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Ms. Debra Justus
Agency for International Development
Office of Energy
S.A. 18, Room 508
Washington, DC 20523

RE: Grant No. DAN-5128-9-3069-00

Dear Ms. Justus:

Enclosed please find five copies of "The Transition to Commercial Energy in Developing Countries: A Case Study of Households in Indian Cities," a report which completes our obligation under the above-referenced grant.

We welcome your comments on the report, particularly as it may serve as a precursor to a longer, book-length manuscript undertaken by our collaborators at Osmania University and intended to elaborate on many of the issues. Please direct your comments to Dr. Molly K. Macauley, at (202) 328-5043.

Yours sincerely,

Joel Darmstadter

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Enclosures

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THE TRANSITION TO COMMERCIAL ENERGY IN DEVELOPING COUNTRIES: A CASE STUDY OF HOUSEHOLDS IN INDIAN CITIES

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This paper is circulated for information and discussion. Comments are welcome.

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The views expressed in this paper are those of the author and should not be interpreted as representing the views of either the Agency for International Development, Osmania University, Ravishankar University, the University of Kashmir, or Resources for the Future.

THE TRANSITION TO COMMERCIAL ENERGY IN DEVELOPING COUNTRIES: A CASE STUDY OF HOUSEHOLDS IN INDIAN CITIES

I. Introduction and Summary

The transition in developing countries from traditional to commercial fuels is one of the least understood and under-researched areas of energy analysis.[1] Yet this transition figures prominently in major policy problems, ranging from the adequacy of energy resources in these countries, to the role of energy in economic growth and income distribution, to the relationship of use and environmental degradation. The substitution of petroleum for fuelwood, for example, may relieve pressure on forest resources (in turn, reducing erosion and flooding), but also leads to larger oil import bills and fewer opportunities for poor households to modernize their use of energy. Understanding patterns of economic substitution among fuels remains incomplete, just as does research on the links between fuelwood demand and deforestation.[2] Consequently, the interaction of demand between traditional and commercial fuels has become an area of significant policy interest.

A major sector where the transition from traditional to commercial fuels is taking place is in urban households. This study investigates this sectoral transition in Raipur, a city in the Indian state of Madhya

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1. In this study, the generally accepted distinction between traditional and commercial fuels is adopted: traditional fuels include wood, charcoal, and animal and crop wastes, and commercial fuels include petroleum products, natural gas, coal, and electricity. The distinction has been made on the basis of the typical trading of commercial fuels in commercially organized markets, although the distinction can become blurred, especially in urban areas. See discussion in Dunkerley, Ramsay, and coauthors (1981, pp. 45-46).

2. For an up-to-date overview of the gamut of these issues concerning energy and developing countries, and an excellent bibliography, see International Development Research Centre (1986).

Pradesh. The focus of the study is on the use of energy for cooking, estimated to constitute about 80% of household energy consumption in developing countries.[3] Using household survey data, the study identifies patterns of commercial and traditional energy consumption as determined by relative prices of energy, family income, and family size.

This approach closely follows an earlier study by Alam, Dunkerley, and coauthors (1984) that investigates household energy use in Hyderabad, the capital of the state of Andhra Pradesh. Conforming to the framework of the Hyderabad study is intended to improve understanding of interurban patterns in the sectoral fuel transition. In addition to differences in average income between the two cities, variation in fuel prices might also be expected to affect household energy use. In particular, climate and resource endowments, which can be significant determinants of fuel prices, are quite different between Hyderabad and Raipur. Hyderabad is located in a southern, semi-arid region with limited forest resources; Raipur is situated in humid central India and has abundant forest resources (see map in figure 1). Recognizing and measuring such interurban differences may improve national energy policymaking. Likewise, policies that directly or indirectly alter urban income distributions or relative prices may have consequences for patterns of energy use.

In addition to an investigation of interurban variation within India, the Raipur study, like the Hyderabad research, contributes methodologically to the sparse literature on energy use in developing countries. The contribution arises primarily because both studies are based on survey data collected expressly for the studies. Although survey-based analysis is

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3. See Cecelski, Dunkerley, and Ramsay (1979, p.7).

becoming more frequent,[4] researchers in large part have had to rely only on highly aggregated, nationwide data or secondary data to understand energy use in developing countries.[5]

Among the conclusions of this study are:

-- Mean monthly per capita consumption of energy for cooking in Raipur is close to reported estimates for households in other areas of India.

-- Wood is the predominant cooking fuel. Households at all income levels, except a small percentage of those with the highest incomes, use wood for 36% to more than 80% of cooking-energy consumption.

-- The average use of liquified petroleum gas (LPG) for cooking approaches at most about 40% among only 3% of the highest income households.

-- Certain traditional and commercial fuels are often jointly used -- wood and kerosene, in low- and middle-income households, and charcoal or coal, together with kerosene, found in small amounts at all income levels. Thus, traditional and commercial fuels appear imperfectly substitutable, or in fact may be complements rather than substitutes. Fuel complementarity may prevail in the case of consumption of charcoal and kerosene or coal and kerosene, reflecting in particular the use of traditional stoves to prepare certain foods (a practice that other research has found to characterize many households irrespective of income).

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4. For example, recent analyses based on survey data include Sazama's (1986) study of Costa Rica and Down's (1985) research on Indonesia.

5. See Dunkerley, Ramsay, and coauthors (1981, chapters 2 and 3), Cecelski, Dunkerley and Ramsay (1979); or Henderson (1975).

-- Scale economies with respect to household size are evident in the use of energy for cooking.

-- Income elasticities for energy are commensurate with elasticities estimated in the Hyderabad study and elsewhere. The elasticities indicate that a 10% increase in income will increase energy demand about 5%. Increases in income also increase the share of LPG, and decrease the share of wood, in energy expenditures.

-- Levels of total energy consumption in Raipur and Hyderabad are quite similar, and may be explained by the nearly identical mean household incomes and income distributions between the cities. Energy expenditures are larger in Raipur, however, possibly due to differences reported in fuel prices in each city (leading also to different fuel mixes for households).

The next section of the study describes the survey. Part III presents analytical results for Raipur, and part IV offers comparisons with Hyderabad. The concluding section suggests directions for further research.

II. The Raipur Survey

The survey was administered to 495 randomly sampled households in the city of Raipur during 1985. Information was collected regarding household size and age composition, income, education, occupation, and housing. Questions about energy consumption included types and quantities of energy used for cooking in the household, energy expenditures, appliance

ownership, and fuel preferences. Additionally, the survey gathered information on seasonal variations in fuel consumption, the types of energy-using activities undertaken by the household; and changes in energy use over the last ten years. Appendix A contains a copy of the survey.

The variables selected for this study include:

1) Monthly household income;
2) Number of adults in the household;
3) Number of children in the household; and
4) Monthly household consumption of and expenditures for these fuels in cooking:
   a) fuelwood;
   b) charcoal;
   c) coal;
   d) kerosene; and
   e) liquified petroleum gas.[6]

Where possible, this information was cross-checked for consistency with more qualitative questions asked during the survey; for example, information regarding the price and quantity of coal used by the household was compared with the household's answer to a separate question, "Do you use coal?" About six percent of the 500 observations were eliminated from the sample because of a missing or inconsistent response to at least one of the selected variables.

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6. Fuels included in the survey but omitted from the analysis account for only about 5% of total cooking energy in the sample. The omitted fuels are sawdust, charcoal briquettes, bio-gas, coke, crop wastes, dung, and electricity. Electricity is used primarily for lighting.

III. An Overview of Household Energy Use in Raipur

This section describes the results of the survey. Patterns of energy use as measured by quantities consumed are reported first, followed by an analysis of energy expenditures.

Energy Consumption

Table 1 offers a starting point for depicting general patterns of household fuel use as reported in the survey data. The table presents data on energy consumption by type of fuel and across income classes. As indicated, the mean monthly household consumption of energy for cooking in Raipur in 1985 was 1.8 million Btu's.[7] In per capita terms this represents about 3.2 million Btu's annually, an amount comparable to estimates for urban households in other Indian cities.[8] Wood is the predominant source, accounting for about 60% of total cooking energy. LPG, charcoal, kerosene, and coal each comprise some 8 to 12% of the total.

Because the physical combustion efficiencies of these fuels vary widely, and because combustion efficiency transforms fuel into the actual energy services used by households, it is also informative to convert the energy "input" data to energy "output" data. Both measures provide

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7. Appendix B lists the Btu-equivalent conversion factors for each fuel.

8. The per-capita amount for Raipur is based on average family size as measured by the survey. Estimates for other cities are noted in Cecelski, Dunkerley, and Ramsay (1979, pp. 15-17). These cities include Delhi and Bombay, where per capita consumption among lower-income households in the mid-1970's was estimated at 4.5 to 5.4 million Btu's; assuming that about 80% of household energy use is for cooking (as noted above) results in 3.6 to 4.3 million Btu's per capita. These lower-income households may be reasonably comparable to average-income households in Raipur, because mean income in Raipur is less than in Delhi and Bombay.

insights into research and policy questions related to energy use; for example, input quantities indicate the level of demand for energy resources such as petroleum or wood, and output quantities indicate the approximate extent to which resources are physically substitutable while maintaining a given level of energy services.[9] The most notable effect of the conversion to output energy units is the significant disparity between the efficiencies of traditional and commercial fuels. Cooking with wood and wood-derivatives such as coal and charcoal is highly inefficient; cooking with LPG and to a lesser extent kerosene is much more efficient. For instance, only about 30% as much LPG (in Btu's) is necessary to supply the same level of cooking services provided by a given quantity of wood. As discussion of the conversion measurements indicates, much of the disparity is attributable to the contribution of the cooking medium (as examples, an open fire or an LPG stove) to energy efficiency.[10]

Table 2 displays the data from table 1 converted to output energy. Reflecting the effect of using converted units to measure output energy, the ratio of average total output and input energy is about 25%. Compared with the large share of wood in input energy, wood and LPG together account for the largest shares of actual energy services as measured by output energy (42% and 28%, respectively). The share of kerosene is also large (18%). Shares of charcoal and coal are comparatively small (8% and 3%, respectively).

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9. Although the distinction between energy input and output is widely acknowledged, conversion factors that accurately adjust for differences in qualities of a given fuel -- say, various types of wood or different cooking techniques that may affect fuel efficiency -- are more difficult to specify. Appendix B lists the factors used here and the sources for this information. In addition, an informative discussion of combustion efficiency is in International Development Research Centre (1986, especially pp. 84-85).

10. See reference in preceding note.

Tables 1 and 2 also illustrate marked differences in the specific fuels used as household income varies. Average monthly household income in the sample is about 1400 rupees (Rs); about 75% of the sample households are at or below this income level. Among households with below-average income, wood supplies from 50 to more than 80% of input energy. Even middle- and above-average income households use wood for as much as 36 to 45% of input energy. Only the highest income households, with at least twice the average income, use wood in amounts approaching 10% or less of their total input energy. These households represent about 6% of the sample population.

The use of LPG sharply contrasts with this pattern of wood consumption. LPG as an energy input is used only in small amounts at the lowest incomes. It comprises 12 to 18% of input energy for a large range of middle incomes, and from a fourth to a third of input energy among above-average income households. The use of LPG approaches at most about 40% among only 3% of the highest income households.

Charcoal or coal, together with kerosene, supplement the input energy requirements of all households, although charcoal, rather than coal, tends to be used by households with middle and above-average income.

A similar pattern of the income-related use of specific fuels describes the share of fuels in providing actual energy services, as indicated in table 2. Because wood, charcoal, and coal have lower combustion efficiencies than LPG or kerosene, these fuels contribute less to output energy than to input energy. Even in terms of output energy, however, wood continues to supply from nearly 40 to some 70% of energy services in average and below-average income households. Kerosene also provides a large share of output energy for these households, and LPG

supplies more than 25% of energy services for households with incomes as low as 1250 Rs. The output share of LPG also rises more sharply with income than its share in energy input.

The tables indicate the proportional use of kerosene and coal, and to some extent, kerosene and charcoal, at incomes up to about 2500 Rs.[11] The use of a chulah, a traditional stove which requires combining coal or charcoal with kerosene, may underlie this pattern of proportional quantities; the prevalence of the pattern across income groups may reflect household preferences for the taste imparted by chulahs.[12]

Tables 3 and 4 make possible additional inferences about fuel patterns by reporting the number of households using various combinations of fuels. The use of several fuels may reflect the desire to be able to substitute among fuels as a safeguard against shortages of some fuels,[13] or patterns of complementarity across fuels.

As tables 3 and 4 suggest, wood and kerosene (which can also be combined in a chulah), and to a lesser extent, wood, kerosene, and coal are the most likely combinations among lower-income households (less than 1250 Rs.). Combinations of wood and kerosene or LPG and kerosene are most frequent among middle- and upper-income groups. Some higher-income households also combine LPG, kerosene and charcoal. Only the highest-

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11. The particularly large amount of charcoal used by households with incomes of 3000-4000 Rs. (see tables 1 and 2) may reflect reporting errors, in that these data appear inconsistent with the patterns otherwise prevailing for this fuel at these higher income levels.

12. See Kharbanda and Qureshi (1985, p.63) for evidence of household preferences for chulahs. A survey of appliance ownership in Calcutta also indicates the use of chulahs at all income levels. See Cecelski, Dunkerley, and Ramsay (1979, p. 26).

13. For instance, see discussion in Alam, Dunkerley, and coauthors (1984, p. 66).

income households in the sample use one fuel exclusively; about 38% of households with incomes over 4000 Rs. use LPG alone.

Energy Expenditures

Table 5 illustrates the relationship between household energy consumption, energy expenditure, and income. Spending on energy inputs increases with income, reflecting the higher prices of those fuels that comprise the energy mix of higher-income households. As the price data in table 6 indicate, the Btu-price of LPG, for instance, is nearly three times as large as that of firewood. As a percent of income, energy expenditures decline as household income rises. In addition, total energy consumption per household increases more rapidly with income when output energy is measured than when input energy is measured. This suggests that cooking may involve more or larger meals as households use more efficient types of energy, or that associated with more efficient energy are additional attributes, such as convenience, cleanliness, or taste (this point will be discussed further below).

Larger household incomes partly reflect larger household size, however (see table 7). For this reason, the regression results described in table 8 are helpful in disentangling the separate effects of household income and size on energy consumption and expenditure. The regressions relate household energy input, output, and expenditure to income and size. As is typical of empirical evaluations of household consumption, variables are expressed in logarithms to capture the nonlinearity of the size distribution of income (in general, and as will be discussed later, in this

study, income distributions tend to be skewed towards low- and middle-income households).[14]

As is also typical, household size is scaled to account for differences in the age composition of households. Accordingly, household "equivalent size" is a weighted sum of the number of adults and children, with weights declining for additional adults and for children. For this study, weights are 1 for the first adult, .64 for each additional adult, and .37 for each child.[15] Reported household size and equivalent measures are both listed in table 7. As the table demonstrates, scaling reduces the variation in household size across income groups and increases the variation in mean monthly per capita income.

Table 8 lists regression results. Equations (a) and (b) confirm that energy consumption increases slightly with income, even after controlling

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14. The functional form used here is double logarithmic, in that both the dependent and independent variables are expressed as logarithms. This form corresponds to that used in the Hyderabad study, although there are other functional forms that are often used. Among the implications of the double-logarithmic form for the underlying nature of demand for energy are that 1) the elasticity of demand is constant with respect to income, and 2) the so-called "adding up" constraint is not necessarily satisfied ("adding-up" requires the weighted sum of income elasticities over all (energy and non-energy) components of household demand to equal 1, where the weights represent the share of each component in total household expenditure). The first implication is a testable hypothesis, but insofar as constant elasticities are estimated in most studies, including those of developing country energy patterns to be discussed below, the assumption is retained for purposes of this study. The second implication has been found to bias parameter estimates less in cross-section data, as are used here, than in time-series data. For additional discussion, see, among others, Deaton and Muellbauer (1980) and references cited therein, and with special reference to energy consumption, Lareau and Darmstadter (1983, especially pp. 74-75), and Bohi (1981). Future research on developing country energy demand might address both issues.

15. These weights are reported in Layard and Walters (1978, p. 450). As reported, the weights for children vary with age. Because the Raipur data do not include age information, children receive the average value noted above.

for household size, but that consumption of output energy is more responsive to changes in income than is input energy. Because the regressions are estimated in logarithms, the coefficients can be interpreted as elasticities. Both input and output energy are thus normal goods, in that their estimated income elasticities are positive and significant, and necessities (as opposed to luxury goods), in that the elasticities are less than one. A 10% increase in income generates an estimated increase in the consumption of input energy of about .9% and of output energy of about 5%, almost six times the increase in input energy. Increases in income thus appear to lead to small increases in energy consumption, and also to substitution towards more efficient types of energy.

Economies of scale in energy use are also evident, in that energy use increases less than proportionately with household size. Scale effects are more pronounced for output energy, as an increase in household size leads to a smaller increase in consumption of output energy than of input energy. Again, this result reflects the effect of the composition of types of energy with respect to energy efficiency; households cooking more or larger meals because of larger household size increase their consumption of energy, but by slightly less in output terms than in input terms.

Another way to demonstrate the relationship between income and energy consumption is using expenditure information. Regression (c) in table 8

indicates that spending on energy increases with income, holding household size constant.[16] Expenditures as a percent of income vary with income by the amount (b-1), where b represents the coefficient on (ln Y) in regression (c).[17] Because the estimated coefficient is less than one, expenditure as a percentage of income decreases with income.

The expenditure elasticity (as distinguished from the income elasticities described above) is measured by reported household expenditure on input energy (that is, using input quantities and input prices, rather than quantities or prices reflecting efficiency adjustments noted earlier). Thus, the elasticity reflects the response of actual spending by households to changes in income. Because expenditure and income elasticities are algebraically equal for commodities that do not require input versus output measurement, it is instructive to observe that the expenditure elasticity estimated here more closely approximates the income elasticity measured with respect to output rather than input energy.[18] The probable reason for this result is that the response of expenditure to a change in income

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16. Estimating expenditure patterns using cross-section data, as is done here, frequently involves the problem of heteroskedasticity. The problem arises when the error term is correlated with income; low-income households spending a larger proportion of income on necessities, for example, are likely to have lower unexplained variance than high-income households having more discretionary income. Tests for heteroskedasticity did not indicate it to be a problem in the Raipur data, however. Results of the test are available from the author.

17. This result follows because of the use of logarithms in the functional form for the regressions: $\ln (EXP/Y) = \ln EXP - \ln Y = a + b \ln Y - \ln Y = a + (b-1) \ln Y$, where EXP and Y denote energy expenditures and income, respectively.

18. The algebraic derivation of income and expenditure elasticities is straightforward. Regression results should yield roughly equal elasticity parameters but different intercepts, which are shifted because the expenditure equations are the quantity equations scaled by the price terms. For discussion of both points, see Deaton and Muellbauer (1980, p. 19).

involves interfuel substitution towards more efficient fuels (as income increases). Thus, input quantities weighted by prices (that is, energy expenditure as used in regression (c)) approximate the levels of actual energy services purchased by households (that is, reflect energy efficiency). Moreover, the expenditure elasticity probably captures the effects of nonefficiency attributes of fuels, such as taste or cleanliness, that higher-income households demand.[19]

Expenditure on specific fuels as a percent of total energy expenditure also varies with income, as indicated in regressions (d) and (e).[20] Increases in income lead to decreases in the share of spending on fuelwood, and increases in the share of spending on LPG.[21] Regressions analogous to (d) and (e) for kerosene, coal and charcoal perform quite poorly on the basis of summary statistics, and income is not a significant determinant of spending on these fuels. As noted earlier, it appears that households tend to use some quantities of these fuels irrespective of household income.

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19. See Behrman and Deolalikar (1987) for discussion of this point in the case of food and nutrients. In that case, the total expenditure elasticity for nutrients is overstated by the total expenditure elasticity for food, because the demand for nonnutritive qualities (convenience, appearance, taste) also responds to income and hence influences the measurement of food expenditure elasticity.

20. In equations (d) and (e), expenditure on specific fuels is expressed as a share of total energy expenditure to better satisfy the adding up constraint mentioned above. See also discussion in Deaton and Muellbauer (1980, pp. 17-18). The variables in these equations are expressed per capita.

21. The sample for each regression includes only those households reporting use of the fuel in question; it can be shown that the estimated coefficients may be biased towards zero (in other words, households who do not use LPG or kerosene, for example, may not use these fuels because LPG or kerosene stoves are unaffordable; if so, then omitting these households from the regression sample also can reduce the estimated sensitivity of spending to income). An alternative, although more complicated model of energy consumption would take account of joint decisions about appliance purchase and fuel use.

This section has summarized observed patterns of fuel use, income, and household size for Raipur. The next section compares these observations to findings of a similar study of Hyderabad.

IV. Raipur and Hyderabad: Can generalizations be made?

One of the purposes of this study is to make possible a comparison between household energy use in Raipur and Hyderabad, and in the process, begin to build a body of information from the level of detail enabled by household surveys. Towards this end, factors which might be expected to lead to different patterns of interurban energy use include variation in the determinants examined above -- income and household size -- as well as differences in climate, resource endowment, fuel prices, and household preferences. This section first describes some of these factors as they pertain to Raipur and Hyderabad and then follows the organization of the previous section in discussing patterns of energy consumption and expenditure.[22]

By way of background information, Raipur, with a population of 339,000, is one of the larger urban areas in the state of Madyha Pradesh; Hyderabad, the capital of the state of Andhra Pradesh, is the fifth largest city in India and has a population of 2.1 million.[23] Both Madyha Pradesh and Andhra Pradesh are among the geographically largest but lowest income

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22. Except where noted in this section, information about Hyderabad is from Alam, Dunkerley, and coauthors (1984, chapter 6).

23. These population figures are for the cities of Raipur and Hyderabad, which are part of the larger Raipur and Hyderabad districts. Population estimates are from the 1981 Census of India (see Cleveland (1986, p. I.15)).

states in India, with 1977-78 per capita net domestic product below the all-India average by some 30% and 15% for Madyha Pradesh and Andhra Pradesh, respectively.[24] Mean household incomes reported in the survey data for Hyderabad and Raipur cities are not statistically different, however. Moreover, the distributions of income are remarkably similar (see figure 2). These results have several strong implications for some of the similarities in energy consumption that will be discussed below.

As noted in section I, the climate and resource endowments of Raipur and Hyderabad are very different. These differences may explain interurban fuel price differentials that are also apparent from the survey data, and in turn explain several of the dissimilarities in fuel use. Raipur is located in humid central India and has abundant forest resources. Hyderabad is in a semi-arid southern area with more limited forests. These differences may give rise to the higher fuelwood prices in Hyderabad reported in table 9.[25] Lower prices in Hyderabad for charcoal and kerosene may be due to that city's well-developed transportation network, although this is inconsistent with the higher price for LPG. Prices for kerosene and LPG are government-controlled throughout India, however, and it is difficult to separate price influences attributable to resource endowments and transportation from the effects of government allocation policy.

To be sure, measurable differences in household preferences -- particularly those which may underlie the patterns of fuel use in cooking -- are difficult to specify. Two observations are noted here, based on

24. See Mills and Becker (1986, p. 185).

25. In addition, the somewhat higher humidity of Raipur may mean that the energy output conversion factors (appendix B) are biased upward for this city.

census and other national survey data, but investigating them further is a subject for later research. One observation from demographic information is that both Raipur and Hyderabad are primarily Hindu, although each has sizeable Christian and Muslim populations as well.[26] A second observation is the significance difference between the states of Andhra Pradesh and Madhya Pradesh in per capita calorie consumption -- that of Andhra Pradesh is about 98% of the average for India, whereas Madhya Pradesh, together with all of the more northern states, is some 30% above the Indian average. This pattern likely reflects distinct interregional differences in diet, crops, and food preparation, although without additional information it is difficult to infer implications of these caloric differences for the energy-intensity of cooking.[27]

Comparing patterns of fuel use in Raipur and Hyderabad, the strongest similarity is in total levels of energy consumption. There is no significant difference in mean levels of household input and output energy consumption. Mean input and output energy for Raipur are 1.8 million Btu's and 450 million Btu's, respectively; these amounts are insignificantly different from corresponding figures for Hyderabad (1.2 million Btu's and 453 million Btu's).[28]

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26. The demographic data do not provide the distribution of income across these groups, precluding further analysis of the interaction of religion and caste with income. Moreover, whether religious preferences have measurable implications for diet in particular and in turn, for energy use are not estimable solely from the percentage of the population that is Hindu, say, as only about 25% of Hindus are vegetarians.

27. Food expenditures as a percent of income are comparable for both states and are also comparable to the all-India average. See Mills and Becker for both calorie and food expenditure data (1986, p. 187).

28. Throughout this discussion, tests for statistically different sample means are conducted at .1% levels of significance. The difference in output energy is insignificant even if coal consumption, not reported in the Hyderabad study, is excluded from the Raipur data.

There is a significant difference in monthly spending on energy, however. In Raipur, spending averages 86 Rs.; for Hyderabad, it is 77 Rs.[29] As a fraction of monthly income, energy expenditure in Raipur is 8%, about 50% higher than in Hyderabad. Therefore, surveyed households in both cities make comparable demands on energy resources (in terms of Btu's of input energy) and seek a comparable level of cooking services (in terms of output energy), but households in Raipur spend more, both absolutely and relative to household income, to obtain these services. The equivalence of average household income and the nearly identical income distribution of the cities (recall figure 2) may largely explain these patterns of energy consumption, whereas differences in fuel prices may underlie patterns of energy expenditure. For example, although the reported prices of both fuelwood and LPG are lower in Raipur than in Hyderabad, the price of LPG relative to fuelwood within Raipur exceeds the corresponding price ratio within Hyderabad. Raipur households tend to use more wood and less LPG than Hyderabad households; input shares of wood and LPG in Raipur are 61% and 12%, respectively, and are 41% and 24%, respectively, in Hyderabad.[30] Raipur households also use more charcoal but less kerosene; shares of these fuels in input energy are each about 10%, whereas in Hyderabad they are 5% and 31%, respectively. Higher relative prices in Raipur of charcoal and kerosene -- expressed as a ratio with fuelwood prices, each is about 50% higher than in Hyderabad -- may have offset slightly lower prices of LPG and fuelwood in the cost of energy for the average Raipur household.

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29. Expenditures in Hyderabad have been adjusted for inflation using the GDP deflator (see note a, table 9).

30. For the reader's convenience, the relevant table from the Hyderabad study is contained in appendix C.

A further review of fuel combinations reported by the surveys of Raipur and Hyderabad suggests these additional observations.[31] The household with average income in each city (and average incomes are equal between the cities) use different fuels; in Raipur, the household with average income uses wood and kerosene, but the corresponding household in Hyderabad uses kerosene and LPG or LPG alone. Kerosene use alone tends to be the dominant fuel in low- and middle-income households in Hyderabad (at incomes from 500 to about 1550 Rs, kerosene alone is used in 25 to 50% of households); among upper-middle- and upper-income households, kerosene and LPG, and LPG alone are the dominant fuels (comprising the fuel mix for 60 to nearly 80% of households with these incomes). In Raipur, wood and kerosene are the fuel mix for households over a much larger range of incomes, constituting from 70 to nearly 90% of the energy used at the lowest incomes to mean income; even among households with almost twice the mean income (up to about 2500 Rs.), this mix accounts for 40 to 50% of fuel consumption. LPG with kerosene or with charcoal, or LPG alone, are the predominant mixes at higher income levels.[32]

It was noted earlier that kerosene appears to be used in proportion to the use of wood or charcoal throughout a wide range of incomes in Raipur; such pattern is not apparent in Hyderabad. One reason for the difference may lie in the Raipur and Hyderabad surveys. The Raipur survey question asking how much kerosene is used followed a series of questions about the use of fuels for cooking only, and may have elicited a response limited to

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31. The observations are based on information in tables 3 and 4 and appendix C.

32. Note, however, the small sample size for the Raipur survey at incomes above 2000 Rs.

cooking quantities. In the Hyderabad survey, the question pertaining to amount of kerosene used did not follow questions focusing on cooking, and thus responses may have included not only cooking quantities but quantities for lighting, too, leading to the large reported amounts of kerosene use.

Based on estimates of income and expenditure elasticities, several results of the Hyderabad study are corroborated here. The income elasticities with respect to input energy, although of opposite sign for the cities, are in both cases quite small. As reported in table 8, in the case of Raipur, the elasticity of income based on input energy is .09. The estimate for Hyderabad is -.05.

Output energy increases with income in both cities but the estimated elasticity is larger for Raipur -- .45, compared with .26 for Hyderabad. As discussed in section III, expenditures on energy approximate output elasticities, and in the case of Raipur, the expenditure elasticity is .47; for Hyderabad, it is .21. The expenditure elasticity for Raipur is close to urban area elasticities estimated for Indian cities by Ray (1980).[33]

With respect to the effect of household size on energy consumption and expenditure, the coefficients follow a similar pattern. They are positive, indicating economies of scale in cooking, and smaller for output energy than for input energy. For example, a 1% increase in household size increases output energy consumption by .18% and .22% for Raipur and Hyderabad, respectively.

Regressions for Raipur relating spending on specific fuels to household income indicate that expenditure on wood as a percent of total spending on

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33. His estimates range from .49 to .78 depending on the functional form of his estimating equation, and include energy for light as well as for cooking. In addition, he uses a much more complete system of equations that encompasses all categories of household spending.

energy decreases with income; expenditure on LPG increases with income. These results tend to support conclusions of the Hyderabad study.[34]

V. Conclusions and Suggestions for Further Research

The reader is referred to the introductory section for a summary of the specific research findings in this study. What follows below highlights areas for future research.

The Raipur and Hyderabad studies both confirm the role of rising incomes in facilitating the urban household's switch from traditional fuels to LPG. The switch from traditional fuels to another commercial fuel, kerosene, is not so clear cut. In the case of Hyderabad, as in other studies of household fuel use, kerosene use tends to vary with income, increasing with income until above-average income levels, and then declining as greater use is made of LPG.[35] Households in Raipur at all income levels use only small amounts of kerosene, however. Except for the highest income households, kerosene also appears to be used in quantities roughly proportional to quantities of coal or charcoal. Some combinations of commercial and traditional fuels thus appear to be complementary in use, rather than substitutable, and unrelated to income. Future research relating appliance ownership to fuel use could investigate patterns of traditional/commercial fuel complementarity, such as those that might arise from use of stoves like the chulah, and fuel substitutability, arising when kerosene stoves, for instance, displace wood fires.

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34. The results are not directly comparable because the estimating equations in the studies are not identical; however, price data contained in the Hyderabad study, together with the table reproduced in appendix C, corroborate the observation made above.

35. See, for example, Cecelski, Dunkerley, and Ramsay (1979, pp. 23-25).

Although not directly tested in this research, both studies also indicate the influence of prices in the fuel transition. For example, in Raipur, reported fuelwood prices are lower, and households with equivalent incomes use more wood in Raipur than in Hyderabad. Understanding how much of the price differences are attributable to resource endowments, transportation networks, and government price and quantity controls is another subject for future interurban energy research.

Income and expenditure elasticities in both studies indicate the larger role of income in influencing the amount of energy providing cooking services than in determining the level of aggregate energy resource demand to satisfy those services (that is, the difference between "output" and "input" energy). In this regard, the explanation offered in section III as to why expenditure elasticities should approximate income elasticities measured with respect to output energy may contribute to the literature on household energy use, insofar as that literature has frequently pointed out, but not explored, this result. An implication of these patterns of elasticities for energy policy is, as has been generally noted, that government policies which directly or indirectly affect income might be expected to cause households to shift towards commercial fuels not only to obtain greater fuel-efficiency but to enjoy attributes of cleanliness, taste, or convenience as well.[36] Given the discussion of the role of relative prices, however, and in light of the observation that households with equal incomes in Raipur and Hyderabad nonetheless choose a different fuel mix, changes in income may well have different interurban effects.

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36. See, for example, International Development Research Center (1986, chapters 4 and 12) for discussion of energy policy and resource management.

Such interurban differences will affect the effectiveness of policy responses to the array of energy issues mentioned in the introduction. For instance, income and fuel price variation across cities will govern the aggregate response to national government policies regarding commercial fuels. Also, policies that alter income distributions may influence aggregate energy use, even if the intent of such policies is unrelated to energy. Finally, understanding the relation of energy and the environment -- for example, in projecting fuelwood consumption to assess demands for forest resources -- may benefit from such urban research insofar as it may improve modeling of interregional differences in household behavior and energy use.

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Figure 1. India, showing Raipur and Hyderabad.
Source: Based on Bhagwati and Srinivasan (1975).

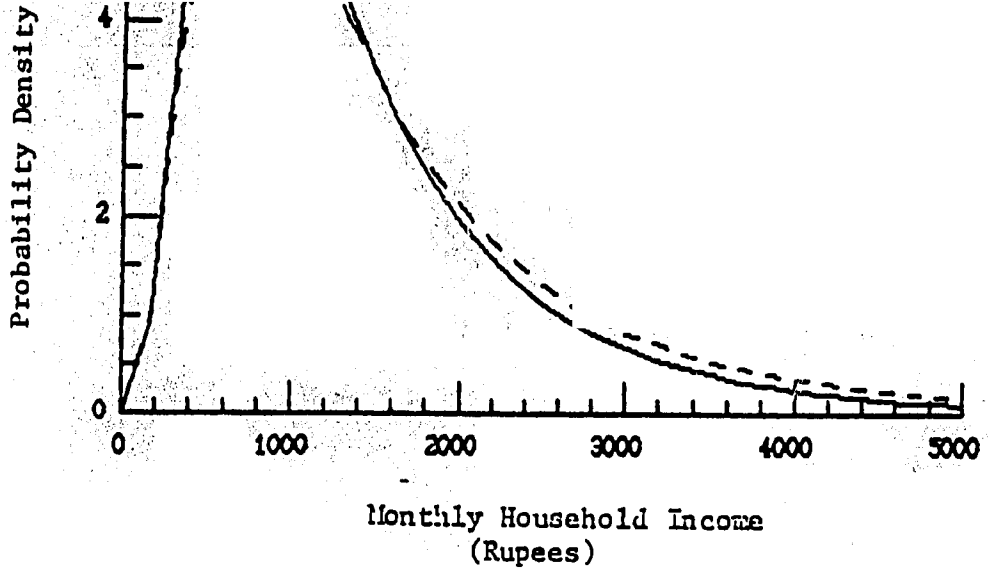

Figure 2. Distribution of Household Incomes in Raipur and Hyderabad. The area under the curve between any two income levels gives the probability that household income lies in this interval. Data are based on survey information reported in the text.

Table 1. Monthly mean household input energy consumption by type of fuel and income group. (in million Btu's)

Monthly Income	Wood	(%)	Charcoal	(%)	Kerosene	(%)	LPG	(%)	Coal	(%)	Total	(%)
(Rs.)												
0-500	1.2	(87)	.0	(3)	.1	(9)	*	(1)	0	(0)	1.4	(100)
501-750	1.3	(79)	.1	(4)	.2	(10)	*	(2)	.1	(5)	1.7	(100)
751-900	1.2	(67)	.1	(8)	.2	(11)	.1	(4)	.2	(10)	1.8	(100)
901-1000	1.2	(63)	.1	(8)	.2	(10)	.1	(5)	.3	(14)	1.9	(100)
1001-1250	1.3	(68)	.1	(7)	.2	(10)	.2	(12)	.1	(4)	1.9	(100)
1251-1500	1.2	(57)	.2	(8)	.2	(8)	.3	(16)	.2	(11)	2.1	(100)
1501-2000	1.0	(56)	.2	(13)	.2	(11)	.3	(18)	*	(2)	1.8	(100)
2001-2500	.8	(45)	.4	(23)	.1	(5)	.5	(26)	0	(0)	1.8	(100)
2501-3000	.6	(36)	.3	(20)	.2	(9)	.6	(33)	*	(2)	1.7	(100)
3001-4000	.4	(15)	1.0	(39)	.2	(9)	.6	(24)	.3	(13)	2.6	(100)
over 4000	.2	(11)	.5	(25)	.1	(4)	.8	(38)	.5	(22)	2.1	(100)
Total Sample	1.1	(61)	.2	(10)	.2	(9)	.2	(12)	.1	(8)	1.8	(100)

Notes: (%) — Indicates percent of individual fuel in total household energy consumption. Rows may not sum to totals due to rounding.

* Quantity consumed is positive but less than 50,000 Btu's.

Table 2. Monthly mean household output energy consumption by type of fuel and income group. (in million Btu's)

Monthly Income (Rs.)	Wood (%)	Charcoal (%)	Kerosene (%)	LPG (%)	Coal (%)	Total (%)
0-500	.2 (72)	* (3)	.1 (22)	* (3)	0 (0)	.3 (100)
501-750	.2 (65)	* (3)	.1 (22)	* (7)	* (2)	.4 (100)
751-900	.2 (52)	* (7)	.1 (24)	* (12)	* (5)	.4 (100)
901-1000	.2 (50)	* (7)	.1 (22)	.1 (14)	* (6)	.4 (100)
1001-1250	.2 (46)	* (5)	.1 (19)	.1 (28)	* (2)	.5 (100)
1251-1500	.2 (37)	* (6)	.1 (15)	.2 (37)	* (4)	.5 (100)
1501-2000	.2 (33)	* (9)	.1 (19)	.2 (38)	* (1)	.5 (100)
2001-2500	.1 (25)	.1 (15)	* (8)	.3 (52)	0 (0)	.5 (100)
2501-3000	.1 (18)	.1 (11)	.1 (13)	.3 (58)	0 (0)	.6 (100)
3001-4000	.1 (8)	.2 (26)	.1 (14)	.4 (47)	* (4)	.8 (100)
over 4000	* (5)	.1 (15)	* (5)	.5 (68)	* (7)	.7 (100)
Total Sample	.2 (42)	* (8)	.1 (18)	.1 (28)	* (3)	.5 (100)

Notes: (%) — Indicates percent of individual fuel in total household energy consumption. Rows may not sum to totals due to rounding.

* Quantity consumed is positive but less than 50,000 Btu's.

Table 3. Household fuel choice decisions: number and percent* of households according to income level.

Monthly Income	Wood Only (%)	Wood & Kerosene (%)	Kerosene Only (%)	LPG & Kerosene (%)	LPG Only (%)	Total in Table 3 (%)	Total Households in Sample
(Rs.)							
0–500	10 (17)	44 (76)	1 (2)	1 (2)	0 (0)	56 (97)	58
501–750	4 (6)	50 (72)	1 (1)	2 (3)	0 (0)	57 (83)	69
751–900	6 (8)	37 (51)	0 (0)	5 (7)	2 (3)	50 (68)	73
901–1000	2 (3)	29 (50)	0 (0)	4 (7)	3 (5)	38 (66)	58
1001–1250	0 (0)	16 (44)	1 (3)	4 (11)	2 (6)	23 (64)	36
1251–1500	1 (2)	17 (31)	1 (2)	7 (13)	6 (11)	32 (58)	55
1501–2000	2 (4)	12 (24)	3 (6)	8 (16)	5 (10)	30 (60)	50
2001–2500	0 (0)	3 (23)	0 (0)	1 (8)	2 (15)	6 (46)	13
2501–3000	0 (0)	3 (13)	0 (0)	5 (21)	6 (25)	14 (58)	24
3001–4000	0 (0)	2 (12)	0 (0)	1 (6)	1 (6)	4 (24)	17
over 4000	0 (0)	0 (0)	0 (0)	1 (8)	5 (38)	6 (46)	13
Total Sample	25 (5)	213 (46)	7 (2)	39 (8)	32 (7)	316 (68)	466

* Figures in parentheses are percent of all sample households in income level.

Table 4. Household fuel choice decisions: number and percent* of households according to income level.

Monthly Income (Rs.)	Wood & LPG & Kerosene (%)	Kerosene & Charcoal (%)	LPG & Charcoal (%)	Wood & Kerosene & Charcoal (%)	Wood & Kerosene & Coal (%)	LPG & Kerosene & Charcoal (%)	LPG & Kerosene & Coal (%)	Total in Tables 3 & 4 (%)	Total Households in Sample
0-500	0 (0)	0 (0)	0 (0)	1 (2)	0 (0)	1 (2)	0 (0)	58 (100)	58
501-750	1 (1)	1 (1)	0 (0)	2 (3)	4 (6)	1 (1)	1 (1)	67 (97)	69
751-900	2 (3)	7 (10)	0 (0)	4 (5)	9 (12)	0 (0)	0 (0)	72 (99)	73
901-1000	2 (3)	5 (9)	1 (2)	4 (7)	6 (10)	1 (2)	0 (0)	57 (98)	58
1001-1250	5 (14)	1 (3)	0 (0)	2 (6)	1 (3)	1 (3)	1 (3)	34 (94)	36
1251-1500	3 (5)	1 (2)	1 (2)	6 (11)	2 (4)	3 (5)	0 (0)	48 (87)	55
1501-2000	6 (12)	3 (6)	2 (4)	3 (6)	0 (0)	1 (2)	0 (0)	45 (90)	50
2001-2500	0 (0)	0 (0)	4 (31)	1 (8)	0 (0)	2 (15)	0 (0)	13 (100)	13
2501-3000	3 (13)	0 (0)	2 (8)	2 (8)	1 (4)	1 (4)	0 (0)	23 (96)	24
3001-4000	2 (12)	2 (12)	3 (18)	0 (0)	0 (0)	3 (18)	2 (12)	16 (94)	17
over 4000	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (23)	0 (0)	9 (69)	13
Total Sample	24 (5)	20 (4)	13 (3)	25 (5)	23 (5)	17 (4)	4 (1)	442 (95)	466

Figures in parentheses are percent of all sample households in income level.

Table 5. Monthly mean household energy consumption and expenditure by income group.

Monthly Income (Rs.)	Energy Consumption (mm Btu's) Input	Output	Energy Expenditures Total (Rs.)	as Percent of Income
0-500	1.4	.3	53.0	14.3
501-750	1.7	.4	64.0	10.0
751-900	1.8	.4	75.8	9.1
901-1000	1.9	.4	78.5	7.9
1001-1250	1.9	.5	90.1	7.6
1251-1500	2.1	.5	95.8	6.5
1501-2000	1.8	.5	95.2	4.9
2001-2500	1.8	.5	111.8	4.5
2501-3000	1.7	.6	115.9	3.9
3001-4000	2.6	.8	170.4	4.5
over 4000	2.1	.7	150.8	2.5
Total Sample	1.8	.5	85.7	8.1

Table 6. Household fuel prices as reported in Raipur survey, 1985.

Fuel	Mean Price (Rs./unit)	Rs./ mm Btu a/	Converted Rs./mm Btu a/
Firewood	.48/kg	34	198
Charcoal	1.59/kg	57	283
Kerosene	2.88/litre	78	163
LPG	62.55/15 kg	96	160
Coal	.86/kg	31	309

Note: a/ Conversions to mm (million) Btu use the factors in appendix B.

Table 7. Measures of household size and income.

Monthly Income (Rs.)	Household Size	Monthly Income per Capita (Rs.)	Equivalent Household Size a/	Income per Equivalent Capita (Rs.)
0-500	4.67	91.9	2.85	140.8
501-750	5.68	127.8	3.39	207.0
751-900	6.51	148.5	3.76	247.1
901-1000	5.90	194.2	3.63	304.2
1001-1250	6.33	210.3	3.67	348.5
1251-1500	8.35	219.2	4.95	350.9
1501-2000	7.38	337.5	4.42	520.9
2001-2500	8.46	337.7	5.19	530.7
2501-3000	8.00	467.8	4.78	747.5
3001-4000	9.00	515.3	5.36	812.6
over 4000	9.00	889.8	5.68	1370.8
Total Sample	6.67	233.3	3.98	370.2

Note: a/ See text.

Table 8. Regression results.

Dependent Variable	Constant Term	Monthly Household Income	Household Size	adj.R^2
(a) Monthly household input energy	12.84 (52.28)***	.09 (2.36)**	.48 (8.28)***	.18
(b) Monthly household output energy	9.57 (53.42)***	.45 (16.43)***	.18 (4.35)***	.46
(c) Monthly household expenditure on energy	.87 (4.54)***	.47 (15.85)***	.20 (4.49)***	.45
(d) Monthly household expenditure on wood as percent of total energy expenditure a/	.47 (.96)	-.43 a/ (-4.84)***		.06
(e) Monthly household expenditure on LPG as percent of total energy expenditure a/	-2.80 (-4.77)***	.17 a/ (1.81)*		.02

Notes: All variables are expressed in logarithms.

T-statistics are in parentheses.

* Significant at 10% level.
** Significant at 5% level.
*** Significant at 1% level.

a/ Variable is expressed per capita based on equivalent household size.

Table 9. Household fuel prices in Raipur and Hyderabad.

Fuel	Mean Price, 1985 Rs./unit Raipur	Hyderabad a/
Firewood	.48/kg	.58/kg
Charcoal	1.59/kg	1.38/kg
Kerosene	2.88/litre	2.39/litre
LPG	62.55/15 kg	66.56/15 kg
Coal	.86/kg	not available

Note: a/ Mean prices for Hyderabad are from Alam, Dunkerley, and coauthors (1984, p. 68), and are converted to 1985 prices using the GDP deflator for India (reported in International Monetary Fund (1986, p. 389)).

Appendix A. Fuelwood Survey -- Raipur
Household Energy Consumption

DATE OF INTERVIEW : ... ...
साक्षात्कार का दिनांक

TIME BEGUN : ... ...
आरंभ समय

ADDRESS : ... ...
पता

WARD : NUMBER NAME : ... ...
वार्ड नम्बर नाम

LOCALITY OR MOHULLA : ... ...
स्थान या मोहल्ला (पारा)

HOUSE NUMBER : ... ...
मकान नम्बर

NAME OF THE HEAD OF HOUSEHOLD : ... ...
परिवार के मुखिया का नाम

NAME OF RESPONDENT ... ...
उत्तरदाता का नाम

RELATION TO HEAD OF HOUSEHOLD : ... ...
परिवार के मुखिया से सम्बन्ध

INTRODUCTION

We are from Raipur, Collecting information for the **Fuelwood Survey Project-Raipur**, jointly undertaken by Prof. M. Naimuddin (Osmania University, Hyderabad), Dr. (Mrs.) Joy Dunkerley (Resources for Future, Washington D. C., U. S. A.) and Prof. P. C. Agarwal (Ravishankar University, Raipur). Would you Please answer a few questions for us about your household and its energy use. It will take only a few minuntes. Your answers will be kept strictly confidential. The information you give us could help to ensure that there will not be a shortage of energy in future.

परिचय

हम रायपुर के ही हैं और **जलाऊ लकड़ी सर्वेक्षण परियोजना-रायपुर** के लिए कुछ जानकारी इकट्ठा कर रहे हैं जिसे प्रो. नइमुद्दीन (उस्मानिया विश्वविद्यलाय, हैदराबाद), डा. (श्रीमती) जॉय डनकर्ली (रिसोर्सेज़ फ़ार फ़्यूचर, वाशिंगटन डी. सी., यू. एस. ए.) तथा प्रो.पी.सी अग्रवाल (रविशंकर वि. वि. रायपुर) ने मिलकर आरंभ किया है। क्या आप कृपया अपनी गृहस्थी और उसके ऊर्जा उपयोग के विषय में हमारे लिए कुछ प्रश्नों के उत्तर देंगे? इसमें कुछ मिनट का ही समय लगेगा। आपके उत्तरों को पूरी तरह गोपनीय रखा जायेगा। आपके द्वारा दी गयी जानकारी से इस बात को निश्चित करने में मदद मिल सकती है कि भविष्य में ऊर्जा की कमी न हो।

A FAMILY INFORMATION
पारिवारिक सूचना

1. Number of people in household ?

   परिवार में व्यक्तियों की संख्या ?

MALE पुरुष	FEMALE स्त्री	ADULTS (above) (प्रौढ़ १६ से बड़े)	CHILDREN (under 16) (बच्चे १६ से छोटें)	TOTAL योग
( )	( )	( )	( )	

2. Educational level of adults ?

   प्रौढों का शैक्षणिक स्तर ?

LITERATE साक्षर	FINISHED PRIMARY SCHOOL प्रायमरी स्कूल पास	FINISHED HIGHER SEC. SCHOOL हायर सेक. स्कूल पास	FINISHED TECHNICAL SCHOOL टेक्निकल स्कूल पास	FINISHED UNIVESITY विश्वविद्यालय पास	TOTAL NUMBER OF LITERATES कुल साक्षरों की संख्या
( )	( )	( )	( )	( )	( )

3. How many household members are earning ? ( )

   परिवार के कितने सदस्य कमा रहे है ?

4. Who is working in the family ?

   परिवार में कौन काम पर लगा है ?

HUSBAND पति	WIFE पत्नी	OTHERS (Specify relation and number) अन्य (बताइये : सम्बन्ध तथा संख्या)
( )	( )	1. ( )
		2. ( )
		3. ( )
		4. ( )
		5. ( )

5. What are their occupations ?

   उनके व्यवसाय क्या है ?

NAME OF OCCUPATION व्यवसाय का नाम		NUMBER OF WORKERS काम करने वालों की संख्या)
Doctors	डाक्टर	( )
Engineers	इंजीनियर	( )
Lawyers	वकील	( )
Technicians	तकनीकज्ञ	( )
Businessme	व्यापारी	( )
Teachers	शिक्षक	( )
Officers	अधिकारी	( )
Clerks	क्लर्क	( )
Class IV Employees	चतुर्थ श्रेणी कर्मचारी	( )
Labourers	मजदूर	( )
Others (Specify)	अन्य (कौन ?)	( )

Nots : Total Should add upto question No. : 3.

सूचना : योग को प्रश्न संख्या – ३ के बराबर होना चाहिये ।

6. Number of earning members by age-groups ?
कमाने वाले सदस्यों की आयु–वर्ग अनुसार संख्या ?

10–20	20-30	30-40	40-50	50 and above तथा अधिक
( )	( )	( )	(	

Note : Total should add up to question No. : 3.

सूचना : योग को प्रश्न संख्या –३ के बराबर होना चाहिये ।

7. Can you estimate the total monthly income of the household including the income of all earning members from all sources ?
क्या सभी कमाने वाले सदस्यों की सभी साधनों से आमदनी को सम्मिलित करते हुए आप परिवार का सम्पूर्ण मासिक आमदनी का अनुमान लगा सकते हैं ?

Rs_____ रुपये

B HOUSING INFORMATION
मकान की जानकारी

8. Is your house owned or rented ?
आपका घर अपना है या किराये का ?

Owned	अपना	( )
Rented	किराये का	( )

9. If rented, what is the the monthly rent ?
यदि किराये का है तो मासिक किराया कितना है ? Rs_____ रुपये ।

10. If owned, what is the approximate monthly rental value of your house ?
यदि अपना है, तो आपके घर का मासिक किराया लगभग कितना मिल सकता है ? Rs_____ रुपये ।

11. TO BE FILLED IN BY THE INVESTIGATOR
प्रश्नकर्ता द्वारा भरा जाय

What is the type of residence ?
आवास किस प्रकार का है ?

Residence	Single Family	एक परिवार वाला	( )
आवास	Multi Family	बहु परिवार वाला	( )

12. What is the type of the house ?
घर किस प्रकार का है ?

Type of house	Apartment	संयुक्त आवास	( )
घर का प्रकार	Pucca	पक्का	( )
	Kaccha	कच्चा	( )
	Hut	झोपडी	( )
	Others	अन्य	( )
	(Specify)	(क्या ?)	( )

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13. How many rooms are there in the house ?
घर में कितने कमरे हैं ? ( )

Note : Investigators should not include kitchen, Bath rooms, Latrines, Fuel room and Cattle room.
सूचना : प्रश्नकर्त्ता रसोई, स्नानकक्ष, पाखाने, ईंधन का कमरा तथा पशुओं का कमरा सम्मिलित न करें।

Note . Investigators should not ask the following question in obviously poor households but should mark 'NO' in the appropriate place.
प्रश्नकर्त्ता स्पष्ट रूप से निर्धन घरों में नीचे लिखा प्रश्न न पूछें वरन उपयुक्त स्थान पर 'NO' लिखें।

14. Do you have paid help in the house ?
क्या घर में तनख्वाह का नौकर है ?

YES हाँ ☐ NO नहीं ☐

15. If yes, how many ?
यदि हाँ, तो कितने ? _____.

16. Are there any restrictions on using fuelwood for cooking imposed by :
क्या खाना पकाने के लिए लकडी के उपयोग पर इसकी ओर से कोई रोक है

a. Government	सरकार	YES हाँ ☐	NO नहीं ☐
b. Landlord	मकान मालिक	YES हाँ ☐	NO नहीं ☐

The investigator observe and answer this question. If the answers are not obvious the investigator should ask the respondent.
प्रश्नकर्त्ता को देख कर इस प्रश्न का उत्तर देना चाहिये। यदि उत्तर स्वयं स्पष्ट न हों तो प्रश्नकर्त्ता को उत्तरदाता से पूछना चाहिये।

17. Does the house have :
क्या घर में यह है :

Telephone	टेलीफोन	( )
Running Water	नल का पानी	( )
Electricity	बिजली	( )
Private W. C. facilities	निजी पाखाना	( )

C TYPES OF ENERGY USED IN THE HOUSEHOLD
घर में उपयोग में आ रही ऊर्जा के प्रकार

18. Which is the main type of energy you use for cooking ?
आप खाना पकाने के लिए मुख्यत किस प्रकार की ऊर्जा का उपयोग करते है ?

Firewood	जलाऊ लकडी	( )
Saw Dust	लकडी का भूसा	( )
Coal	पत्थर का कोयला	( )
Coal Briquette	पत्थर के कोयले का गोला	( )
Charcoal	लकडी का कोयला	( )
Coke	कोक	( )
Kerosene	मिट्टी का तेल	( )
L. P. G.	एल. पी गैस	( )
Electricity	बिजली	( )
Dung	गोबर	( )
Bio-Gas	गोबर गैस	( )
Others (Specify)	अन्य (क्या?)	( )

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19. Do you use Firewood
क्या आप जलाऊ लकडी का उपयोग करते है ?

YES हाँ ☐ NO नहीं ☐

20. If yes, what quantity did you use last month ?
यदि हाँ, तो आपने पिछले महीने कितनी मात्रा का उपयोग किया ?

_____ (= _____ Kg. कि. ग्रा.)

Note : INVESTIGATORS : Respondents should be encouraged to respond in the unit in which they customarily purchasewood. If the unit is other than the recognised weight please ask them or try yourself to estimate the weight in Kilograms.

सूचना : प्रश्नकर्त्ता : उत्तरदाता तौल की जिस इकाई में आम तौर से लकडी खरीदते हैं उसी में उत्तर देने को उन्हें प्रोत्साहित करें । यदि वह इकाई तौल की मानक इकाई से भिन्न है तो तौल को किलोग्राम में पूछें या आप स्वयं अनुमान लगायें ।

21. If yes, how much did you pay in rupees for the firewood last month ?
यदि हाँ, तो आपने पिछलें महीने में कितने रुपये की जलाऊ लकडी खरीदी थी ?

Rs_____ रुपये ।

22. If yes, do you or your family members ever collect any firewood free of cost ?
यदि हाँ, तो क्या आप या आपके परिवार के सदस्य कभी मुफ्त की जलाऊ लडकी इकट्ठा करते हैं ?

YES हाँ ☐ NO नहीं ☐

23. If yes, how much of this collected firewood amounts to in weight in an average month ?
यदि हाँ, तो एक औसत महीने में इस इकट्ठा की हुई जलाऊ लकडी का वजन कितना होता है ? _____ Kg कि.ग्रा.

24. Do you use Saw Dust ?
क्या आप लकडी के भूमे का उपयोग करते हैं ?

YES हाँ ☐ NO नहीं ☐

25. If yes, what quantity did you use last month ?
यदि हाँ, तो आपने पिछले महीने कितनी मात्रा का उपयोग किया था ?

_____ (= _____ Kg कि. ग्रा.)

26. If yes, how much did you pay in rupees for this Saw Dust last month ?
यदि हाँ, तो आपने पिछले महीने कितने रुपये का लकडी का भूमा खरीदा था ?

Rs_____ रुपये ।

27. Do you use Coal ?
क्या आप पत्थर के कोयले का उपयोग करते हैं ।

YES हाँ NO नहीं

28. If yes, what quantity did you use last month ?
यदि हाँ, तो आपने पिछले महीने इसकी कितनी मात्रा का उपयोग किया था ?

_____ Kg. कि. ग्रा.

29. If yes, how mucn did you pay in rupees for this Coal last month ?
यदि हाँ, तो आपने पिछले महीने कितने रुपये का पत्थर का कोयला खरीदा था ?

Rs_____ रुपये

30. Do you use Coal Briquette ?
क्या आप पत्थर के कोयले के गोले का उपयोग करते हैं ?

YES हाँ ☐ NO नहीं ☐

31. If yes, what quantity did you use last month ?
यदि हाँ, तो आपने पिछले महीने इसकी कितनी मात्रा उपयोग में लायी थी ?

_____ Kg. कि. ग्रा.

32. If yes, how much did you pay in rupees for this Coal Briquette last month ?
यदि हाँ, तो आपने पिछले महीने कितने रुपये के पत्थर के कोयले के गोले खरीदे थे ?

Rs___ _____ रुपये ।

33. Do you use Charcoal ?
क्या आप लकडी के कोयले का उपयोग करते हैं ?

YES हाँ ☐ NO नहीं ☐

34. If yes, what quantity did you purchase last month ?
यदि हाँ, तो आपने पिछले महीने इसकी कितनी मात्रा खरीदी थी ?

_____ Kg. कि. ग्रा.

35. If yes, how much did you pay in rupees for this Charcoal last month ?
यदि हाँ, तो आपने पिछले माह कितने रुपये का लकडी का कोयला खरीदा था ?

Rs_____ रुपये ।

36. Do you use Coke ?
क्या आप कोक का उपयोग करते हैं ?

YES हाँ ☐ NO नहीं ☐

37. If yes, what quantity did you purchase last month ?
यदि हाँ, तो आपने पिछले महीने इसकी कितनी मात्रा खरीदी थ

_____ Kg. कि. ग्रा.

38. If yes, how much did you pay in rupees for this Coke las
यदि हाँ, तो आपने पिछले महीने कितने रुपये का कोक खरीदा

Rs_____ रुपये ।

39. Do you use Kerosene ?
क्या आप मिट्टी के तेल का उपयोग करते हैं ?

YES हाँ ☐ NO नहीं ☐

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40. If yes, what quantity did you purchase last month ?
यदि हाँ, तो आपने पिछले महीने इसकी कितनी मात्रा खरीदी थी ?

___Litres लिटर

41. If yes, how much did you pay in rupees for this Kerosene last month ?
यदि हाँ, तो आपने पिछले महीने कितने रुपये का मिट्टी का तेल खरीदा था ?

Rs_____ रुपये

42. Do you use L. P. G. ?
क्या आप एल. पी. गैस का उपयोग करते हैं ?

YES हाँ ☐ NO नहीं ☐

43. If yes, how many cylinders do you have ?
यदि हाँ, तो आपके पास कितने सिलिंडर है ?

NUMBER संख्या ( )

44. What type of cylinders do you buy ?
आप किस प्रकार का सिलिंडर खरीदते है ?

_____Kg. कि. ग्रा. Value मूल्य Rs _____

_____Kg. कि. ग्रा. Value मूल्य Rs _____

45. If yes, how long does a cylinder last ? _____ (in days)
यदि हाँ, तो एक सिलिंडर कितने समय तक चलता है ? (दिन)

46. Do you, use Electricity ?
क्या आप बिजली का उपयोग करते हैं ?

YES हाँ ☐ NO नहीं ☐

47. If yes, how much electricity did you use last month ?
यदि हाँ, तो आपनें पिछले महीने कितनी बिजली उपयोग में लायी थी ?

_____ K. W. H. or Units कि. वा. घन्टे या युनिट

48. If yes, how much did you pay in rupees for this electricity ?
यदि हाँ, तो आपने पिछले महीने इस बिजली पर कितने रुपये खर्च किये थे ?

Rs_____ रुपये ।

Note : Investigators should see the latest Electricity Bill.

सूचना : प्रश्नकर्त्ता को नवीनतम बिजली बिल देखना चाहिये ।

49. Do you use Dung ?
क्या आप गोबर का उपयोग करते हैं ?

YES हाँ ☐ NO नहीं ☐

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50. How much Cattle dung did you use last month as fuel ?
आपने पिछले महीने ईंधन के रुप में कितने गोबर का उपयोग किया था ?

Qty. मात्रा _____ ; Cost मूल्य Rs _____ रुपये ।

51. How much Cattle dung did you sell as fuel last month ?
आपने पिछले महीने कितना गोबर ईंधन के रूप में बेचा था ?

Qty. मात्रा _____ ; Cost मूल्य Rs _____ रुपये ।

52. If yes, in form of Cakes or Dung ?
यदि हाँ, तो छेना या गोबर के रूप में ?

Cakes छेना ☐ Dung गोबर ☐

53. How much dung did you purchase in quantity last month
आपने पिछले महीने गोबर की कितनी मात्रा खरीदी थी ? _____

Note : Respondents may give number of balls or cakes as quantities. We can later estimate the weight of each ball or cake.

सूचना : उत्तरदाता मात्रा के लिए गोलों या छेनों की संख्या बतला सकते हैं। हम बाद में प्रत्येक गोले या छेने की तौल का अनुमान लगा सकते हैं।

54. How much did you pay for this purchased dung ?
आपने यह गोबर कितने में खरीदा था ?

Rs _____ रुपये ।

55. Did you collect free of charge any dung last month ?
क्या आपने पिछले महीने मुफ्त में कुछ गोबर इकट्ठा किया था ?

YES हाँ ☐ NO नहीं ☐

56. If yes, how much was collected in quantity or weight ?
यदि हाँ, तो कितनी मात्रा या तौल में यह इकट्ठा किया गया था ?

Weight तौल ☐

Estimated Cost अनुमानित मूल्य Rs _____ रुपये ।

57. Do you use Bio-Gas ?
क्या आप गोबर गैस का उपयोग करते हैं ?

YES हाँ ☐ NO नहीं ☐

58. If yes, what quantity did you use last month ?
यदि हाँ, तो आपने पिछले महीने कितनी मात्रा का उपयोग किया था ?

59. If yes, how much did you pay in rupees for this Bio-Gas last month ?
यदि हाँ, तो आपने पिछले महीने कितने रुपये की गोबर गैस खरीदी थी ?

Rs _____ रुपये ।

60. Do you use crop wastes (such as stalks or rice husk) ?
क्या आप फसल के बेकार भाग (जैसे कि डंठलें या धान के छिलके) का उपयोग करते हैं ?

YES हाँ ☐ NO नहीं ☐

61. If yes, how much in quantity did you use last month ?
यदि हाँ, तो आपने पिछले महीने कितनी मात्रा का उपयोग किया था ?

62. If yes, how much did you pay in rupees for this crop waste ?
यदि हाँ, तो आपने पिछले महीने यह फसल का बेकार भाग कितने रुपये में खरीदा था ?
Rs._____रुपये

63. Did you collect any crop waste free of charge last month ?
क्या आपने पिछले महीने कुछ फसल का बेकार भाग मुफ्त में इकट्ठा किया था ?
YES हाँ ☐ NO नहीं ☐

64. If yes, how much was collected in quantity ?
यदि हाँ, तो कितनी मात्रा में इकट्ठा किया था ?
QTY. मात्रा_____Kg. कि. ग्रा.
Estimated. Cost अनुमानित मूल्य Rs. _____रुपये ।

65. Did you use other forms of energy last month ?
क्या आपने पिछले महीने ऊर्जा के अन्य प्रकारों का उपयोग किया था ?
YES हाँ ☐ NO नहीं ☐

66. If yes, please specify and estimate amounts.
यदि हाँ, तो कृपया उसका नाम तथा अनुमानित मूल्य बताइये ।

Name of Energy ऊर्जा का नाम	Amount (Rs.) मूल्य (रुपये)
1.	
2.	
3.	

D Seasonal Variations in energy use
ऊर्जा के उपयोग में ऋतु के साथ परिवर्तन

67. Do your purchases of the following fuels differ in winter, summer and monsoon ?
क्या निम्नलिखित ईंधनों की आपकी खरीद में जाड़ा, गर्मी तथा बरसात में भिन्नता रहती है ?

Name of the fuel ईंधन का नाम		Yes हाँ	No. नहीं
Firewood	जलाऊ लकड़ी	( )	( )
Saw Dust	लकड़ी का भूसा	( )	( )
Coal	पत्थर का कोयला	( )	( )
Coal Briquette	पत्थर के कोयले का गोला	( )	( )
Charcoal	लकड़ी का कोयला	( )	( )
Coke	कोक	( )	( )
Kerosene	मिट्टी का तेल	( )	( )
L P. G.	एल. पी. गैस	( )	( )
Electricity	बिजली	( )	( )
Dung	गोबर	( )	( )
Bio-Gas	गोबर गैस	( )	( )
Others (Specify)	अन्य (क्या ?)	( )	( )

68. If yes please estimate your purchases during the three seasons :
यदि हां, तो तीनों ऋतुओं में अपनी खरीद का अनुमान कीजिये :

FUEL ईंधन		Monthly Average in the Season ऋतु में मासिक औसत		
		Summer गर्मी	Monsoon बरसात	Winter जाड़ा
Firewood जलाऊ लकड़ी	Qty. मात्रा	....	....	....
	Value मूल्य Rs	....	....	....
Saw Dust लकड़ी का भूसा	Qty. मात्रा	....	....	....
	Value मूल्य Rs	....	....	....
Coal पत्थर का कोयला	Qty. मात्रा	....	....	....
	Value मूल्य Rs	....	....	....
Coal Briquette पत्थर के कोयले के गोले	Qty. मात्रा	....	....	....
	Value मूल्य Rs	....	....	....
Charcoal लकडी का कोयला	Qty. मात्रा	....	....	....
	Value मू य Rs	....	....	....
Coke कोक	Qty. मात्रा	....	....	....
	Value मूल्य Rs	....	....	....
Kerosene मिट्टी का तेल	Qty मात्रा	...	....	....
	Value मूल्य Rs	....	....	...
L. P. G. एल पी. गैस	Qty मात्रा	....	....	....
	Value मूल्य Rs	....	....	.. .
Electricity बिजली	Qty. मात्रा	....	....	....
	Value मूल्य Rs	....	....	....
Dung गोबर	Qty. मात्रा	...	....	....
	Value मूल्य Rs	....	....	....
Bio Gas गोबर गैस	Qty. मात्रा	....	...	....
	Value मूल्य Rs	....	....	....
Others (Specify) अन्य (क्या ?)	Qty. मात्रा	....	...	...
	Value मूल्य Rs	....	....	....

E. USES OF ENERGY IN THE HOUSEHOLD
घर में ऊर्जा के उपयोग

69. How many times a day do you cook (light the stove) ?
आप एक दिन में कितने बार पकाते हैं (स्टोव/चूल्हा जलाते हैं)?

One time	एक बार	( )
Two times	दो बार	( )
Three times	तीन बार	( )
or More times	या अधिक बार	( )

70. Do some of your household members take meals usually outside the house.
क्या आपके परिवार के कुछ सदस्य आम तौर से घर से बाहर खाना खाते हैं ?

YES हाँ ☐ NO नहीं ☐

71. If yes, how many meals per day and how many household members per day
यदि हाँ, तो प्रति दिन कितने खाने और प्रति दिन परिवार के कितने सदस्य ?

Meals खाने ☐ Members सदस्य ☐

72. On which type of stove do you cook your food ?
आप किस प्रकार के स्टोव पर खाना पकाते हैं ?

Name of the stove	स्टोव का नाम		
Wood Stove (Chulha)	चूल्हा	( )	( )
Coal Stove	पत्थर के कोयले की सिगडी	( )	( )
Charcoal Stove	लकडी के कोयले की सिगडी	( )	( )
Saw Dust Stove	लकडी के भूसे की सिगडी	( )	( )
Kerosene Stove	मिट्टी के तेल का स्टोव	( )	( )
Gas Stove	गैस का स्टोव	( )	( )
Electric Stove/Hot Plate	बिजली की सिगडी/हाट प्लेट	( )	( )
Others (Specify)	अन्य (क्या ?)	( )	( )

73. Do you use the following appliances for cooking ?
क्या आप खाना बनाने में निम्नलिखित यंत्रों का उपयोग करते हैं ?

Name of the Appliance	यन्त्र का नाम	
Rice Cooker	चावल कुकर	( )
		( )
Grinder	ग्राइण्डर	( )
Toaster	टोस्टर	( )
Electric Mixer	बिजली का मिक्सर	( )
Others (Specify)	अन्य (क्या ?)	( )

74. Do you have the following appliances ?
क्या आपके पास निम्नलिखित यंत्र हैं ?

Aircooler	एयर कूलर	( )
Refrigerator	रेफ्रिजरेटर	( )
Record Player	रेकार्ड प्लेयर	( )

SD

Water Heater	वाटर हीटर	( )
Washing Machine	वाशिंग माशीन	( )
Sewing Machine (Electric)	सिलाई मशीन (बिजली की)	( )
Electric Iron	बिजली की इस्तरी	( )
Electric Clock	बिजली की दीवाल घड़ी	( )
Electric Fan	बिजली का पंखा	( )
Television (Black/Colour)	टेलीविज़न (काला/रंगीन)	( )
Radio (Electric)	रेडियो (बिजली का)	( )
Water Pump (Electric)	पानी का पम्प (बिजली का)	( )

75. Does any family member conduct a commercial activity in the house, such as :
क्या परिवार का कोई सदस्य घर में कोई व्यापारिक कार्य करता है, जैसे कि :

NAME OF THE ACTIVITY	कार्य का नाम	( )
Make and Sell food	खाना पकाना तथा बेचना	( )
Sewing (use electric Sewing Machine)	सिलाई (बिजली की सिलाई मशीन का उपयोग)	( )
Furniture Making	फर्नीचर बनाना	( )
Welding and Soldering	वेल्डिंग तथा सोल्डरिंग	( )
Radio and Fan repair	रेडियो तथा पंखा मरम्मत	( )
Spray Painting	स्प्रे पेन्टिंग	( )
Power looms	पावर लूम.	( )
Others (Specify)	अन्य (क्या ?)	( )

F FUEL PREFERENCES
ईंधन की पसन्द

76. What is your preferred fuel ?
आपकी पसन्द का ईंधन कौन सा है ?

NAME OF THE FUEL ईंधन का नाम		ORDER OF PREFERENCE पसन्द का क्रम
Firewood	जलाऊ लकड़ी	( )
Saw Dust	लकड़ी का भूसा	( )
Coal	पत्थर का कोयला	( )
Coal Briquett	पत्थर के कोयले के गोले	( )
Charcoal	लकड़ी का कोयला	( )
Coke	कोक	( )
Kerosene	मिट्टी का तेल	( )
L. P. G.	एल. पि. गैस	( )
Electricity	बिजली	( )
Dung	गोबर	( )
Bio-Gas	गोबर गैस	( )
Others (Specify)	अन्य (क्या ?)	( )

G CHANGES IN FUEL USE

ईंधन के उपयोग में परिवर्तन

77. Has the total quantity of energy used in your household increased over the past 10 years ?
क्या पिछले १० साल में आपके परिवार में ऊर्जा के उपयोग की कुल मात्रा बढ़ गयी है ?

YES हां ☐ NO नहीं ☐

78. If yes, is this due to :
यदि हां, तो क्या इस कारण से है ?

Larger Family	पहले से बडा परिवार	( )
More appliances	पहले से अधिक यंत्र	( )
More frequent, larger and better meals	पहले से अधिक बार, अधिक मात्रा में और अधिक अच्छा खाना	( )

79. Which fuel did you use for cooking 10 years ago ?
आप दस साल पहले खाना पकाने में किस ईंधन का उपयोग करते थे

NAME OF THE FUEL	ईंधन का नाम	USED FOR COOKING खाना पकाने में काम आया
Fire wood	जलाऊ लकडी	( )
Saw Dust	लकडी का भूसा	( )
Coal	पत्थर का कोयला	( )
Coal Briquette	पत्थर के कोयले के गोले	( )
Charcoal	लकडी का कोयला	( )
Coke	कोक	( )
Kerosene	मिट्टी का तेल	( )
L. P. G.	एल. पी. गैस	( )
Electricity	बिजली	( )
Dung	गोबर	( )
Bio-Gas	गोबर गैस	( )
Others (specify)	अन्य (क्या ?)	( )

80. What was the MAIN cooking fuel used 10 years ago ?
१० साल पहले खाना पकाने के उपयोग में आने वाला प्रमुख ईंधन क्या था ?

NAME OF THE FUEL	ईंधन का नाम	
Firewood	जलाऊ लकडी	( )
Saw Dust	लकडी का भूसा	( )
Coal	पत्थर का कोयला	( )
Coal Briquette	पत्थर के कोयले के गोले	( )
Charcoal	लकडी का कोयला	( )
Coke	कोक	( )
Kerosene	मिट्टी का तेल	( )
L. P. G.	एल. पी. गैस	( )
Electricity	बिजली	( )

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Dung	गोबर	( )
Bio Gas	गोबर गैस	( )
Others (specify)	अन्य (क्या ?)	( )

Note : Please check the most important.
नोट : सब से महत्वपूर्ण के सामने सही ✓ का चिन्ह भरें

81. Which fuels do you use for cooking now ?
आज कल आप खाना पकाने में किन ईंधनों का उपयोग करते हैं ?

NAME OF THE FUEL	ईंधन का नाम	
Fire wood	जलाऊ लकड़ी	( )
Saw Dust	लकड़ी का भूसा	( )
Coal	पत्थर का कोयला	( )
Coal Briquettes	पत्थर के कोयले के गोले	( )
Charcoal	लकड़ी का कोयला	( )
Coke	कोक	( )
Kerosene	मिट्टी का तेल	( )
L. P. G.	एल. पी. गैस	( )
Electricity	बिजली	( )
Dung	गोबर	( )
Bio-Gas	गोबर गैस	( )
Others (specify)	अन्य (क्या ?)	( )

82. Which are the main fuels used for cooking now in order of preference ?
आज कल खाना पकाने के उपयोग में लगे प्रमुख ईंधन पसन्द के क्रम में कौन से हैं ?

NAME OF THE FUEL ईंधन का नाम		ORDER OF PREFERENCE पसन्द का क्रम
Firewood	जलाऊ लकड़ी	( )
Saw Dust	लकड़ी का भूसा	( )
Coal	पत्थर का कोयला	( )
Coal Briquette	पत्थर के कोयले के गोले	( )
Charcoal	लकड़ी का कोयला	( )
Coke	कोक	( )
Kerosene	मिट्टी का तेल	( )
L. P. G.	एल. पी. गैस	( )
Electricity	बिजली	( )
Dung	गोबर	( )
Bio-Gas	गोबर गैस	( )
Others (Specify)	अन्य (क्या ?)	( )

83. Has the rising cost of Kerosene and L. P. G. over the past 10 years lead you to use more Firewood ?
क्या पिछले १० साल में मिट्टी के तेल और एल. पी. गैस की कीमत बढ़ जाने के कारण आप जलाऊ लकड़ी का अधिक उपयोग करने लगे हैं ?

YES हाँ ☐ NO नहीं ☐

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84. Our studies show that cooking with wood is more expensive than cooking with fuels such as kerosene and Gas because of the heat which is lost. Do you agree ?

हमारे अध्ययनों से पता चलता है कि मिट्टी के तेल और गैस जैसे ईंधनों से खाना पकाने के मुकाबले लकड़ी से खाना पकाना अधिक खर्चीला है क्योंकि इसमें गर्मी बेकार चली जाती है। क्या आप इस बात से सहमत हैं ?

YES हाँ ☐ NO नहीं ☐ Don't know नहीं मालूम ☐

85. If yes, why do you continue to use wood ?
यदि हाँ तो आपने लकड़ी का उपयोग क्या चालू रखा है ?

Food tastes better	खाना अधिक स्वाद लगता है	( )
Stove is cheaper	चूल्हा सस्ता है	( )
Stove is more convenient	चूल्हे में अधिक सुविधा है	( )

86. Would you be more interested in trying a new stove if it could cut your fuel use by half ?
क्या आप एक नये स्टोव का उपयोग करके देखना पसन्द करेंगे यदि उससे आपके ईंधन का खर्च घट कर आधा रह जाये ?

YES हाँ ☐ NO नहीं ☐

87. If yes, how much would you be willing to pay for such a stove ?
यदि हाँ, तो आप ऐसा स्टोव कितने रुपये में खरीदना पसन्द करेंगे ? Rs_____ रुपये।

88. What was the cost of your present stove ?
आपका वर्तमान स्टोव कितने रुपये में खरीदा गया था ? Rs_____ रुपये।

89. And how long does it last ?
और यह कितने समय तक चलता है ?

TYPE	प्रकार	Cost in Rs मूल्य रुपये	Life (Years) टिकाऊपन (वर्ष)
Wood Stove	चूल्हा	( )	( )
Coal Stove	पत्थर के कोयले की सिगडी	( )	( )
Charcoal Stove	लकडी के कोयले की सिगडी	( )	( )
Sow Dust Stove	लकडी के भूसे की सिगडी	( )	( )
Kerosene Stove	मिट्टी के तेल का स्टोव	( )	( )
Gas Stove	गैस का स्टोव	( )	( )
Electric Stove/ Hot Plate	बिजली की सिगडी/ हाट प्लेट	( )	( )

H· THE FUTURE
भविष्य :

90. Do you expect to increase energy consumption in future ?
क्या आप भविष्य में ऊर्जा के उपयोग को बढ़ाने की आशा करते हैं ?

YES हाँ ☐ NO नहीं ☐

91. If yes, give reasons ?
यदि हाँ, तो कारण दीजिए ?

Larger family	पहले से बडा परिवार	( )
More appliances	पहले से अधिक यंत्र	( )

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92. Are you using the fuel of your choice today ?
क्या आप आज अपनी पसन्द के ईंधन का उपयोग कर रहे हैं ?

YES हाँ ☐ NO नहीं ☐

93. If no, why ?
यदि नहीं तो क्यों ?

Too expensive	बहुत महँगा है	( )
Not available	मिलता नहीं है	( )

Note : The following information is to be supplied by the investigators :
सूचना : निम्नलिखित जानकारी प्रश्नकर्त्ताओं द्वारा दी जानी है ?

DEGREE OF COOPERATION सहयोग की मात्रा		VALIDITY OF RESPONSE उत्तरों की वैधता	
Good	अच्छा	Truthful	सत्य
Satisfactory	संतोषजनक	Doubtful	सन्देहपूर्ण
Bad	बुरा	Very doubtful	बहुत सन्देहपूर्ण

If we decide to administer additional, more detailed questionnaires, including information on types of food prepared and the different types of fuel associated with the preparation, types of stoves and their costs, source, frequency and mode of payment for energy, would this be a suitable family to include ?

यदि हम इसके अतिरिक्त कुछ और तथा अधिक विस्तारपूर्ण प्रश्नावलियों का प्रयोग करने का निर्णय लें, जिनमें पकने वाले खानों के प्रकार और खाना तैयार करने में उपयोग किये जाने वाले ईंधनों के विभिन्न प्रकार, स्टोव के प्रकार और उनकी कीमत, ऊर्जा के स्रोत, उसके भुगतान का तरीका और बारंबारता सम्मिलित हों तो क्या यह परिवार सम्मिलित करने के लिए उपयुक्त होगा ?

YES हाँ ☐ NO नहीं ☐

SUPERVISOR
सुपर वाइजर

OBSERVATIONS
प्रेक्षण

Appendix B. Conversion factors for input and output energy.

Fuel	Original Units	Input Energy (British thermal units (Btu's))	Output Energy Coefficient
Firewood	kg	14250	.17
Charcoal	kg	28099	.20
Kerosene	litre	36745	.48
LPG	kg	43569	.60
Coal	kg	27800	.10

Sources: Input and output measures are for cooking use; all measures except coal are from Alam, Dunkerley, and coauthors (1984, pp. 53 and 58); measures for coal are from Desai (1981, p. 50).

CONSUMPTION OF FUELS FOR COOKING BY HOUSEHOLDS

TABLE 6.3 : Monthly mean household energy consumption group and fuel+

*(in million Btu)**

Household Income Group	Wood	Charcoal	Kerosene	LPG	Total
(Rs.)					
0-500	.688 (63)	.086 (8)	.281 (26)	.043 (4)	1.098 (109)
501-750	.529 (48)	.075 (7)	.435 (39)	.067 (6)	1.106 (100)
751-900	.615 (49)	.063 (5)	.452 (36)	.124 (10)	1.254 (100)
901-1000	.452 (40)	.033 (3)	.408 (36)	.250 (22)	1.143 (100)
1001-1250	.600 (46)	.073 (6)	.402 (31)	.242 (18)	1.317 (100)
1251-1500	.561 (43)	.038 (3)	.389 (30)	.311 (24)	1.299 (100)
1501-2000	.376 (32)	.029 (2)	.372 (31)	.412 (35)	1.189 (100)
2001-2500	.473 (36)	.079 (6)	.311 (24)	.431 (33)	1.295 (100)
2501-3000	.388 (30)	.039 (3)	.368 (29)	.486 (38)	1.281 (100)
3001-4000	.272 (23)	.023 (2)	.312 (26)	.575 (49)	1.182 (100)
over 4000	.337 (22)	.166 (11)	.336 (22)	.718 (46)	1.557 (100)
Total sample	.500 (41)	.061 (5)	.378 (31)	.290 (24)	1.229 (100)

* Per cent of individual fuel in total household energy consumption in parentheses.

+ Covering only households bearing municipal numbers. Squatter and slum households not included.

Source: Reproduced from Alam, Dunkerley, and coauthors (198
p. 55.