Research Methodology", at the current level of standardization of
the design of questionnaires, it can be treated more as an art than as a science (Krishnaswamy et
al., 2006). The cardinal approach to developing a questionnaire is to make it simple and avoid
the inclusion of ambiguous and leading questions. The steps followed in designing the
questionnaire for this study are explained below:

**Step 1: Information sought**
The variables under each one of the factors listed in section 3.2.1 guided the information
required.

**Step 2: Type of questionnaire**
It was decided to use a structured questionnaire with few open ended questions thrown at the end
to facilitate discussion. There were some variables which needed more than one question to be
asked and this was incorporated in the design. The overall response was then gauged by
summing up the ratings of individual responses and then checking as to in which range the sum
falls.

**Step 3: Method of administration**
Because some questions required eliciting information regarding behavior – past and present—
and intended attitudes and opinions, it was decided to administer the questionnaire through an
interview by the researcher.

**Step 4: Form of response**
To facilitate measuring the strength of the respondent’s answer and also because of large number
of alternatives possible, only structured questions were used for the main part of the
questionnaire.

**Step 5: Wording and phrasing of questions**
In accordance with the cardinal principle of maintaining simplicity, all questions were made
simple and straight forward.

**Step 6: Sequence of questions**
The sequence was decided entirely by the order of the factors and the variables under each factor
as listed under section 3.2.1. Simple questions like, location, family background, etc., were
included in the beginning. Care was taken to see that questions are free from any bias in the
beginning. This also resulted in neutral questions being asked in the beginning.
Step 7: Layout of questions
The format and the layout of the questionnaire was physically designed to eliminate recording errors avoiding branching of questions and no codes were used.

Step 8: Iteration
Steps 1 to 7 were followed through several iterations before pretesting.

Step 9: Pre-testing and revision of questions
Pilot study was carried out with a sample of 50 households to validate the questionnaire and the method of administration.

4.3 MEASUREMENT SCALE SELECTION
A research is as good as the data which goes in to it. Data, when used for some quantitative analysis is as good as the measurement done on it. It would not be an exaggeration to say, therefore, that a research is as good as the measurements made in it. Measurement is, thus, is the most vital part of any research study. Measurement is inalienably bound to scaling, which can be thought of as the continuum on which measurements are made and the measured entity is located. Experts in the field of empirical research (Krishnaswamy et al, 2006) have mentioned about three major ways of obtaining measured data: (i) administering a standard instrument already developed, tested and validated by others; (ii) administering an instrument that is specially developed by the researcher and (iii) recording of already measured data.

For this study, because of the nature of the data being collected (most of the questions are related to attitudes, opinions and categories), it was decided to use Likert scale to measure the strength of the respondent’s answer. The Likert scale has several advantages: It is relatively easy to construct a Likert scale and can be performed without a panel of judges. It is also considered to be more discriminating and reliable because of larger range of responses typically associated with it (Boyd et al., 1986, Kothari, 2007). Though it has some limitations, some of them are met by using a cumulative scale as has been done in this study. For ease of analysis a score ranging from 1 to 5 has been used, with 5 and 1 indicating the most and least favourable responses respectively.
4.4 THE QUESTIONNAIRE

The way in which specific questions were designed and formulated is explained here. (The entire questionnaire is shown in Appendix 4. For postulations regarding the direction of influence of all the variables refer to section 3.2.2).

The questionnaire was titled “Survey of the Urban Households’ Attitude in Choosing Energy Efficient Technologies”. Part 'A' of the questionnaire dealt with the Survey form identification, where-in the identity of the household is established (Name of the respondent, Profession and Location of the household).

Part 'B' of the questionnaire dealt with Demographic and Economic background. The variables covered under this factor are: Family size, Type of residence, Ownership of residence, Size of the house, Educational qualification of the head of the household, Annual income, Ownership of energy consuming assets and Monthly expenditure. As Likert scale rating of 5 to 1 is used, the range for all variables is divided into 5 sub groups. Accordingly Family size is subdivided into (a) Six and above (b) Five (c) Four (d) Three (e) Two and below. This was done after referring to NSSO household expenditure data and Mysore district statistics data (NSSO, 2008, Zilla Panchayat, Mysore, 2007).

Under type of residence, the categories were (a) Farm house and the like (b) Independent multiple floor (c) Independent single floor (d) Apartment – above 2 bed rooms (e) Apartment up to 2 bed rooms. For this variable and for Ownership of residence and Size of the house, discussions with the real estate agents and MUDA (Mysore Urban Development Authority) officials helped in forming the categories. Under Ownership of residence, five different types were considered: (a) Own (b) Long term lease (c) Company lease (d) Rented (d) Others ( Joint ownership and the like). As the study is focused on Middle, Upper middle and High income group households, the size of the house categories were chosen accordingly: (a) 2600 sq ft (square feet) and above (b) 2100 to 2600 sq ft (c) 1600 to 2100 sq ft (d) 1200 to 1600 sq ft (e) 1200 sq ft and below.
The five categories chosen under Educational qualification of the head of the household are (a) Doctorate (Ph.D) (b) Post Graduate (PG) (c) Graduate (Bachelor's Degree) (d) Plus two (PUC) (e) SSLC (Secondary School Leaving Certificate) and below.

Choosing categories under Annual Income posed a great challenge because of the difficulties of measuring or even gauging the true income of a household in the Indian context as discussed under section 3.4. The pilot study greatly helped in formulating the categories under Annual income to somewhat satisfactory level. Even here some stout assumptions were required to be made. One particular problem which deserves mentioning here especially with respect to salaried households is that, in India after the implementation of the Sixth pay commission report, the annual income of most of the salaried households has gone up substantially but their life styles have not changed much. Most of the households have invested their extra income in buying a house and then a car and hence it will be some time before their life style changes from what it was during the period of the survey. So we had to judge the income group of the households by their ownership of assets. Accordingly the following Annual income groups are used for the study: (a) Above ₹8 lakhs (b) ₹7 lakhs-8 lakhs (c) ₹6 lakhs-7 lakhs (d) ₹5 lakhs-6 lakhs (e) Below ₹5 lakhs.

Literature survey and thorough discussions with the experts helped in forming a list of energy consuming assets generally owned by the urban households. During the interview the households were asked as to which of these assets they own and provision was made to add any other asset that the household possessed. For scaling purpose, the following categories were formed: (a) More than 35 (b) 30-35 (c) 25-30 (d) 20-25 (e) below 20.

For monthly expenditure of households, figures quoted by Max-NCAER (National Council of Applied Economic Research) survey and NSSO were used to begin with (Shukla, 2007, NSSO, 2008,). But probably because of large regional disparities found in India, the pilot study revealed that, these figures needed a substantial scaling-up. Accordingly, the following categories were used for the final study: (a) Above ₹25000 (b) ₹20000-25000 (c) ₹15000-20000 (d) ₹10000-15000 (e) Below ₹10000.
Part 'C' of the questionnaire was connected with The Possession and Awareness about EETs and the variables covered under this factor are: Awareness about energy efficient technologies, Number of energy efficient technologies owned by the household, Degree of satisfaction derived, The importance of technology, Awareness about environment, Awareness about energy consumption and Energy conservation habits.

The household’s Awareness about EETs was measured by asking the respondents about the characteristics of EETs. Some of the characteristics that households were expected to know are: EETs provide the same service consuming less energy, EETs use renewable energies, EETs result in lesser carbon emissions, EETs do not degrade the environment and they are sustainable. Like ownership of energy consuming assets, the ownership of EETs also was measured by preparing a list of possible EETs available in the market that the households can afford and enquiring as to how many of these EETs the household had?

Because it was hypothesized that a household which is largely satisfied with the existing EETs that it has, is more likely to show a greater adoption of EETs, the households were asked as to what extent they are satisfied with the EETs that they already had. Under the Importance of the technology of the device, it was required to measure as to what extent the household wants a particular EET to be a nice technically packaged device. The hypothesis here was that, a household which does not bother much about the technical packaging of the EET, is more likely to show a greater adoption of EETs. To measure this, households were asked to mention the importance that they give for the following technical aspects of an EET: (i) Design aspects (quality, reliability, maintainability etc.) (ii) Compatibility with other devices (iii) Aesthetics (iv) Ease of operation and (v) After sale service.

To measure the Awareness of the households about general environmental issues, the households were asked as to what they knew about some of the commonly encountered environmental issues by them in their everyday lives like: Bio-diversity, Sustainable development, Global warming, Global climate change and Ozone layer depletion. The depth of awareness of the households
about these issues gives the overall awareness of the households about general environmental issues. Similarly, the Awareness of the households about energy consumption facts was measured by asking households a few questions about some general energy consumption facts like Per capita energy consumption in India as compared to the rest of the world, Household sector energy consumption in India relative to other sectors, Qualitative measure of the amount of energy that can be saved through energy efficiency and conservation measures and their knowledge about Energy related pollutions.

Under Energy conservation habits of the households, the ability of the households to suggest and recollect ways of efficient energy usage was directly taken as a measure of their Level of energy conservation practice.

Part 'D' of the questionnaire was related with Personal / Behavioral factor and the variables considered under this factor were Concern for environment, Ego, Attitude towards change, Technology-savvy, Willingness to invest and Willingness to adopt.

The households’ concern for environment was measured by asking them three specific questions. The first question was about their view on the balance to be achieved between protecting the environment and the economy. Households which gave top priority to the protection of environment are assumed to show a greater adoption of EETs and CHs. The second question was about the strength of their agreement about the fact that the households should contribute willingly towards energy efficiency as it can make a difference to the society. The third question asked them to suggest some ways of reducing urban pollution. The Ego factor measures how much proud the household feels in owning EETs. This was measured by measuring the strength of the household’s agreement about treating an EET as a status symbol and feeling proud to display its stock of EETs. The households’ attitude towards change was measured by asking them as to what extent they were ready to change their life style, in order to accommodate EETs.

The technology-savvy nature of the household is another variable which is assumed to be influencing the adoption of EETs and CHs. If the household as a whole is interested in the use of
technical gadgets, it is assumed to be tech-savvy. This was measured by asking the household as to whether it feels that using technical gadgets makes life more interesting? Most of the households came up with spontaneous arguments for and against this factor.

Because EETs generally require initial investment, it was felt necessary to ask whether the household is ready for this. For this the household was directly asked as to whether it was ready to pay extra for EETs. The use of certain EETs may require the households to spend some time in getting acquainted with their usage, so that maximum benefit can be drawn from its usage. For this, the households were asked whether they were willing to devote some time to learn the proper usage of an EET. The strength of their response was taken as a measure of the households’ willingness to adopt EETs.

Part 'E' of the questionnaire is connected with the financial issues and the specific variables covered under this factor are Income, Savings from energy efficient devices, Initial investment and Running cost.

Under the income variable the emphasis was on measuring the impact of the household’s change in income upon the adoption of EETs. Hence, the households were asked as to whether they will increase their investment in EETs proportionately, if there was an increase in their income in the near future. Obviously the household’s opinion about the savings that may result on account of the use of EETs and CHs will have a bearing on the adoption of EETs and CHs. Hence, the households were asked as to how much do they think would be the savings on account of adoption of EETs and CHs. Under Initial investment, the objective was to measure the importance attached by the households to the Initial investment of an EET. Hence, the households were directly asked to mention their importance to the Initial investment of an EET. It should be mentioned here that this question also serves the purpose of cross checking the answer obtained for the question on the households’ willingness to invest in EETs. Opinion of the households about the running cost of an EET is another important financial variable influencing the adoption of EETs. Here again the households were asked to mention the amount of maintenance cost that they think was associated with the usage of EETs.
Part 'F' of the questionnaire deals with the influence of the Government policies on the households' adoption of EETs and CHs. The variables considered under this factor were: Subsidies, Regulations, Incentives, Facilitation, Product information, Adequacy of information and Risk coverage.

Under the first variable 'Subsidies', the households were asked whether they feel Subsidies were required for promoting adoption of EETs? It is important to remember here that the hypothesis is: a household which does not feel the need for subsidies by the government is more likely to show a greater adoption of EETs. As it is hypothesized that a household which feels that government interventions in the form of introducing strict regulations for the adoption of EETs and CHs is not necessary and the households should take up these things on their own, is more likely to show a greater adoption of EETs and CHs, the households were asked about their opinion with respect to the need for government regulations for enforcing the adoption of EETs and CHs.

Under 'Incentives', the households were asked about the incentives that the government was providing. It should be mentioned here that a household which feels that the government is already providing lot of incentives and there is no need to further enhance it, is more likely to show a greater adoption of EETs and CHs. Under 'Facilitation', the households were asked about the efforts that the government was exerting in things like providing well structured markets, approved suppliers and so on. Again, here the hypothesis is that a household which feels greatly satisfied with the government efforts, is likely to show a greater adoption of EETs and CHs.

Under 'Product information', the households were asked whether they need product information in the form of 'energy labeling', 'star ratings' and others, for them to adopt EETs? The assumption here again is that, a household which says that it doesn’t need any such information is likely to show a greater adoption of EETs and CHs.
Under 'Adequacy of information' the households were asked whether they were satisfied with the amount of information about EETs that they were getting from various agencies. A household which is quite satisfied with the information that it is getting is assumed to show a greater adoption of EETs and CHs. Under 'Risk coverage', the households were asked whether they need risk coverage in the form of say insurance, for them to adopt EETs and households which disagreed were assumed to show a greater adoption of EETs.

The last part of the questionnaire (part 'G') consisted of additional open ended questions which may help in some general discussion about the attitudes of the households in adopting EETs and CHs and also about other related issues.

In conclusion, this chapter has provided a detailed account of questionnaire design along with the hypothesis and measurement scaling. This facilitates better comprehension of the conclusions drawn based upon the statistical analysis of the responses to these questions.

4.5 VALIDITY AND RELIABILITY

Questionnaires as measuring instruments should be both valid and reliable. In management research, establishing validity and reliability is complex, especially when behavioral and psychological properties are being measured. There is always a chance that measurements may be of doubtful validity and reliability. Hence, validation assumes great importance.

4.5.1 Validity

The most common definition of validity is epitomized by the question “Are we measuring what we think we are measuring?” (Krishnaswamy et al., 2006). Validity refers to the degree to which the instrument measures what it is supposed to measure. Validity can also be thought of as utility (Kothari, 2007). In other words validity is the extent to which differences found with a measuring instrument reflect the true differences among those being tested. One of the methods used to determine the validity of a questionnaire is, to use a panel of experts who shall judge how well the measuring instrument meets the standards. This method was used in this study to establish the validity of the questionnaire. A panel of five experts was used and their suggestions
were incorporated in the questionnaire design. This ensured the Content validity of the questionnaire. Because of the difficulties involved in estimating the other two types of validity, namely: Criterion related validity and Construct validity, individual and expert judgment was resorted to, to assure these validities (Kothari, 2007).

4.5.2 Reliability
Reliability refers to the consistency of measurement. If the reliability is satisfied by an instrument, then one can be confident that transient and situational factors are not interfering. This implies that Reliability is stability, dependability and predictability. It is known that, the square of the simple correlation coefficient which gives the proportion or percentage of the variance shared by two variables is the coefficient of determination. Reliability coefficient is also a coefficient of determination. Theoretically it measures how much variance of the total variance of a measured variable is ‘true’ variance. The reliability coefficient can be obtained by correlating the true scores with the scores of the measured variable and by squaring the resulting correlation coefficient. This explains the basics of the most widely used measure of Reliability—the Cronbach’s alpha. In this research work, after the pilot study, the Cronbach’s alpha was computed using SPSS version 14.0 software and it yielded a value of 0.641 which is considered to be satisfactory in exploratory studies. Since Cronbach’s alpha is interpreted as a correlation coefficient its value ranges from 0 to 1. Larger the value of Cronbach’s alpha, greater is the reliability. It is also true that as sample size increases the value of Cronbach’s alpha also increases (SPSS manual, 1990). The reliability test was also ran after the full blown study and the Cronbach’s alpha was found to be 0.676. Thus, the reliability of the findings of the study is established statistically.

As mentioned above, most of the statistical analysis was carried out using SPSS version 14.0 software. The details of the preliminary statistical analysis and the modeling techniques used along with the results are explained in the subsequent chapters.