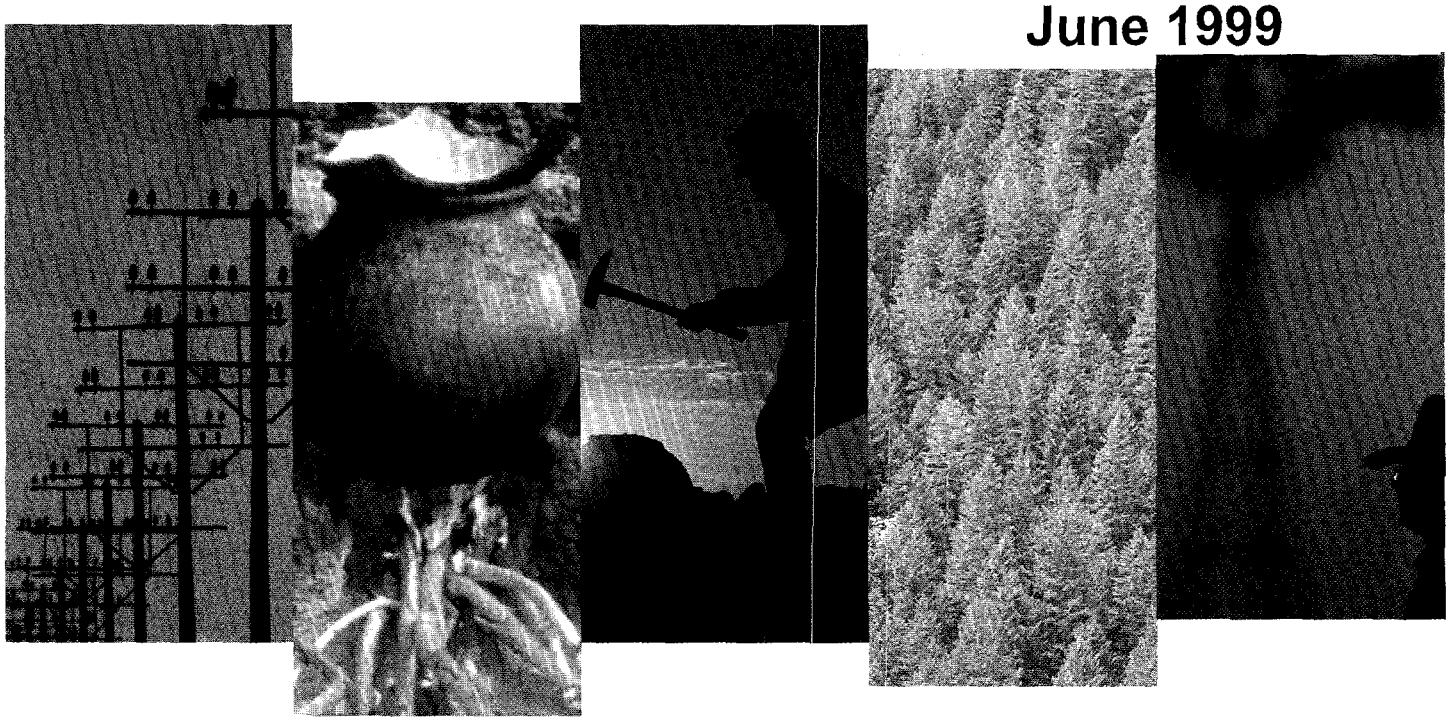
India

Household Energy Strategies for Urban India

The Case of Hyderabad

ESM214
June 1999



Energy

Sector

Management

Assistance

Programme

ESMAP

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JOINT UNDP / WORLD BANK

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

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FUNDING

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India
Household Energy Strategies for Urban India: The Case of Hyderabad

June 1999

Joint UNDP/World Bank Energy Sector Management Assistance Programme
(ESMAP)

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Preface

This report is the result of the efforts of the collaboration between the Institute for Energy and Environmental Studies in Hyderabad and the World Bank. The study was initiated as a result of the concern in developing countries during the 1980s over deforestation related to urban fuelwood markets, and later concerns regarding the uneven development of urban markets for modern fuels. The project was implemented by the ESMAP Program and the fieldwork was cofinanced by the World Bank and the Government of The Netherlands.

To our knowledge, this report represents the most thorough study of urban household energy consumption and its implications for energy policy in India. The fieldwork consisted of a household survey of about 3,000 families in the city of Hyderabad, focus group interviews conducted in varying income groups in Hyderabad, surveys of fuelwood depots, interviews with commercial establishments, interviews with kerosene and LPG distributors, and a detailed analysis of both satellite imagery and aerial photographs of the biomass cover around the city. There was extraordinary cooperation with the India Resources Information and Management Technologies, Pvt. Ltd (INRIMT) and the Survey of India. This was essential for producing definitive studies of the biomass concentrations around the city of Hyderabad. In addition, during the course of the study, there were consultations with a number of heads of government departments in the State of Andhra Pradesh. They extended their full cooperation and support for the project.

Acknowledgments

This report was prepared by a joint effort of the World Bank and the Institute of Energy and Environmental Studies. The main authors of the report are Douglas Barnes (Leader of the International Team) and Manzoor Alam (Leader of the India Team). However, significant contributions to this report were made by Jayant Sathaye, Keith Openshaw, Geeta Reddy, and M. Naimuddin. The preparation of the report also would not have been possible without the dedication of the staff and consultants of the Institute of Energy and Environmental Studies. Valuable contributions were made by all those listed below.

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Abbreviations and Acronyms

KgOE	kilogram of oil equivalent
kWh	kilowatt hour
kW	kilowatt
km	kilometer
kV	kilovolt
LPG	liquefied petroleum gas
mt	metric tons
MWh	megawatt hour
MW	megawatt
TWh	terawatt hour

Currency Equivalents

US$1.00 = 34 Indian Rupees

Energy Conversion Factors

	Energy Content			Efficiency for Cooking
Fuel Type	*Megajoules*	*KgOE*	*Kilocalories*	*Percent*
LPG (kg)	45.0	1.059	10,800	60
Electricity (kWh)	3.6	0.085	860	75
Kerosene (liter)	35.0	0.824	8,400	35
Charcoal (kg), 5% Moist. C. 4% Ash	30.0	0.706	7,200	22
Wood (kg), 15% Moist. C. 1% Ash	16.0	0.376	3,840	15
Coal (kg) (can vary significantly)	23.0	0.541	5,520	NA
Dung (kg) 15% Moist. C. 20% Ash	14.5	0.341	3,480	NA
Straw (kg) 5% Moist. C. 4% Ash	13.5	0.318	3,240	NA

Executive Summary

1. Metropolitan Hyderabad, with a population of almost 5 million, is one of the megacities of India. Its growth trend compares with three of the four premier metropolitan cities in India—Bombay, Calcutta, and Madras. Only New Delhi, with its exceedingly fast population growth rate, is significantly ahead of these metropolitan areas. Hyderabad is also one of the historic cities of India, founded in 1591 as the capital of the kingdom of Golconda. Its modern phase of development commenced in 1956, when it was declared the capital of the Telugu-speaking state of Andhra Pradesh. Since its emergence as the capital, besides being a nodal administrative center in India, Hyderabad has also developed as one of the leading commercial and industrial metropolises of the country. For these reasons, Hyderabad can be viewed as typical of the largest of Indian cities, and it has faced many of the same urban problems. These include rapid population growth resulting in overcrowding, congestion, and high levels of urban pollution.

2. One significant development in India's largest cities has been the rapidly changing energy use patterns that involve a switch from traditional to modern fuels. It was only 15 years ago that approximately one-third of the population in Hyderabad was dependent on wood fuels, and the size of the wood trade in the city was quite large. The rapid growth of Hyderabad into one of India's megacities has involved a significant shift in energy use patterns.

3. The rationale for conducting this study is based on several different overlapping issues. First, the study aims to evaluate the impact of the patchwork of energy sector policies for poor people in urban areas and whether they actually help the poor as intended. Second, the research aims to determine if the "deforestation problem" near Hyderabad was lessening because of a transition away from fuelwood toward modern fuels. Finally, the study focuses on urban consumers' viewpoint concerning their energy situation. This executive summary provides a brief overview of the findings and recommendations. More detailed recommendations are provided in the final chapter of this report.

Main Findings Regarding Energy in Urban Hyderabad

4. The main findings of the study are as follows: Interfuel substitution has taken place at a very significant pace for urban households in Hyderabad during the 1980s and 1990s. (See Figure 1.) The government policy to subsidize most household fuels on the one hand has led to the greater use of modern fuels such as LPG, but also has had the undesirable effect of both formal and informal rationing of such fuels. For the most part, the subsidies which are supposed to assist the poor are not very well directed, and in reality, most of the subsidies end up in the hands of middle- and high-income households. For example, LPG subsidies barely reach any poor households. For the electricity sector, the State Electricity Board has expanded service to almost the entire population of Hyderabad during the last 15 years. As a result of this service expansion, poor pricing policies, and the inability to collect bills, however, the company is under

increasing financial strain, which has resulted in poor customer service. Finally, deforestation has eased around the city. This report recommends that existing forestry policy that encourages local management of forest resources should be continued.

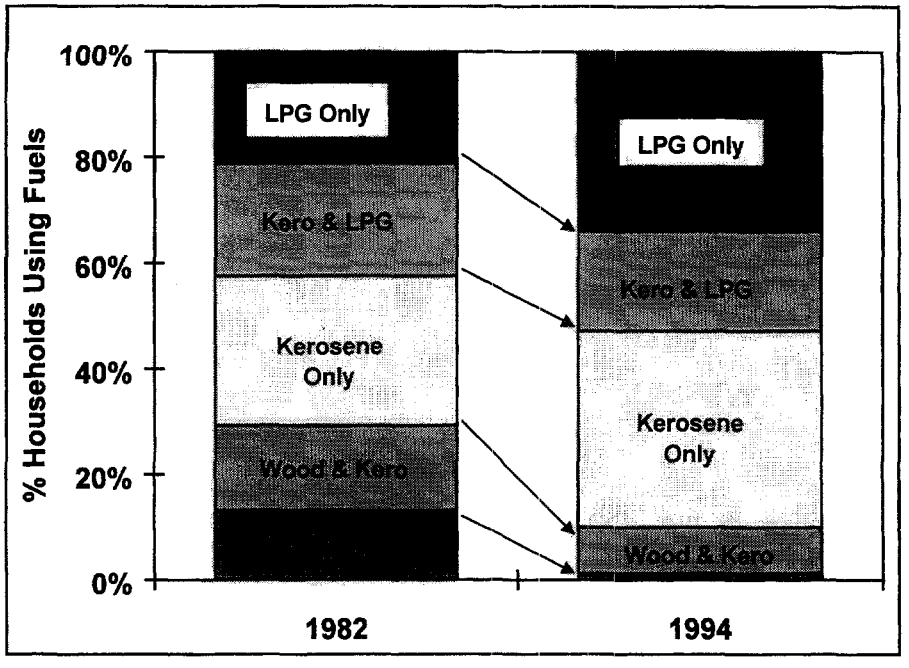
5. Interfuel substitution is taking place very rapidly in urban Hyderabad, as people switch from wood to kerosene, from kerosene to LPG, and even sometimes from wood to LPG. This substitution is taking place in spite of the fact that there has been limited income growth per person in Hyderabad during the last 15 years. This suggests that much of the fuel substitution has resulted from liberalization of energy markets rather than income growth. It is likely that this trend will continue and even accelerate, as it is likely that incomes will grow and affordability will increase during the coming decades.

6. The markets for energy in urban Hyderabad are influenced extensively by government policies. The main policies having an impact on the sector are limits on the import of petroleum products, household fuel subsidy programs, and electricity distribution policies. The subsidies in urban Hyderabad are quite large (about 80 million rupees, or US$2.3 million per month) and are likely to continue to grow as more and more people switch to modern fuels. As noted, these subsidies. which are meant to help the poor, are not very well directed. In fact, the majority of the subsidies end up in middle and upper-class households that can afford to pay market rates for fuels. Likewise, policies to limit imports of fuels create periodic local scarcities. In such scarcity situations, it is the poor who are last to gain access to the fuel. This is evidenced by the fact that the poor in hyderabad had no access to kerosene until LPG became more widely available for urban, middle class households.

7. Although the public distribution system for kerosene is to some extent helping poor people, it is not very well targeted, as it benefits the more wealthy and middle class households as well. In fact, the poorest households without addresses can not gain access to ration cards, and are actually paying world market prices for kerosene or are using very expensive fuelwood for cooking. In addition, the ration shops often get kerosene only periodically, so the supply of the fuel is somewhat sporadic.

8. The State Electricity Board (SEB) is under increasing financial strain as it is pressured to provide more service with less revenue. The large government loans and subsidies coming to the SEBs (as opposed to getting most of their financial requirements from customer billing) create an incentive structure that motivates managers to meet government targets, as opposed to providing quality service to customers. The consequence is that public opinion of the SEB is extremely low. Focus group interviews of middle class and higher-income households reveal support for reforming and liberalizing the distribution of electricity, even if it means higher prices. There was no similar level of support from poor people, so special considerations are necessary for dealing with their problems in the event of reform.

Figure 1 Changes in Choice of Household Cooking Fuels, Hyderabad, 1982 & 1994



9. The combination of a significant transition away from wood as a cooking fuel in Hyderabad, combined with forestry policies that stress conservation of forests and changing land use patterns in rural areas has resulted in deforestation rates that have slowed considerably in the metropolitan region. This is very good news, and existing policies should be strengthened to maintain this important trend.

General Policy Recommendations to Continue Improving Energy Access in Hyderabad

10. The policy trend toward market reforms for energy are moving in the right direction, but need to be strengthened and continued. The subsidies that are currently given across the board to all households in urban Hyderabad can be reduced and still have a significant, positive impact on poor urban households through constructive re-direction. Although the targeting of these subsidies can be a problem, the following recommendations can result in a more direct impact for poor people than the current policies.

LPG Distribution and Retailing

11. The recent policies to open up petroleum markets for household fuels such as LPG and kerosene should be continued and supported. The greater access to LPG at world market prices has actually helped the poor. In addition, importing greater quantities of LPG has meant that the market for this product has expanded among the middle and higher-income consumers. The study finds that the middle class and wealthy appreciate the convenience of LPG and will continue to use it, even with higher prices.

The switch to LPG has also had the benefit of freeing up kerosene for the urban poor. Thus, the general recommendation is to continue to liberalize imports and to allow price competition of LPG at world market prices.

12. Regarding LPG, poor and lower-middle class households can be effectively targeted by making initial LPG service more affordable. This could be accomplished through the distribution of LPG in smaller bottles and by incorporating the costs of initial connection fees (bottle and stove) on the monthly bill. A credit could be given for about one year's time, or it could be incorporated into the price of LPG, meaning that the LPG in smaller bottles would cost slightly more than LPG in standard bottles. The price of LPG in the smaller bottles should never be below the price of LPG in large bottles.

Kerosene and the Public Distribution System

13. Although the public distribution system for kerosene is reaching poor urban households, the system of distribution of kerosene through ration shops at subsidized prices creates a parallel market for the fuel. In this regard, it is important to maintain the subsidy for kerosene, while at the same time opening up kerosene distribution to the private market. It is proposed that the sale of subsidized kerosene through the ration shops be eliminated and all sales of kerosene be made through the retail markets. A greater diversity of kerosene distributors should be encouraged. If a subsidy for kerosene is desirable, it is recommended that a coupon be issued only to poor ration card-holders that will entitle them to purchase kerosene from a retailer (including any ration shops that keep selling kerosene) at a subsidized price. The consequence of this policy would be to more directly target the poor with the subsidy, to open up the market for the fuel, and to discourage diversion of subsidized kerosene to the transport sector.

The Electricity Sector

14. To improve service for urban residential electricity consumers, there is a necessity to promote electricity sector reforms, including those involving pricing and institutional issues. The poor record of bill collection and the high level of subsidies going to middle and high-income electricity consumers combine to put significant financial pressure on the State Electricity Board. As a consequence, the recommendation is that the price of electricity be raised and the SEB mount an aggressive campaign to eliminate the high number of illegal connections—which may be as much as 30 percent of the population in the city—and to collect bills in a timely fashion. However, this cannot be done on an ad hoc basis, without assurance that service levels for all segments of society will be improved. It is clear that the public is skeptical that this can be achieved with the existing distribution system and management. The survey finds that middle class and higher-income households would accept increasing prices that are combined with assured improvement in service levels.

15. The continuing poor service of the State Electricity Board may be difficult to change without fundamental power sector reforms. Consumers are mixed in their opinions on whether such reforms should include privatization, with higher-income

groups favoring it and lower-income groups maintaining a cautious attitude in fear of much higher prices. Part of the problem of ensuring adequate power supply for residential consumers in Hyderabad revolves around the heavy subsidies that are going to agricultural pumping in the state. These issues are quite complicated and have been addressed in the Bank's dialogue with the government on power sector reform, so this paper will not go into the details of possible reforms. However, this paper does uncover very deep distrust among the customers of the State Electricity Board and some support for moving distribution to either the private sector or some other form of organization, as long as the poor are not badly hurt in the process.

16. The survey reveals that consumers are prepared to pay higher prices for electricity, as long as they perceive that service is improved and the burden of pricing or sector reform is fairly distributed. To improve the very low consumer confidence in the electricity sector, the most important goal of any electricity company—private or public—should be to either improve electricity service or have a credible, understandable plan to improve service that can be conveyed to customers. Although this sounds relatively simple, achieving improved service will require much greater emphasis on understanding customer needs, the flexibility to service those needs, and the financial ability to meet such needs. Clearly, it is imperative to have a well-articulated but flexible plan to improve service and communicate this to the public. The plan should include specific steps that are being taken to improve service levels. Such a plan might include features such as a prompt and aggressive campaign to eliminate illegal connections and to collect electricity bills.

17. Recent developments in electricity sector reform are likely to change the way electricity is generated and distributed in the state. The State of Andhra Pradesh has started a process of electricity reform to take place over the next decade, and this reform includes a reorganization of the State Electricity Board and pricing policies for electricity. Of greatest relevance to urban household, the initial stage of the reform will created two companies, separating the generation from the transmission and distribution. One of the goals of the reforms is to have a better focus on customer service through greater system efficiency and reliability

18. The electricity sector reforms presently being carried out by the Government of Andhra Pradesh with the assistance of the World Bank are aimed towards improving electricity service. This should have significant positive and direct benefits for poor households, since this study has found that most poor households have electricity. However, the argument also is made that the financial resources that are freed up in the reform of the sector will benefit the poor. Such "indirect" benefits are no consolation to poor households facing rising electricity prices. Also, it would be difficult to tell whether any avoided electricity subsidies are used in to reduce poverty.

19. As a consequence, it is recommended that special attention should be given to assure that poor households are not adversely effected either by privatization or rising prices. This may be accomplished through a planned social impact assessment to be carried out by the new transmission and distribution company. The report should have as its goal not only to avoid harm, but also to make recommendations that would involve significant direct benefits for the poor. As indicated in this report, the poor are suspicious

of the reforms, and they also are most likely to be impacted by increase in electricity prices.

20. The poor can be targeted effectively though lifeline rates for electricity, because poor households use very little electricity. A lifeline rate can be designed based on the household load compared to income. The findings of this study are that a lifeline rate of 40-50 kWh per month would assist the poorest 30 percent of the households who spend a high percentage of their income on energy. The existing lifeline rate for the first 50 kWh is appropriate, but the fixed charge on the bill raises the overall electricity price for poor people. Also, a policy to keep connection charges for minimal service very low remains an efficient policy if combined with strict enforcement and policing of illegal connections. A grace period of one billing period should be granted before disconnection due to non-payment of bills. The combination of these policies would yield affordable and equitable results.

The Forestry and Woodfuels Sector

21. The fuelwood trade in Hyderabad is based on market principles and is functioning efficiently. Such policies should be maintained and reinforced through local forest management programs in the peri-urban and rural areas surrounding the city. The forestry department should continue programs that encourage farmers to grow (and harvest) trees on their own farms, since this is the main source of fuelwood for Hyderabad City. Since commercial enterprises are increasingly using wood, it is recommended that the coal subsidy and allocation system be eliminated and coal distribution be based on market principles. In addition, the poorest of the poor are still using fuelwood for cooking in Hyderabad and are paying high prices for it in many instances. Improved stove programs to increase the efficiency of wood cooking stoves and reduce the cash outlay for fuel would be an effective policy.

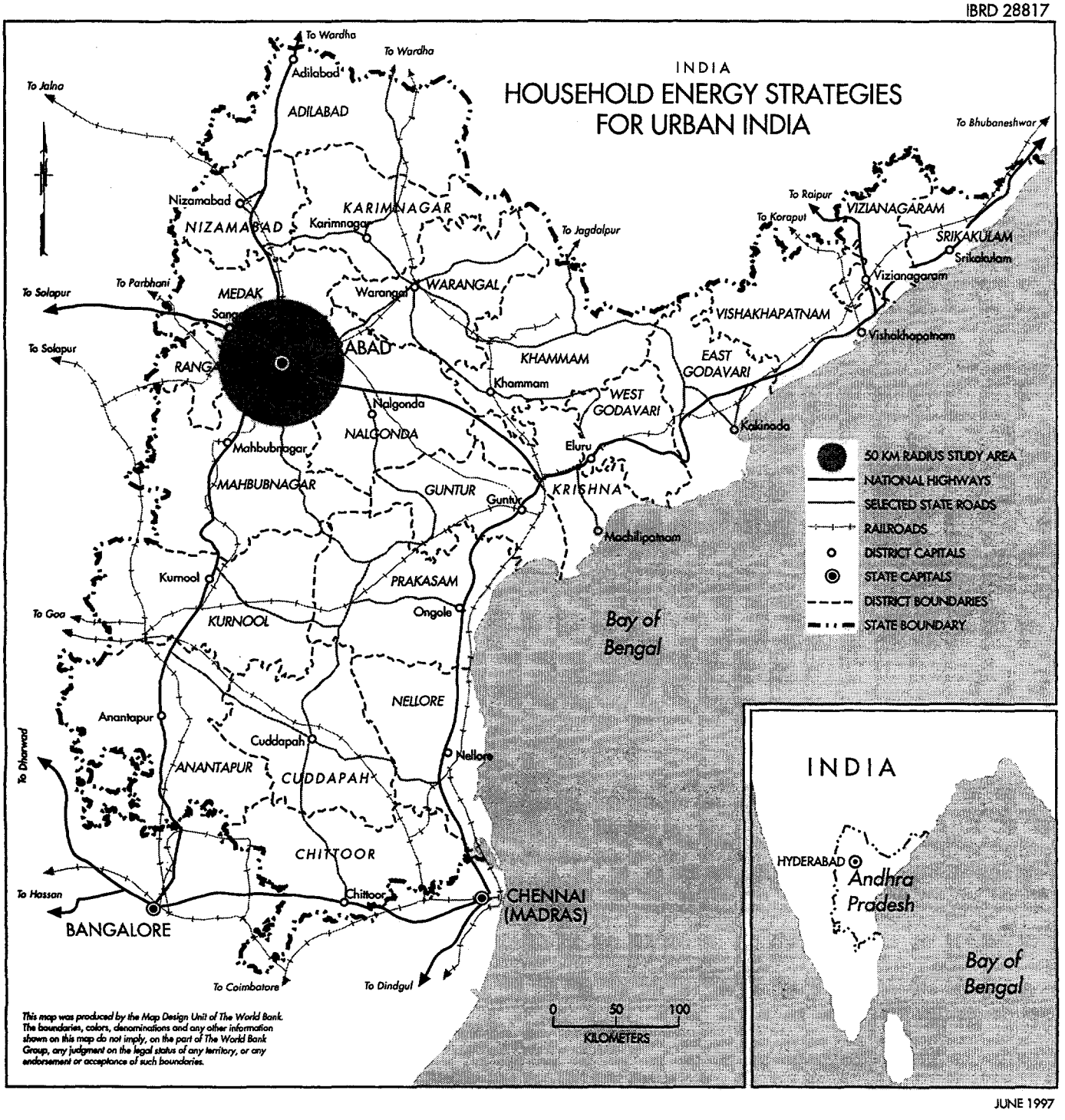
1

Introduction

1.1 Metropolitan Hyderabad, with a population of almost 5 million, is one of the megacities of India. In its growth trend, it compares favorably with three of the four premier metropolitan cities in India—Bombay, Calcutta, Delhi and Madras. Only New Delhi, with its exceedingly fast population growth rate, is significantly ahead of these others. The population growth of metropolitan Hyderabad has been steadily rising since 1961, but the rise notably increased during 1981-91. For these reasons, Hyderabad can be viewed as a typical of cities in India in the category of "megacity"

1.2 Hyderabad is one of the historic cities of India, founded in 1591 as the capital of the kingdom of Golconda (see Map 1). Its modern phase of development commenced in 1956, when it was declared the capital of the Telugu-speaking state of Andhra Pradesh. Since its emergence as the capital besides being a nodal administrative center in India, Hyderabad has also developed as one of the country's leading commercial and industrial centers.

1.3 In spite of its rich cultural heritage, Hyderabad has experienced many of the same urban problems of other major cities in India. These include rapid population growth resulting in overcrowding, congestion, and high levels of urban pollution. One interesting development in India's large cities has been the rapidly changing energy use patterns, involving a switch from traditional to modern fuels. It was only 15 years ago that a significant proportion of the population in Hyderabad was dependent on wood fuels and the size of the wood trade in the city was extremely large. The rapid growth of Hyderabad into one of India's megacities has involved a significant shift in energy use patterns. These trends are introduced in this chapter and explored more thoroughly in the main body of this report.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KILOMETERS
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JUNE 1997

Trends and Issues for Residential Energy

1.4 Interfuel substitution is taking place very rapidly in urban Hyderabad as people move from wood to kerosene, from kerosene to LPG, and even sometimes from wood to LPG. This substitution is taking place in spite of the fact that there has been limited growth in real incomes during the last 15 years. This suggests that much of the fuel substitution has come from liberalization of energy markets. It is likely that this trend will continue and even accelerate, as it is likely that incomes will grow and affordability will increase during the coming years.

1.5 The markets for energy in urban Hyderabad are influenced extensively by government policies. The main policies having an impact on the sector are limits on the import of petroleum products, household fuel subsidy programs, and electricity distribution policies. The energy subsidies in urban Hyderabad are very large (about 80 million rupees per month) and are likely to continue to grow as more and more people switch to modern fuels. Unfortunately, these subsidies, which are meant to help the poor, are not very well directed. In fact, the majority of the subsidies end up in middle and upper-class households that can afford to pay market rates for fuels. Likewise, policies to limit imports of fuels create periodic local scarcities. In such scarcity situations, it is the poor who are the last to gain access to the fuel. This is evidenced by the fact that the poor had no access to kerosene until LPG became more widely available for urban middle class households.

1.6 Although the public distribution system and its reliance on ration cards is helping poor people afford kerosene, it is not very well targeted and is also benefiting the more wealthy and middle class households disproportionatly. In fact, the poorest households without addresses cannot gain access to ration cards and are actually paying world market prices for kerosene or are using very expensive fuelwood for cooking. In addition, the ration shops often get kerosene only periodically, so the supply of the fuel is somewhat sporadic.

1.7 The State Electricity Board is under increasing financial strain as it is pressured to provide more service with less revenue. The large government loans and subsidies coming to the SEBs (as opposed to getting most of their income from customer billing) creates an incentive structure that motivates managers to meet government targets, as opposed to providing quality service to customers. The consequence is that public opinion regarding the SEB is extremely low. Focus group interviews of middle class and higher-income households reveal support for reforming and liberalizing the distribution of electricity, even if it means higher prices. There was no similar level of support from poor people, so special consideration should be given to dealing with their problems if reform is forthcoming.

1.8 The energy problems of the urban poor are most acute. They lack the means to shift to cleaner and more efficient fuels and continue to use the inefficient and relatively expensive fuels. As a result, they often pay more for fuel on a useful energy basis than the upper-income groups. In this study, the energy problems of the urban poor are examined in depth. The purpose of this is to gain a clear understanding of the issues involved in order to make pragmatic policy recommendations, with a view to eliminating the bottlenecks which prevent the upward movement of the poor on the "energy ladder."

1.9 Firewood is still an important source of cooking energy among the poor. An assessment of their firewood demand provides an estimate of the total demand in the urban market and the consequent impact on biomass changes in the hinterland. There has been a decline in biomass resources around Hyderabad, but this decline has diminished dramatically during the last ten years. The decline of biomass is a function of the consumption of firewood in urban markets, the expansion of urban built-up areas, increasing population in rural areas, and development activities such as road and railroad construction. That deforestation rates have slowed considerably in the metropolitan region is due to a significant transition away from wood as a cooking fuel in Hyderabad combined with forestry policies that stress conservation of forests and changing land use patterns in rural areas. This is very good news and existing policies should be strengthened to maintain this important trend.

1.10 The fuelwood trade in Hyderabad is already based on market principles and this should not be changed. The forestry department should continue programs that encourage farmers to grow (and harvest) trees on their own farms, since this is the main source of fuelwood for Hyderabad City. Since commercial enterprises are increasingly using wood, it is recommended that the coal subsidy and allocation system be eliminated and coal distribution be based on market principles.

1.11 Finally, attitudes and perceptions of people are important determinants of their choice of fuels and in identifying their energy problems clearly. Their attitudes, perceptions, and degrees of awareness are strongly influenced by cultural factors and levels of education and income. Households with higher levels of education and income enjoy greater opportunities and comforts and have different attitudes towards energy policy issues, energy tariff changes, and possible privatization of energy services. These issues are also examined in this study.

A Brief Review of Research on National Energy Policies and Urban Areas

1.12 The main focus of Indian government agencies such as The Planning Commission has been guided by national energy policies that encourage self-sufficiency and reduced dependence on imported petroleum products. The reason for this is the critical role that energy plays in national economic development, the acute shortage of petroleum products in India, and the growing demand for them in the country. A number of expert committees were appointed to make appropriate energy policy recommendations, focusing on the availability of indigenous energy resources in the context of overall demand and supply. These committees have confined themselves to the broader issues relating to the overall demand for petroleum products and have recommended strategies to reduce the import of oil products through increased local production and improved technology, thereby increasing energy efficiency and reducing the intensity and quantity of consumption.

1.13 The reports from these committees stress that energy consumption in India should be monitored, but mainly with a view to preventing excessive rise in the consumption of petroleum and petroleum products. For instance, the *Report of the Fuelwood Study Committee* (Government of India, 1982) stressed the need to minimize "dependence on imported energy resources" and maximize the production and utilization

of national resources. Despite their advocacy of reduced consumption of petroleum products such as LPG and kerosene in the domestic sector, these reports nonetheless projected that the consumption of commercial energy would increase over time because of the rise in per capita income, the rise in industrial production, the increase in population, higher levels of urbanization, increasing levels of mechanization, and increased demand in the population for energy-related consumer comforts. This point has been most stressed in the *Report on the Sectoral Energy Demand in India* (Government of India, 1991), which focused attention on energy demand as it relates to demographic and income changes, urbanization, and improvements in end use efficiencies. This report postulated that structural changes in the economy could lead to rapid interfuel substitution and changes in per capita energy consumption.

1.14 The domestic sector is one of the most important users of commercial and traditional sources of energy. It accounts for almost half of the total energy consumed in India. Urban households specifically are significant consumers of both traditional and commercial sources of energy. Forty-seven percent of urban households use traditional energy for various end uses. The importance of both commercial and traditional fuels in urban areas is further highlighted by the fact that, about two-thirds of the urban households in India use commercial fuels, and the remaining one-third use biomass fuels such as wood and charcoal for cooking (Government of India, Office of Registrar, 1993). This is further corroborated by the figures furnished the Advisory Board on Energy (1985), which indicated that 31 percent of the total cooking energy needs of urban households were met by firewood. The Advisory Board has projected that firewood will continue to be an important source of cooking energy in India's urban centers in the foreseeable future, because alternate sources of energy are just not available.

1.15 Despite the importance of the household sector, no serious endeavor was made by the Government of India to assess its energy needs and evolve a strategy to ensure a steady supply of energy to domestic consumers. The expert committee reports cited above do not provide any indication of interfuel substitution, energy transition, and end uses of energy at the household level. The committees are themselves critical of this vital gap in urban-use energy data. They emphasize the need to conduct empirical studies in order to appreciate, plan for, and better manage the urban energy demand and supply scenario. In the absence of relevant data, the reports fail to furnish any insight into consumption patterns and trends in the household sector. In view of this, they deal with urban energy use problems in terms of generalities and aggregates, broadly divided into commercial and traditional sources of energy.

1.16 Even research studies on energy use in urban India have been somewhat limited in scope. The earliest study on urban energy demand was completed by the National Council of Advanced Economic Research (1959). This revealed that Bombay had at that date already reached an advanced stage of energy transition. The use of household appliances in urban Karnataka was covered in a very limited fashion in the Karnataka study (Reddy and Reddy, 1983). The main national study on this subject was completed by the National Council of Advanced Economic Research in 1985 (Natarajan, 1985). Another study that covered household energy issues for several cities in Maharashtra documented that people in both large urban areas and towns were increasingly moving toward the use of LPG and kerosene for cooking (Kulkarni et al.

1991). This study examined energy consumption patterns, end uses of energy, incomes and types of fuel used, income-energy expenditure relationships, electricity, and the use of appliances.

1.17 It is the goal of this report to furnish data, other information, and recommendations that will enable policy-makers and urban analysts to develop a proper understanding of the domestic energy use problems of urban and metropolitan cities in India, and the energy use problems of the domestic sector in particular. In this respect, it may remedy some of the omissions on urban household energy use of the studies and research efforts cited above. It is hoped that this report will serve as an aid to policy-makers to formulate an appropriate strategy to provide urban domestic consumers with clear and efficient fuels at affordable cost.

Focus of this Study

1.18 The focus of this study is the provision of basic information on urban household energy use that may be useful as an input in the energy policy-making process for the metropolitan cities of India. The findings based on Hyderabad are not unique, in that the city is bound by the same national energy policies that have an impact on most other cities of its size and character. However, the study generalizations may not be applicable to smaller towns and cities. The topics addressed are detailed below.

- The patterns of income growth and distribution are examined; this includes identification of households below the poverty line.
- Energy consumption patterns for the domestic sector are detailed for both urban and suburban areas, along with end use patterns, subsidies, and consumer preferences.
- The rapid growth in the use of LPG is examined in some detail, along with policies to support this trend.
- The opportunities and problems associated with the growth of electricity use are detailed, especially the degradation of service quality to urban households.
- The benefits and problems of rationing kerosene through the public distribution system are examined, along with the implications for poor households.
- The impact of firewood harvesting on the ecology of the hinterlands surrounding Hyderabad is examined by analyzing issues of deforestation, land degradation, and local resource management.
- Possible policy changes are recommended, based on the results of the study, particularly relating to energy subsidies, market distortions, and access to energy by urban poor people.

Methods of Analysis

1.19 This study is based on a comprehensive analysis of urban energy issues as they relate to the residential sector. The method of analysis combined extensive background research, interviews with key government and energy industry officials, focus group interviews of household consumers according to different income and

cultural profiles, measurement of electricity use by common household appliances, and finally, a comprehensive survey of household energy use, opinions, and attitudes towards energy services and policies in Hyderabad.

1.20 The household survey included a representative sample of both urban and peri-urban areas within and around the Hyderabad metropolitan area. The survey involved interviews of about 2,800 randomly selected households in all areas of the city (see Appendix A for greater details on methods). It was conducted during March through June of 1994 and yielded information on socioeconomic characteristics of the households, energy use patterns and consumption quantities, an inventory of household appliances, and the attitudes and opinions of households on a wide variety of energy-related issues, including energy pricing and privatization of energy supply and distribution.

1.21 The study also includes surveys of energy retailers, including wood traders, LPG distribution companies, appliance retailers, and others. In addition, focus group interviews were conducted among energy consumers. The focus groups were typically located in a consumer's house and involved a collection of typical consumers stratified by income and cultural group. The results of these focus groups provided greater depth of information on energy issues than could be gathered through formal surveys alone.

1.22 All of the methods described above were utilized in analyzing the patterns of urban household energy use in Hyderabad and how they are affected by prevailing energy policies. Clearly, this study is based on a great number of sources which were utilized for cross-checking the results of each of the different methods. The result is a study of energy use patterns in a typical urban metropolitan area in India that has greater breadth and depth than any previous effort of its kind.

Organization of Report

1.23 This report first presents a socioeconomic profile of urban Hyderabad, followed by a detailed assessment of energy use patterns in the city. The national policies that have an impact on energy use are evaluated, along with their effectiveness in promoting interfuel substitution and in providing a safety net for the poor. In this regard, the levels of energy subsidies for different income classes are examined in detail. The problems and opportunities in promoting energy efficiency and energy efficiency behavior are also a subject that is examined very thoroughly. Finally, changes in fuelwood consumption are related to levels of peri-urban deforestation and policies to encourage land management patterns that will lead to sustainable use of local resources. The concluding chapter makes recommendations for urban energy policies more generally based on the information yielded by this study.

2

Socioeconomic Profile of Metropolitan Hyderabad

2.1 One of the principal economic development issues of net oil-importing developing countries like India has been whether or not these nations would be able to sustain rapid economic growth in the face of rising world energy prices and rapid depletion of their native energy resources. This has been particularly true since the early 1970s. Before turning to energy issues, however, and to aid in understanding energy demand and consumption issues specifically related to the household sector in Hyderabad, this report first provides a profile of the socioeconomic characteristics of the city's population and an overview of its growth since the early 1950s.

Demographic Profile of Hyderabad City

Rapid Population Growth

2.2 The population of Hyderabad City has grown phenomenally, from 1.12 million in 1961 to over 3 million by 1991 (see Table 2.1). If the suburban areas are also included, then the city's population would have been 4.3 million as of 1991, making Hyderabad the fifth-largest metropolitan area in India after Bombay, Calcutta, Delhi, and Madras. As can be observed from Table 2.1, the suburban population has contributed greatly to this explosive growth. The suburban population, which was a mere 10.6 percent of the metropolitan population in 1971, constituted almost one-third of its total population in 1991. Furthermore, the annual suburban population growth rate during 1981-91 was a remarkable 11.3 percent compared with the 3.2 percent growth rate of the Hyderabad Municipal Corporation area, including Secunderabad Cantonment.

Table 2.1
Population Increase of Metropolitan Hyderabad, Selected Years, 1951-91

Years	Municipal Corporation		Hyderabad Urban Agglomeration (HUA)*		Suburban Population	
	Population (million)	Compound Growth Rate (% p.a.)	Population (million)	Compound Growth Rate (% p.a.)	Percent of HUA Population	Compound Growth Rate (% p.a.)
1951	1.03		1.13		8.8	--
1961	1.12	0.84	1.25	1.0	10.4	2.7
1971	1.61	3.7	1.80	3.7	10.6	3.9
1981	2.15	2.9	2.76	4.4	22.1	12.4
1991	2.96	3.2	4.74	5.5	37.6	11.3

Source: Computed from 1. Alam & Alikhan ,"Metropolitan Resurvey" (unpublished), 1982.
2. Census of India, 1991.

* Includes Municipal Corporation of Hyderabad, Secunderabad and Municipal Corporation portion of Ranga Reddy District.

Rise in Literacy

2.3 The growth of the city has been accompanied by a rise in literacy levels. The proportion of the population that is literate increased particularly between 1967 and 1994; from a mere 40 percent to 76 percent (see Table 2.2). Most of this increase occurred between 1967 and 1982. The increase has been only marginal— just 2 percent— in the subsequent 12 years (1982-94). However, it is a matter for concern that 24 percent of the population of a major metropolitan area like Hyderabad is still illiterate. The level of education could have a significant influence on household fuel choice and in particular, on household awareness of various energy-related matters like conservation, relative efficiency of appliances, and pricing of energy products.

Table 2.2
Level of Literacy in Metropolitan Hyderabad, 1967, 1982, & 1994

Year	% of Literates in the Sample
1967	48
1982	74
1994	76
Income Group (Per capita in Rs. per month)	
Very low (up to Rs. 250)	60
Low (Rs. 251-375)	73
Middle (Rs. 376-583)	80
Upper Middle (Rs. 584-990)	86
High (> Rs. 991)	93
Total Metropolitan Hyderabad	76

Source: Hyderabad survey data, 1994.

2.4 As might be expected, the least educated are concentrated in the "low" and "very low" income groups (see Table 2.3). Sixty percent of the literate population in the

"very low" income group do not have education even up to the high school level. While 7 percent and 12 percent of literates, respectively, in the two lowest income groups have education up to the intermediate level, graduates account for only 3 and 6 percent of the literates in these groups. The percentage of literates not having education up to the high school level in the "middle," "upper middle," and 'high" income groups ranges between 18 percent and 38 percent, which is quite low compared to the 60 percent of the "very low" low income group. One positive feature that must be noted in this context is that, between 1982 and 1994, the percentage of all people having an education at the high school level increased from 40 percent to 51 percent.

Table 2.3
Percentage Distribution of Literate Population by Level of Education and Income Group, Metropolitan Hyderabad, 1994

	Higest Level of Education Attained					
Income Group (Per capita in Rs. per month)	*Below High School*	*Up to High School*	*Interme-diate*	*ITI/ Polytechnic*	*Gradu-ates*	*Post-Graduates*
Very low (< Rs. 250)	60	29	7	0.6	3	0.2
Low (Rs. 251-375)	51	29	12	0.9	6	1
Middle (Rs. 376-583)	38	31	14	2	14	1
Upper Middle (Rs. 584-990)	28	26	16	2	24	4
High (> Rs. 991)	18	17	13	3	37	12
Total Metropolitan Hyderabad	40	26	12	2	17	3

Source: Hyderabad survey data, 1994.

Economic Development of Hyderabad City

Income Growth - Not Keeping Pace with Inflation

2.5 Unfortunately, the demographic growth of Metropolitan Hyderabad is not supported by an even faster pace of economic development. Although incomes have grown in the period between 1967 and 1994, the pace of inflation has grown even faster. This means that overall, there has been a decline in purchasing power. In addition, when the patterns of income distribution are taken into consideration, the highest income groups have increased their purchasing power, while the poor and middle class have lost ground. These findings, although somewhat discouraging, are interesting in the context of the dynamic changes in energy use in the city that are documented in later sections of this paper.

2.6 As indicated, this study is fortunate to have had access to three household surveys that were conducted in 1967, 1982, and 1994. Although the techniques used for measuring income differ somewhat from each other, they are roughly comparable. The

results of the surveys confirm that, without adjusting for inflation, both income per household and income per capita have increased between 1967 and 1994 at an annual compound growth rate of 10.2 percent and 9.9 percent respectively (see Table 2.4). This means that as the city has grown, the economy of the city has expanded to accommodate this growth.

Table 2.4
Average and Per Capita Income of Households, Metropolitan Hyderabad, 1967, 1982 & 1994 (measured in current prices)

Year	*Per Household Income (Rs./month)*	*Per capita Income (Rs./month)*	*Compound rates of growth of Average Household Income*	*Compound rates of growth of Per capita Income*
1967	308.86	49		
1982	1841.93	297	12.6	12.8
1994	4219.00	630	7.2	6.5
1967-94			10.2	9.9

Source: Metropolitan Hyderabad and its Region, Alam & Khan, 1972; Alam & Alikhan, "Metropolitan Resurvey" (unpublished), 1982; Hyderabad survey data, 1994.

2.7 Although the figures for income growth appear impressive, Hyderabad has experienced significantly high levels of inflation, especially during the last 15 years. To determine the actual purchasing power of households, the income figures from the surveys were adjusted for inflation. The average and per capita income figures for 1967, 1982, and 1994 have been deflated using the consumer price index for industrial workers in Hyderabad City, which is available with base 1960=100 from the *Statistical Abstract for Andhra Pradesh.* (Directorate of Economics and Statistics, A.P).

2.8 Measured in real terms, there was actually a decline, though marginal, in the monthly average and per capita incomes of the households in Hyderabad City between 1982 and 1994. After adjusting for the increase in prices between 1967 and 1994, the increase in the average and per capita household incomes has not been as marked as when incomes are measured in current prices (see Table 2.5). Table 2.5 highlights that, measured in terms of constant 1960 prices, the average income per household has actually increased from Rs. 187.19 per month in 1967 to Rs. 312.8 per month in 1994, registering a compound rate of growth of only 1.9 percent per annum. Meanwhile, per capita income increased from Rs. 29.70 per month in 1967 to Rs. 46.7 per month in 1994, growing at a compound rate of 1.7 percent per annum. The decline in income in real terms between 1982 and 1994 is probably the result of the combined effect of the lowering of state income for 1994, a large increase in prices between 1982 and1994, and the increase in unemployment.

2.9 To verify the findings on income growth shown in Table 2.5, an analysis was conducted of household domestic product in Andhra Pradesh for a 15-year period (see Table 2.6). At the state level, there is no uniform trend, but interestingly, net household domestic product *and* household domestic product expressed as per capita income is lower for certain years. Since the economy of Andhra Pradesh is very sensitive to agricultural output, any lowering of this output results in lower income levels for that

year. Both 1982 and 1994 were years for which per capita income was lower than for the previous years. The lower income observed for 1994 is probably a reflection of the general lowering of income at the state level in that year.

Table 2.5
Average and Per Capita Household Income, Hyderabad City, 1967, 1982, & 1994 (in constant 1960 prices)

Year	*Per household Income (Rs./month)*	*per capita Income (Rs./month)*	*Compound rates of growth of average household Income*	*Compound rates of growth of per capita Income*
1967	187	29		
1982	382	61	4.9	4.5
1994	312	46	(-)1.6	(-)2.3
1967-94			1.9	1.7

Note: Different deflators were used to study income at constant prices. The consumer price indices for industrial workers and for urban non-manual employees were used for the base years 1960 and 1982. The results obtained in all the cases corroborated that there was a decline in real income in Hyderabad between 1982 and 1994.

Source: Alam & Khan, op. cit., 1972.; Alam & Alikhan, op cit, 1982; Hyderabad survey data, 1994.

Table 2.6
Household Domestic Product, in Aggregate and in Terms of Per capita Income, Andhra Pradesh, 1980-95 (in constant 1980-81 prices)

Year	*Household Domestic Product (million Rs.)*	*Per Capita Household Income (Rs.)*
1980-81	73	1300
1981-82	84	1558
1982-83	85	1545
1983-84	88	1578
1984-85	86	1501
1985-86	70	1549
1986-87	86	1461
1987-88	95	1576
1988-89	110	1789
1989-90	115	1041
1990-91	117	1779
1991-92	120	1788
1992-93	120	1761
1993-94	131	1888
1994-95	131	1859

Source: Bureau of Economics and Statistics, Hyderabad, Andhra Pradesh.

2.10 To further validate the income findings, the data from the 1994 household survey were deflated according to the 1982 base consumer price index for industrial workers. As was done in 1982, the 1994 households were ordered by income quintiles. This makes it possible to compare the 1982 and 1994 income groups according to their

level of income (see Table 2.7). Interestingly, the lowest income groups lost the most income between 1982 and 1994, while the higher income groups actually gained income during the period. Real per capita income has fallen by about 55 percent for the lowest 17 percent of the population and by 42 percent in the next-lowest income group.

Table 2.7
Mean Monthly Per Capita Income of Hyderabad across all Income Groups, 1982 & 1994

Income Group (at 1982 Prices) (Rs. per household per month)	*Mean Monthly Per capita Income*		*Difference in Mean Monthly Per capita Income (Col. 3 - Col. 2)*	
	1982 (Rs.)	*1994 (Rs.)*	*(Rs.)*	*(%)*
0-500	106	48	(-) 57.85	(-) 54.58
501-1000	180	104	(-) 75.94	(-) 42.1
1001-2000	274	229	(-) 45.67	(-) 16.0
2001-3000	462	413	(-) 49.50	(-) 10.7
3001-4000	612	731	(+) 119.67	(+) 19.55
>4000	777	1416	(+) 639.0	(+) 82.0

Source: Hyderabad survey data of 1982 and 1994.

2.11 By contrast, the proportion for the households in the two highest income categories increased in real terms. The per capita income of the highest 17 percent of the population increased by 82 percent, while households in the next-highest income group increased their.income by 20 percent. Though the real income of the highest groups has increased, this increase is not enough to offset the declining real income of all the other income groups, so the level of income during the period 1982-94 declined overall.

2.12 Another plausible explanation for the decline in household incomes measured in constant prices may be found in the fact that the earner-to-non-earner ratio in Metropolitan Hyderabad is quite high, with nearly four non-earners per every earner. Also, as noted earlier, the 1994 survey data compared with 1982 survey data reveals that the overall employment situation in Metropolitan Hyderabad has actually worsened between these years. The proportion of earners in the total population declined from 27.5 percent in 1982 to 25 percent in 1994.

2.13 To conclude, the dominance of low-income groups in the metropolitan economy is highlighted by the fact that the per capita monthly income of 23.6 percent of the sample households is below the poverty line, denoted by the per capita figure of Rs. 264 for urban India (1991-92 prices) as determined by the Planning Commission. The per capita income of another 9 percent is just marginally above the poverty line. Thus, nearly 30 percent, or almost one-third of the entire sample population households (270,491) live under conditions of stark poverty.

Occupational Structure

2.14 Hyderabad is a multi-functional metropolis with business (trade and commerce), skilled jobs (industries), and administration as the principal sources of employment. Of these three, business has an edge over the other two, claiming a little

over one-fourth of the total employed people (see Table 2.8). Hyderabad has always been a pre-eminent center for administration and services however. It still maintains that status if we combine into one occupational unit the professional, teaching, and administrative functions. These three together claim 27 percent of the total employed people and constitute the single largest group of the employed. The "high" (60 percent of the total) and "upper middle" (35 percent of the total) income groups are concentrated in these three occupational areas.

2.15 Semi-skilled and unskilled work dominates the occupational structure in the "very low" and "low" income groups, which in turn is a reflection of the low levels of education at these income levels. The proportion of earners engaged in these inferior and low-paid activities declines steadily with increases in income, from 44 percent and 33 percent in the "very low" and "low" income groups, until they account for only 5 percent of the earning population in the "high" income group.

Table 2.8
Percentage Distribution of Earners by Occupations, Metropolitan Hyderabad, 1994

Income Group (Per capita in Rs. per month)	*Occupations*							
	Profes-sional	*Teaching*	*Business*	*Admini-stration*	*Skilled*	*Semi-skilled*	*Un-skilled*	*Others*
Very low (< Rs. 250)	0.2	0.7	25	3	24	14	30	2
Low (Rs. 251-375)	1.5	2	30	8	24	16	17	3
Middle (Rs. 376-583)	5	3	26	12	27	14	10	4
Upper Middle (Rs. 584-990)	9	6	29	20	20	10	5	2
High (> Rs. 991)	24	11	23	25	11	5	0.5	2
Total Metropolitan Hyderabad	8	5	26	14	21	11	12	2

Source: Hyderabad survey data,1994.

2.16 The Hyderabad economy is dominated by low wages in the skilled, semi-skilled, and unskilled occupations. These three occupation categories account for 44 percent of the total employed individuals among the sample households. It can be seen from Table 2.8 that the service sector, including teachers, skilled professionals (incorporating medical practitioners, lawyers, engineers, and management experts) and administrators constitutes only 27 percent of total employment. It is these professionals who dominate the occupational structure of the "high" income groups and which are barely represented at the lower income levels. Even at the "middle" and "upper middle" income levels, the proportion of highly skilled professionals does not exceed 9 percent.

Summary and Conclusion

2.17 Hyderabad is a very dynamic city that mirrors many of the problems that are faced by other cities in India. Although the city has had a significant amount of economic growth, this increase in prosperity has been offset by the influx of poor, rural immigrants to the city. These immigrants have swollen the ranks of the poor who must be served by the city's infrastructure. With this as background, we now turn to the dynamics of urban energy use in Hyderabad.

3

Changing Energy Trends in the Household Sector of Hyderabad

3.1 The household energy policies of the Indian government have been changing along with its economic policies. As will be documented in this chapter, the energy policies meant to help the poor do have an impact on urban energy use in Hyderabad, but not always in the ways intended. This chapter therefore focuses on changing energy policies and how energy use is changing in urban Hyderabad.

3.2 Interfuel substitution is taking place very rapidly in urban Hyderabad as people switch from wood to kerosene and from kerosene to LPG; this in spite of the fact that there has been limited real income growth on average in Hyderabad during the last 15 years. This suggests that much of the growth in the use of modern fuels has come from both the liberalization of energy markets and increased availability of fuels such as LPG, along with the increasing purchasing power of middle and higher-income groups. It is likely that this trend will continue and even accelerate during the coming decades. The structure and composition of domestic energy consumption in metropolitan Hyderabad is assessed in this chapter, with particular emphasis on the extent of the transition from traditional to modern fuels during the last decade.

Energy Policies and Programs Affecting Urban Hyderabad

3.3 The markets for energy in urban Hyderabad are influenced significantly by Indian government policies. The main policies influencing the sector are limits on the import of petroleum products, household fuel subsidy programs for petroleum products, and electricity pricing and distribution policies. Before turning to energy use patterns in Hyderabad, we describe the programs that have resulted from these policies and their impact on household energy use.

Kerosene Subsidies through Ration Card Program

3.4 Kerosene has long been viewed as the fuel used mainly by poor people in urban India and the government has utilized its national public distribution systems for selling kerosene products. The system works as follows. Consumers are issued ration cards that cover a wide variety of products, including basic foodstuffs such as rice. Anyone who has a ration card is permitted to purchase various products from designated retailers called ration shops. Kerosene is available at the ration shops in limited

quantities at subsidized prices. In theory, kerosene in India is sold only through the ration shops, so all other kerosene sold in the market is considered illegal. Although the ration card system is helping poor people afford kerosene to some extent, it is not very well targeted and is also benefiting the more wealthy and middle class households as well. In fact, the poorest households without addresses cannot gain access to ration cards and are actually paying world market prices for kerosene, or are using very expensive fuelwood for cooking. In addition, the ration shops often get kerosene, only periodically, so the availability of the fuel is somewhat sporadic.

LPG Distribution through Government-Affiliated Retailers

3.5 LPG has traditionally been distributed through retail dealers associated with the national petroleum companies. The distribution companies had exclusive rights to sell LPG, but they were required to follow pricing policies set by the government. The pricing policies are based on the principle that LPG should be sold at a price that reflects internal production costs in India, regardless of the world market price. However, there was not enough LPG produced within India to satisfy the demand for the fuel. As a consequence, a system was developed to limit the number of families that could purchase LPG from the distribution companies. The LPG retailers developed customers lists, limited the number of LPG bottles customers could have, and serviced only customers on that list. Thus, the retailers concentrate on established— and typically well-off— customers because their supplies are insufficient to meet the demand of all people that want LPG. All other customers are put on a waiting list. Because LPG is a highly desirable cooking fuel and fairly inexpensive compared to wood and other fuels, tens of thousands of people put their names on the waiting list to obtain LPG.

3.6 Recent policies have opened up the LPG market to private retailers, but they are permitted to sell only imported LPG. The price of LPG from these retailers is higher than the price that must be paid to the government-affiliated retailers. The combination of an increased number of private retailers and an expansion of LPG supply to government-affiliated retailers has resulted in a tremendous growth in LPG use in Hyderabad. The increasing LPG supplies have meant that the market for this product has expanded among middle and high-income consumers, and even some poor consumers. It also has meant that the annual subsidy going to LPG users now is approximately 17 crore rupees (US$500 million). This study finds that the middle class and wealthy appreciate the convenience of LPG and will continue to use it even with higher prices. Also the switch to LPG has had the benefit of freeing up kerosene for the urban poor.

Electricity and the State Electricity Boards

3.7 In most of India, electricity for urban households is supplied by the State Electricity Boards. The State Electricity Board is a vertical government monopoly that controls production, transmission, and distribution of electricity to urban households. Although urban households receive some subsidies as a result of electricity pricing policies, the main subsidies in the electricity sector go to rural agricultural consumers. The State Electricity Boards are suffering great financial strain because of these agricultural subsidies, and at the same time they are under great pressure to provide better service to urban consumers. However, by trying to maintain near-universal service levels with limited financial resources, the quality of service has declined significantly,

including many brownouts, blackouts, and voltage drops. The opinion of the public in Hyderabad toward the A.P. State Electricity Board is extremely low. Focus group interviews of middle class and higher-income households reveal support for reforming and liberalizing the distribution of electricity, even if it means higher prices. There was not a similar level of support from poor people, so special consideration should be given to dealing with their problems in the event of reforms.

Fuelwood as Sole Market-Based Household Fuel

3.8 Whereas modern fuels are heavily regulated, the fuelwood trade in Hyderabad is based on market principles. The main trend in the fuelwood trade in Hyderabad is that there has been a shift from serving household customers to commercial ones. In the space of nearly 15 years, the number of people using fuelwood as a cooking fuel has declined significantly, so the market has contracted and re-oriented itself toward other customers. Many commercial customers are using wood to replace or to enhance the calorific value of the poor-quality coal that they previously used in their enterprises. The good news concerning the decline in fuelwood use by urban households is that deforestation in the Hyderabad region has slowed considerably. Existing policies should be strengthened to maintain this important trend.

3.9 To summarize, government policies are very important in shaping household energy demand in Hyderabad. As will be discussed later, the subsidies in urban Hyderabad are quite large (over 80 million rupees per month) and are likely to continue to grow as more and more people switch to modern fuels. Unfortunately, these subsidies, which are meant to help the poor, are not very well directed. In fact, the majority of the subsidies end up in middle and upper-class households that can afford to pay market rates for fuels. Likewise, policies to limit imports of fuels create periodic local scarcities. In such scarcity situations, it is the poor who are the last to gain access to the fuel, as evidenced by the fact that they had no access to kerosene until LPG became more widely available for middle class households.

The Transition to Modern Fuels in Hyderabad

3.10 In this section, the structure and composition of energy consumption in metropolitan Hyderabad are evaluated, with particular emphasis on the transition from traditional to modern fuels during the last decade. To obtain a profile of the transition in fuel use over the years, the results of the present study are compared with those obtained in a study conducted for Hyderabad City during the period of 1981-82 (Alam et al. 1985). This section will examine the overall patterns of energy use in Hyderabad, along with the changes in energy use in urban households.

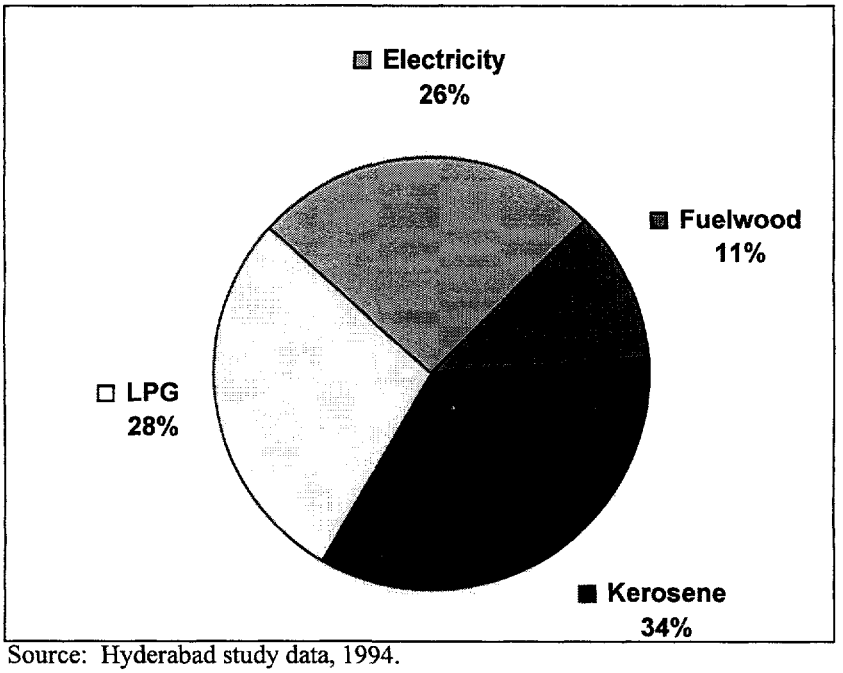
Overall Patterns of Total Energy Use

3.11 The total demand for energy in the household sector is determined by the demand of the various energy-dependent domestic functions such as cooking, water heating, lighting, air cooling, and entertainment. This demand for energy is met by a mix of commercial and traditional energy sources. The, survey conducted for this report reveals that the predominant commercial fuels are electricity, and petroleum products in the form of kerosene and LPG. Fuelwood is the main traditional energy source used,

while agricultural residue, sawdust, dung, and charcoal are a negligible proportion (less than 1 percent) of the total fuel mix. The main fuels studied in this chapter (consumption, expenditures, and use trends) are therefore firewood, kerosene, LPG, and electricity.

3.12 The total household energy consumption in Hyderabad, including fuelwood, is about 2,500 metric tons of oil equivalent per month. The proportionate share of the different fuels used is illustrated in Figure 3.1. As indicated, the use of fuelwood is rapidly disappearing and now constitutes just over 10 percent of total household energy consumption. (This amount is even less when the relative efficiency of fuels is taken into consideration.) As will be illustrated later, this is a dramatic change compared to 1982.

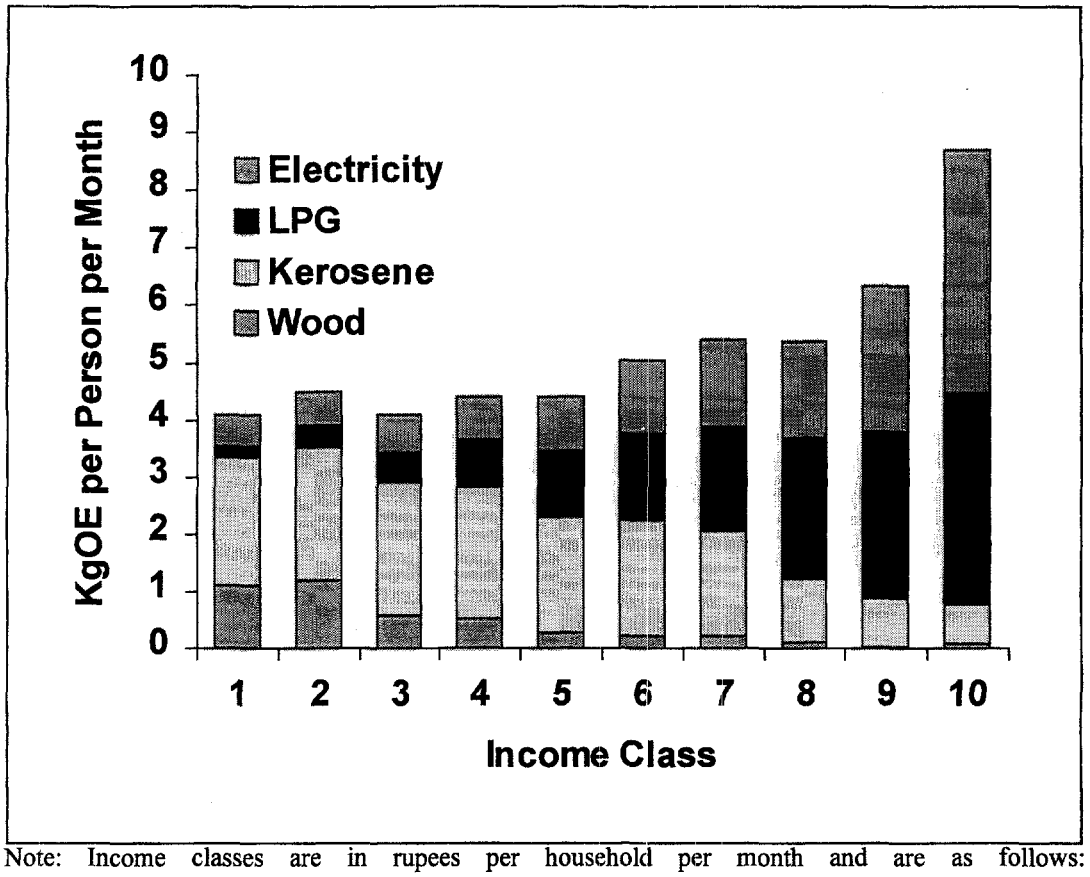
Figure 3.1 Fuel Sources for Household Energy Use, Hyderabad, 1994 (total energy use = 25.6 Million KgOE per month)



Source: Hyderabad study data, 1994.

3.13 The overall patterns of energy use hide rather significant differences in the energy used among income groups. Both kerosene and wood dominate energy use in the lowest (by income) 40 to 50 percent of the population (see Figure 3.2). The use of wood declines rather quickly as incomes rise and is now used by only a very low percentage of the population. On the other hand, kerosene is now a staple fuel for low-income households in Hyderabad. During the last 15 years, most low-income households using wood have now switched over to kerosene. Although these populations use some electricity and LPG, the level of use is rather low compared to more wealthy households. As shown in Figure 3.2, the use of both LPG and electricity are very dependent on the level of income, starting in the middle income ranges. The use of LPG and electricity accounts for about 50 percent of total energy use in the middle-income ranges, and for over 90 percent of total energy use in the highest income groups.

Figure 3.2 Fuel Sources for Household Energy Use by Income Decile, Hyderabad, 1994 (kilograms of oil equivalent per person per month)



Note: Income classes are in rupees per household per month and are as follows: 1= < 185, 2 = 186-250, 3 = 251-300, 4 = 301-375, 5 = 376-498, 6 = 499-583, 7 = 584-725, 8 =726-990, 9 = 991-1480, 10 = > 1480.
Source: Hyderabad study data, 1994.

3.14 The overall patterns of energy use are clear. The poor use less energy than more wealthy households and are very reliant on wood and kerosene. It should also be noted that the poor with ration cards do take full advantage of the subsidized kerosene, consuming virtually the equivalent of one month's allotted supply of kerosene of 15 liters per household per month. As will be seen later, despite the fact that the poor use less energy, the percent of their income spent on energy is actually higher than that of more wealthy households. Before turning to these issues, the paper examines changing patterns of energy demand in Hyderabad.

Changing Demand for Cooking Fuel

3.15 On the subject of changing demand for cooking fuel, a point that is worth mentioning is that the overall energy efficiency of cooking fuels in use has improved significantly during the last 15 years as a consequence of the increasing use of kerosene and LPG stoves. The amount of heat that is burned for cooking is called the input energy and the amount that actually is absorbed by pots, pans, and other vessels in the cooking

process is called useful energy. The difference between these two figures is actually wasted heat that escapes around the sides of the pan. It is well known that cooking with fuelwood stoves, which have efficiencies of 10 to 15 percent, is less efficient that cooking with kerosene stoves that have efficiencies of about 35 percent. Likewise, at between 55 and 60 percent efficiency, cooking with LPG stoves is even more efficient. The efficiency of using electric stoves is somewhat higher than even LPG, but few people cook with electricity in Hyderabad.

3.16 Households consumed about the same amount of useful energy for cooking in 1994 as they did in 1992. This is only logical, as it requires only so much useful energy to cook food. For example, boiling rice requires a certain amount of heat, which will not vary by energy type. *However, the amount of energy used to produce the approximately 9.5 kilograms of oil equivalent of useful energy necessary for household cooking is 30 percent less in 1994 compared to 1982 (see Table 3.3).* The reason for this is the switch from fuelwood to both kerosene and LPG, and has resulted in lower requirements of input energy. An additional benefit is that the fuel-based smoke and fumes from cooking that are harmful to the health of women have also been significantly decreased in urban households in Hyderabad.

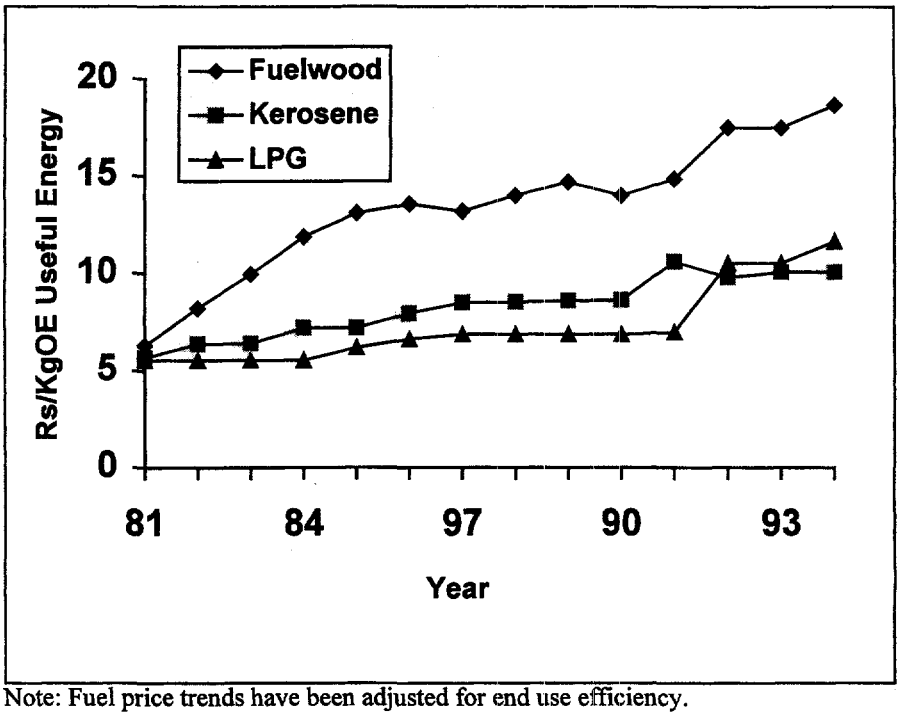
Table 3.3
Average Monthly Household Input and Useful Cooking Energy Consumption, by Fuel Type, Hyderabad, 1982 & 1994

Fuel Type	Input energy (KgOE/month/HH)		Useful energy (KgOE/month/HH)	
	1982	1994	1982	1994
Firewood	13.3	2.1	2.0	0.3
Kerosene	8.4	11.0	2.9	3.9
LPG	7.0	8.9	4.2	5.3
Total cooking energy	28.8	22.0	9.2	9.5

Source: (1) Alam et al, Fuelwood in Urban Markets, 1985.
(2) Hyderabad survey data, 1994.

3.17 The factors which influence the transition from firewood are the greater availability of fuels like kerosene and LPG and the relative prices of those fuels vis-à-vis firewood. As noted, in India, while the government subsidizes kerosene and LPG prices, market forces determine the cost of firewood, especially in urban areas. The increasing scarcity of biomass supplies has resulted in an increasing price for fuelwood. In Hyderabad, the price of firewood increased from just above 5 rupees to over 15 rupees per kilogram of oil equivalent for useful energy between 1981 and 1994 (see Figure 3.3). By contrast, both kerosene and LPG increased from just over 5 rupees to between 9 and 10 rupees per kilogram of oil equivalent in the same period. These figures clearly show that the price of firewood in Hyderabad has increased more rapidly than the prices of both LPG and kerosene, leading to a transition from fuelwood to kerosene and LPG. This means that, on the basis of daily household operating expenses, modern fuels such as kerosene and LPG have become much more affordable than wood for cooking.

Figure 3.3 Useful Energy Price of Cooking Fuels, Hyderabad, 1981-94 (Rs. per KgOE of cooking energy)



Note: Fuel price trends have been adjusted for end use efficiency.
Source: Hyderabad survey data, 1994.

3.18 In addition to purchasing more modern fuels for cooking, consumers also must purchase stoves and in some instances pay for service initiation fees. The costs of such appliances and fees are an important reason why more people have not switched to LPG for cooking (see Table 3.1). The cost of a wood stove is typically only about 50 rupees, and in some instances, consumers can make their own stoves with a few stones or bricks. Kerosene stoves range in price from 80 to 130 rupees, so they are quite affordable. However, the fees for obtaining service for LPG are greater than 1,000 rupees from government suppliers, and about 2,000 rupees for the new private sector suppliers. In addition to these fees, LPG stoves cost in excess of 1,500 rupees. The difficulty of qualifying for a service connection combined with the costs of the connection and the stove is a significant barrier for poor people in adopting LPG for cooking.

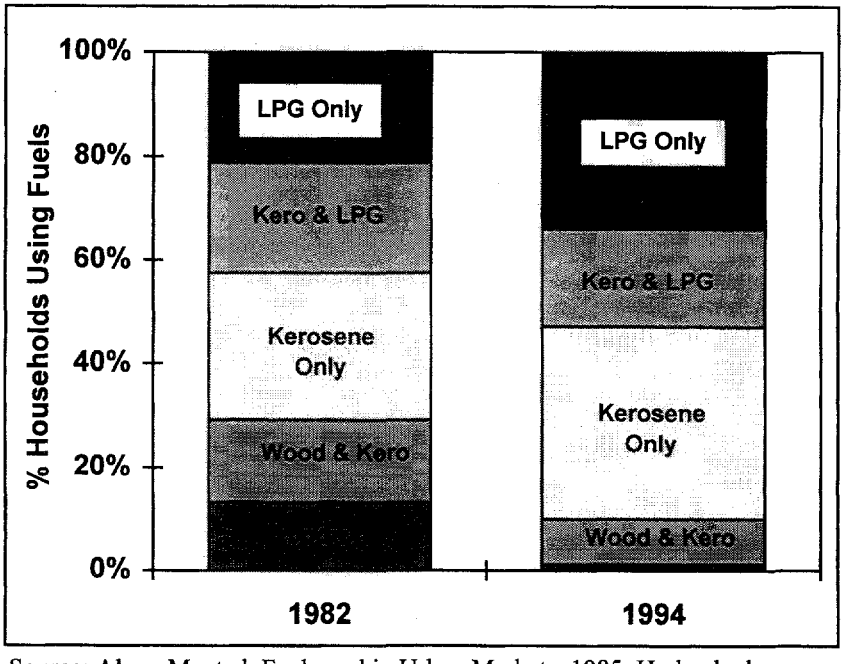
3.19 As a result of the significant differences in the costs of sources of cooking energy, the proportion of households depending exclusively on firewood has fallen drastically, from 13 percent in 1982 to only 1 percent in 1994 (see Figure 3.4). Likewise, the percentage of households employing a mix of wood and kerosene has declined from 16 percent to 8 percent. Meanwhile, there has been a significant increase in the number of people using both kerosene and LPG. The percentage of people using only kerosene for cooking has increased from 28 to 37 percent. The equivalent growth for LPG has been from 21 to 33 percent. These figures clearly illustrate the transition from the use of fuelwood to kerosene and LPG for cooking.

Table 3.1
Stove and Connection/Bottle Costs for Cooking Fuels, Hyderabad, 1994

Cost Type and Fuel	*Cost (rupees)*
Stove	
Wood	Approx. 50
Kerosene-Ordinary	80-90
Kerosene-Pressure	120-150
Kerosene-Wick	135-150
LPG Stove	1500-3000
LPG National Sector Connection Charges	
Deposit	900
Regulator	100
Cylinder	108
LPG Private Sector Connection Charges	
Deposit & Regulator	1950
2nd Cylinder	189

Source: Hyderabad survey data, 1994.

Figure 3.4 Changes in Household Choice of Cooking Fuels, Hyderabad, 1982 & 1994



Source: Alam, M. et al, Fuelwood in Urban Markets, 1985; Hyderabad survey data, 1994.

3.20 The rate at which the transition is taking place may not be discerned in studies that cover relatively short periods of time. This is demonstrated by the survey data on the levels of fuel use over the three years prior to the 1994 survey date, as shown in Table 3.2. Based on recall questions in the survey, between 60 and 70 percent of all

households using a particular energy source recorded no change in their consumption of kerosene, fuelwood, or LPG. However, people generally perceived that they are using more energy now compared to three years ago. Such changes in consumption are probably due to some interfuel substitution, changes in family size, or changes in cooking habits due to increasing income.

Table 3.2
Fuel Use Reported by Households for Three Years Prior to 1994 Survey, Hyderabad
(percentage of consuming households)

Fuel Type	Use more now than before	Use less now than before	Use same now as before	Did not use
Kerosene	23	12	64	1
Fuelwood	23	13	61	-
LPG	18	7	70	5

Source: Hyderabad survey data, 1994.

3.21 The question may be asked why there has been such a dramatic change in cooking energy use patterns in Hyderabad. There are several explanations. The first is that the availability of LPG has been improved significantly since 1982. Although LPG was very competitive from a price standpoint even in 1982, people had difficulty obtaining the fuel from the government-affiliated retailers. The second is that, at official prices, LPG is still quite competitive with kerosene and less expensive than fuelwood. Finally, people seem willing to pay for more expensive stoves and service initiation fees if they have sufficient income. However, the poor tend to use kerosene rather than LPG stoves because the former are less expensive. Fuelwood is the only fuel which is not dependent on government policy. Its price has remained above the price of other fuels, probably because more easily accessible fuelwood has already been harvested from around Hyderabad and most new supplies now come from farmers' fields. Because they have difficulty getting rationed kerosene and partly because of the low stove costs, the poorest of the poor still use fuelwood, even though it is twice as expensive as either kerosene or LPG.

Near-Universal Electricity Coverage in Hyderabad City

3.22 In spite of the rapid growth of metropolitan Hyderabad, the city has achieved near-universal electricity service. The survey indicates that over 98 percent of households are connected to the grid and served by the State Electricity Board. In 1981, the number of households with electricity was officially listed at about 50 percent of the urban population, although actual figures may have been higher because of unregistered connections. Notwithstanding the significant problems with the quality of electricity service, it is evident from the survey that all people in the city benefit from the availability of electricity. Since the earlier survey did not collect information on the extent of household electricity use, these issues in the electricity sector are examined in greater detail in the next chapter.

A Shift from Coal to Fuelwood in the Commercial Sector

3.23 The decline in fuelwood use by households in urban Hyderabad documented in this study is not duplicated in the commercial sector. Commercial establishments have been reducing their use of coal and increasing their use of fuelwood as a source of process heat energy (see Table 3.4). In informal interviews with commercial entities, the reasons given for the reduction in the use of coal were that the quality of coal has declined significantly during the last 15 years and fuelwood leaves behind much less ash than coal. This shift was confirmed in interviews with wood wholesalers and retailers, who say that their customer base has shifted from households to commercial establishments such as restaurants, bakeries, and ceremonial halls.

3.24 The estimated demand for fuelwood is documented in both the household surveys and in a survey of wood retailers in metropolitan Hyderabad. Once again, comparable data were available for both 1982 and 1994 to allow for comparisons of fuelwood demand over time. The figures indicate a marked decline of over 60,000 metric tons in overall use of wood for energy in urban households between 1982 and 1994. By contrast, both the commercial and the social and religious sectors each increased their use of wood by about 30,000 metric tons during the same period. These overall results indicated that, even though the city of Hyderabad grew by over 3 million people, the level of wood consumption in the city was stable. It is not surprising that the survey of wood retailers and wholesalers indicates that very few new businesses have started during this 12-year period.

Table 3.4
Changes in Sectoral Demand for Fuelwood, Hyderabad, 1982 & 1994

Demand Sector	*Wood consumption (mt per year)*		*Compound growth rate, 1982-94*	
	1982	1994	% Total change	% Annual change
Household	154,031	92,499	-51	-4
Commercial establishments*	13,700	43,015	114	10
Social & religious	10,000	34,368	123	10
Total	177,731	169,882	-5	-0.3

* Includes hostels.
Note: The rates of change are compound growth rates.
Source: Alam, M. et al, Fuelwood in Urban Markets, 1985; Hyderabad survey data, 1994.

3.25 The decrease in the use of coal in commercial establishments and industry is harder to document. Interviews of small industries that require process heat revealed that owners are dissatisfied with the quality of the coal they are receiving from government suppliers. However, they were unwilling to discuss the amount of coal they used compared to 10 years ago because they feared that they would lose their ration of

subsidized coal. However, it is evident from Table 3.5 that in the commercial sector (restaurants and bakeries), wood is being used in much greater quantities than coal. Unfortunately, because of the unreliability of the data, similar figures for small industries cannot be provided.

Table 3.5
Energy Sources for Process Heat in Restaurants and Bakeries, Hyderabad, 1994

Demand Sector	*Fuel Consumption (restaurants*)*		*Fuel Consumption (bakeries)*	
	Percent of restaurants using	*Estimated demand (KgOE/yr)*	*Percent of bakeries using*	*Estimated demand (KgOE/yr)*
Fuelwood	57	12,597,760	58	2,836,016
Kerosene	12	310,534	8	21,180
Coal	64	4,920,802	8	136,360
LPG	48	2,254,938	20	95,400

* Includes hostels.

Source: Hyderabad survey data, 1994.

3.26 The movement from coal to wood in the commercial and small industry sectors in Hyderabad is interesting because of the potential environmental benefits that might result. Wood is a renewable energy that today is harvested mainly from local farms around Hyderabad. When properly burned, wood gives off fewer pollutants and leaves less ash compared to coal. From the standpoint of global warming, the sustainable production and use of wood in local industries is a positive development. However, it should be cautioned that such sustainability has been made possible only because of the dramatic decline in the use of wood for cooking by urban households. With this qualification, the environmental benefits of the energy use changes taking place in Hyderabad are positive and should be encouraged.

Summary and Conclusion

3.27 There have been substantial changes in domestic fuels use in metropolitan Hyderabad in the past 12-15 year. For cooking, the use of fuelwood has fallen very substantially as households have switched to more modern fuels, mostly kerosene and LPG. The use of kerosene and LPG is greatly influenced by the government subsidy programs in place, although their relative costs, even with the subsidies, has resulted in a fairly clear socioeconomic stratification, in terms of which types of households tend to use these fuels. Another substantial change in the energy "picture" for households in the metropolitan area is that Hyderabad has achieved near-universal coverage for electricity service. Electricity service is also subsidized by the Indian government, though the service provided by the A.P. State Electricity Board is poor (brownouts, blackouts, and voltage fluctuations) because of institutional and other problems.

4

Social and Economic Consequences of Present Energy Use Patterns for the Household Sector of Hyderabad

4.1 The main social reasons for government energy subsidies are that they provide a social safety net for the poor and encourage urban households to benefit from modern energy sources. This chapter reviews energy use and expenditures and the effectiveness of these energy programs in reaching the poor by examining the price of energy and the effective subsidies for different income classes. In addition, public perceptions of energy and energy programs are examined in some detail.

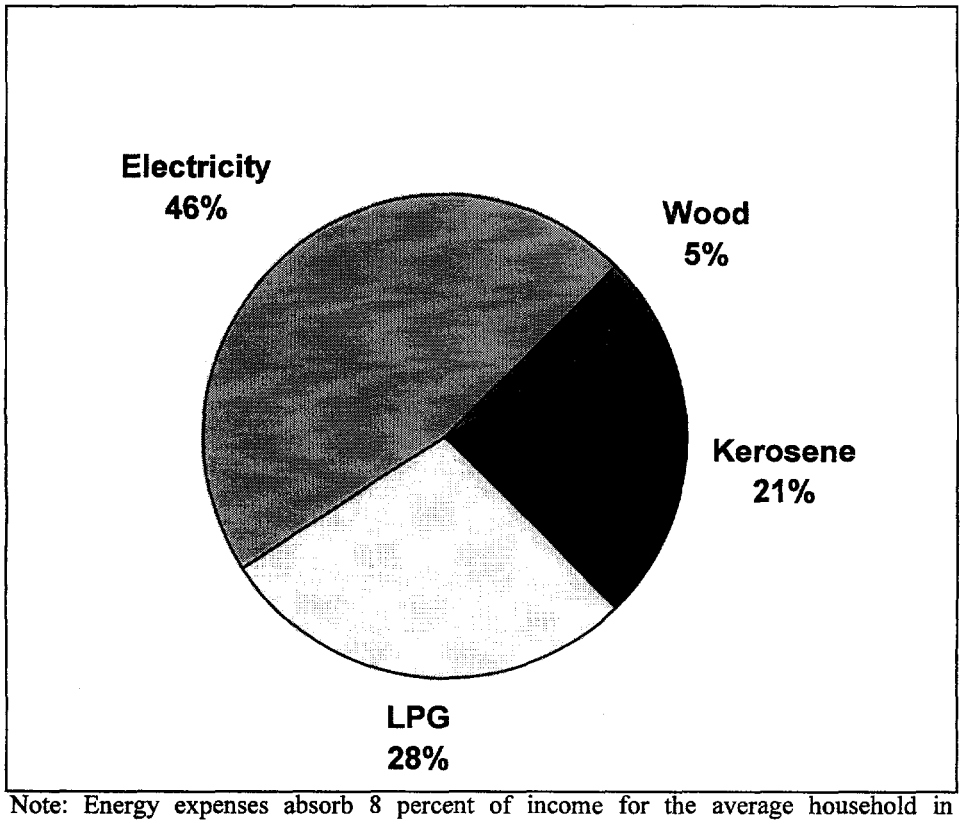
Energy Use and Energy Expenditures

4.2 Energy is a very important component of consumer spending in Hyderabad, especially for the urban poor. The total overall household spending on energy per month in Hyderabad is Rs. 212, or about 8 percent of total income. As indicated in Figure 4.1, for the average household in Hyderabad, electricity takes the largest share of income spent on energy, followed by LPG and kerosene. Electricity is used for lighting and for appliances such as fans, televisions, radios, and stereos, but it is used rarely for cooking. By contrast, the other main fuels—LPG and kerosene—are used primarily for cooking. Thus, the picture of energy expenditures in Hyderabad once again confirms that wood is no longer such an important household fuel. Wood has been virtually squeezed out of household budgets, except for the poorest households. By contrast, the use of electricity for uses other than cooking has been growing as an important energy expense.

4.3 The overall pattern is that lower-income groups use less energy than higher-income households, but energy is a very significant part of lower-income household budgets. As detailed in Table 4.1, the single largest expenditure for energy spending by the poor is for kerosene, which is used mainly for cooking. The amount of kerosene available through the ration card program for the poor is 15 liters per month, which would result in a cost for a household of about Rs. 45 per month. Poor households, which are typically spending over Rs. 50 per month on kerosene, are therefore supplementing their subsidized supplies with purchases on the open market at non-subsidized prices. Once again, the figures indicate that wood is no longer a

significant component of energy spending and even the poorest households use a significant amount of kerosene for cooking. It is also very clear that LPG use is highly dependent on income. The figures for expenditures for LPG demonstrate steady increases, from an average of 12 rupees per month for the poorest households, to over 100 rupees per month in the highest-income households.

Figure 4.1 Energy Expenses for Average Household, by type of Energy, Hyderabad, 1994



Note: Energy expenses absorb 8 percent of income for the average household in Hyderabad.

Source: Hyderabad survey data, 1994.

4.4 Another significant energy expense for the urban poor is electricity, which is used mainly for lighting. The urban poor are spending on average just less than 50 rupees per month on electricity. The pattern for electricity expenditures is interesting, because, as demonstrated in Table 4.1, the amount of money spent on electricity is relatively stable through the four lowest income classes. It then begins to rise with income. This means that the poorest households are using electricity for very basic needs, such as lighting.

4.5 As Table 4.1 demonstrates, the poor spend a very high proportion of their income on energy. In the poorest income groups, people are paying as much as 15 percent of their income on energy, mainly for kerosene for cooking and electricity for lighting (see Figure 4.2). The poorest households pay close to 5 percent of their income on the very little electricity that they use for lighting, compared to most other urban households in Hyderabad. The latter are paying between 2.5 to 3 percent of their income

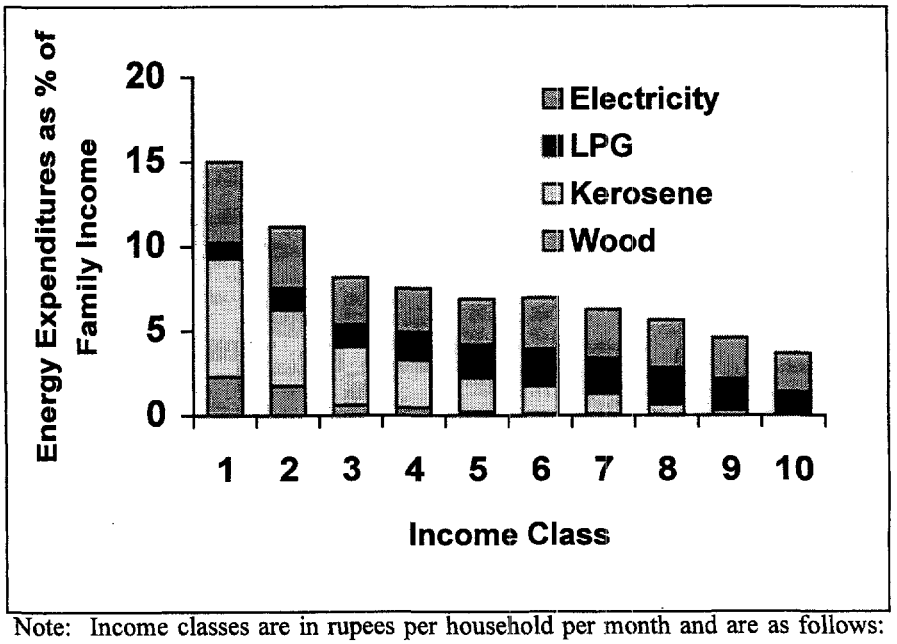
on electricity, but are using much more of this energy source. Focus group interviews of poor households revealed that, due to income constraints, people are already very conservative in their use of energy. They tend to turn off lights when they exit rooms and generally conserve electricity use to reduce their bills. The poor also opposed any changes which would result in rising electricity prices, saying that they could not afford it.

Table 4.1
Monthly Household Expenditures on Energy, by Income Class, Hyderabad, 1994

Income Decile (Rs/capita/mo)	*Rupees per Family per Month*					*Percent of income*
	Wood	*Kerosene*	*LPG*	*Electricity*	*Total*	
<185	23.9	69.7	12.7	48.9	162.6	15.4
185 - 250	25.6	64.5	20.3	54.0	170.6	11.2
250 - 300	11.4	60.1	25.9	53.9	157.0	8.2
300 - 375	13.2	57.9	41.1	57.8	182.5	7.8
375 - 498	4.4	47.0	57.2	72.6	190.7	7.2
498 - 583	3.6	38.9	65.8	85.2	195.4	6.8
583 - 725	4.1	38.1	76.9	114.0	235.5	6.2
725 - 990	2.0	22.1	92.1	118.7	234.8	5.6
990 - 1480	0.1	12.7	95.3	125.2	235.6	4.6
>1480	0.6	9.0	102.9	222.2	338.4	3.7
Average	9.4	42.3	58.3	96.3	212.0	7.7

Source: Hyderabad survey data, 1994.

Figure 4.2 Household Energy Expenditures by Income Class, Hyderabad, 1994



Note: Income classes are in rupees per household per month and are as follows: 1= < 185, 2 = 186-250, 3 = 251-300, 4 = 301-375, 5 = 376-498, 6 = 499-583, 7 = 584-725, 8 =726-990, 9 = 991-1480, 10 = > 1480.
Source: Hyderabad survey data, 1994.

4.6 Expenditures on kerosene, used mainly for cooking, constitute about 7 percent of budget expenses for the lowest-income households. This percentage is virtually nothing for the highest-income groups. Most people in the lowest-income groups take full advantage of the government kerosene subsidy program. To meet their total fuel requirements for cooking, however, they must also make additional kerosene purchases on the open market at world market prices. As might be expected, the focus group interviews revealed most poor people were dissatisfied with the erratic and inconsistent supply of kerosene coming from the public distribution system, but were opposed to privatization which would raise their costs significantly. This is understandable, given that they already spend about 5 to 7 percent of their incomes on kerosene.

4.7 Middle class households spend between 6 and 8 percent of their income on energy and they tend to be concerned with both the cost and reliability of service. In one focus group that involved working women, it was clear that the participants understood that privatization of electricity services would both improve service and mean higher prices for energy. They were mixed in their opinions concerning whether the convenience of better service was worth the higher prices that they would have to pay. Some in the group felt that the price of electricity was already high and further increases in prices would be a hardship for them. Others were in agreement with privatization of energy supplies in principle, but were worried about how private companies would deal with safety issues. However, all understood that privatization would increase the efficiency of the distribution system.

4.8 The main energy expenditures of the highest-income groups are for LPG for cooking and for electricity for lighting and appliances. The budget expenditures of these groups on energy are in the range of 3 to 5 percent, and they are much more concerned about quality of service than about the additional charges that they might be charged for improved service. In focus group interviews, higher-income households were more worried about problems related to the supply of LPG and electricity rather than the prices or subsidies. One LPG supply difficulty often cited was distributors' delay in replacing cylinders once they become empty. People in higher- income groups also strongly complained about the many voltage fluctuations and power cuts. In general, they strongly favored privatization of electricity and LPG distribution, as it would greatly improve the quality of services. They were aware of the better service in cities with private distribution companies, such as Bombay and Calcutta. They felt that private industrial groups should be entrusted with the responsibility of ensuring better service.

Energy Prices and Subsidies

4.9 Energy prices and subsidies are a direct consequence of energy policies, and they can have both intended and unintended consequences. A well-meaning policy to keep energy prices low for poor people may result in scarcity of supplies. Likewise, efforts to control flows may result in informal markets characterized by high prices. The energy policy environment in Hyderabad has already been described. This section presents in detail the effects of these policies from the point of view of consumers.

4.10 Because energy constitutes a significant expense for poor households in urban areas, the prevailing energy pricing policies are very important for the urban poor. The fact that fuelwood prices are high relative to other fuels was noted in the previous chapter. Regarding modern fuels, the price of energy for different income groups is relatively constant, with the exception of kerosene. This means that both poor and wealthy households pay approximately the same prices for non-fuelwood energy, so every income group is receiving subsidies.

4.11 As previously noted, kerosene is the cooking fuel of the poor. Government policies have been effective in keeping the overall price of kerosene paid by consumers low. The average price of kerosene paid by households in Hyderabad is about Rs 3.4 per liter compared to a world market price of Rs. 5.5 (see Table 4.2). The policy to make kerosene affordable has actually resulted in poor people paying slightly higher prices for kerosene than more wealthy families. The reason for this is quite simple. The ration available for kerosene is about 15 liters per month. This is not enough cooking, for which the average family needs about 20 liters. As a consequence, poor families without the ability to afford the initial costs of LPG must turn to the informal market for kerosene or wood, and both fuels are much more expensive in this arena. Kerosene is available in the informal market at about Rs 5 to 7 per liter. This use of a combination of kerosene from the ration shops and from the informal market effectively raises the price that the poor must pay compared to households in the middle-income groups, which can use a combination of subsidized kerosene and subsidized LPG.

Table 4.2
Comparative Prices Paid for Household Energy, by Income Class, Hyderabad, 1994

	Price of Energy Reported by Consumers			
Income Decile (Rs/capita/mo)	*Wood (Rs/kg)*	*Kerosene (Rs/ltr)*	*LPG (Rs/14.2 kg)*	*Electricity (Rs/kWh)*
<185	1.14	3.51	107	1.06
185 - 250	1.15	3.64	108	1.05
250 - 300	1.26	3.53	107	1.07
300 - 375	1.26	3.39	107	1.07
375 - 498	1.80	3.27	108	1.02
498 - 583	1.50	3.29	107	1.06
583 - 725	1.35	3.33	107	1.02
725 - 990	1.72	3.34	107	1.03
990 - 1480	1.44	3.30	107	1.04
>1480	0.82	3.26	107	1.04
Market or Reference Price	1.23	5.50	175	1.50

Source: Hyderabad survey data, 1994.

4.12 By comparison with kerosene, the price of both electricity and LPG are very stable across income groups. In 1994, the official price of LPG was Rs. 107 per bottle, and this is what consumers were paying. At the time of the survey, very few people were buying LPG from private retailers. The results of the survey regarding electricity usage was somewhat unexpected, since the electricity company charges consumers increasing rates for increasing levels of consumption. For example, the initial block at a use level of 50 kWh costs Rs. 0.70, while the highest-use block—usage above

500 kWh—costs Rs. 1.45. However, as demonstrated in Table 4.2, the price per kWh actually paid varies very little across income groups. This is probably due to a monthly service charge for the meter, which raises the effective price of electricity for poor households. The service charge is regressive for poor urban consumers, since it raises the overall price of electric power for those in the lowest electricity-use categories, who are mostly poor people.

4.13 The effect of these relatively constant prices on the subsidy levels received by different income groups is that the poor receive fewer overall subsidies, because they use less energy than households in higher-income groups. These findings are confirmed when comparing the total subsidies per household in different income classes (see Table 4.3). The poorest households receive on average an aggregate subsidy of Rs. 64 per month, most of which is derived through the kerosene purchased at ration shops. The main subsidies received by the highest-income households are derived from their relatively heavy use of LPG and electricity; they receive total subsidies of Rs 153 per month. This is well over twice the level of subsidies received by poor households in the lowest-income groups. If one assumes Rs. 1.5 per kWh as a reasonable price to pay for electricity based on average costs for the electricity company, then examining the data from Table 4.3, the highest-income groups are receiving close to Rs. 90 of subsidy per month for electricity, which is an amount that they can easily afford to pay.

Table 4.3
Per Household Energy Subsidies, by Income Class, Hyderabad, 1994

	Rupees per Family per Month					
Income Decile (Rs/capita/mo)	*Wood*	*Kerosene*	*LPG*	*Electri-city*	*Total*	*Total Energy Expenses*
<185	0	36	7	21	64	162.6
185 - 250	0	32	12	22	64	170.6
250 - 300	0	31	15	24	70	157.0
300 - 375	0	34	24	26	83	182.5
375 - 498	0	29	33	31	93	190.7
498 - 583	0	24	38	36	96	195.4
583 - 725	0	22	45	40	107	235.5
725 - 990	0	13	54	46	113	234.8
990 - 1480	0	8	56	53	115	235.6
>1480	0	6	61	87	153	338.4

Source: Hyderabad survey data, 1994.

4.14 The question as to whether the *total* subsidy flows for household energy in Hyderabad most benefit the wealthiest households can be answered by examining Table 4.4. This table presents the total subsidy per month for the lowest to the highest income groups in Hyderabad City. It is estimated that all households together receive a total subsidy of over Rs. 80 million per month. Remarkably, the largest single subsidy for all the income groups is the electricity subsidy for the richest 10 percent of the households in Hyderabad, which receives a total of over Rs. 7 million per month. This group pays the lowest percentage of household income for energy and can afford to pay more for energy, yet ironically, it receives the highest subsidy.

4.15 Although there may be problems with the rationing of kerosene, Tables 4.3 and 4.4 clearly indicate that, in terms of reaching poor households, it is the most effective policy intervention. The two poorest income groups receive a subsidy of close to Rs. 7 million per month through this program, while the highest 20 percent of households, which do not use kerosene very much, receive only slightly more that 1 million rupees per month as a class. In fact, it is a well-known informal practice for higher-income households to give lower-income service households the use of their ration cards for purchasing kerosene for their families. However, the highest two income groups are well compensated through other subsidies, as they receive over Rs. 22 million per month in subsidies for electricity and LPG combined.

Table 4.4
Aggregate Household Energy Subsidies, by Income Class, Hyderabad, 1994

	Million Rupees per Month				
Income Decile (Rs/capita/mo)	*Wood*	*Kerosene*	*LPG*	*Electricity*	*Total*
<185	0	3.1	0.6	1.8	5.5
185 - 250	0	3.6	1.4	2.4	7.4
250 - 300	0	2.1	1.0	1.6	4.7
300 - 375	0	2.9	2.0	2.2	7.2
375 - 498	0	2.4	2.7	2.5	7.6
498 - 583	0	2.1	3.2	3.0	8.1
583 - 725	0	2.0	4.0	3.6	9.6
725 - 990	0	0.9	4.0	3.4	8.3
990 - 1480	0	0.8	5.3	5.0	11.1
>1480	0	0.5	5.2	7.3	13.0
Total	0	20.4	29.4	33.1	82.5

Source: Hyderabad survey data, 1994.

Table 4.5
Monthly Household Subsidy for Electricity, by Income Class, Hyderabad, 1994

	Assumed Costs of Production per kWh					
	Costs = Rs 1.50		Costs = Rs. 2.00		Costs = Rs. 2.25	
Income Decile (Rs/capita/mo)	Subsidy per HH (Rs)	Total subsidy (Rs million)	Subsidy per HH (Rs)	Total subsidy (Rs million)	Subsidy per HH (Rs)	Total subsidy (Rs million)
<185	21	1.8	43	3.7	54	4.6
185 - 250	22	2.4	45	5.1	57	6.5
250 - 300	24	1.6	49	3.3	61	4.0
300 - 375	26	2.2	54	4.6	67	5.8
375 - 498	31	2.5	64	5.2	81	6.6
498 - 583	36	3.0	74	6.2	93	7.8
583 - 725	40	3.6	89	8.0	114	10.2
725 - 990	46	3.4	96	7.0	121	8.8
990 - 1480	53	5.0	110	10.5	139	13.3
>1480	87	7.3	187	15.9	237	20.1
Total	38	33.1	81	69.8	102	88.2

Source: Hyderabad survey data, 1994.

4.16 As indicated, the electricity subsidy in Table 4.4 assumes an average per kilowatt-hour cost of about Rs. 1.50. The problem with using an average cost to calculate this subsidy, however, is that it is based on old plant and equipment, and any new addition to capacity is going to add to the 1994 average costs of production. Table 4.5 demonstrates calculations for the subsidy for electricity at different costs of distribution. The results indicate that, at an assumed cost of production of about Rs. 2.00 per kWh, the poorest income groups would receive subsidies ranging between Rs. 40 and 50 per household per month, while the highest income households would receive a subsidy of over Rs. 180 per household per month. Thus, the highest income groups would still receive a subsidy four to five times that of the lowest income groups, and it illustrates the problems that the State Electricity Boards face in covering any new costs of production and distribution for urban households in ways that would be reasonably equitable.

4.17 The clear implications of these findings is that the subsidies for energy are not being well targeted. Both the electricity and the LPG subsidies substantially benefit the more well-off households, but have had very little benefit for poor households. It should be noted that in 1996, the price of electricity was raised. It now ranges from Rs. 0.80 per kWh for consumers consuming less than 50 kilowatt hours per month, to Rs. 2.65 per kilowatt hour for customers consuming over 400 kilowatt hours per month.

Attitudes of Households Toward Energy Programs and Policies

4.18 Peoples' attitudes toward energy programs in Hyderabad vary according to their socioeconomic status and the fuels that they use for cooking. Such activities as cooking, turning on lights, and using appliances all are important energy uses for urban households. This section reveals preferences and attitudes toward both energy services and service providers.

Attitudes toward Cooking Fuel Service

4.19 As noted, the three main cooking fuels used in Hyderabad are wood, kerosene, and LPG. For purposes of highlighting the differences in opinions among these fuel user groups, the study has classified households according to the main fuel that they use for cooking. However, there is a strong correlation between income and the type of these fuels used, so many of the attitudes identified should be understood as resulting both from experience in using a particular cooking fuel and a household's level of income.

4.20 Most of the people in Hyderabad feel that the type of energy they are using is convenient, but somewhat expensive. Reflecting that wood is a good fuel for cooking, over three-quarters of wood users agree that wood is convenient for cooking. On this issue, focus groups held with households from the Banjara community (many of whom have migrated from rural areas to Hyderabad) revealed that the reason for their cooking with wood was partly because of the familiarity with using it in rural areas and partly because they had difficulty obtaining the other fuels. Many of the women in the Banjara interview expressed a preference for using wood in the preparation of non-vegetarian food.

4.21 By contrast, over 90 percent of kerosene and LPG users feel that their fuel is convenient for cooking, even though they are somewhat concerned that the fuel is rather expensive (see Table 4.6). The convenience of using LPG also came out strongly in the focus groups, where middle class working women indicated that the ease of cooking with LPG fits into their busy lifestyles. Concerning changing lifestyles, one of the focus group participants indicated that earlier, eating rice along with *dal* and curries was considered a meal, but sandwiches and other fast food are now also eaten as part of lunch or dinner. From these interviews, it became clear that the convenience of cooking with kerosene and LPG in a busy urban environment tends to outweigh the expense of using these fuels.

Table 4.6
Perceived Convenience of Various Cooking Fuels, Hyderabad, 1994

	% Agreeing Fuel is Convenient		
Main Household Cooking Fuel	*Wood*	*Kerosene*	*LPG*
Wood Users	74	78	32
Kerosene Users	30	94	50
LPG Users	13	45	90
Total Sample	23	68	75

Source: Hyderabad survey data, 1994.

4.22 People in Hyderabad have definite concerns over the impact of cooking fuels on health. The perception that cooking with wood is harmful to the health is widespread among all groups, regardless of the fuel that they are using for their household cooking (see Table 4.7). Close to 50 percent of all households perceive that burning wood is not good for the family's health. Kerosene is perceived to be better, but 30 percent of households still feel that it can cause health-related problems. LPG is perceived as posing few health problems by most households, and generally is regarded as the cleanest-burning fuel for household cooking.

Table 4.7
Perceived Health Problems of Various Cooking Fuels, Hyderabad, 1994

	% Agreeing that Burning Fuel Causes Health Problems		
Main Household Cooking Fuel	*Wood*	*Kerosene*	*LPG*
Wood users	48	16	5
Kerosene users	48	25	6
LPG users	49	38	6
Total sample	48	31	6

Source: Hyderabad survey data, 1994.

4.23 As indicated, there has been a significant switch from wood to kerosene, and from kerosene to LPG in Hyderabad. The figures presented in Table 4.8 (Part A) indicate that approximately 45 percent of the survey population switched fuels during the lifespan of the family. About 14 percent of the population switched from wood to kerosene, and close to 30 percent switched from kerosene to LPG. An illustration of this

process involved an interview with a woman in a lower-income household. She expressed a preference for food cooked on firewood. However, the respondent said that, "In the present circumstances, the use of firewood is cumbersome, as it requires constant monitoring and blowing, is slow to start, and is uneconomical." The two main reasons for switching to these fuels (kerosene and LPG) are greater convenience and less pollution (see Table 4.8, part B).

Table 4.8
Percent of Households Reporting Switching Cooking Fuels and their Reasons for Switching, Hyderabad, 1984-94

Part A

Main Household Cooking Fuel	% Switching Fuels During Lifetime of Family			
	Did not Switch	Switched from Wood to:	Switched from Kerosene to:	Total
Wood users	5	NA	0%	5
Kerosene users	28	14	NA	42
LPG users	22	2	28	52
Total sample	55	16	28	100

Part B

Households Changing Fuels	Reason for Switching (% switching fuels during lifetime of family)				
	More efficient	More economical	Less polluting	More convenient	Other
Wood switchers	(no one switched to this fuel)				
Kerosene switchers	26	27	45	57	8
LPG switchers	45	31	33	76	4
Total switchers	39	30	37	70	5

NA in part A stands for not applicable.

Note: The figures in each cell in Part B represent a percentage of the total households (1) switching to wood, (2) switching to kerosene, and (3) switching to LPG.

Source: Hyderabad survey data, 1994.

4.24 Despite the greater convenience of kerosene and LPG, there continue to be problems with the distribution of these fuels. Although the problems were greater 10 years ago, people still feel that the fuels are difficult to get in the marketplace. Over 50 percent of people using kerosene feel that it is hard to get in the market (see Table 4.9). The focus group interviews confirm these findings, as a majority of participants in the lower-income groups were concerned with the erratic supply of kerosene throughout the month. The ration shops often run out of their allotted kerosene in a few days after they receive new supplies. The irregular supply forces consumers to buy at particular periods, although they have enough money to buy the entire allotted quantity at one time if enough kerosene is made available.

4.25 Similarly, close to 50 percent of LPG users perceive that it is difficult to obtain LPG, reflecting that it is often difficult to get second bottles of the fuel from the distributors. Distributors also often take a long time in replacing a cylinder, especially if only one customer in a local area has asked for a replacement. Some people had problems associated with the mixing up of cylinders from different companies.

Table 4.9
Perceptions Regarding Difficulty of Purchasing Cooking Fuels in the Market, Hyderabad, 1994

	% Agreeing Fuel is Hard to Get in the Market		
Main Household Cooking Fuel	*Wood*	*Kerosene*	*LPG*
Wood users	34	58	11
Kerosene users	34	54	23
LPG users	30	44	46
Total sample	32	50	34

Source: Hyderabad survey data, 1994.

4.26 The opinion of the higher-income focus groups is that, because of such problems, the distribution of LPG should be entrusted to private industrial groups. They feel that this would assure better service to customers. By contrast, the participants in the middle-income focus group also were concerned about problems with LPG supply, but were apprehensive about privatization because of concerns about rising prices and problems related to the safety of LPG bottles and stoves. Regardless of the real reasons, it is obvious that, according to the group interviews, obtaining sufficient fuel supplies in Hyderabad is a matter of concern in all of the income groups.

4.27 To summarize, the evidence is clear that people are switching fuels in Hyderabad for several reasons. Both LPG and kerosene are perceived to be more convenient and less polluting. People are moving up the "energy ladder" despite some perceptions that the more modern fuels are somewhat expensive. People in higher-income groups would like to see greater participation of the private sector in fuel distribution, while people in the lower-income groups are worried that greater involvement of private sector companies will mean that prices will rise and safety might be compromised. Finally, the functioning of energy markets in Hyderabad is not very smooth, as people feel that the fuels that they are using are relatively hard to obtain.

Attitudes Toward Electricity Supply and Distribution

4.28 Attitudes toward electricity supply in Hyderabad are mixed. On the one hand, people were generally satisfied with their electricity supply, but consumers also had significant complaints about electricity service. In general, there is frustration with service and no general awareness about the reasons for the service being poor.

4.29 The fact that the electricity distribution system is serving almost all households in Hyderabad is a very real accomplishment. However, focus group interviews and the survey revealed that the reliability of the power supply is a major problem for everyone, rich and poor. The survey revealed that households with electricity suffer over two scheduled or unscheduled power cuts per day (see Table 4.10). Furthermore, over half of all households suffer either daily or weekly unscheduled power cuts of varying duration. Although households in the higher-income groups have a slightly lower rate of supply interruption, over 40 percent of the highest income households must endure daily or weekly unscheduled power interruptions. One qualification regarding these findings is that the surveys were conducted during the summer months, a time of frequent power outages. Nevertheless, it is clear that the supply of electricity to residential consumers is fraught with problems.

Table 4.10
Electricity Supply Interruptions, by Income Class, Hyderabad, 1994

Income Decile (Rs/capita/mo)	Number of Times Electricity Failed Last Month	"What is the frequency with which unscheduled power cuts occur?" Daily (%)	Weekly (%)	Monthly (%)	Rarely or Never (%)
<185	75	43	11	5	37
185 - 250	70	49	10	7	29
250 - 300	73	46	11	8	31
300 - 375	69	42	15	5	37
375 - 498	64	48	10	6	36
498 - 583	70	44	10	7	38
583 - 725	67	41	14	8	29
725 - 990	67	36	11	6	46
990 - 1480	68	36	11	5	37
>1480	68	29	14	5	52
Average	69	41	12	6	39

Numbers in response columns represent responses of survey population.
Source: Hyderabad survey data, 1994.

4.30 The majority of people in Hyderabad are satisfied with electricity service, regardless of income class. People know that electricity is beneficial for them, but they are dissatisfied with electricity service as it exists today. Although 80 percent of people feel that electricity is very convenient, about 38 percent of people are dissatisfied with electricity service and there are very strong feelings on the subject of electricity supply. This is probably a reflection of the unscheduled electricity cuts.

Table 4.11
Perceptions of Electricity Service, Hyderabad, 1994

Statements Reflecting Electricity Satisfaction	% Agreeing or Disagreeing with Statement: Agree	No Opinion	Disagree
It is true that using electricity is very convenient	80	12	8
Electricity for cooking is too expensive	56	37	7
I am very happy with my electricity supply situation	58	4	38

Source: Hyderabad survey data, 1994.

4.31 The cost of supply interruptions—in terms of lowering the quality of lighting services, stopping productive home-based work, and preventing consumers from using fans and televisions—is difficult to measure. However, the expenses of securing substitute services when power fails are one thing that can be measured. The main substitute measured in the survey was for household lighting. Many households use candles, kerosene for lamps, and other combustibles as back-ups in case of power outages. Although the amounts of money spent on such combustibles is not large—Rs. 11 per month on average—this does constitute a significant percentage of households' monthly electricity bills (see Table 4.12). As indicated previously, poor consumers use electricity mainly for lighting, so their electricity bills are fairly low. Thus, the amount of candles, kerosene, or other combustibles used by the three lowest income groups because of power outages actually constitutes an average of 15 percent of these groups' electricity bills. In other words, *consumers could afford to pay 15 percent more for electricity to*

improve service without suffering any net financial loss, even in the lowest income groups.

Table 4.12
Consumers' Costs for Lighting Associated with Electricity Failure, Hyderabad, 1994

Income Decile (Rs/capita/mo)	Cost of Combustibles (Rs/mo)	Cost of Combustibles (% of monthly electric bills)	Cost of Capital Equipment (Rs)[a]
<185	8	14	15
185 - 250	8	15	12
250 - 300	9	20	17
300 - 375	9	17	19
375 - 498	10	17	20
498 - 583	10	16	40
583 - 725	12	15	49
725 - 990	13	15	129
990 - 1480	14	13	99
>1480	14	9	738
Total	11	15	104

[a] These figures represent the *average* cost of capital equipment (lamps, battery lights, etc.) for alternative lighting within each income class.

Note: Combustibles include candles, kerosene, and other consumables. Capital equipment includes only kerosene wick and pressure lamps, LPG pressure lamps, emergency battery lights, and gasoline or kerosene generators.

Source: Hyderabad survey data, 1994.

4.32 In addition to the expenses for combustibles such as candles and kerosene, consumers must also make some capital investments for associated equipment. As might be expected, in the lower-income groups, the main alternative to electricity is a kerosene wick or pressure lantern. For higher-income groups, alternative equipment can include small gasoline or kerosene generators. As indicated in Table 4.12, the amount of money spent on such capital equipment rises with income. Some of the averages for the higher-income groups are misleading, however. This is because expensive back-up generators—of which only six appeared in the entire survey—distort the averages for the relevant income groups. Obviously, they distort the average as well for all income groups together (Rs. 104). Nevertheless, this overall average of Rs. 104 per household over 5 million households in Hyderabad does mean that power shortages and blackouts are a considerable cost to households and to the economy.

4.33 Consumers seem somewhat willing to pay for better electricity service. Although the amount of money and degree of service improvement were not specified in the part of the survey that elicited this information, over 30 percent of all consumers indicated that they would be willing to pay for better electricity service. This was especially true for higher-income households, over 40 percent of which were willing to pay higher prices for a more reliable power supply (see Table 4.13). This also was confirmed by the focus group interviews, where higher-income participants volunteered that privatization of electricity would greatly improve service. Middle income groups were mixed on the subject of rising prices and better service, but mistrusted private companies more than the higher-income groups. Finally, low-income groups did not see how they could afford higher prices, no matter how much the service was improved.

Table 4.13
Household Willingness to Pay for Fewer Power Failures, Hyderabad, 1994
(percent of sample population)

Attitudes Toward Willingness to Pay and Billing	*Agree*	*No Opinion*	*Disagree*
"I am willing to pay more for electricity if fewer power cuts and dimming"			
Average for sample	34	17	47
Poorest 10% of sample population	25	19	56
Richest 10% of sample population	42	12	46
"My electricity bill is easy to understand"			
Average for sample	62	28	10
Poorest 10% of sample population	36	47	17
Richest 10% of sample population	79	16	5

Source: Hyderabad survey data, 1994.

4.34 Although the electricity bills in Hyderabad are relatively straightforward, there apparently is some difficulty among poorer households in understanding their bills. As indicated in Table 4.13, most of the higher-income households have no problems reading and understanding their bills, but only about one-third of poorer households have no difficulty in this regard. Given the importance of bill collection for the electricity company serving Hyderabad, there should perhaps be a more concerted effort to make electricity bills more clearly understandable for lower-income consumers.

Knowledge of Energy Subsidies

4.35 People's perceptions of energy pricing and the fairness of energy pricing policies can be very important for the implementation of changes in energy policy. It is evident from Table 4.14 that very few people know the basis of energy pricing for the fuels that they use every day in their homes. This finding should be qualified by the fact that people who do not use a particular fuel will respond "do not know" to such questions. Even with this qualification, the numbers are fairly dramatic. Over 70 percent of households do not know whether LPG or electricity is subsidized. This indicates that for urban household energy consumers in Hyderabad, there is a virtual void of information on the pricing of energy that they use every day of their lives.

4.36 However, many people do know that kerosene is subsidized. The reason for this is that kerosene bought through ration shops can be compared to more expensive kerosene bought on the open market. As a consequence, one-third of the sample and one-half of higher-income consumers realize that kerosene is subsidized. As indicated previously, the higher-income households are receiving the greatest amount of energy subsidies per family; remarkably, one-fifth of this same group thinks that they are being taxed for this energy.

Table 4.14
Consumers' Knowledge of Energy Subsidies, Hyderabad, 1994
(percent of sample population)

	"Is Fuel Taxed or Subsidized?"			
Fuel Type	*Taxed*	*Neither taxed nor subsidized*	*Subsidized*	*Do not know*
Kerosene bought in ration shops:				
Average for Sample	7	3	35	55
Poorest 10% of Population	5	4	25	66
Richest 10% of Population	6	1	49	44
LPG purchased through distributors:				
Average for Sample	9	3	16	72
Poorest 10% of Population	2	0	3	95
Richest 10% of Population	20	5	35	41
Electricity from State Electricity Board:				
Average for Sample	13	4	9	74
Poorest 10% of Population	9	0	1	90
Richest 10% of Population	18	7	19	56

Source: Hyderabad survey data, 1994.

4.37 Clearly, the energy companies supplying fuels for urban households have not adequately communicated the basis for energy prices and the level of energy subsidies. In such an environment, it is no wonder that consumers react negatively to any prospect for reducing subsidies and increasing prices for the energy they use in their households on a daily basis.

Summary and Conclusions

4.38 The energy situation in Hyderabad has improved over the last 14 years. More people have electricity than ever before. In addition, households are increasingly switching from wood to kerosene and from kerosene to LPG because of the greater convenience and lessened smoke produced in cooking with these fuels.

4.39 As the markets for LPG have been liberalized and expanded, many households have taken advantage of clean-burning LPG for cooking. As poor consumers also move up the energy ladder to kerosene, wood is now being used as a main fuel by very few households in Hyderabad. This indicates that policies to improve energy access have been moving in the right direction. In spite of the improvements in energy supply and use in the city, there are still some bottlenecks in the distribution system. There is also a substantial lack of knowledge among consumers concerning energy pricing policies and the extent to which some commonly-used fuels are subsidized.

4.40 A major issue is the effectiveness of energy subsidies in reaching poor urban households in Hyderabad. Although some subsidies do reach poor people, the vast majority of the subsidies are being garnered by high-income groups, mainly because of the subsidies for LPG and electric power. The poor, who spend a significant proportion of their income on energy, are being reached mainly through kerosene subsidies. The implications are clear: the existing structure of energy subsidies is inefficient in meeting the objective of assisting the poor, and there is a need for corrective policy measures.

4.41 The majority of households in Hyderabad perceive that there are supply problems involving energy. Although all people get enough energy to meet their basic needs, there are bottlenecks and difficulties, partly caused by policies to limit the amount of fuels available for sale at subsidized prices. From focus group interviews, higher-income households are clearly irritated by these difficulties and support changing policies to improve supplies, even if it means higher prices. Poorer households are also concerned about energy access problems, but they are worried that policy measures to increase supply will cause rising prices. This will cause difficulties, because these households are already paying a significant proportion of their income for energy—as much as 15 percent at the lowest income levels. Once again, this argues against the current system, which provides higher-income households—ones that can afford to pay more—with the largest share of energy subsidies.

4.42 The well-known problems of Hyderabad's electricity distribution system—blackouts, brownouts, and voltage fluctuations averaging several times a day—emerged clearly in the survey, in terms of people's attitudes and perceptions concerning electric power service. The reported service disruptions were very high during the period of the survey. In addition, significantly more poor than wealthy households reported difficulty in understanding their electricity bills. However, the survey also revealed that despite these problems, people are generally pleased to have electricity.

4.43 Given the emphasis placed on energy pricing by both the Indian government and by international agencies, a rather surprising finding is that a large proportion of people in Hyderabad do not know whether the energy they use every day is subsidized or taxed. Thus, the government is gaining little in terms of goodwill among consumers vis-a-vis the extensive subsidies going into energy. On the contrary, supply agencies face stiff resistance in the face of efforts to raise prices to cover rising costs and improve service. This resistance might be explained in part by the lack of knowledge among consumers that the energy they are using is already subsidized by government distribution companies.

4.44 Policy changes recommended for improving the bottlenecks in energy distribution and improving consumer service are dealt with in the concluding chapter of this study. Before turning to these issues, the next chapter deals with energy conservation and use by urban households in Hyderabad.

5

Household Appliances and Energy Efficiency

5.1 Households in urban areas of India are increasingly using a wide variety of electric appliances to improve their standard of living. The first use of electricity by most households is for space illumination. Lighting allows people to read, socialize, and perform a wide array of activities. In addition to lighting, space cooling made possible by fans and air coolers is important for people living in Hyderabad's relatively hot climate. Also, most people now have some form of communication or entertainment devices, including televisions, radios, and tape recorders. Finally, although water heating with electricity is still limited to higher-income groups, it comprises an ever-larger percentage of electricity use, because heating water requires a significant amount of electric power.

5.2 This chapter relies on information from two different sources: the main survey and a smaller appliance use survey. In the main survey, information was gathered from nearly 2,800 households on 28 different types of appliances in use, including lamps using incandescent bulbs and fluorescent tubes. This made it possible to determine the ownership patterns, levels of penetration, and saturation rates of different appliances in households in metropolitan Hyderabad. In the smaller survey, 55 households were selected to measure the electricity consumption of appliances through metering. The goal was to examine the electricity consumption of the appliances in the field, where many factors influence their performance level and their levels of efficiency.

Profile of Appliance Ownership

5.3 This section describes the patterns of electricity use and appliance ownership in Hyderabad. The high appliance ownership rates in Hyderabad are not unique in Asia. Similar levels are found in many other Asian cities. For instance, Table 5.1 illustrates that the patterns found in Hyderabad are mirrored in other cities in India and The Philippines (see Table 5.1). Other Asian cities could be added to the table and the results would be similar.

Table 5.1
Saturation of Electric Household Appliances in Selected Cities, India and the Philippines

	Percent of Households with Appliances				
	India			The Philippines	
Appliance Type	Hyderabad	Pune	Ahmednagar	Manila	Cebu
Lights	100	100	100	100	100
Electric fan	96	77	78	87	55
TV (black & white)	53	41	39	--	--
Stereo system/tape recorder	52	--	--	19	22
Electric iron	45	--	--	--	--
Refrigerator	37	38	28	61	37
Electric mixer/blender	41	--	--	--	--
Television (color)	32	37	31	--	--
Radio	30	--	--	--	--
VCR & VCP	25	12	7	--	--
Electric water pump	17	--	--	--	--
Water heater/geyser	14	39	23	1	1
Air cooler	16	--	--	--	--
Washing machine	8	--	--	--	--
Vacuum cleaner	3	--	--	--	--
Coffee percolator	2	--	--	--	--
Electric rice cooker	2	--	--	--	--
Electric oven	4	--	--	--	--
Electric stove	2	--	--	--	--
Air conditioner	1	2	1	2	0.4
Acqua guard	0.8	--	--	--	--

-- Data not available.
Source: Hyderabad survey data, 1994; *Energy* vol. 19, no. 5 (1994); surveys conducted in 1989-90.

5.4 The following section examines household illumination, information, and communication uses of electricity, and space cooling and water heating. Hyderabad households use electricity for lighting and on average, households have close to six light bulbs each (Table 5.2). Almost all households in Hyderabad have fans, which are now almost a necessity and are used regularly during the extremely hot weather of the summer months. These appliances are followed in popularity by entertainment devices, including televisions, stereo systems, and tape recorder/players. The next-most popular item is refrigerators, which are fast becoming a necessity for storing food and cooling drinks. Both heating and pumping water are becoming more popular among households in Hyderabad, with about one household in five owning such appliances.

Household Illumination

5.5 Lighting is the most common use of electricity in Hyderabad, with all households using electric lights. The type of electric lamps used in Hyderabad are incandescent bulbs and fluorescent tube lights. Virtually no households are using compact fluorescent lamps. The tube lights have a greater efficiency than incandescent bulbs in terms of light output per unit of electricity consumed. However, there are several barriers to the greater use of fluorescent lamps. During times of low voltage, which are common in Hyderabad, the tube lights often will not turn on or they will

flicker. The highest income households in Hyderabad use over 10 lamps per household and over half of these are the more efficient tube lights. Interestingly, low-income households tend to use incandescent bulbs more frequently than fluorescent tubes. Informal interviews with low-income households conducted during the pre-survey revealed that many of them did not use the more efficient tube lights for two reasons. First, tube lights have starting problems caused by low voltage, and second, they involve higher initial expenses compared to incandescent bulbs.

Table 5.2
Extent of Household Lighting, Hyderabad, 1994

	Incandescent Bulbs			*Fluorescent Tubes*			*Total*
Income Decile (Rs/capita/mo)	*% using bulbs*	*No. of bulbs*	*Wattage of bulbs*	*% using tubes*	*No. of tubes*	*Wattage of tubes*	*(wattage of lights)*
<185	99	3.4	140	52	0.9	36	176
185 - 250	99	3.5	154	58	1.2	40	194
250 - 300	100	3.8	169	64	1.3	44	213
300 - 375	99	4.0	167	71	1.6	55	222
375 - 498	99	4.2	163	78	1.9	62	225
498 - 583	99	4.0	147	81	2.2	70	217
583 - 725	99	4.8	172	90	2.7	87	259
725 - 990	98	4.9	181	92	3.2	100	281
990 - 1480	97	5.1	155	91	3.4	104	259
>1480	98	7.7	179	97	4.5	128	307
Average	99	4.6	162	78	2.3	73	236

Source: Hyderabad survey data, 1994.

5.6 Consumers in Hyderabad are aware that fluorescent tubes use less energy than incandescent bulbs. Over 85 percent of households included in the survey agreed with the statement that "Tube lights consume less electricity than (incandescent) light bulbs." These results were confirmed in focus group interviews with low-income and middle-income households. Several low-income households had fixtures for tube lights, but the lights were not in working order. When asked the reason why they did not replace the tubes, these respondents indicated that they were aware of the greater efficiency of the tube lights, but because of low voltage, the lights often would not start and the ends of the tubes became black. As a consequence, when the tube lights burned out, they did not replace them. An interesting implication of these findings is that *improved electricity service would lead both to lower costs of production (because lighting is typically required during times of expensive peak demand) and to a shift to more efficient forms of lighting. The latter would lower the cost of lighting to consumers, and especially, to poor consumers.*

Information and Communications/Entertainment

5.7 During the last 15 years, the expansion of entertainment and information appliances has virtually exploded. The ownership and use of black and white and color televisions in Hyderabad is now commonplace in over eight of ten households (see Table 5.3). The second-most common electronic device is a tape recorder/player, which has replaced radios as the source of music and entertainment. VCRs and stereo systems are

found only in the highest income groups, but these are also becoming much more common. The combination of extensive television ownership along with other entertainment devices has led to the decline in the use of radios. In addition to these devices, cable television services are now available to many households in Hyderabad, although it is common only among the highest income groups.

Table 5.3
Extent of Information and Entertainment Appliances in Households, Hyderabad, 1994

	Extent of Appliance Ownership (percent of households)						
Income Decile (Rs/capita/mo)	TV	Color TV[a]	B&W TV[a]	VCR	Stereo	Radio	Tape Recorder
<185	64	6	58	0	1	28	18
185 - 250	66	7	60	0	3	30	24
250 - 300	83	9	74	1	3	33	28
300 - 375	78	15	64	0	4	34	32
375 - 498	86	21	65	2	6	28	42
498 - 583	88	29	58	6	7	37	49
583 - 725	92	39	54	8	12	33	53
725 - 990	94	54	41	12	16	24	56
990 - 1480	93	58	37	15	15	29	59
>1480	97	75	24	37	33	29	61
Average	84	32	53	8	10	31	42

[a] Figures in the column "TV" are largely inclusive of the figures in the columns "Color TV" and "B&W TV".

Note: Figures in this table represent only those households in appliance survey with electricity.

Source: Hyderabad survey data, 1994.

5.8 Televisions, tape recorder/players, and radios use very little power, so their use does not represent a major consideration in conserving electricity. However, any local information campaign concerning energy policy or energy conservation should consider the wide array of media appliances that are now available and in widespread use in Hyderabad.

Space Cooling and Water Heating

5.9 The summers in Hyderabad are very hot. Temperatures often reach over 100 degrees Fahrenheit during the summer months, which makes household cooling appliances such as fans a necessity. The circulation of air serves the dual purpose of providing a cooling breeze and keeping away flying insects such as mosquitoes. Over 96 percent of Hyderabad households have some sort of fan. Even the lowest income groups have at least one fan per household, and this figure rises to almost five in the highest income groups. The higher-income groups have the added comfort of owning evaporative air coolers. Evaporative air coolers are much more common than air conditioners because they are much less expensive to purchase and also do not consume as much electricity as air conditioners. As will be evident later, households with air conditioners consume significantly more electricity compared to households without air conditioners. In spite of these differences in appliance ownership, electricity use by even the poorest households for space cooling and increased comfort is significant.

Table 5.4
Extent of Space Conditioning for Households, Hyderabad, 1994

Income Decile (Rs/capita/mo)	Ownership of Air Cooling Appliances				
	% with Fan	Fans per household	% with air coolers	% with air conditioners	% with coolers or conditioners
<185	90	1.6	1	0	1
185 - 250	93	1.7	2	0	2
250 - 300	98	2.1	4	0	4
300 - 375	95	2.1	5	0	5
375 - 498	97	2.3	9	0	9
498 - 583	98	2.5	9	0	19
583 - 725	99	3.2	18	0	18
725 - 990	97	3.4	27	0	27
990 - 1480	100	3.5	32	1	33
>1480	99	4.7	46	8	49
Average	96	2.8	16	1	16

Note: Figures in this table represent only those households in appliance survey with electricity.
Source: Hyderabad survey data, 1994.

5.10 The use of electricity for refrigerating food has become much more common in Hyderabad during the last 15 years. Once considered only affordable by the wealthiest households, refrigerators are now widespread in middle and higher-income groups (see Table 5.5). Slightly fewer than 40 percent of all households in Hyderabad have refrigerators, most of which require manual defrosting. The penetration rate of refrigerators in the highest income group is close to 9 out of 10 households. The demand for heated water for bathing and cleaning also has risen significantly in Hyderabad. However, water heaters have not reached the penetration levels of refrigerators, possibly because they are heavier users of electricity and the warm climate does not make them as much of a necessity.

Table 5.5
Extent of Refrigeration and Water Heating for Households, Hyderabad, 1994

Income Decile	% of Households with Refrigerator			% of Households with Water-Heating Appliances		
Rs/capita/mo)	Total	Old style	Frost-free	Total	Geyser	Immersion
<185	3	3	0	1	0	1
185 - 250	7	7	1	1	0	1
250 - 300	13	13	2	2	0	2
300 - 375	18	17	2	4	1	4
375 - 498	28	28	4	6	1	5
498 - 583	36	36	5	9	3	6
583 - 725	46	46	5	12	5	7
725 - 990	65	65	10	20	6	14
990 - 1480	68	67	13	29	14	16
>1480	85	85	13	47	31	17
Average	37	37	6	14	6	7

Note: Figures in this table represent only those households in appliance survey with electricity.
Source: Hyderabad survey data, 1994.

5.11 Appliance ownership in Hyderabad is rapidly increasing, and by all indications can be expected to increase even further during the coming decades. It is clear that space conditioning with coolers and to some extent air conditioners is starting to increase. This means that both energy conservation measures and the expansion of a reliable supply of electric power are policy issues that are very important for improving household welfare.

Energy Conservation Potential and Appliance Use

5.12 Energy conservation has significant support among residential electricity users in Hyderabad. Many households in Hyderabad already practice energy conservation.

5.13 In this section, the energy use characteristics of Hyderabad households and of the appliances they use is discussed in the context of the potential for energy conservation. This analysis is based only on households that could produce their electricity bills. This was just less than 2,000 households, or about two-thirds of the total in the study.

5.14 The addition of appliances to a household obviously will have a significant impact on electricity use. In Table 5.6, the figures for the predicted use of electricity by households are derived from a formal statistical analysis of household characteristics and appliance ownership and use. An average household in Hyderabad consumes about 18 kilowatt hours of electricity per month for miscellaneous appliances such as fans. Lighting is by far the most significant household use of electricity in Hyderabad. For every 100 watts of lighting added by households, the average electricity use increases by about 13 kilowatt hours per month. The addition of a refrigerator would add between 20 and 40 kilowatt hours to usage per month, depending on its size and efficiency. The predicted level of electricity use reported in Table 5.6 is lower than expected, probably because of the extensive power outages during the period covered by the survey. Such outages have a greater impact on appliances that are used on a 24-hour basis, such as refrigerators. An air cooler rated at about 110 watts adds 40 kilowatt hours to monthly electricity use. Air conditioners increase electricity use by about 156 kilowatt hours per month. These findings for refrigerators and air coolers and conditioners are confirmed by the measurement surveys in which meters were placed on particular appliances for one week at a time to measure their electricity consumption.

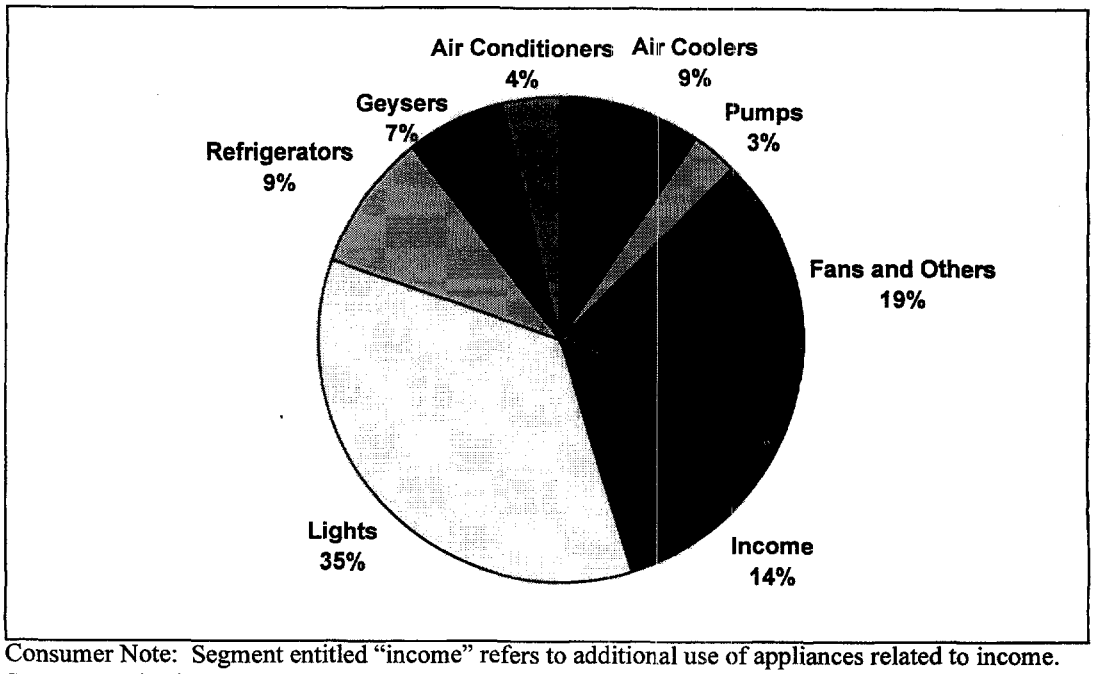
5.15 To understanding the potential for energy efficiency in the residential sector, we need to know the contribution of appliances to overall residential electricity use. As a consequence, we have calculated the proportion of electricity use accounted for by various appliances for the average residential consumers in Hyderabad, based on the penetration rate of these appliances in urban households (see Table 5.6 and Figure 5.1). As can be seen, the use of both fluorescent tubes and incandescent bulbs contributes to over one-third of all residential electricity use. All households use electricity for lighting, and the average number of lamps used is over six per household (four incandescent bulbs and two fluorescent tubes). Thus, there is great potential for energy conservation through implementation of a program to encourage fluorescent lighting.

Table 5.6
Household Appliance Use and Electricity Consumption, Hyderabad, 1994

	Households with Cooling/Heating Appliances		
Appliances	*Predicted (kWh/mo contribution based on each additional appliance)*	*Predicted (kWh/mo contribution based on appliance penetration)*	*Measurement Survey**
Minimum (fans, small appliances, etc.)	18	18	NA
Income (1000 rupees)	3	13	NA
Lights (100 watts)	13	33	NA
Refrigerator (165 liters size)	20	8	42
Air coolers	39	9	40
Air conditioners	156	4	NA
Geysers	68	6	78
Water pumps	15	3	20
Average total consumption	NA	93	NA

Notes: Figures in this table represent only those households in appliance survey with electricity
The equation for predicting electricity use is: Electricity use (kWh per month) = 18 + .003*Income + 0.13*Light Watts + 19*Refrigerators + 68*Geysers + 156*Air conditioners + 39*Air coolers + 14* Pumps; R square = 0.42; Metered households = 1,987.
Source: Hyderabad survey data, 1994.

Figure 5.1 Contribution to Household Electricity Use of Appliances, Hyderabad, 1994



Consumer Note: Segment entitled "income" refers to additional use of appliances related to income.
Source: Hyderabad survey data, 1994.

5.16 At the present time, lighting constitutes the largest load for urban households in Hyderabad, but it is also clear that the addition of heavy electricity-using appliances will grow, as the penetration of refrigerators, geysers, and air coolers increases

in the middle and high- income groups, and spreads to the lower-income groups as well. Today these appliances contribute about 26 percent of the total electricity use by Hyderabad households. Air conditioners and pumps, which are electricity-intensive, are not as common in Hyderabad and do not contribute as much to electricity use. However, the use of these appliances is expected to grow as the number of people who can afford to pay for them increases over the coming years. Improving the efficiency of such appliances could reduce the growing demand for electricity and keep costs of providing power service low.

5.17 The conclusion is that there is considerable potential for electricity conservation in the urban residential sector in Hyderabad. For lighting, space cooling, and water heating, more efficient technologies exist that reduce electricity consumption without reducing benefits to households. Before turning to such issues, we examine the receptivity of consumers to energy conservation.

Attitudes Toward Energy Efficiency

5.18 Most people in Hyderabad are concerned about the energy situation in both their city and their country. Perhaps because of difficulties in obtaining LPG, electricity brownouts and blackouts, kerosene shortages, or high gasoline prices, most people in the survey agreed with the statement, "The energy situation in India today worries me a great deal." Not only are people concerned about the energy situation, most of them feel that they are doing something about it (see Table 5.7). An overwhelming number of people indicated that they are not only aware of, but are practicing energy conservation in their homes.

Table 5.7
General Household Attitudes, Energy Conservation, Hyderabad, 1994

	Response (% of households)		
Statements on which Households were Surveyed	*Agree*	*No opinion*	*Disagree*
The energy situation in India today worries me a great deal	70	21	8
I practice energy conservation in my house	84	10	6
I do not know what I can do to save energy	21	12	68

Source: Hyderabad survey data, 1994.

5.19 The focus group interviews revealed that the types of energy conservation behaviors being practiced by households vary significantly with income class. Within the lowest income groups, necessity prompts conservation. People with small amounts of income are very conscious of their energy expenditures, and by implication, they understand that conserving energy saves them money that can be spent on other goods and services. They perceive energy conservation not in terms of appliance efficiency per se, but in terms of changing their behavior to use existing appliances more efficiently. For instance, they indicated that they use lights and fans only when required, cook with lids on the pans over a low flame, and have ingredients ready for cooking to save time and energy. By contrast, people in the middle and higher-income groups perceived energy conservation to involve both efficient appliances and conservation behavior. Among the women in the highest income groups, the feeling was that they saved energy through the use of modern appliances such as microwave ovens and efficient cooking

habits. The men in this group leaned more toward realizing energy improvements through changing technologies.

5.20 The idea that people are concerned about energy conservation also was revealed very strongly in the survey questions involving energy pricing and appliance purchases. Once again, the higher-income groups tended to be stronger supporters of paying more for higher-efficiency appliances. Most households in Hyderabad support the idea of spending a little more on appliances to lower their expenses on electricity. For instance, over seven out of ten people take energy efficiency into consideration when purchasing appliances and would be willing to pay more for appliances that are more efficient. Likewise, most people would be willing to pay for efficient lighting as long as the payback period is less than two years (see Table 5.8). This opinion is actually put into practice by higher-income households, which purchase fluorescent tubes in greater numbers than poorer households.

Table 5.8
Household Attitudes and Opinions, Specific Energy Conservation Options, Hyderabad, 1994

	Response (% of households)		
Statements on which Households were Surveyed	*Agree*	*No opinion*	*Disagree*
When purchasing, I take into consideration the efficiency of the appliances	77	18	5
Tube lights consume less electricity than light bulbs	86	13	1
I would be willing to pay more to buy appliances that are very efficient	71	20	8
Increasing the prices people pay for energy in the form of LPG, kerosene, or electricity is an efficient way to make people conserve energy	41	13	44
I would be willing to buy a new kind of electric light bulb if electricity saved would pay for the bulb in six months	75	19	7
I would be willing to pay for a new kind of electric light bulb if electricity saved would pay for the bulb in 2 years	67	20	13

Source: Hyderabad survey data, 1994.

5.21 Higher energy prices are generally recognized as resulting in lower energy consumption. Over 40 percent of the survey population agreed that higher energy prices lead to energy conservation. While it is true that an equal number of people disagree with this notion, it still demonstrates that there is an awareness of energy conservation issues among many people.

5.22 Unfortunately, visits to appliance shops in Hyderabad revealed that it is very difficult to determine the electricity consumption of heavy electricity-using appliances from information available in the stores. Air conditioners were the only appliance for which energy consumption data were provided on the appliance itself. Thus, even though households are prepared to pay more for efficient appliances, there is no easy way for them to judge which popular brands are energy efficient.

5.23 The conclusion is that consumers are aware that energy conservation is an important issue and practicing energy conservation behavior can reduce their energy

expenditures. They are also very willing to purchase more efficient appliances. At the present time, however, it is very difficult for them to determine which ones are the most efficient when making a purchase. Most purchases are thus made based on the basis of brand name recognition. *One implication of these findings is that priority should be given to appliance testing and efficiency labeling requirements. These labels should include not only the appliance efficiency, but the yearly range of operating costs of comparable alternative appliance brands (without actually mentioning particular brands).*

Summary and Conclusions

5.24 People in Hyderabad are very aware of the energy problems that they face on a daily basis. Electric power interruptions, the long waiting lists for getting LPG service, and shortages of kerosene in the ration shops bring the country's energy problems down to a very personal level. As a consequence, people are very favorable to ways or programs that involve energy conservation. Among the lowest income groups, people are more concerned with saving money than saving energy. In the higher-income groups, people are more concerned about energy and environmental problems and ways that they can help that are not too expensive or too demanding on their lifestyles.

5.25 Appliance ownership is growing very fast in Hyderabad, even among the lowest income groups. Most people in Hyderabad now have lights, fans, and even televisions. The next wave of appliance ownership will entail the purchase of more expensive and heavier electricity-using appliances such as refrigerators, air coolers, and water heaters. The prospective growth in the use of these appliances means that electricity demand will accelerate in the near future. As a consequence, programs that save electricity will alleviate problems of expanding capacity to meet such demands.

5.26 Recommendations for improving electricity efficiency in Hyderabad involve several overlapping programs. Since household lighting accounts for approximately one-third of the residential electricity use, programs to encourage consumers to switch from incandescent bulbs to fluorescent or compact fluorescent lamps would make lighting more affordable and reduce the growth of electricity demand. However, one of the main problems faced in getting consumers to replace incandescent lighting is that low voltage levels cause fluorescent tubes to flicker or not start. As a consequence, *the improvement of electricity service is a significant prerequisite to implementing any program to encourage the use of fluorescent lighting.* In addition, the use of new coatings to make florescent lighting more pleasing has not yet reached the market in Hyderabad.

5.27 People in Hyderabad are willing to consider purchasing more efficient appliances if the operating costs of the appliances are reduced. The problem is that appliances do not carry labels that give consumers any information on the amount of electricity they use. As a consequence, consumers have little idea about the actual operating costs of the appliances that they are considering for purchase. *It is therefore recommended that a program be established to test and label heavy electricity-using appliances such as air coolers, water heaters, refrigerators, and air conditioners.*

5.28 Promoting electricity efficiency through rational electricity pricing is very important. As previously indicated, at the time the survey was being conducted in 1994, the highest income groups were receiving a large subsidy from the SEB because of high rates of appliance ownership. More recently, electric power rates have been increased to more adequately reflect the SEB's costs. This is a step forward in terms of sending signals to consumers to conserve energy. However, pricing alone is often not enough. It is in the electricity companies' interests to promote efficiency in energy use among consumers so that they can keep costs down. *The State Electricity Board and appliance manufacturers should not only improve consumer service, but should also promote energy efficiency through publicity campaigns.* Since consumers are already favorably inclined toward conserving energy, such campaigns could have the dual benefit of building public trust and reducing long-term investment costs for the companies. Although it is important for the SEBs to expand electricity production to meet the growing demand for electricity, it is equally important to promote efforts to use existing supplies of electricity more efficiently.

6

Fuelwood Demand and its Effect on Surrounding Rural Areas

6.1 Fuelwood was once a dominant source of cooking energy in both urban and rural India. Although its importance in urban settlements is progressively declining, a little over 30 percent of urban households in India still use it for cooking. For a variety of reasons, such as the concentration of the poor in the larger urban centers (particularly in the metropolitan cities) and the inaccessibility, lack of availability, and relatively high cost of commercial fuels, fuelwood will continue to be used by urban consumers in India in the foreseeable future. Sometimes the intensity of demand in urban markets lead to indiscriminate harvesting of trees, which causes extensive soil erosion. Such a development can outpace forest regeneration and normal conservation measures fail to check the process of land degradation.

6.2 Metropolitan Hyderabad has always been a major center for fuelwood consumption, as was brought out in the study, *Fuelwood in Urban Markets* (Alam et al. 1985). This study of the fuelwood markets of Hyderabad serves as a benchmark and provides the opportunity to make a comparative study of the fuelwood markets at two discrete points of time, 1981 and 1994. The demand for wood in Hyderabad has given rise to a flourishing trade in wood products which are basically of two types, logs and fuelwood. While logs now are primarily used for construction purposes, fuelwood is used as a source of energy. The trade in logs and fuelwood is open, based on market forces. Because of the vast demand for wood, including both logs and fuelwood, metropolitan Hyderabad receives supplies from both distant centers and from its immediate hinterlands.

6.3 In the past, supplies of fuelwood originated both from the government forests and private sources. However, there have been important changes in the forest policy of Andhra Pradesh in recent years. One result of this is that the movement of wood from all types of government-owned forests has been prohibited. Wood is now supplied to Hyderabad City almost entirely from private forests, waste lands, and isolated trees on private farms. The new forest policy is expected to alleviate the degradation of forests due to the pressure of urban demand for wood and to encourage the growth of private forests and tree planting on waste lands. In this chapter, the demand and supply surrounding fuelwood in the Hyderabad metropolitan market is examined in depth, including changes that have occurred in the marketing system over time.

Biomass Demand in Hyderabad and Catchment Area

Fuelwood Demand in Hyderabad

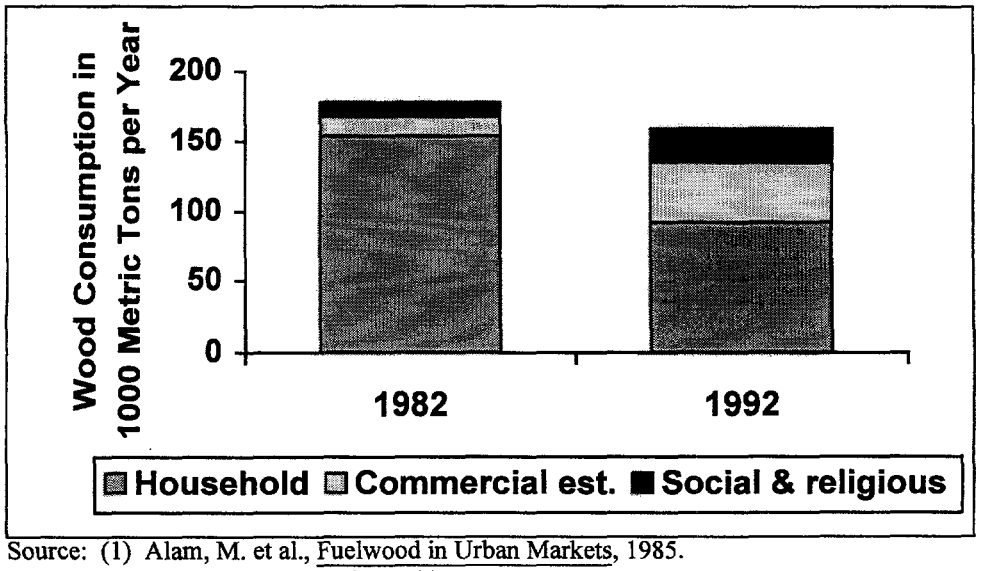
6.4 The substitution of kerosene and LPG for fuelwood in the household sector has resulted in a declining demand for fuelwood in Hyderabad. In absolute terms, household demand has declined by 61,000 metric tons, at the rate of a little over 5,000 metric tons per year (see Table 6.1 and Figure 6.1). On the other hand, the demand in the commercial and social/religious sectors has been rising steeply, at the rate of 2,400 metric tons and 2,000 metric tons per year, respectively. In 1982, the household sector provided 87 percent of the total demand. By 1994, its share had dropped to 55 percent. By contrast, the respective shares of the commercial and social/religious sectors had risen sharply from 8 percent and 5 percent in 1982, to 25 percent and 20 percent—a three-fold increase during the short period of 12 years.

Table 6.1
Estimates of Sectoral Demand for Fuelwood, Hyderabad, 1982 & 1994

	1982		*1994*		*Change 1982-94*	
Demand Sector	*Metric tons/year*	*% of total*	*Metric tons/ year*	*% of total*	*Metric tons/year*	*Percent*
Household	154,031	87	92,499	55	-61,532	-40
Commercial establishments	13,700	8	43,015	25	29,315	214
Social & religious	10,000	5	34,368	20	24,368	244
Total	177,731	100	169,882	100	7,849	-4

Source: (1) Alam, M. et al., Fuelwood in Urban Markets, 1985.
(2) Hyderabad survey data, 1994.

Figure 6.1 Demand for Fuelwood by Sector, Hyderabad, 1982 & 1994



Source: (1) Alam, M. et al., Fuelwood in Urban Markets, 1985.
(2) Hyderabad survey data, 1994.

6.5 As noted, the demand for household energy has significantly changed over the last decade. While the population of Hyderabad increased by over 90 percent between 1981 and 1994 to 5 million, household demand for fuelwood decreased by 50 percent, and for charcoal by nearly 60 percent. This is an average decrease for wood fuel of 52 percent. However, the demand for wood fuels in the non-household sector has increased, somewhat in line with the population increase, but not sufficiently to counter the decrease in household demand. The aggregate effect is that the total demand for fuelwood has decreased by 23 percent, and that for charcoal by 7 percent, with a combined decline for fuelwood and charcoal of 11 percent.[1]

6.6 While the urban demand for wood fuel decreased between 1981 and 1994, the demand for other wood products, particularly poles, saw logs, and sawn wood has increased. This increase has more than offset the decrease in demand for wood fuel, which means there has been an overall increase in urban demand in Hyderabad for wood and wood products.

Combined Rural and Urban Demand for Fuelwood

6.7 Of course, demand for wood does not only emanate from urban areas. People in rural areas use wood in very large quantities. Rural populations in the areas surrounding Hyderabad that use wood, straw, and dung for cooking have increased by nearly 30 percent between 1981 and 1994, to an estimated 5.9 million people. While much of the rural wood demand, especially fuelwood and poles, is regarded as non-commercial (branches, twigs, and tree tops) compared to urban commercial wood products, all of the former must be taken into consideration when analyzing wood removals from the Hyderabad catchment area. Table 6.2 demonstrates the difference in demand for wood, in terms of roundwood equivalents for the urban and rural populations living within a 100-kilometer radius of Hyderabad.

6.8 At the current rate of urbanization, metropolitan Hyderabad will double itself in 15 years to a population of about 10 million people. This will lead to a doubling of the housing stock, assuming no change in the average family size. Thus, while it is anticipated that fuelwood will continue to become a marginal household fuel in urban areas, this fall in demand may be more than offset by the increase in fuelwood demand in the non-household sectors. To this should be added the predicted increase in demand for wood in construction, furniture and joinery, and other wood-using industries. There will

[1] The estimated demand for fuelwood and charcoal given here excludes the use of these fuels by small-scale industry. A cursory survey was done in some fuelwood-using industries such as edible oil extraction mills, textile plants (silk and terylene), footwear makers, utensil manufacturers, and chemical works. Many owners were reluctant to give figures of consumption, because they were using the wood to supplement or as a substitute for (subsidized) coal, for which they had been allocated a quota. The general consensus was that although wood is more expensive than coal, the supply is reliable. Also, it is possible that some of the coal is resold at market prices. The wood-using industries, such as sawmills, also use wood waste as a boiler fuel to kiln dry sawn wood. The 1994 estimated consumption of fuelwood by these small-scale industries is about 45,000 metric tons. (Alam Manzoor, 1996). In addition, a negligible quantity of charcoal may be used by blacksmiths. In comparison, the 1981 demand in this small industries sector may have been about 24,000 metric tons of fuelwood.

thus be a moderate but growing demand for all wood products in Hyderabad over the next 15 years.

Table 6.2
Estimated Rural and Urban Demand for Wood, Hyderabad Catchment Area, 1982 & 1994 (million metric tons, roundwood equivalent)

	1982				1994				Difference (1981-94)	
	Rural	Hyderabad	All Urban	Total	Rural	Hyderabad	All Urban	Total	Urban	Total
Population (millions)	4.63	2.59	3.09	7.72	5.90	4.97	5.75	11.65	2.66	3.93
Wood Type										
Fuelwood	1.19	0.24	0.29	1.48	1.51	0.22	0.25	1.76	-0.04	0.28
Charcoal	0.01	0.01[1]	0.01[1]	0.02	0.01	0.01[1]	0.01[1]	0.02	0.00	0.00
Poles	0.14	0.02	0.02	0.16	0.18	0.04	0.05	0.23	0.03	0.07
Saw logs	0.07	0.05[2]	0.06[2]	0.13	0.09	0.08[2]	0.09[2]	0.18	0.03	0.05
Total wood[5]	1.41[4]	0.32[3]	0.38[3]	1.79	1.79[4]	0.35[3]	0.40[3]	2.19	0.02	0.40

Note: Catchment area encompasses all urban and rural populations living within a 100-kilometer radius of Hyderabad. Also, it is assumed that some charcoal, saw logs and sawn wood, plus all panel and paper products come from outside the 100-kilometer radius, of Hyderabad, estimated as follows:

1. Total charcoal wood, 0.12 million mt, 85 percent from outside Andhra Pradesh, (Alam M. et al, 1985). Of the charcoal from A.P., only about half will be from within the 100-km. radius.
2. For 1981, total saw logs, 0.11 million mt. This excludes 0.04 million mt. of off-cuts already counted in fuelwood total. For 1994, total saw logs, 0.20 million mt. This excludes 0.07 million mt. of off-cuts already counted in the fuelwood total.
3. For 1981, total roundwood demand, 0.54 million mt. This excludes 0.03 million mt. of roundwood used for panel and paper production, consumed in Hyderabad and other urban areas. For 1994, total roundwood demand, 0.62 million mt. This excludes 0.06 million mt. of roundwood used for panel and paper production, consumed in Hyderabad and other urban areas.
4. For 1981, this excludes 0.02 million. mt of roundwood used for panel and paper production consumed within the rural 100-km. radius catchment area. For 1994, his excludes 0.02 million mt. of roundwood used for panel and paper production consumed in the rural 100-km. radius catchment area.
5. For 1981, estimated total demand, in roundwood equivalent terms, for all wood products, including panels and paper, in millions of mt: Rural 1.43; Urban 0.57; Total 2.00. For 1994, estimated total demand in roundwood equivalent terms for all wood products, including panels and paper, in millions of mt: Rural 1.81; Urban 0.68; Total 2.49.

Sources: Alam , M. et al., Fuelwood in Urban Markets, 1985; FAO Annual Forest Products Yearbook 1981, (adapted). (Rome: FAO, 1983); Unni N.V.M. et al., Fuelwood Sustainability in Rural Areas. (Hyderabad: National Remote Sensing Agency, 1992); 1981 Census of India (Government of India; 1982).

Geographic Distribution of Fuelwood Supply

6.9 The government of Andhra Pradesh has prohibited the supply of wood from government forests. Supplies are now being received mainly from private forests, waste lands, and isolated trees on farmlands. The total annual supply of wood (including both logs and fuelwood) to Hyderabad is 288,000 metric tons, including 172,800 metric tons of fuelwood. In 1982, Hyderabad consumed 177,731 metric tons of fuelwood. There has thus been a small drop in the demand for fuelwood, primarily due to a dramatic decline in the demand from the household sector, from 154,031 metric tons in 1982 to 92,498 metric tons in 1994. The demand in the commercial and social/religious sectors

has been rising rapidly, however. The decline in the demand for fuelwood by households has been more than offset by the rise in the demand for logs. Thus, the overall supply of wood to the city has increased. The total value of trade at Hyderabad wood auction centers increased from Rs. 3.57 crores (US$1.2 million) in 1982 to Rs. 25 crores (US$7.0 million) in 1994, an increase of 300 percent in value in about a decade.

6.10 The sources of wood supply are widely spread out. The distances from which fuelwood is brought to the city vary between 63 and 136 kilometers. There is hardly any change from 1982 in the average distance and sources of supply of wood to Hyderabad City, though the total supplies have increased significantly. The bulk of the wood to the auction centers is brought mainly from the adjoining districts. Two opposite forces appear to be exerting pressure on the areas of wood supplies. The reduction in the forest area and tree cover on the outskirts of the city are pushing the area of supply further away from the city, while rising transport costs are forcing suppliers to bring logs and fuelwood from the nearest available sources. It is notable that bullock carts, which were used prominently to transport chipped wood to the city in 1982, have now ceased to operate.

6.11 As already mentioned, the wood market of Hyderabad is based on supply and demand. This makes the functioning of the market flexible and ensures its smooth functioning. The wood market comes close to the classical competitive market model. There are a large number of sellers and purchasers in the market. It is also interesting to note that business worth millions of rupees is transacted everyday in these markets, and most transactions are on a cash basis.

Changes to Forest and Wooded Areas in the Hyderabad Hinterlands

6.12 Over the last 100 years, the population of India has increased four-fold, from just over 225 million to more than 930 million. In another 50 years, it may be the most populous nation on earth. This tremendous increase in population has and will continue to have a significant impact on land use and natural resources, both renewable and non-renewable. One hundred years ago, 90 percent of the population lived in rural areas; today it is about 60 percent. These statistics are mirrored in the population living in and around Hyderabad. Table 6.3 provides estimates of the rural and urban population within radii of 50 and 100 kilometers of Hyderabad between 1894 and 1994.

6.13 While the urban population of India, including that of Hyderabad, has increased nearly 20 times in 100 years, the rural population has increased less than three times. Thus, within a 100-kilometer radius of Hyderabad, the combined rural/urban increase has been nearly five-fold over the 100-year period, whereas within a 50-kilometer radius, it has been more than eight-fold.

Table 6.3
Estimated Population, Hyderabad and Vicinity, Selected Years, 1894-1994
(millions)

Year Rural/Urban	1894	1928	1963	1971	1981	1991	1994
			50-km. radius of Hyderabad				
Rural	0.51	0.56	0.82	0.95	1.15	1.34	1.40
Urban	0.28	0.57	1.40	1.92	2.71	4.43	5.17
Total	0.79	1.13	2.22	2.87	3.86	5.77	6.57
			100-km. radius of Hyderabad				
Rural	2.05	2.25	3.29	3.84	4.63	5.59	5.90
Urban	0.33	0.68	1.64	2.20	3.09	4.98	5.75
Total	2.38	2.93	4.93	6.04	7.72	10.57	11.65

Notes: The population was estimated based on the populations of the following districts in proportion to their area within the specified radii: Hyderabad, Rangareddi, Medak, Nalgonda and Mahbub Nagar. The small areas of Warangal and Nizamabad within the 100-kilometer radius were included in Nalgonda and Medak, respectively.

Sources: Alam, M. et al, Perspectives on Patterns and Trends of Energy Consumption in an Indian Metropolis (draft report) (Hyderabad: The Institute of Energy and Environmental Studies, 1996); FAO Annual Agricultural Production Yearbook 1976, 1984, 1994, (projected and adapted) (Rome: FAO, 1978, 1986, 1996); Census of India 1961, 1971, 1981 & 1991 (adapted) (Government of India, 1962, 1972, 1982, 1992); D.N. Elhance, Economic Statistics of India Since Independence (Allahabad, India: Kitab Mahal Private Ltd., 1962).

6.14 The need for more food and wood products to satisfy the requirements of this increase in population has affected the quantity and quality of forest and woodland areas within a 50-mile radius of Hyderabad (see Table 6.4). In the 35-year period from 1928 to 1963, the forest area shrank by nearly half and the scrub land decreased by 60 percent, for a combined total loss of over 112,000 hectares of wooded area—more than 3,200 hectares per year. Most, if not all of this land was converted into agricultural use to meet the growing food demands of the increased population of more than 1 million people. In the 31-year period from 1963 to 1994, the loss of wooded areas declined significantly, to less than 640 hectares per year, despite a population increase of more than 4 million people. In the period 1963 to 1981, the average loss was 780 hectares per year, whereas from 1981 to 1994, this annual loss declined to 420 hectares per year. In addition, from 1963 to 1994, the land under agriculture decreased by an average of 480 hectares per year, with arable land decreasing by over 1,600 hectares per year. This latter decrease was offset by an increase in fallow land, but pastoral land decreased by about 500 hectares per year.

6.15 Despite this decrease in the arable area, food grain production in India increased substantially, due to a doubling of the areas under irrigation, improved seed varieties, and better management. These initiatives doubled the unit grain production per hectare. From 1965 to 1980, the irrigated area increased by 50 percent, and from 1980 to 1994, it increased by another 25 percent. On the other hand, the increase in unit rice production was the reverse; 25 percent from 1965 to 1980 and 50 percent from 1980 to 1994. The main cause of the increase can be attributed to improved seed varieties. This "green revolution" and intensification of agriculture is one of the reasons for the decline in the deforestation rate.

Table 6.4
Land Use Changes within a 50-kilometer Radius of Hyderabad, Selected Years, 1928-94
(all figures in square kilometers)

Land Use Type	*1928*	*1963*	*1981*	*1994*
Wooded land	2073	949	807	752
Forest	1055	530	445	365
Scrub land	1018	419	362	387
Agricultural land	4486	5620	5518	5470
Arable	2855	3600	3466	3098
Fallow	900	1133	1290	1641
Pastoral	731	887	762	731
Barren/rocky land	675	498	474	470
Built up areas	28	70	135	257
Water bodies	160	135	130	124
Miscellaneous: non-agric.	435	585	793	784
Total	7857	7857	7857	7857

Note: As with the estimate for population, the land uses in Hyderabad, Rangareddi, Medak, Nalgonda and Mahbub Nagar were tabulated and divided in proportion to the areas within the 50-kilometer radius of Hyderabad. The built-up areas were estimated using the 1994 figure based on the urban population at the specific date. Similarly, the estimates of water bodies were made from 1985-86 and 1994 data. Miscellaneous non-agricultural land is a residual figure and could include all categories of non-agricultural land.

Sources: Alam, M. et al., Perspectives on Patterns and Trends of Energy Consumption in an Indian Metropolis, (draft report) (Hyderabad: The Institute of Energy and Environmental Studies, 1996);. FAO Annual Agricultural Yearbook 1963, 1981, & 1993, (projected and adapted).(Rome: FAO, 1965, 1983, & 1995); N.V.M. Unni et al., Fuelwood Sustainability in Rural Areas. (Hyderabad: National Remote Sensing Agency, 1992); Indian Agricultural Statistics 1956-57; 1961-62 & 1962-63; 1977-78 to 1981-82; and 1985-86 to 1987-88, (Directorate of Economics & Statistics, Ministry of Agriculture, Government of India); Survey of India maps, 1928 & 1988.

6.16 While the rate of deforestation has been declining, it appears that the composition of the forests and scrub lands is deteriorating, principally through overuse. There is a gradual but perceptible decline of tree cover in wooded formations from dense forest types to open scrub, via open forests and dense scrub. Thus, there is a tendency for the stocking density to degrade gradually.

Estimated Woody Growing Stock in Hyderabad Catchment Area

6.17 An inventory was commissioned to monitor the change in land use and woody growing stock between the mid-1980s and the mid-1990s in the 100-kilometer radius around Hyderabad (see Table 6.5). This study was undertaken by the Indian Resource and Management Technology Ltd. (INRIMT) of Hyderabad. Landsat imagery was compared for two periods; namely, January to December 1986, and May 1993 to May 1994. Nine land use types were recognized and land use areas and changes were tabulated for the two periods. A detailed description of this survey is available in a separate report (N.V.M. Unni et al., 1996).

6.18 The land use categories developed for this inventory are slightly different from those given in Table 6.4. (Tables 6.4 and 6.5 were developed from a combination of maps and data from the sources cited for both tables, and from the research prepared for this report). For the INRIMT study, the wooded areas have been sub-divided into dense and open forests and scrub. The agricultural land is classified into intensive, moderate, and scanty, as opposed to arable, fallow, and pastoral, as in Table 6.4. There are no barren/rocky or miscellaneous non-agricultural categories (except for roadside); these are included in the "scanty agricultural" category.

6.19 As shown in Table 6.5, agricultural lands occupy about 84 percent of the catchment area and contain an estimated 39 percent of the woody growing stock. Forests occupy 4 percent of the land area and have 28 percent of the growing stock. This is nearly the same as scrub lands (29 percent), but these types cover 9 percent of the land area. The remaining 4 percent of the growing stock is in urban areas and along roads. In the eight-year period from 1986 to 1994, an estimated 0.5 million metric tons of woody biomass has been lost from the forests and scrubs. *Most of this loss of trees (over 90 percent) was due to a loss and/or degradation of open and dense scrub land.* Agricultural areas increased by an estimated 22,000 hectares in this eight-year period, and increased their growing stock by about 0.1 million metric tons of wood. Thus, the net loss of woody growth is an estimated 0.4 million tons, or an average of 50,000 metric tons of wood per year.

6.20 The estimated standing stock of trees and shrubs in wooded areas was 28 metric tons per hectare—43 metric tons per hectare in forests and 21 metric tons per hectare in scrub lands. Dense forests had an estimated standing stock, on average, of 103 metric tons per hectare; the range was between 79 metric tons per hectare and 122 metric tons per hectare. On average, open forests contained less than one-third the volume or weight of the dense forest: an average of 29 metric tons per hectare, with a range of 22 metric tons to 40 metric tons per hectare. Most of the dense scrub areas had a standing mass of about 18 metric tons per hectare, but because large trees were present in one-quarter of the plots, the average standing stock was increased to about 40 metric tons per hectare. There is a much smaller variation in the open scrub sample plots. The estimated average standing stock was 12 metric tons per hectare, with a range between 10 and 14 metric tons per hectare.

6.21 Agricultural lands have an average of nearly 3 metric tons of woody biomass per hectare, with just under 2 metric tons per hectare on intensive agricultural areas, and just over 3 metric tons per hectare on scanty agricultural areas. A 1989 inventory of trees outside the forested areas carried out for the Andhra Pradesh Forestry Department estimated the standing stock of woody biomass to be 1.8 air dry metric tons per hectare (1.6 dry metric tons per hectare.). This is somewhat less than the estimates in the present study, but this earlier study excluded scanty agricultural lands.

Table 6.5
Land Use and Associated Biomass Changes, Hyderabad Catchment Area, Mid-1980s to Mid-1990s

Land Use Category	Area (sq. km.)			Woody biomass[2] (000 mt)		
	1986	1993/94	Change	1986	1993/94	Change
Wooded land	4,177	3,989	-188	11,789	11,312	-477
Dense forest[3]	257	252	- 5	2,601	2,550	- 51
Open forest	1,032	1,023	- 9	2,982	2,956	- 26
Dense scrub	972	904	- 68	3,907	3,634	-273
Open scrub	1,916	1,810	-106	2,299	2,172	-127
Agricultural land	26,299	26,517	218	7,624	7,697	73
Intensive agric.	2,785	2,728	- 57	529	518	- 11
Moderate agric	4,856	4,889	33	1,311	1,320	9
Scanty agric.	18,658	18,900	242	5,784	5,859	75
Built-up areas	284	286	2	195	197	2
Water bodies	529	497	- 32	0	0	0
Roads[1]	146	146	0	533	533	0
Total	31,435	31,435	0	20,141	19,739	-402

Note: 1. It has been assumed that an estimated roadside length of 5834 km. were on average 25 m. wide (including 5-m. strips on each side where the trees grow). The estimated growing stock of woody biomass was 91.75 air dry mt per km., or 36.5 mt/ha.

2. From plot measurements in the various land use categories, the measured standing stock of woody biomass, in air dry mt per hectare is as follows:

Dense forest, 103; open forest, 28.9; dense scrub 40.2; open scrub, 12.0; intensive agriculture, 1.9; moderate agriculture, 2.7; scanty agriculture, 3.1; built-up areas, 6.9. It is assumed that the standing stock per ha for the different land use categories has not changed between the two periods. The sample plots were measured between 1991 and 1995.

3. Forests include plantations and woodlots.

Source: Unni, N.V.M. et al., Fuelwood Sustainability in Rural Areas. (Hyderabad: National Remote Sensing Agency,. 1992); Unni N.V.M. et al., "Biomass Estimation and Changes in the Vegetal Cover in the Fuelwood Catchment of Hyderabad," Hyderabad, 1995.

Hyderabad Catchment Area: 1994 Supply of and Demand for Wood Products

6.22 The 1994 demand for wood products within a 100-kilometer radius of Hyderabad is estimated to be approximately 2.19 million metric tons (see Table 6.2), of which 0.40 million metric tons were in urban areas (Hyderabad, 0.35 million metric tons). Only the "high" estimate of annual growth of woody biomass from the INRIMT study (2.16 million metric tons) is near the estimated demand. The other two annual increment estimates; namely, 1.72 million metric tons ("moderate") and 1.48 million metric tons ("low") are considerably below the 1994 demand for wood products. Of course, only the urban demand for wood fuel products was based on recent information. The information for rural consumption of wood products and urban non-wood fuel consumption was estimated from indirect sources. Also, the source of the wood raw material and the percentage of it which came from the Hyderabad catchment area is again open to debate.

6.23 Nevertheless, the present study reveals that the woody resources around Hyderabad are under stress. Over the 8 years between 1986 and 1993-94, 17,400 hectares of scrub land and 1,400 hectares of forest were lost, resulting in a decrease of tree capital of nearly 0.5 million metric tons—60,000 metric tons per year (see Table 6.5). At the same time, there has been a net loss of intensive and moderate agricultural land (2,300 hectares). Thus, the argument about taking "forest" land for agricultural development cannot be sustained. While some of this 60,000 metric tons will be burned on the spot to clear land and provide fertilizer, and while some trees may have been preserved by the farmer or land developer, the bulk would have been salvaged and used for wood products.

6.24 However, it appears from this study's survey of the auction markets in Hyderabad that most of the traded fuelwood and saw logs coming into the metropolis are from farmland, not forests. The tree species sold at these auctions were mainly from farmland. Although about 5 percent were sawmill off-cuts, some of these off-cuts may have been from forest species. Lorry drivers interviewed said that they collected the wood from farming areas, and this was verified by identifying the tree species—neem, mango, babul, and babulka—all of which are principally "farm" trees.

6.25 The farmers are responding to this increasing urban market for wood products, but at the same time it appears that they are eating into the tree and scrub capital to meet some of their own requirements. There is still a considerable amount of woody biomass within the 100-kilometer radius of Hyderabad—an estimated 20 million metric tons (see Table 6.5). However, a constant erosion of this capital could eventually cause substantial environmental stress.

Summary and Conclusions

6.26 Forest ecology is being adversely affected by the dual forces generated by urbanization. The growth of dynamic economic activities such as trade and commerce, industry, and tertiary services leads to a rapid growth in demand for land to organize economic activities and accommodate the growing population. This results in massive expansion of built-up areas and changes in land use, including displacement of biomass cover. This process affects the immediate periphery of the city contiguous to the existing built-up areas. The expansion of built-up areas occurs in concentric circles. Consequently, the changes in land use, including changes in biomass cover, are also concentric. In the outer ring however, biomass cover changes follow the transport routes, consistent with the direction of the growth of built-up areas. The expansion of built-up areas has not, however, encroached on forest lands.

6.27 Increasing urbanization has exercised tremendous pressure on the demand for fuelwood. Evidence of this is notably marked in the hinterland of metropolitan Hyderabad, mainly along the transport routes. Historically, extensive forest lands have been degraded into scrub woodland or their densities have been substantially reduced by frequent harvesting. In some areas, total deforestation has taken place as a consequence of urban demand. This reduction of biomass adversely affects overall sustainability, which is a cause for concern.

6.28 The combination of the following developments has been very beneficial for forest and scrub areas surrounding Hyderabad: the easing of fuelwood demand in urban areas, the increasingly attractive market for farmers to grow trees, government policies of forest conservation, tree regeneration, social forestry, the prohibition of tree harvesting on government forest lands, and the banning of the outward movement of wood from these forests. There has been a substantial drop in the deforestation rate in the hinterland of Hyderabad, from 28 square kilometers per year during 1928-67 to only 2 square kilometers per year during 1963-87. The deforestation rate calculated through satellite images reveals an even lower rate of forest decimation, at 1.3 square kilometers per year. The satellite data does stress the point that demand for fuelwood in metropolitan Hyderabad exercises considerable pressure on fuelwood resources in the hinterlands.

6.29 However, people and communities contemplating growing trees are getting mixed signals from government and local authorities. On the one hand, there are extension efforts which encourage communities and individuals to plant trees and to manage wood lots and natural woodland areas. This should continue and be expanded. On the other hand, there are barriers and/or constraints which discourage people from growing trees. In theory, permission has to be obtained to thin or fell trees. In practice, this permission has been relaxed for "non-forest" trees such as neem. But a private individual or a community is not free to fell "forest" species, even if they are on private land. This rule is a deterrent to tree planting, especially indigenous tree species, a thing that one arm of government is trying to encourage!

6.30 Very little market intelligence is available to private individuals about the opportunities and markets for wood and wood products. The Andhra Pradesh government, through its forest service, has in the past planned for demand from state forests and plantations. There is also a general consensus that trees compete with crops for land use; for the subsistence farmer, then, land is at a premium. In practice, many tree species, if judiciously planted, can assist agricultural production by, for example, improving micro-climates, providing soil nutrients, improving the soil structure, supplying animal fodder and fruit, etc., as well as furnishing wood and other tree products.

6.31 Within the Hyderabad catchment area, there are about 400,000 hectares of forests and scrub lands. If it is government policy to preserve these areas under trees, then some additional wood products have to be provided from elsewhere, and these areas have to be better managed. Banning the cutting of trees in forests will not stop them being felled if there is a demand for wood and an alternative supply is too difficult to obtain. Thus, a first priority is to increase supply close to the demand center. The stocking density on all wooded formations is low, an average of less than 30 metric tons (45 cubic meters) per hectare. This should and can be increased significantly. Most of the scrub areas are common lands, with the local communities having some say over their use. These areas should be vested in the local communities, or in some cases, in individuals, who can then be given help and advice on the management of these areas.

7

Summary and Conclusions

7.1 The rapid population growth and urban geographic expansion experienced by Hyderabad has put great strain on all urban services, and the energy sector is no exception. The energy sector in Hyderabad can be characterized as one of both great achievements along with significant problems. Among the achievements, the most remarkable is that the city has undergone a significant transition from traditional to modern fuels during the last 15 years. The expansion of the use of LPG by middle and higher-income households has meant that poor households now have access to and use kerosene for cooking. The significant switch to kerosene and LPG has resulted in decreasing fuelwood use among urban households, which in part is responsible for declining rates of deforestation around the city. In addition, the use of electricity in Hyderabad has grown significantly for a variety of end-use services. Virtually all households in Hyderabad now use electricity, as service has been expanded to over 600 thousand mainly low- and lower-middle income households (or about 3 million people) during the last 15 years. Even the poorest households in Hyderabad have electric lights and fans for use during the hot summers.

7.2 In spite of these successes, the household energy sector in Hyderabad still has significant problems. There are persistent shortages of LPG and kerosene. At present, there are thousands of customers on the waiting lists for LPG and many people are eager for a second LPG bottle because they experience significant delays in getting refills after their existing bottle runs out. Likewise, kerosene is available in only limited amounts from the retailers affiliated with the public distribution system. Typically, people can obtain their allotment of kerosene only two days per month. The electricity sector is held in very low esteem by consumers. Consumers are experiencing over two power cuts per day in most parts of Hyderabad, and actually are spending significant amounts of money to make up for the lost power. It is apparent from the survey results that approximately one-third of electricity customers either do not get electricity bills or are unable to produce them.

7.3 In this chapter, we first summarize the basic trends and patterns of household energy consumption, followed by a section on policies recommended to improve energy markets. The final section deals with how to assist the poorest populations through any significant changes in energy sector policies.

Summary of Trends in Household Energy Patterns and Policies

7.4 In India, traditional sources of energy, especially firewood and dung cakes, have had an important role to play in meeting the bulk of the domestic energy requirements. Over the years, however, the reliance on traditional forms of energy has been declining, while the share of modern fuels like kerosene, LPG, and electricity has increased, especially among the poor. The transition to modern fuels is due to a combination of higher household income; increased availability of kerosene, LPG, and electricity; rapid urbanization; and subsidized prices for modern fuels. Given the importance of the household sector in national energy consumption, the long-term sustainability of current policies, along with satisfaction of the social and equity objectives of the government of India are major concerns for the country.

7.5 **Rapid interfuel substitution in 1980s and 1990s.** The household energy sector in urban Hyderabad can be characterized by a very rapid rate of interfuel substitution. The main trend is that people in the middle class have switched from using kerosene to using LPG for cooking. Since there is a limited amount of kerosene in India due to import restrictions, this switch of the middle class from kerosene has meant that poor people can now gain access to it. As a consequence, all but the poorest low-income households in Hyderabad have switched from using wood to using kerosene for cooking. This substitution has taken place in spite of stagnant income growth overall among low-income groups in Hyderabad. The growth and use of modern fuels has therefore resulted from factors other than income growth. These include greater availability of fuels directly caused by liberalization of fuel markets, growth in the number of high- income households, and the shift to a higher percentage of women in the workforce (which creates a demand for more convenient fuels). These trends are likely to continue during the coming decade as markets expand further and incomes grow within urban Hyderabad.

7.6 **Government policy involves significant energy subsidies.** This report finds that the household energy sector in Hyderabad is influenced greatly by government policies to control and subsidize different types of energy. There are several different types of policies that have an impact on urban household fuel use. They include policies to limit the import of petroleum products, the exclusive distribution of kerosene through the government public distribution system, the provision of significant subsidies for kerosene and LPG, and the allotment of subsidies by the State Electricity Board through electricity pricing and distribution management. The dual policies of limiting the quantities of energy available for sale and mandating limited amounts of subsidies for energy programs has resulted in difficulties for some households in obtaining fuels because of periodic local scarcities. Generally, it is poor people who must bear the *burden of local* fuel scarcities. The level of energy subsidies just for urban households in Hyderabad is quite large, about Rs. 1 billion (US$30 million) per year in total for electricity, LPG, and kerosene. Such subsidies can be justified if they help the poor, but the findings of this study are that only a small percentage of the energy subsidies actually reach poor people. Although the poor do benefit from the kerosene subsidies, the majority of energy subsidies are going to people who could afford to pay higher prices for energy services. Not only can they afford to pay for services, but the surveys and focus group interviews indicate that they would be willing to pay for improved service, increase supply, etc.

7.7 **Public distribution system not well directed to help the poor.** The public distribution system has only been partially successful in reaching the poor. Kerosene can be purchased at subsidized prices by people with ration cards. The evidence from the survey is that the poor do take advantage of using this subsidized kerosene for cooking. Almost all poor households with ration cards purchase and use the 15 liters per month that they are permitted under the current system. However, consumers complained that the kerosene was available only twice for a few days after it was delivered to ration shops, after which the ration shops ran out of their allotted quantities. In addition, the poorest of the poor—those without ration cards or permanent addresses—are entirely left out of the system and must use kerosene purchased at market prices (double the price of kerosene from ration shops) or buy expensive fuelwood for cooking. Frequently, much of the subsidized kerosene earmarked for use by urban households is being diverted to the transport and other sectors.

7.8 **LPG subsidies reach mainly middle and high-income households.** Fifteen years ago in Hyderabad, LPG was the "rich person's fuel." During the last 15 years, the amount of LPG consumed in urban Hyderabad has expanded significantly, as India has stepped up efforts to import LPG. However, the policy of selling LPG at the price of internal production costs of the fuel was continued, which means that the sale of every bottle of LPG involves a subsidy of Rs. 60-70, for a total country-wide subsidy of about US$500 million (Rs. 17 billion). The use of LPG rapidly moved into the middle class. However, there are still long waiting lists of thousands of households for the government-subsidized LPG. To some extent, the availability problems in the sector are being addressed through an opening up of the market to private retailers, who must import the fuel and pay a small tariff on it. Although the availability of LPG has improved, there are still significant price differences between the private sector LPG and the LPG sold through government-approved retailers. The policies to continue expanding service levels and privatization of the retail markets should be encouraged, but clearly, the subsidies for LPG need to be redirected toward poorer households.

7.9 **State Electricity Board expands service but is under increasing strain.** The Andhra Pradesh State Electricity Board has been very successful in expanding electricity service in Hyderabad. Virtually all households with the minimum housing requirements have electricity. This has significantly improved the quality of life and productivity of poor people in the city, as they have access to high-quality lighting, fans, and television sets. However, this very successful program for expanding service has put the electricity supply company under increasing financial stress. Because of policies to subsidize electricity to the urban residential (approximately Rs. 400 million or US$12 million annually) and agricultural sectors (much larger subsidies than for the residential sector), the electricity industry is in very poor financial condition. The consequence is that the quality of electricity supply has suffered because of the inability of the State Electricity Board to invest in distribution and generation. Unfortunately, trying to maintain near-universal service levels with limited financial resources has caused many brownouts and both scheduled and unscheduled service cuts. The poor quality of service inevitably has resulted in a very low public opinion of the State Electricity Board, and people generally have no faith that increasing prices will improve service levels. Focus group interviews of middle and high-income households reveal support for reforming and

liberalizing the distribution of electricity, even if it means higher prices. There was no similar level of support for higher prices from the poor, so special consideration should be given to providing cost relief to this segment of the population, such as having a lifeline rate for the first 40 kWh of electricity service.

7.10 Recent developments in electricity sector reform are likely to change the way electricity is generated and distributed in the state. The State of Andhra Pradesh has started a process of electricity reform to take place over the next decade, and this reform includes a reorganization of the State Electricity Board and pricing policies for electricity. Of greatest relevance to urban household, the initial stage of the reform will created two companies, separating the generation from the transmission and distribution. One of the goals of the reforms is to have a better focus on customer service through greater system efficiency and reliability.

7.11 **Forest policy encourages local management.** The pricing of fuelwood in Hyderabad is based entirely on market principles. The shift of households to the use of both kerosene and LPG for cooking has resulted in decreased pressure on the natural resources around Hyderabad. Household fuelwood demand in the city has declined during the last 15 years, as the number of people using fuelwood as a main cooking fuel has dropped from about one-third to one-twentieth of the population. Although this decline has been partially offset by increasing demand for fuelwood in the commercial sector, the overall demand has not increased significantly in spite of a population growth in this period (1982-94) of about 3 million people. In addition to stable demand for fuelwood, forest sector policies for the region have begun to stress principles of local resource management and forest conservation. According to the local resource assessment completed in this study, the combination of improved forest management and stable fuelwood demand has resulted in a reduction in the rate of deterioration of the biomass resources around the city. These positive environmental trends are very good news and should be monitored and encouraged during the coming decades.

Policies and Sector Reforms to Improve Energy Markets in Hyderabad

7.12 Many of the energy policies being implemented in India at the present time are moving in the right direction. The continued efforts to encourage private retail development and expand the markets for LPG and kerosene have had a very positive impact on households in Hyderabad. In addition, the policies to expand electricity service to most people in urban areas have definitely had a positive impact on the quality of life of urban people, especially the poor. In this section, we review policies that should be pursued to continue improving the residential energy sector in urban areas of India.

7.13 **Enhance availability and access to LPG and kerosene through market reform.** The policies to open up the markets for LPG, mainly for urban households, should be continued and supported. The greater access of middle income households to LPG has helped the poor. The increased imports of LPG have meant that the market for this product has expanded among the middle and higher-income consumers. The study finds that the middle class and wealthy appreciate the convenience of LPG and will continue to use it, even at higher prices. In fact, many households would like to have a

second, reserve bottle of LPG, so that there is no inconvenience when the bottle in use becomes empty.

7.14 Middle class and high-income households can afford to pay for LPG and would benefit from more open markets and competition, even with higher market prices. Although people in the middle class are somewhat concerned about the price of LPG, in general, they support policies to make the fuel more available. As noted, the switch of middle class households to LPG has had the benefit of making kerosene available for the urban poor. With ever-greater availability, however, it is anticipated that LPG will be used by even more lower middle-class and poor people.

7.15 Despite this progress, further reforms are necessary. The retail distribution for LPG needs to be completely open to competition. All competitors should play by the same rules and regulations. It is laudable that the government has been opening up the sector to private business. However, with significant subsidies going to government-backed retailers and the levy of modest import taxes on new private business distributors of LPG, the playing field is hardly level for the development of new businesses. Such differences in the playing field are not viable over the longer term, and the goal should be to develop competition among retailers who are playing by the same rules and regulations.

7.16 Given that LPG is a premium household cooking fuel used by high-income households, the goal should be to eliminate the subsidy for LPG while ending policies to limit imports of the fuel. The rising price of LPG will soften the foreign exchange problems associated with opening up the markets for LPG. Also, LPG is such a small share of the total oil imports for the country that the net impact of these policies will be positive in all respects. The current two-tier policy that favors government-backed retailers and limits LPG imports has not only kept the fuel out of the hands of the poor, but has also kept its use from penetrating rural areas as well.

7.17 Thus, the recommendation is to continue to liberalize imports of LPG and to allow prices to rise to market levels, along with the removal of LPG subsidies. The reason for this recommendation is that the amount of additional LPG that will need to be imported to satisfy consumer demand for the product will be very small relative to the size of India's overall oil imports. In 1994-95, the net use of oil averaged about 60 million metric tons of oil equivalent and cost about US$7 billion. LPG use accounted for only 3.5 million metric tons of oil equivalent, or just above 5 percent of total oil use. In addition, most poor people do not use or have access to LPG, so the increase in price initially will not have a great impact on their welfare. In any event, the subsidy for LPG is not reaching the poor households which are most in need of lower energy expenses. A further opening up of the markets may also encourage more poor people to use LPG, since they already are spending significant amounts of money on kerosene for cooking.

7.18 As for kerosene, the existing distribution system does reach poor urban households. Almost all poor households take their full ration of kerosene every month. Only the poorest households in the lowest 10 percent of the population cannot get subsidized kerosene for cooking and lighting. However, the entire apparatus of the ration distribution system is cumbersome and distorts the market for kerosene, as there is a two-tiered pricing system. (To make this system more effective, the government has even

tried to use dyes to differentiate subsidized kerosene from the unsubsidized product.) The two-tiered pricing system has the effect of limiting the development of retail distributions systems for kerosene, since the majority of demand is satisfied at subsidized prices through the small ration shops. Thus, most of the distribution of kerosene is done through the ration shops. Unfortunately, the ration shops are very inefficient at distributing the kerosene, as kerosene typically is only available several days a month and sells out relatively quickly.

7.19 The solution to the problem of the two-tier markets is to encourage the development of retail markets for kerosene at world market prices. The subsidy for kerosene is reaching poor households, and it is important for them to be able to keep receiving the subsidy. Thus, poor ration card-holders could be issued stamps that could be used to redeem kerosene from any retail vendor, including the ration shops that currently sell the kerosene. For such a process to work, the import restrictions on kerosene would have to be removed and the price of kerosene allowed to rise to world market levels by all retail vendors.

7.20 **Promote electricity sector reform and improve service for urban residential electricity sector.** Near-universal service coverage in Hyderabad has now been achieved. The next important step for the State Electricity Board is to focus on improving the reliability and quality of service. There are many different proposals on institutional setups that might resolve some of the problems in the electricity sector. Regardless of whether the final institutional form of the electricity industry is public, private, or one broken up into smaller functional enterprises (generation, distribution, and transmission), this study offers several valuable insights.

7.21 The financial and management problems of all the State Electricity Boards have resulted in unreliable service to urban consumers. The Andhra Pradesh State Electricity Board is losing significant amounts of revenue. Through surveys, focus group interviews, and interviews with policy-makers, this study has identified several different problems that underlie this state of affairs.

7.22 The problems include power cuts and brownouts, low tariffs, inaccurate meters, uncollected bills, and undue political interference in bill collection and disconnection policies. Electricity consumers in Hyderabad indicate that in addition to scheduled power cuts, they experience on average two to three unscheduled power cuts per day. All of the focus group interviews confirmed that consumers value electricity service very highly, but are very frustrated with the current service quality. Many of the problems are caused by the failure of the State Electricity Board to recover costs because of inadequate pricing policies or through the inability to collect bills from consumers. Although the price of electricity was recently raised by the State Electricity Board, it should be ensured that the resulting increase in revenue is sufficient to improve energy services to consumers. The industry is beset with problems that are both managerial and political. Many of the problems are rooted in the political pressure brought to bear on the industry to not cut off service to a range of political constituencies. The result is the inability to legitimately cut off service to customers not paying their bills.

7.23 Electricity consumers are badly misinformed about many aspects of the electricity sector. Most people do not know whether electricity is taxed or subsidized, or

how a "fair" price for electricity is determined by the electricity industry. Communication between the electricity industry and its customers is poor at best. People perceive that electricity is "of great value," but perceive price hikes as unfair. People want better service, but mistrust the electricity industry to deliver it. Any policy or other reforms in the electricity industry must be accompanied by better communication of the benefits of the service to the consumers who must pay the bills. It is clear that the public is skeptical that this can be achieved with the existing distribution system and management. One possible solution to this problem might be a regulatory agency that approves pricing requests from the electricity distribution company; such requests could involve public hearings.

7.24 The minimum requirement is that the State Electricity Board or a distribution company must be more consumer-oriented and be given a clear mandate to collect electricity bills without undue political influence. The present situation, in which a large percentage of residential consumers either are not billed or do not pay their bills, is not sustainable, and is part of the reason for the poor electricity service provided to all consumers. Some consumers are aware that they can either illegally tap the electricity supply, wire around meters, or simply not pay their electricity bills without having their electricity service terminate. It is possible that if such problems are resolved, residential revenue collection might increase anywhere from 10 to 30 percent.

7.25 But in practice, what other solutions are there to these problems? Certainly, power sector reform is necessary to mitigate undue political influence on the industry. Part of the problem of ensuring adequate power supply for residential consumers in Hyderabad is related to the heavy subsidies that are going to agriculture for water pumping in the state. These issues are quite complicated and have been addressed elsewhere, so this paper will not go into the details of possible reforms. But even within the existing electricity industry, there are several policies that can be pursued. In Maharashtra, for example, marginal cost tariffs have improved the revenue of that State Electricity Board. As another example, bill collection might be turned over to a private company—an entity that would also have responsibility for installing and maintaining meters. Group metering and bill payment might be considered in areas with substandard housing and very low loads.

7.26 The good news is that many consumers are prepared to pay higher prices for electricity, as long as they perceive that service is improved and the burden of pricing or sector reform is fairly distributed. To improve the very low consumer confidence in the electricity sector, the most important goal of any electricity company, private or public, should be to either improve electricity service or have a credible, understandable plan to improve service that can be conveyed to customers. Although this sounds relatively simple, achieving improved service will require much greater emphasis on understanding customer needs, the flexibility to service those needs, and the financial ability to meet them. Clearly, it is imperative to have a well-articulated but flexible plan to improve service and to communicate this effectively to the public. The plan should include specific steps that are being taken to improve service levels. Such a plan might include features such as a prompt and aggressive campaign to eliminate illegal connections and collect electricity bills.

7.27 The most recent changes that are taking place in the electricity sector in Andhra Pradesh involve the initial of a long term program of reorganization of the power industry in the state to meet existing and growing demand for electricity. The first phase of the reform will involve the separation of generation and transmission and distribution into two separate companies, the establishment of a regulatory commission, and the development of a new set of rules and regulations to support the privatization of the industry. According to the new rules and regulations, subsidies for different electricity using consumers would be permitted, but they must be explicitly targeted from fiscal budgets. The eventual privatization of the electricity industry is the overall goal of the reforms. The effect of these changes on the household sector can be quite beneficial, but they must be done in such a way that the poor are not adversely effected.

7.28 **Fuelwood trade based on market principles functioning efficiently.** The fuelwood trade in Hyderabad is already based on market principles and this should not be changed. The forestry department should continue programs that encourage farmers to grow and harvest trees on their own farms, since this now is the main source of fuelwood for Hyderabad City. This would include forestry extension support to provide advice and technical assistance to farmers. In addition, the more recent programs that encourage local communities to manage neighborhood forests is also a step in the right direction.

7.29 A related issue that emerged in the investigation of fuelwood use by commercial establishments is that the coal subsidy for such enterprises is being maintained, in spite of the fact that they have substantially switched to fuelwood as a source for heat. Because commercial enterprises are increasingly using wood, it also is recommended that the coal subsidy and the coal allocation system for small commercial establishments be eliminated, and that coal distribution be based on market principles.

Policies to Help the Process of Fuel Transition Among the Urban Poor

7.30 The subsidies that are currently given across the board to all households in urban Hyderabad can be reduced and still have a significant impact on poor urban households. Although accurate, effective targeting of these subsidies can be difficult, the following recommendations can better target and result in a greater benefit for the poor people than the current policies.

7.31 **Maintain electricity lifeline rates.** The poor can be targeted effectively through a lifeline rate for electricity. A lifeline rate can be designed based on the low electricity load of poor households. The findings of this study are that a lifeline rate for 40 to 50 kWh of consumption per month would assist the poorest 23 percent of households, who pay a significant proportion of their income for even this meager amount of power use. The current policy of having a lifeline rate for poor people is a good one, but the fixed meter charges raise the effective electricity rates for households in this group. In addition, a policy to keep connection rates for minimal service very low would be an efficient one, if combined with strict enforcement and policing of illegal connections. A grace period of one billing period should be allowed before disconnection due to non-payment of bills. The results of the survey and the focus group interviews indicate that the high value placed on electricity use by consumers means that

very few people would choose not to have electricity service. Thus, any credible disconnection policy would alleviate the bill collection problems.

7.32 The subsidies for the lifeline rate could be recovered through higher rates for consumers who use greater levels of electricity. The combination of these policies would be affordable and equitable. At the present time, the State Electricity Board has an increasing block rate, with minimum service charges. Recently, this block rate has been simplified and the overall electricity rate has been raised. The key for the industry to effectively assist low-income households and improve consumer services is therefore to collect bills from all customers, including both high- and low-income households.

7.33 The electricity sector reforms presently being carried out by the Government of Andhra Pradesh with the assistance of the World Bank are aimed towards improving electricity service. This should have significant positive and direct benefits for poor households, since this study has found that most poor households have electricity. However, the argument also is made that the financial resources that are freed up in the reform of the sector will benefit the poor. Such "indirect" benefits are no consolation to poor households facing rising electricity prices. Also, it would be difficult to tell whether any avoided electricity subsidies are used in to reduce poverty.

7.34 As a consequence, it is recommended that special attention should be given to assure that poor households are not adversely effected either by privatization or rising prices. This may be accomplished through a planned social impact assessment to be carried out by the new transmission and distribution company. The report should have as its goal not only to avoid harm, but also to make recommendations that would involve significant direct benefits for the poor. As indicated in this report, the poor are suspicious of the reforms, and they also are most likely to be impacted by increase in electricity prices. This can be accomplished in a number of ways, including lifeline rates or having a fixed payment for minimum service levels.

7.35 **Lower initial costs of LPG service and end supply rationing.** At present, the poor do not have access to or do not adopt LPG service for two reasons. The first is that the initial connection fees for service are very high for them. The cost of the stove, the initial service fee, and the bottle are all barriers. In addition, many poor people cannot afford to buy one month's service (one bottle) at one time. The long waiting lists for subsidized LPG mean that the poor are the last to gain access to service. Elimination of subsidies and import restrictions on LPG retailers already have been recommended to. open up the market. In the face of the inevitably higher prices that would result, there are several recommendations that would encourage the poor to adopt LPG. Lowering the cost of LPG service could be accomplished through the distribution of LPG in smaller bottles (3 to 6 kilograms) and by incorporating the costs of initial connection fees (bottle and stove) in the monthly bill. This credit could be given for the period of about one year or it could be incorporated into the price of LPG. Retailing LPG in smaller bottles would obviously entail slightly higher costs than LPG in standard bottles. Since it is recommended that the price of LPG in the smaller bottles be the same price as that in large bottles, this would require a slight cross-subsidy for the consumers using the small bottles.

7.36 **Target kerosene subsidies to poor households.** In view of the existing level of poverty in Hyderabad, the subsidy for kerosene ought to be retained to benefit only the poor. Under the existing public distribution system, the poor and middle class are benefiting most from the subsidy on kerosene. However, the poor are not always able to obtain subsidized kerosene when they need it, because the rationed supply runs out shortly after it is received in the shops. This study has observed that it is mostly the very poor who purchase kerosene on the open market to fill their requirements for cooking fuel. In view of this, it is recommended that the sale of kerosene through the ration shops for the wealthy and middle income groups (pink card holders in Andhra Pradesh) be discontinued and only the target group (white card holders) should be entitled to purchase subsidized kerosene. Simultaneously, the sale of kerosene through private retail outlets should be encouraged. The middle and upper-income groups would be able to purchase their requirement of kerosene at these establishments at world market prices.

7.37 An alternative recommendation is that the sale of subsidized kerosene through the ration shops should be stopped. All sales of kerosene should be made through the retail markets. Small distributors of the fuel should be encouraged. A coupon should be issued only to poor ration card holders that will entitle them to purchase kerosene from participating retailers, including ration shops. The consequence of this policy would be to more directly target the kerosene subsidy to the poor. It would also open up the market for fuel and would simultaneously discourage diversion of subsidized kerosene to other sectors.

7.38 **Target the poorest households for improved biomass stoves.** The poorest of the poor are still using fuelwood for cooking. The study has found that fuelwood is one of the most expensive cooking fuels in Hyderabad, but poor people who cannot afford LPG or who do not have access to a kerosene ration card are the main ones cooking with wood. The poor also spend a significant proportion of their income on energy. The targeting of improved biomass stoves to the poorest urban households would be an effective policy, since it would reduce the cash outlays of the poor for fuel. Although the efficiency of stoves using wood in small commercial establishments was not measured, this would be an important area for further research.

7.39 Most stove programs are now targeted to rural areas. But improved fuelwood stoves could save the urban poor both time and money as well.

Conclusion

7.40 Although the energy policies for the household sector in Hyderabad are moving toward liberalizing markets and this trend should be encouraged, many existing energy policies intended to be socially progressive are not achieving their goals. The energy subsidies intended for the poor now go mainly to higher-income households, with the exception of the kerosene sold through the public distribution system. The resulting combination of lower revenues and limited supplies has resulted in poor distribution of energy to all households. The rich do not need the subsidy and are willing to pay higher prices if they are guaranteed that their energy services would improve. The poor need the subsidy, but are not well targeted by existing energy policies.

7.41 The elements of better energy policies for the household sector in Hyderabad would couple market pricing policies with improved energy services for middle and higher-income households; open up energy markets to competition to promote better customer service for all households; and finally, to better direct the energy subsidies now going to high and middle income households to the poor. The redirection of subsidies can be accomplished through lifeline rates for electricity, lower initial costs for new LPG consumers, and the promotion of improved fuelwood stoves for the urban poor.

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Appendix A: Sampling Design

The Hyderabad energy survey was conducted through a stratified random sampling of 2,000 households in the Municipal Corporation Area of Hyderabad (MCH) and 800 households in the suburbs. The size of the sample was 0.38% of the universe or the total number of households for Hyderabad Urban Agglomeration, as per the Census of India 1991.

The sample size of households used for the socioeconomic survey of Hyderabad in 1966 and for the energy survey in 1982 was almost the same; i.e., 0.4% of the universe. In addition to the main household survey, a special survey of 400 slum households was also conducted to investigate the specific energy problems of this population relating to demand and supply, consumption, pricing, energy use transition, accessibility, and interfuel substitution.

A two-stage stratification of sample households was adopted. In the first instance, metropolitan Hyderabad was divided into historical regions of growth such as (1) South Hyderabad or old city, (2) North Hyderabad, (3) Secunderabad, and (4) suburbs. The sample households within the historical regions of the incorporated area were first distributed on a pro-rata basis according to the proportion of the total census households distributed in each historical region. The incorporated area of Hyderabad was further divided into 35 administrative units called wards. The sample households of the three regions; that is, North: 947 households (with 12 administrative units), South: 669 households (with administrative 11 units), and Secunderabad: 384 households (with 12 administrative units), were allocated among administrative units in proportion to the total number of census households located in each.

In the second stage of stratification, the ward-based sample households were reallocated by the municipal blocks and the morphological zones in which they were located. The morphological regions were delineated in a Hyderabad study conducted in the early 1960s (Alam, 1965). Each morphological region represented a distinct socioeconomic and cultural entity. (Alam, 1965). The four regions were: (1) The Derelict Region, (2) The Static Region, (3) The Region of Internal Dynamism, and (4) The Region of External Expansion. While the first three regions were confined to the incorporated area, the Region of External Expansion extended beyond the MCH and covered the suburban settlements. Subsequent studies have confirmed the validity of these morphological regions, which divide the population of Hyderabad into four homogeneous regions.

Eight hundred suburban households were selected for the sample survey. The suburbs were divided into four sectors: North, South, East, and West (see Table A-2). The number of sample households was distributed among these sectors in proportion to the number of census households located in each. The sector-based distribution of 800 suburban sample households was: North: 314 households, South: 56 households, East: 220 households, and West: 210 households.

Once the distribution of the number of households by historical regions in MCH and by sectors in the suburbs was completed, the households were selected randomly as per the normal sampling procedure (see Appendix Table A-1).

In addition to the main energy survey, a special survey of 400 slum households was carried out to identify the key energy problems of the urban poor and develop policy recommendations to mitigate their difficulties. The slum households were randomly picked from the seven administrative divisions called Municipal Circles within the Municipal Corporation of Hyderabad in metropolitan Hyderabad. The sample slum households constituted 0.36 percent of the total slum households in the incorporated area and were proportionately distributed among the seven municipal circles according to their respective numbers of total households (see Appendix Table A-3).

A detailed questionnaire was prepared covering socioeconomic population characteristics, household energy consumption and prices, changes in fuel use and fuel mix during the last two to five years, and electrical appliances (ownership, use, and efficiency). The questionnaire also contained attitudinal questions relating to energy efficiency and policy issues. The questionnaire was used for the main energy survey, as well as for the slum households.

Once drafted, the questionnaire was pre-tested among 30 households spread over different income groups. In light of the responses during pre-testing, the questionnaire was thoroughly discussed and modified, where necessary, in consultation with the World Bank team led by Dr. Douglas Barnes, and including Dr. Keith Openshaw and Dr. Jayant Sathaye. Their comments were very useful in finalizing the questionnaire, which was then used in canvassing the households.

It took nearly five months to complete the canvassing of the schedules. During the tabulation, processing of the schedules, and cleaning of the data, three filled-in schedules each for the suburban and slum survey areas were found unsatisfactory and were rejected.

In order to collect data on the use of fuels by small-scale commercial establishments such as restaurants, bakeries, confectioneries, and student hostels and messes, a random sampling procedure was adopted and questionnaires were canvassed.

The method for the collection of data had to be changed from situation to situation. For instance, the figures on firewood arrivals were obtained by visiting the firewood auction centers and weighing centers and by interviewing the commission agents (Addadars) and firewood selling agents (Asamies). The owners and managers of marriage function halls were interviewed and schedules were also canvassed with them. The same method was used with the responsible officers of the Seva samithies, who manage the traditional crematoria, and of the Municipal Corporation, who control the two electric crematoria.

The information on cultural groups was obtained through Case Studies (CS) and Focus Group Interviews (FGI).

Table A-1
Sample Households in the Municipal Corporation of Hyderabad and Secunderabad

Ward	Sample No. of Households	% of Total No. of Census Households
Hyderabad North		
1.	178	8.9
2.	102	5.1
3.	72	3.6
4.	24	1.2
5.	52	2.6
6.	73	3.6
7.	36	1.8
8.	124	6.2
9.	48	2.4
10.	57	2.8
11.	44	2.2
12.	56	2.8
Hyderabad South		
13.	88	4.4
14.	50	2.5
15.	24	1.2
16.	116	5.8
17.	96	4.8
18.	144	7.3
19.	80	4.0
20.	48	2.4
21.	30	1.5
22.	38	1.9
23.	42	2.1
Secunderabad		
24.	30	1.5
25.	8	0.4
26.	4	0.2
27.	6	0.3
28.	12	0.6
29.	56	2.8
30.	10	0.5
31.	8	0.4
32.	12	0.6
33.	46	2.3
34.	48	2.4
35.	138	6.9
TOTAL	2000	100

Note: Municipal wards are sub-divided into blocks. The morphological regions of the respective historical regions were identified. The sample households were finally distributed by morphological regions at the block level proportionate to the number of census households in each block. From each block, another 25% households were selected as part of a reserve list to serve as substitutes in case of no response from the households on the original list.

A massive amount of data has been collected through this household survey. The data was processed, cleaned, and tabulated with the computer facility

available at the Institute for Energy and Environmental Studies through the courtesy of the World Bank.

Table A-2
Sample for Outer Regions of Metropolitan Hyderabad (Urban Agglomeration)

Part	*Locality*	*% of PPS Method*	*Sample Households*
North	Secunderabad cantonment,	11.5	92
	Osmania University	0.5	4
	Hyderabad district of R.R. Dist.	5.3	42
	Malkajgiri	9.0	72
	Qutbullapur	8.2	66
	Alwal	4.8	38
	Total	39.3	314
South	Balapur		
	Kothapet	0.8	6
	Hydersha Kotla		
	Venkatpur		
	Mallapur		
	Rajendra Nagar		
	Shamshabad	5.3	42
		1.0	8
	Total	7.1	56
East	L.B. Nagar	11.2	90
	Kapra	6.9	55
	Uppal Kalan	6.8	53
	Gaddiannaram	2.7	22
	Total	27.6	220
West	Kukatpally	14.7	118
	Seri Lingampally	5.2	42
	Ramchandrapuram	3.7	30
	Patancheru	1.2	10
	B.H.E.L.	1.3	10
	Total	26.1	210
	Grand Total	72.3	800

Table A-3
Sample Households in the Slums of Hyderabad and Secunderabad, Metropolitan Hyderabad (Urban Agglomeration) (distribution of total and sample slum households)

Administrative Divisions or Municipal Circles	*No. of Slums*	*Total Households*	*Percentage*	*Sample Households*
I	148	29433	25.6	102
II	72	8668	7.5	30
III	132	18107	15.9	64
IV	107	23924	20.8	83
V	77	14687	12.8	51
VI	32	10903	9.5	38
VII	89	9098	7.9	32
Total	657	114820	100	400

Note: The 35 wards of MCH are administratively grouped into seven Municipal Circles.

Appendix B: Questionnaire

Institute of Energy and Environmental Studies (I.E.E.S.), Hyderabad

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ID Family | | | | | | | | | |

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HOUSEHOLD ENERGY ACTIVITY SURVEY

Hyderabad - 1994

World Bank Sponsored Project

Date : .....

Eumerators' Name : .....

Supervisor's Name : .....

Q1 Name of Respondent :	Q1		
Q2 House No. :	Q2		
Q3 Locality :	Q3		
Q4 Block / Ward No. :	Q4		
Q5 Hyderabad :North = 1 South = 2 Secunderabad = 3 Suburban = 4	Q5		☐
Q6 ***Type of Housing Construction*** 1. Pucca 2. Kacha 3. Other	Q6		☐
Q7 ***Morphological Zone*** 1. Derelict Region 2. Static Region 3. Region of Internal Dynamics 4. Region of External Expansion	Q7		☐

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	SOCIO - ECONOMIC	**1**		
SE1	Respondent's Relationship to Head of the Household 1. Head 2. Wife 3. Son 4. Daughter 5. Daughter-in-Law 6. Other (Specify)	SE1		☐
SE2	Respondent's Level of Education 1. Illiterate 2. Upto Primary School 3. Upto Middle School 4. Upto High School 5. Upto Intermediate 6. I.T.I. / Polytechnic 7. Graduate 8. Post Graduate	SE2		☐
SE3	Sex of the Head of the Household 1. Male 2. Female	SE3		☐
SE4	**Housing Information :**			
SE4.1	Do you own the house in which you stay? Yes (1) No (0)	SE4.1		☐
SE4.2	If you stay in a rented house Monthly Rent in (Rs.)	SE4.2		☐☐☐☐☐
SE5	**Household Information :** How many persons eat and sleep in your household? (No. of People)			
SE5.1	Male Members (16-65)	SE5.1		☐☐
SE5.2	Female Members (16-65)	SE5.2		☐☐
SE5.3	Male Children (Under 15)	SE5.3		☐☐
SE5.4	Female Children (Under 15)	SE5.4		☐☐
SE5.5	Adult Members above 65	SE5.5		☐
SE5.6	Total Family Members	SE5.6		☐☐
SE5.7	Others (Servants, etc)	SE 5.7		☐
SE6	What is the level of literacy of the Family members living in your household? (No. of People)			
SE6.1	No. of Illiterates? (Adults)	SE6.1		☐☐
SE6.2	No. of Literates (including Children)	SE6.2		☐☐

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SE7	What is the level of education of members of the household? (No. of People)			
SE7.1	Upto Primary School	SE7.1		
SE7.2	Upto Middle School	SE7.2		
SE7.3	Upto High School	SE7.3		
SE7.4	Intermediate	SE7.4		
SE7.5	I.T.I. / Polytechnic	SE7.5		
SE7.6	Graduates	SE7.6		
SE7.7	Post Graduates	SE7.7		
SE8	How many members in your household earn an income? (No. of People)			
SE8.1	Husband	SE8.1		
SE8.2	Wife	SE8.2		
SE8.3	Sons	SE8.3		
SE8.4	Daughters	SE8.4		
SE8.5	Daughters-in-Law	SE8.5		
SE8.6	Others (Specify)	SE8.6		
SE8.7	Total No. of earners	SE8.7		
SE9	What is the family (Household) members income ? Total Monthly in Rupees Codes : (1) < 1,000 (2) 1,000 – 2,000 (3) 2,001 – 4,000 (4) 4,001 – 6,000 (5) 6,001 – 10,000 (6) 10001 – 15,000 (7) 15,001 – 20,000 (8) 20,001 – 30,000 (9) 30,001 – 50,000 (10) > 50,000			
SE9.1	Husband	SE9.1		
SE9.2	Wife	SE9.2		
SE9.3	Sons	SE9.3		

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SE9.4	Daughters	SE9.4		
SE9.5	Daughters-in-Law	SE9.5		
SE9.6	Remittances from within the Country	SE9.6		
SE9.7	Remittances from Abroad	SE9.7		
SE9.8	Others (Specify)	SE9.8		
SE9.9	Total	SE9.9		
Note :	Record income of members living in the house for (SE9.1 to SE9.5)			
SE10	What is the occupation of the head of the household? 1. Professional (Engineers, Doctors, Lawyers etc.) 2. Teacher 3. Businessman 4. Administrator 5. Skilled Worker 6. Semi-skilled Worker 7. Unskilled Worker 8. Others (Specify)	SE10		
SE11	List the occupations of the members of the household (number of persons)			
SE11.1	Professional	SE11.1		
SE11.2	Teacher	SE11.2		
SE11.3	Businessman	SE11.3		
SE11.4	Administrator	SE11.4		
SE11.5	Skilled Worker	SE11.5		
SE11.6	Semiskilled Worker	SE11.6		
SE11.7	Unskilled Worker	SE11.7		
SE11.8	Manages the House	SE11.8		
SE11.9	Others	SE11.9		

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SE12 During the last 5 years, have you moved to Hyderabad from some other village, city , state or country? 0. No, I have lived here for the last 5 years. 1. Yes, I have moved from rural area within the State. 2. Yes, I have moved from urban area within the State. 3. Yes, I have moved from urban area from another State. 4. Yes, I have moved from rural area from another State. 5. Yes, I have moved from another country.	SE12		☐
SE13 How long has your family lived in this location? Code : Number of Years 1. < 1 year 2. 1–3 years 3. 3–5 years 4. > 5 years	SE13		☐

ENERGY **2**			
Which of the following fuels are used in your household as sources of energy Yes (1) or No (0)			
EGY1. Firewood	EGY1		☐
EGY2. Charcoal	EGY2		☐
EGY3. Kerosene	EGY3		☐
EGY4. LPG	EGY4		☐
EGY5. Electricity	EGY5		☐
EGY6. Others			
EGY6.1 Agricultural Residue	EGY6.1		☐
EGY6.2 Coal	EGY6.2		☐
EGY6.3 Coal Briquettes	EGY6.3		☐
EGY6.4 Dung	EGY6.4		☐
EGY6.5 Saw Dust	EGY6.5		☐
EGY6.6 Non-conventional	EGY6.6		☐
Note: Double check and fill out only the energy sections for which household uses fuel.			

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FIREWOOD 3			
FW1. Does your household use firewood? 1. Normally 2. Seldom 3. No do not use it	FW1		☐
FW2. During the month what percentage is used for the following purposes? Codes: (1) < 10% (2) 10-20 (3) 20.1-30% (4) 30.1-40% (5) 40.1-50% (6) 50.1-60% (7) 60.1-70% (8) 70.1-80% (9) 80.1-90% (10) 90.1-100			
FW2.1 Cooking including boiling water for tea —%	FW2.1		☐☐
FW2.2 For heating water (for bathing, washing clothes) —%	FW2.2		☐☐
FW2.3 Others (Specify) %	FW2.3		☐☐
	Total	100%	
FW3. What percentage of firewood is collected or purchased			
FW3.1 percentage collected (% - code as above)	FW3.1		☐☐
FW3.2 percentage purchased (% - code as above)	FW3.2		☐☐
FW4. How many times per month do you usually purchase firewood	FW4		☐☐
FW5. Usually how many Kgs do you purchase at one time?	FW5		☐☐☐
FW6. Normally how many Kgs of firewood do you buy per month? (in kgs)	FW6		☐☐☐
FW7. Last month how many total rupees did you spend on firewood?	FW7		☐☐☐
FW8. On an average what price did you pay per Kg last month? (in Rs.)	FW8		☐☐☐
FW9. From whom do you normally purchase firewood 1. Retailer 2. Wholesaler 3. Others (Specify)	FW9		☐
FW10. Normally is all the firewood you require available in the market 1. Yes 100% of needs are available 2. No 50% to 90% of needs are available 3. No less than 50% of needs are available	FW10		☐

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FW11. 3 to 5 years ago, did your family use more firewood than today? 1. Did not use it 2. Use less now than before 3. Use same now as before 4. Use more now than before	FW11		☐
FW12. If use more now than before, it has been mainly due to: 1. Increase in family size 2. More variety of dishes 3. More frequent meals 4. Poor quality of firewood 5. Others (specify)	FW12		☐
FW13. If use less than before it has been mainly due to: 1. Decrease in family size 2. Less frequent meals cooked at home 3. Changed pattern of food consumption 4. Improved stove 5. Use of fuel saving utensils 6. Availability of other fuels 7. Others (specify)	FW13		☐
FW14. Are you using fuelwood for business also Yes = 1, No = 0	FW14		☐
FW15. If yes, approximately how many Kg's per month do you use for business. Code: KG/Month (1) < 100 (2) 100-200 (3) 201-300 (4) 301-400 (5) > 400	FW15		☐
FW16. If yes what kind of business do you have: 1. Hairdresser/barber 2. Tailor/dress maker 3. Laundry 4. Carpentry 5. Tea shop 6. Clinic 7. Gold or Silver smith 8. Repair shop (bicycle, car, radio, TV) 9. Others, (specify) Note: Add business types as necessary to code list	FW16		☐
Have you any of the following appliances: FW17.0 Traditional Fuelwood Stove :			
FW17.1 Number of stoves	FW17.1		☐
FW17.2 Hours used daily	FW17.2		☐☐
FW18.0 Efficient/Improved Fuelwood Stove			
FW18.1 Number of stoves	FW18.1		☐
FW18.2 Hours used daily	FW18.2		☐☐

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ID Family | | | | | | | | | |

CHARCOAL **4**			
CHAR1. Does your household use charcoal? 1. Normally 2. Seldom 3. No do not use	CHAR 1		☐
CHAR 2. During the month what percentage is used for the following purposes:			
CHAR2.1 Cooking, including boiling water for tea %	CHAR2.1		☐☐
CHAR2.2 For heating water (for bathing, washing clothes) %	CHAR2.2		☐☐
CHAR2.3 Ironing %	CHAR2.3		☐☐
CHAR2.4 Others (specify) % Codes: (1) < 10 (2) 10-20 (3) 20.1-30 (4) 30.1-40 (5) 40.1-50 (6) 50.1-60 (7) 60.1-70 (8) 70.1-80 (9) 80.1-90 (10) 90.1-100%	CHAR2.4 Total	 100%	☐☐
CHAR3. How many times per month do you usually purchase charcoal?	CHAR3		☐☐
CHAR4. Usually how many Kgs do you purchase at one time?	CHAR4		☐☐☐
CHAR5. Normally how many Kgs of charcoal do you use per month? (in Kg.)	CHAR5		☐☐☐
CHAR6. Last month how many rupees did you spend on charcoal?	CHAR6		☐☐☐
CHAR7 On average what price did you pay per Kg last month? (price in Rs.)	CHAR7		☐☐
CHAR8. From whom do you normally purchase Charcoal ? 1. Retailer 2. Wholesaler 3. Other (specify)	CHAR8		☐
CHAR9. Normally is all the charcoal you require available in the market? 1. Yes, 100% of needs are available 2. No, 50% to 90% of needs are available 3. No, < 50% of needs are available	CHAR9		☐
CHAR10. 3 to 5 years ago did your family use more charcoal than today? 1. Did not use charcoal 2. Use less now than before 3. Use same now as before 4. Use more now than before	CHAR10		☐

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ID Family | | | | | | | | | |

CHAR11.	If use more now than before it has been mainly due to: 1. Increase in family size 2. More variety of dishes 3. More frequent meals 4. Poor quality of charcoal 5. Others (specify)	CHAR11		☐
CHAR12.	If use less now than before it has been mainly due to : 1. Decrease in family size 2. Less frequent meals cooked at home 3. Changed patterns of food consumption 4. Improved stove 5. Use of fuel saving utensils 6. Use other fuel as well	CHAR12		☐
CHAR13.	Are you using charcoal for business also? Yes = 1, No = 0	CHAR13		☐
CHAR14.	If Yes, approximately how many Kg's per month do you use for business? kg/month (write the actual figure)	CHAR14		☐☐
CHAR15.	If yes what kind of business do you have? 1. Hairdresser/barber 2. Tailor/dress maker 3. Laundry 4. Carpentry 5. Tea shop 6. Clinic 7. Gold or silver smith 8. Repair shop (bicycle, car, radio, TV) 9. Other (specify) Note: Add business types as necessary to code list	CHAR15		☐
	Have you any of the following appliances?			
CHAR16.	Charcoal Stove - Traditional :			
CHAR16.1	Number of stoves	CHAR16.1		☐
CHAR16.2	Hours used daily	CHAR16.2		☐☐
CHAR17.	Charcoal Stove - Improved :			
CHAR17.1	Number of stoves	CHAR17.1		☐
CHAR17.2	Hours used daily	CHAR17.2		☐☐

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ID Family | | | | | | | | | |

OTHERS **5**			
OTH1. Of the following which is your main fuel? 1. Agricultural Residue 2. Coal 3. Coal Briquettes 4. Dung 5. Saw Dust 6. Non-conventional	OTH1		☐
OTH2. Does your household use this fuel? 1. Normally 2. Seldom	OTH2		☐
OTH3. During the month what percentage is used for the following purposes:			
OTH3.1 Cooking, including boiling water for tea (%)	OTH3.1		☐☐
OTH3.2 For heating water (for bathing, washing clothes) (%)	OTH3.2		☐☐
OTH3.3 Ironing (%)	OTH3.3		☐☐
OTH3.4 Others (specify) (%)	OTH3.4		☐☐
Codes: (1) <10 (2) 10-20 (3) 20.1-30 (4) 30.1-40 (5) 40.1-50 (6) 50.1-60 (7) 60.1-70 (8) 70.1-80 (9) 80.1-90 (10) 90.1-100%	Total	100%	
OTH4. How many times per month do you usually purchase this fuel?	OTH4		☐☐
OTH5. Usually how many Kgs do you purchase at one time?	OTH5		☐☐☐
OTH6. In one month how many Kgs of the fuel do you normally use? (in Kg)	OTH6		☐☐☐
OTH7. Last month how many total rupees did you spend on this fuel?	OTH7		☐☐☐
OTH8. On an average what price did you pay per Kg last month (price in Rs.)	OTH8		☐☐☐
OTH9. From whom do you normally purchase this fuel? 1. Retailer 2. Wholesaler 3. Other (specify)	OTH9		☐
OTH10. Normally is all the fuel you require available in the market? 1. Yes, 100% of needs are available 2. No, 50% to 90% of needs are available 3. No, < 50% of needs are available	OTH10		☐

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ID Family | | | | | | | | | |

OTH 11.	3 to 5 years ago did your family use more fuel than today? 1. Did not use this fuel (specify the fuel with code eg. OTH 1/2/3) 2. Use less now than before 3. Use same now as before 4. Use more now than before	OTH 11		☐
OTH 12.	If used more now than before it has been mainly due to : 1. Increase in family size 2. More variety of dishes 3. More frequent meals 4. Poor quality of fuel 5. Others (specify)	OTH 12		☐
OTH 13.	If used less now than before, it has been mainly due to : 1. Decrease in family size 2. Changed pattern of food consumption 3. Improved stove 4. Use of fuel saving utensils 5. Use of other fuels as well 6. Others (specify)	OTH 13		☐
OTH 14.	Are you using this fuel for business also? Yes = 1, No = 0	OTH 14		☐
OTH 15.	If yes, approximately how many kg. per month do you use for business? (write the actual figure)	OTH 15		☐☐☐
OTH16.	If yes what kind of business do you have: 1. Hairdresser/barber 2. Tailor/dress maker 3. Laundry 4. Carpentry 5. Tea shop 6. Clinic 7. Gold or silver smith 8. Repair shop (bicycle, car radio, TV) 9. Other, (specify) Note: Add business types as necessary to code list	OTH16		☐
	Have you any of the following appliances?			
OTH17.	Stove - Traditional			
OTH17.1	Number of stoves	OTH17.1		☐
OTH17.2	Hours used daily	OTH17.2		☐☐
OTH18.	Stove - Improved			
OTH18.1	Number of stoves	OTH18.1		☐
OYH18.2	Hours used daily	OTH18.2		☐☐

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ID Family | | | | | | | | | |

KEROSENE	**6**			
KO1. Does your household use kerosene 1. Normally 2. Seldom 3. No do not use		KO1		☐
KO2. During the month what percentage is used for the following purposes:				
KO2.1 Cooking, including boiling water for tea %		KO2.1		☐☐
KO2.2 For heating water (for bathing, washing clothes) %		KO2.2		☐☐
KO2.3 Lighting %		KO2.3		☐☐
KO2.4 Others (specify) %		KO2.4		☐☐
Codes: (1) < 10 (2) 10-20 (3) 20.1-30 (4) 30.1-40 (5) 40.1-50 (6) 50.1-60 (7) 60.1-70 (8) 70.1-80 (9) 80.1-90 (10) 90.1-100%		Total	100%	
KO3. How many times per month do you usually purchase kerosene?		KO3		☐☐
KO4. Usually how many litres do you purchase at one time? (use fractions of litres if necessary)		KO4		☐☐
KO5. Normally how many litres of kerosene do you use per month? (use fractions of litres if necessary)		KO5		☐☐
KO6. How much of the kerosene is purchased from licensed shops? (in litres)		KO6.		☐☐
KO7. Last month how may rupees did you spend on Kerosene?		KO7		☐☐☐
KO8. On an average what price did you pay per litre last month? (price in Rs.)		KO8		☐☐☐
KO9. Normally is all the kerosene that you require available in the market.? 1. Yes 2. No, 50-90% 3. No, less than 50%		KO9		☐
KO10. 3 to 5 years ago, did your family use more kerosene than today? 1. Did not use kerosene 2. Use less now than before 3. Use same now as before 4. Use more now than before		KO10		☐

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ID Family | | | | | | | | | |

KO11. If used more now than before, it has been mainly due to : 1. Increase in family size 2. More variety of dishes 3. More frequent meals 4. Poor quality of firewood 5. Others (specify)	KO14		☐
KO12. If use less than before, it has been mainly due to : 1. Decrease in family size 2. Less frequent meals cooked at home 3. Changed pattern of food consumption 4. Improved stove 5. Use of fuel saving utensils 6. Availability of complementary fuel 7. Others (specify)	KO12		☐
KO13. Are you using kerosene for business also Yes = 1, No = 0	KO13		☐
KO14. If yes, approximately how many litres per month do you use for business Litres/Month (Write the actual figure)	KO14		☐☐
KO15. If yes what kind of business do you have: 1. Hairdresser/barber 2. Tailor/dress maker 3. Laundry 4. Carpentry 5. Tea shop 6. Clinic 7. Gold or silver smith 8. Repair shop (bicycle, car, radio, TV) 9. Other, (specify) Note: Add business types as necessary to code list	KO15		☐
Have you any of the following appliances : KO16. Kerosene wick stove KO16.1 Number of stoves KO16.2 Hours used daily	 KO16.1 KO16.2		 ☐ ☐☐
KO17. Kerosene Pressure stove KO17.1 Number of stoves KO17.2 Hours used daily	 KO17.1 KO17.2		 ☐ ☐☐
KO18. Kerosene wick lamp KO18.1 Number of lamps KO18.2 Hours used daily	 KO18.1 KO18.2		 ☐ ☐☐
KO19. Kerosene Pressure lamp KO19.1 Number of lamps KO19.2 Hours used daily	 KO19.1 KO19.2		 ☐ ☐☐

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LPG	**7**			
LPG1.	Does your household use LPG? 1. Normally 2. Seldom 3. No do not use	LPG1		☐
LPG2.	During the month what percentage is used for the following purposes ?			
LPG2.1	Cooking, including boiling water for tea %	LPG2.1		☐☐
LPG 2.2	For heating water (for bathing, washing clothes) %	LPG2.2		☐☐
LPG2.3	Lighting %	LPG2.3		☐☐
LPG2.4	Others (specify) %	LPG2.4		☐☐
	Codes : (1) < 10 (2) 10-20 (3) 20.1-30 (4) 30.1-40 (5) 40.1-50 (6) 50.1-60 (7) 60.1-70 (8) 70.1-80 (9) 80.1-90 (10) 90.1-100%	Total	100%	
LPG 3.	How many times per month do you usually purchase LPG?	LPG3		☐
LPG4.	How many cylinders do you have?	LPG4		☐
LPG5.	How many days does a cylinder normally last ? (use fractions if necessary)	LPG5		☐☐
LPG6.	Normally how long do you have to wait to get the cylinder? (in days)	LPG 6		☐☐
LPG7.	What is the size of your LPG cylinder in Kilograms? (actual figures)	LPG7		☐☐☐
LPG8.	What price did you pay per cylinder last month? (in Rs.)	LPG8		☐☐☐
LPG9	Is your total demand for LPG met during a normal month ? 1. Yes 100% 2. No, 50% - 90% 3. No, less than 50%	LPG9		☐
LPG10	3 to 5 years ago, did your family use more LPG than today? 1. Did not use it 2. Use less now than before 3. Use same now as before 4. Use more now than before	LPG10		☐

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LPG11	If use more now than before it has been mainly due to : 1. Increase in family size 2. More variety of dishes 3. More frequent meals cooked 4. Greater availability 5. Others (specify)	LPG11		☐
LPG12	If use less than before, if has been mainly due to 1. Decrease in family size 2. Changed pattern of food consumption 3. Improved stove 4. Use of fuel saving utensils 5. Use of other fuels 6. Others (specify)	LPG12		☐
LPG 13.	Are you using LPG for business also Yes = 1. No = 0	LPG13		☐
LPG 14.	If Yes, approximately how many Kg. per month do you use for business? (write the actual figure)	LPG14		☐☐☐☐
LPG 15.	If yes what kind of business do you have? 1. Hairdresser/barber 2. Tailor/dressed maker 3. Laundry 4. Carpentry 5. Tea Shop 6. Clinic 7. Gold or Silversmith 8. Repair shop (Bicycle, Car, Radio, T.V.) 9. Other (specify) Note : Add business types as necessary to code list	LPG 15		☐
LPG16.	Have you any of the following applicances? LPG Stove			
LPG 16.1	Number of Stoves	LPG16.1		☐
LPG16.2.	Hours used daily	LPG 16.2		☐☐
LPG 17.	LPG Range			
LPG 17.1	Number of Ovens	LPG 17.1		☐
LPG 17.2	Hours used daily	LPG 17.2		☐☐
LPG 18.	LPG Mantle Lamp :			
LPG 18.1	Number of Lamps	LPG 18.1		☐
LPG 18.2	Hours used daily	LPG 18.2		☐☐

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	ELECTRICITY **8**			
ELEC1.	For how many years has your household used electricity? (years) Code : (1) < 5 (2) 5-10 (3) 10.1-15 (4) 15.1-20 (5) >20 Enter number for number of years	ELEC1		☐
ELEC2.	What is the average electric bill per month? (Rs.) (Recall)	ELEC2		☐☐☐☐
ELEC3.	What is the average no. of units you consume per month? (no. of units) (Recall)	ELEC3		☐☐☐☐
ELEC4.	To whom do you pay for electricity charges? 1. Electricity board 2. Landlord 3. Neighbour 4. Part of Rent	ELEC4		☐
ELEC 5.	If you are paying to the Electricity Board, could you provide the following information to me from your electric bill? 0. No, could not find bill 1. Yes 2. Refuses to show bill	ELEC5		☐
ELEC6.	Total days for bill	ELEC6		☐☐☐
ELEC7	Total Rupees charged for last bill	ELEC7		☐☐☐☐
ELEC8.	Total units consumed for last bill	ELEC8		☐☐☐☐
ELEC9.	Average units consumed per month	ELEC9		☐☐☐☐
ELEC10.	Electricity consumer No. _____	ELEC10		
ELEC10.1	ERO No. _____	ELEC10.1		
ELEC11	How many households are sharing the electricity bill? (Number of households)	ELEC11		☐
ELEC12.	Are you using electric supply for business also? Yes = 1 No = 0	ELEC12		☐
ELEC13.	If yes what kind of business do you have 1. Hairdresser/barber 2. Tailor/dress maker 3. Laundry 4. Carpentry 5. Tea Shop 6. Clinic 7. Gold or Silver smith 8. Repair shop (Bicycle, Car, Radio, TV) 9. Other, (specify) Note : Add business type as necessary, to code list	ELEC13		☐

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ELEC14.	Over the past one month how many times has the current failed? (number)	ELEC14		
	What is the frequency with which the following problems occur? Code : 1. Daily 2. Weekly 3. Monthly 4. Rarely 5. Never			
ELEC15.	Voltage drops, dimming of lights	ELEC15		
ELEC16.	Unscheduled power cuts	ELEC16		
ELEC17.	Scheduled power cuts : (Summer season) (write actual duration in hours.)	ELEC17		
ELEC 18.	In case of power breakdown do you : 1. Use generator 2. Use emergency lights 3. Use kerosene lamps 4. Use kerosene petromax 5. Use LPG Petromax 6. Use candles 7. Any other source of light (specify)	ELEC18		
18.1	GENERATOR			
ELEC18.1.1	Power generation capacity in KW	ELEC18.1.1		
ELEC18.1.2	Have since (No. of years)	ELEC18.1.2		
ELEC18.1.3	Cost of Generator	ELEC18.1.3		
ELEC18.1.4	Fuel Used : 1. Petrol 2. kerosene 3. Diesel	ELEC18.1.4		
ELEC 18.1.5	Monthly expenditure on the fuel	ELEC18.1.5		
18.2	EMERGENCY LIGHTS			
ELEC18.2.1	Total cost of the Equipment in Rs.	ELEC18.2.1		
ELEC18.2.2	Expenditure incurred per month (Rs.)	ELEC18.2.2		
18.3	KEROSENE LAMPS			
ELEC18.3.1	Total cost of the Equipment	ELEC18.3.1		
ELEC18.3.2	Expenditure incurred per month (Rs.)	ELEC18.3.2		
ELEC18.3.3	Litres used per month	ELEC18.3.3		
18.4	KEROSENE PETROMAX			
ELEC18.4.1	Total cost of the Equipment	ELEC18.4.1		
ELEC18.4.2	Expenditure incurred per month (Rs.)	ELEC18.4.2		
18.5	LPG PETROMAX			
ELEC18.5.1	Total cost of the Equipment	ELEC18.5.1		
ELEC18.5.2	Expenditure incurred per month (Rs.)	ELEC18.5.2		
18.6	CANDLES			
ELEC18.6.1	If you use candles expenditure incurred per month (Rs.)	ELEC18.6.1		

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18.7 ANY OTHERS			
18.7.1. Total cost of Equipment	ELEC18.7.1		
18.7.2 Expenditure incurred per month (Rs.)	ELEC18.7.2		
ELEC19. Do the Bulbs fuse frequently	ELEC19.		
1. No, do not fuse frequently			
2. Fuse due to voltage fluctuation			
3. Fuse due to any other reason (specify)			
ELEC20. Do you have fluorescent tubes?	ELEC20		
1. No			
2. Yes			
ELEC21. If yes, do the tubes fuse frequently?	ELEC21		
1. No, do not fuse frequently			
2. Yes, fuse frequently			
3. Fuse due to voltage fluctuation			
4. Fuse due to any other reason (specify)			
Please give information about the number and (power) capacity, types and number of each type of bulbs and tubes being used in the household			
ELEC22. How many bulbs/tubes do you have in your household?			
ELEC22.1 Incandescent	ELEC22.1		
ELEC22.2 Fluorescent	ELEC22.2		
ELEC23. How many of the bulbs/tubes are used for more than 1/2 hour at a time?			
ELEC23.1 Incandescent	ELEC23.1		
ELEC23.2 Fluorescent	ELEC23.2		

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ELEC24.	**DETAILS OF BULBS USED FOR MORE THAN HALF AN HOUR**			
Incandescent : Bulbs				
LESS THAN 40 WATTS				
(mention watts in brackets)				
INC24.1	No. of Bulbs	INC24.1		
INC24.2	Total hours used in 24 hours	INC24.2		
	Time switched on			
INC24.3	Morning	INC24.3		
INC24.4	Evening	INC24.4		
	Time switched off			
INC24.5	Morning	INC24.5		
INC24.6	Evening	INC24.6		
40 WATTS				
INC24.7	No. of Bulbs	INC24.7		
INC24.8	Total hours used in 24 hours	INC24.8		
	Time switched on			
ICN24.9	Morning	INC24.9		
INC24.10	Evening	INC24.10		
	Time switched off			
INC24.11	Morning	INC24.11		
INC24.12	Evening	INC24.12		
60 WATTS				
INC24.13	No. of Bulbs	INC24.13		
INC24.14	Total hours used in 24 hours	INC24.14		
	Time switched on			
INC24.15	Morning	INC24.15		
INC24.16	Evening	INC24.16		
	Time switched off			
INC24.17	Morning	INC24.17		
INC24.18	Evening	INC24.18		
100 WATTS				
INC24.19	No. of Bulbs	INC24.19		
INC24.20	Total hours used in 24 hours	INC24.20		
	Time switched on			
INC24.21	Morning	INC24.21		
INC24.22	Evening	INC24.22		
	Time switched off			
INC24.23	Morning	INC24.23		
INC24.24	Evening	INC24.24		

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ELEC25.	**Fluorescent Tubes :**		
20 WATTS			
TUB25.1	No. of Tubes	TUB25.1	
TUB25.2	Total hours used in 24 hours	TUB25.2	
	Time switched on		
TUB25.3	Morning	TUB25.3	
TUB25.4	Evening	TUB25.4	
	Time switched off		
TUB25.5	Morning	TUB25.5	
TUB25.6	Evening	TUB25.6	
40 WATTS			
TUB25.7	No. of Tubes	TUB25.7	
TUB25.8	Total hours used in 24 hours	TUB25.8	
	Time switched on		
TUB25.9	Morning	TUB25.9	
TUB25.10	Evening	TUB25.10	
	Time switched off		
TUB25.11	Morning	TUB25.11	
TUB25.12	Evening	TUB25.12	
60 WATTS			
TUB25.13	No. of Tubes	TUB25.13	
TUB25.14	Total hours used in 24 hours	TUB25.14	
	Time switched on		
TUB25.15	Morning	TUB25.15	
TUB25.16	Evening	TUB25.16	
	Time switched off		
TUB25.17	Morning	TUB25.17	
TUB25.18	Evening	TUB25.18	
100 WATTS			
TUB25.19	No. of Tubes	TUB25.19	
TUB25.20	Total hours used in 24 hours	TUB25.20	
	Time switched on		
TUB25.21	Morning	TUB25.21	
TUB25.22	Evening	TUB25.22	
	Time switched off		
TUB25.23	Morning	TUB25.23	
TUB25.24	Evening	TUB25.24	

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ELEC26	**APPLIANCES** Which of the following household appliances do you have? Time should be recorded in Military time (i.e. 1400 for 2 PM, 1700 for 5 PM).			
APL1.	REFRIGERATOR			
APL1.1	Frost Free No – 0 Yes - 1	APL1.1		☐
APL1.2	Nos	APL1.2		☐
APL1.3	Size in litres	APL1.3		☐☐☐
APL1.4	How old is it? (No. of years)	APL1.4		☐☐
APL2.	STORAGE WATER HEATER			
APL2.1	Nos	APL2.1		☐
APL2.2	Total Watts	APL2.2		☐☐☐☐
APL2.3	How old is it? (No. of years)	APL2.3		☐☐
APL2.4	When do you usually first switch it on?	APL2.4		☐☐☐☐
APL2.5	How many hours was it on in the last 24 hours? (use fractions)	APL2.5		☐☐☐☐
APL3.	GEYZER			
APL3.1	Nos	APL3.1		☐
APL3.2	Total Watts	APL3.2		☐☐☐☐
APL3.3	How old is it? (No. of years)	APL3.3		☐☐
APL3.4	When do you usually first switch it on?	APL3.4		☐☐☐☐
APL3.5	How many hours was it on in the last 24 hours? (use fractions)	APL3.5		☐☐☐☐
APL4.	IMMERSION HEATER			
APL4.1	Nos.	APL4.1		☐
APL4.2	Total Watts	APL4.2		☐☐☐☐
APL4.3	How old is it? (No. of years)	APL4.3		☐☐
APL4.4	When do you usually first switch it on?	APL4.4		☐☐☐☐
APL4.5	How many hours was it on in the last 24 hours? (use fractions)	APL4.5		☐☐☐☐

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APL5. AIR CONDITIONER			
APL5.1 Nos.	APL5.1		
APL5.2 Total Watts	APL5.2		
APL5.3 How old is it? (No. of years)	APL5.3		
APL5.4 When do you usually first switch it on?	APL5.4		
APL5.5 How many hours was it on in the last 24 hours? (use fractions)	APL5.5		
APL5.6 How many hours was it on in a typical 24 hours during summer? (use fractions)	APL5.6		
APL6. AIR COOLER			
APL6.1 Nos.	APL6.1		
APL6.2 Total Watts	APL6.2		
APL6.3 How old is it? (No. of years)	APL6.3		
APL6.4 When do you usually first switch it on?	APL6.4		
APL6.5 How many hours was it on in the last 24 hours? (use fractions)	APL6.5		
APL6.6 How many hours was it on in a typical 24 hours during summer? (use fractions)	APL6.6		
APL7. ELECTRIC FAN :			
CEILING FAN			
APL7.1 Nos.	APL7.1		
APL7.2 Size (in inches)	APL7.2		
TABLE FAN			
APL7.3 No.	APL7.3		
APL7.4 Size (in inches)	APL7.4		
PEDESTAL FAN			
APL7.5 Nos.	APL7.5		
APL7.6 Size (in inches)	APL7.6		

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APL8. Electric Iron			
APL8.1 Nos.	APL8.1		☐
APL8.2 Total Watts	APL8.2		☐☐☐☐
APL9. Acqua Guard			
APL9.1 Nos.	APL9.1		☐
APL9.2 Total Watts	APL9.2		☐☐☐
APL10. Black and White TV			
APL10.1 Nos.	APL10.1		☐
APL10.2 Size (in inches)	APL10.2		☐☐
APL11. Color TV			
APL11.1 Nos.	APL11.1		☐
APL11.2 size (in inches)	APL11.2		☐☐
APL12. VCR			
APL12.1 Nos.	APL12.1		☐
APL12.2 Total Watts	APL12.2		☐☐
APL13. Stereo System			
APL13.1 Nos.	APL13.1		☐
APL14. Radio			
APL14.1 Nos.	APL14.1		☐
APL15. Tape Recorder			
APL15.1 Nos.	APL15.1		☐
APL16. Electric Wall Clock			
APL16.1 Nos.	APL16.1		☐
APL17. Electric Rice Cooker			
APL17.1 Nos.	APL17.1		☐
APL17.2 Total Watts	APL17.2		☐☐☐☐

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APL18. Electric Stove			
APL18.1 Nos.	APL18.1		☐
APL18.2 Total Watts	APL18.2		☐☐☐☐
APL19. Electric Oven			
APL19.1 Nos.	APL19.1		☐
APL19.2 Total Watts	APL19.2		☐☐☐☐
APL20. Electric Kettle			
APL20.1 Nos.	APL20.1		☐
APL20.2 Total Watts	APL20.2		☐☐☐☐
APL21. Toaster Oven			
APL21.1 Nos.	APL21.1		☐
APL21.2 Total Watts	APL21.2		☐☐☐☐
APL22. Electric Blender & Mixer			
APL22.1 Nos.	APL22.1		☐
APL23. Electric Wet Grinder			
APL23.1 Nos.	APL23.1		☐
APL23.2 Total Watts	APL23.2		☐☐☐☐
APL23.3 How long is it usually on, once switched on	APL23.3		☐☐
APL24. Coffee Percolator			
APL24.1 Nos.	APL24.1		☐
APL25. Washing Machine (without dryer)			
APL25.1 Nos.	APL25.1		☐
APL25.2 Size	APL25.2		☐☐
APL25.3 Total Watts	APL25.3		☐☐☐☐
APL26. Washing Machine (with dryer)			
APL26.1 Nos.	APL26.1		☐
APL26.2 Size	APL26.2		☐☐☐
APL26.3 Total Watts	APL26.3		☐☐☐☐

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APL27.	Electric Water Pump			
APL27.1	Nos.	APL27.1		
APL27.2	Total Watts/H.P. ( )	APL27.2		
APL27.3	How old is it? (No. of years)	APL27.3		
APL28.	Vaccum Cleaner			
APL28.1	Nos.	APL28.1		
APL28.2	How old is it? (No. of years)	APL28.2		

	FUEL SWITCHING **9**			
A1.	What is your main cooking fuel today? 1.Firewood 2. Agric. residues 3. Coal 4. Charcoal 5. Coal Briquettes 6. Dung 7. Kerosene 8. LPG 9. Electricity	A1		
A2.	Compared to the main fuel you use today for cooking, have you ever in the past used another fuel as your main cooking fuel? 0. No, I have always used this fuel 1. Yes, I switched 1 year ago 2. Yes, I switched 2-3 years ago 3. Yes, I switched 4-6 years ago 4. Yes, I switched 7-10 years ago 5. Yes, I switched 10+ years ago	A2		

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A3. If yes, from which fuel did you switch? 0. Did not switch fuels 1. Firewood 2. Agric. residues 3. Coal 4. Charcoal 5. Coal Briquettes 6. Dung 7. Kerosene 8. LPG 9. Electricity	A3		☐
A4. Besides affordability and accessibility you have shifted because it is :			
A4.1 More efficient	A4.1		☐
A4.2 Economical	A4.2		☐
A4.3 Less polluting	A4.3		☐
A4.4 Convenient	A4.4		☐
A4.5 Any other (specify)	A4.5		☐
A5. Given the choice, I would like to shift from my present fuel to another fuel for cooking 0. Do not want to shift 1. Firewood 2. Agric. residues 3. Coal 4. Charcoal 5. Coal Briquettes 6. Dung 7. Kerosene 8. LPG 9. Electricity	A5		☐
A6. For those who would like to change fuels, but cannot shift fuels ask the following questions: 1. It is too costly to switch, 2. I cannot afford the equipment, 3. The fuel is not available in the market, 4. Regular supply of the fuels is not assured, 5. I cannot get on the list necessary to get the fuel 6. Any other.	A6		☐

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I am going to read to you a list of statements concerning energy use and other issues. I would like you to tell me if you agree or disagree with these statements and how strong your feelings are. The answers are illustrated by the following card. (note: devise a card with a ladder with strongly agree as top (perhaps happy face) and strongly disagree at bottom (perhaps frown): Codes : **1."strongly agree",** **2. "agree".** **3. "no opinion",** **4. "disagree",** **5. "strongly disagree".**			
A7 It is true that using fuelwood for cooking is very convenient	A7		☐
A8 Fuelwood is too expensive for cooking	A8		☐
A9 Burning fuelwood causes health problems	A9		☐
A10 Fuelwood is very hard to get in the market	A10		☐
A11 It is true that using coal for cooking is very convenient	A11		☐
A12 Coal is too expensive for cooking	A12		☐
A13 Burning coal causes health problems	A13		☐
A14 Coal is very hard to get in the market	A14		☐
A15 It is true, that using kerosene for cooking is very convenient	A15		☐
A16 Kerosene is too expensive for cooking	A16		☐
A17 Burning kerosene causes health problems	A17		☐
A18 Kerosene is very hard to get in the market	A18		☐
A19 It is true that using charcoal for cooking is very convenient	A19		☐
A20 Charcoal is too expensive for cooking	A20		☐
A21 Burning charcoal causes health problems	A21		☐
A22 Charcoal is very hard to get in the market	A22		☐
A23 It is true that using LPG for cooking is very convenient	A23		☐
A24 LPG is too expensive for cooking	A24		☐

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A25 Burning LPG causes health problems	A25		☐
A26 LPG is very hard to get in the market	A26		☐
A27 It is generally easy to obtain LPG connection	A27		☐
A28 It is true that using electricity is very convenient	A28		☐
A29 Electricity is too expensive for cooking	A29		☐
A30 Using electricity is very dangerous	A30		☐
A31 I would be willing to pay more for electricity if there were very few power cuts and dimming	A31		☐
A32 I am extremely happy with the fuel that I am using for cooking	A32		☐
A33 I practice energy conservation in my house	A33		☐
A34 I do not know what I can do to save energy	A34		☐
A35 When purchasing I take into consideration the efficiency of appliances	A35		☐
A36 Tubelights consume less electricity than light bulbs	A36		☐
A37 I would be willing to pay more to buy 'appliances that are very efficient	A37		☐
A38 Improved chulhas use less wood than traditional chulhas	A38		☐
A39 My current cooking fuel is more expensive than other fuels that I could use	A39		☐
A40 I would switch to other fuels if I could afford the initial costs	A40		☐
A41 The energy situation in India today worries me a great deal	A41		☐
A42 Increasing the prices people pay for energy in the form of LPG, kerosene or electricity is an effective way to make people conserve energy	A42		☐
A43 I would be willing to buy a new kind of electric light bulb if electricity saved would pay for the bulb in six months	A43		☐
A44 I would be willing to buy a new kind of electric light bulb if electricity saved would pay for the bulb in two years	A44		☐

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A45 My electricity bill is very easy to understand	A45		☐
A46 To lower my electricity bill I try to use electricity sparingly	A46		☐
A47 Your electricity rate is 0.75P. and 1.25P. If reliability is improved to 100% what is the maximum amount per unit that you are willing to pay : 0. Not willing to pay more willing to pay: 1. Rs. 0.25 more/unit 2. Rs. 0.50 more/unit 3. Rs. 0.75 more/unit 4. Rs. 1.00 more/unit 5. Rs. 1.25 more/unit 6. Rs. 1.50 more/unit 7. Rs. 1.75 more/unit 8. Rs. 2.00 more/unit	A47		☐
A48 I am very happy with my electricity supply situation	A48		☐
Please give the answer that you believe is true A49 Kerosene bought in ration shops is 1. Taxed 2. Neither Taxed nor Subsidized 3. Subsidized 4. Do not know	A49		☐
A50 LPG purchased through the LPG distributors is 1. Taxed 2. Neither Taxed nor Subsidized 3. Subsidized 4. Do not know	A50		☐
A51 Electricity purchased from the State Electricity Board is 1. Taxed 2. Neither Taxed nor Subsidized 3. Subsidized 4. Do not know	A51		☐

Enumerator's observations:

Joint UNDP/World Bank

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

LIST OF REPORTS ON COMPLETED ACTIVITIES

SUB-SAHARAN AFRICA (AFR)

Region/Country	*Activity/Report Title*	*Date*	*Number*
Africa Regional	Anglophone Africa Household Energy Workshop (English)	07/88	085/88
	Regional Power Seminar on Reducing Electric Power System Losses in Africa (English)	08/88	087/88
	Institutional Evaluation of EGL (English)	02/89	098/89
	Biomass Mapping Regional Workshops (English)	05/89	--
	Francophone Household Energy Workshop (French)	08/89	--
	Interafrican Electrical Engineering College: Proposals for Short- and Long-Term Development (English)	03/90	112/90
	Biomass Assessment and Mapping (English)	03/90	--
	Symposium on Power Sector Reform and Efficiency Improvement in Sub-Saharan Africa (English)	06/96	182/96
	Commercialization of Marginal Gas Fields (English)	12/97	201/97
Angola	Energy Assessment (English and Portuguese)	05/89	4708-ANG
	Power Rehabilitation and Technical Assistance (English)	10/91	142/91
Benin	Energy Assessment (English and French)	06/85	5222-BEN
Botswana	Energy Assessment (English)	09/84	4998-BT
	Pump Electrification Prefeasibility Study (English)	01/86	047/86
	Review of Electricity Service Connection Policy (English)	07/87	071/87
	Tuli Block Farms Electrification Study (English)	07/87	072/87
	Household Energy Issues Study (English)	02/88	--
	Urban Household Energy Strategy Study (English)	05/91	132/91
Burkina Faso	Energy Assessment (English and French)	01/86	5730-BUR
	Technical Assistance Program (English)	03/86	052/86
	Urban Household Energy Strategy Study (English and French)	06/91	134/91
Burundi	Energy Assessment (English)	06/82	3778-BU
	Petroleum Supply Management (English)	01/84	012/84
	Status Report (English and French)	02/84	011/84
	Presentation of Energy Projects for the Fourth Five-Year Plan (1983-1987) (English and French)	05/85	036/85
	Improved Charcoal Cookstove Strategy (English and French)	09/85	042/85
	Peat Utilization Project (English)	11/85	046/85
	Energy Assessment (English and French)	01/92	9215-BU
Cape Verde	Energy Assessment (English and Portuguese)	08/84	5073-CV
	Household Energy Strategy Study (English)	02/90	110/90
Central African Republic	Energy Assessement (French)	08/92	9898-CAR
Chad	Elements of Strategy for Urban Household Energy The Case of N'djamena (French)	12/93	160/94
Comoros	Energy Assessment (English and French)	01/88	7104-COM
Congo	Energy Assessment (English)	01/88	6420-COB
	Power Development Plan (English and French)	03/90	106/90
Côte d'Ivoire	Energy Assessment (English and French)	04/85	5250-IVC
	Improved Biomass Utilization (English and French)	04/87	069/87
	Power System Efficiency Study (English)	12/87	--
	Power Sector Efficiency Study (French)	02/92	140/91
	Project of Energy Efficiency in Buildings (English)	09/95	175/95

Region/Country	*Activity/Report Title*	*Date*	*Number*
Ethiopia	Energy Assessment (English)	07/84	4741-ET
	Power System Efficiency Study (English)	10/85	045/85
	Agricultural Residue Briquetting Pilot Project (English)	12/86	062/86
	Bagasse Study (English)	12/86	063/86
	Cooking Efficiency Project (English)	12/87	--
	Energy Assessment (English)	02/96	179/96
Gabon	Energy Assessment (English)	07/88	6915-GA
The Gambia	Energy Assessment (English)	11/83	4743-GM
	Solar Water Heating Retrofit Project (English)	02/85	030/85
	Solar Photovoltaic Applications (English)	03/85	032/85
	Petroleum Supply Management Assistance (English)	04/85	035/85
Ghana	Energy Assessment (English)	11/86	6234-GH
	Energy Rationalization in the Industrial Sector (English)	06/88	084/88
	Sawmill Residues Utilization Study (English)	11/88	074/87
	Industrial Energy Efficiency (English)	11/92	148/92
Guinea	Energy Assessment (English)	11/86	6137-GUI
	Household Energy Strategy (English and French)	01/94	163/94
Guinea-Bissau	Energy Assessment (English and Portuguese)	08/84	5083-GUB
	Recommended Technical Assistance Projects (English & Portuguese)	04/85	033/85
	Management Options for the Electric Power and Water Supply Subsectors (English)	02/90	100/90
	Power and Water Institutional Restructuring (French)	04/91	118/91
Kenya	Energy Assessment (English)	05/82	3800-KE
	Power System Efficiency Study (English)	03/84	014/84
	Status Report (English)	05/84	016/84
	Coal Conversion Action Plan (English)	02/87	--
	Solar Water Heating Study (English)	02/87	066/87
	Peri-Urban Woodfuel Development (English)	10/87	076/87
	Power Master Plan (English)	11/87	--
	Power Loss Reduction Study (English)	09/96	186/96
Lesotho	Energy Assessment (English)	01/84	4676-LSO
Liberia	Energy Assessment (English)	12/84	5279-LBR
	Recommended Technical Assistance Projects (English)	06/85	038/85
	Power System Efficiency Study (English)	12/87	081/87
Madagascar	Energy Assessment (English)	01/87	5700-MAG
	Power System Efficiency Study (English and French)	12/87	075/87
	Environmental Impact of Woodfuels (French)	10/95	176/95
Malawi	Energy Assessment (English)	08/82	3903-MAL
	Technical Assistance to Improve the Efficiency of Fuelwood Use in the Tobacco Industry (English)	11/83	009/83
	Status Report (English)	01/84	013/84
Mali	Energy Assessment (English and French)	11/91	8423-MLI
	Household Energy Strategy (English and French)	03/92	147/92
Islamic Republic of Mauritania	Energy Assessment (English and French)	04/85	5224-MAU
	Household Energy Strategy Study (English and French)	07/90	123/90
Mauritius	Energy Assessment (English)	12/81	3510-MAS
	Status Report (English)	10/83	008/83
	Power System Efficiency Audit (English)	05/87	070/87

Region/Country	*Activity/Report Title*	*Date*	*Number*
Mauritius	Bagasse Power Potential (English)	10/87	077/87
	Energy Sector Review (English)	12/94	3643-MAS
Mozambique	Energy Assessment (English)	01/87	6128-MOZ
	Household Electricity Utilization Study (English)	03/90	113/90
	Electricity Tariffs Study (English)	06/96	181/96
	Sample Survey of Low Voltage Electricity Customers	06/97	195/97
Namibia	Energy Assessment (English)	03/93	11320-NAM
Niger	Energy Assessment (French)	05/84	4642-NIR
	Status Report (English and French)	02/86	051/86
	Improved Stoves Project (English and French)	12/87	080/87
	Household Energy Conservation and Substitution (English and French)	01/88	082/88
Nigeria	Energy Assessment (English)	08/83	4440-UNI
	Energy Assessment (English)	07/93	11672-UNI
Rwanda	Energy Assessment (English)	06/82	3779-RW
	Status Report (English and French)	05/84	017/84
	Improved Charcoal Cookstove Strategy (English and French)	08/86	059/86
	Improved Charcoal Production Techniques (English and French)	02/87	065/87
	Energy Assessment (English and French)	07/91	8017-RW
	Commercialization of Improved Charcoal Stoves and Carbonization Techniques Mid-Term Progress Report (English and French)	12/91	141/91
SADC	SADC Regional Power Interconnection Study, Vols. I-IV (English)	12/93	--
SADCC	SADCC Regional Sector: Regional Capacity-Building Program for Energy Surveys and Policy Analysis (English)	11/91	--
Sao Tome and Principe	Energy Assessment (English)	10/85	5803-STP
Senegal	Energy Assessment (English)	07/83	4182-SE
	Status Report (English and French)	10/84	025/84
	Industrial Energy Conservation Study (English)	05/85	037/85
	Preparatory Assistance for Donor Meeting (English and French)	04/86	056/86
	Urban Household Energy Strategy (English)	02/89	096/89
	Industrial Energy Conservation Program (English)	05/94	165/94
Seychelles	Energy Assessment (English)	01/84	4693-SEY
	Electric Power System Efficiency Study (English)	08/84	021/84
Sierra Leone	Energy Assessment (English)	10/87	6597-SL
Somalia	Energy Assessment (English)	12/85	5796-SO
South Africa Republic of	Options for the Structure and Regulation of Natural Gas Industry (English)	05/95	172/95
Sudan	Management Assistance to the Ministry of Energy and Mining	05/83	003/83
	Energy Assessment (English)	07/83	4511-SU
	Power System Efficiency Study (English)	06/84	018/84
	Status Report (English)	11/84	026/84
	Wood Energy/Forestry Feasibility (English)	07/87	073/87
Swaziland	Energy Assessment (English)	02/87	6262-SW
	Household Energy Strategy Study	10/97	198/97
Tanzania	Energy Assessment (English)	11/84	4969-TA
	Peri-Urban Woodfuels Feasibility Study (English)	08/88	086/88
	Tobacco Curing Efficiency Study (English)	05/89	102/89
	Remote Sensing and Mapping of Woodlands (English)	06/90	--
	Industrial Energy Efficiency Technical Assistance (English)	08/90	122/90

Region/Country	*Activity/Report Title*	*Date*	*Number*
Tanzania	Power Loss Reduction Volume 1: Transmission and Distribution SystemTechnical Loss Reduction and Network Development (English)	06/98	204A/98
	Power Loss Reduction Volume 2: Reduction of Non-Technical Losses (English)	06/98	204B/98
Togo	Energy Assessment (English)	06/85	5221-TO
	Wood Recovery in the Nangbeto Lake (English and French)	04/86	055/86
	Power Efficiency Improvement (English and French)	12/87	078/87
Uganda	Energy Assessment (English)	07/83	4453-UG
	Status Report (English)	08/84	020/84
	Institutional Review of the Energy Sector (English)	01/85	029/85
	Energy Efficiency in Tobacco Curing Industry (English)	02/86	049/86
	Fuelwood/Forestry Feasibility Study (English)	03/86	053/86
	Power System Efficiency Study (English)	12/88	092/88
	Energy Efficiency Improvement in the Brick and Tile Industry (English)	02/89	097/89
	Tobacco Curing Pilot Project (English)	03/89	UNDP Terminal Report
	Energy Assessment (English)	12/96	193/96
Zaire	Energy Assessment (English)	05/86	5837-ZR
Zambia	Energy Assessment (English)	01/83	4110-ZA
	Status Report (English)	08/85	039/85
	Energy Sector Institutional Review (English)	11/86	060/86
	Power Subsector Efficiency Study (English)	02/89	093/88
	Energy Strategy Study (English)	02/89	094/88
	Urban Household Energy Strategy Study (English)	08/90	121/90
Zimbabwe	Energy Assessment (English)	06/82	3765-ZIM
	Power System Efficiency Study (English)	06/83	005/83
	Status Report (English)	08/84	019/84
	Power Sector Management Assistance Project (English)	04/85	034/85
	Power Sector Management Institution Building (English)	09/89	--
	Petroleum Management Assistance (English)	12/89	109/89
	Charcoal Utilization Prefeasibility Study (English)	06/90	119/90
	Integrated Energy Strategy Evaluation (English)	01/92	8768-ZIM
	Energy Efficiency Technical Assistance Project: Strategic Framework for a National Energy Efficiency Improvement Program (English)	04/94	--
	Capacity Building for the National Energy Efficiency Improvement Programme (NEEIP) (English)	12/94	--
	EAST ASIA AND PACIFIC (EAP)		
Asia Regional	Pacific Household and Rural Energy Seminar (English)	11/90	--
China	County-Level Rural Energy Assessments (English)	05/89	101/89
	Fuelwood Forestry Preinvestment Study (English)	12/89	105/89
	Strategic Options for Power Sector Reform in China (English)	07/93	156/93
	Energy Efficiency and Pollution Control in Township and Village Enterprises (TVE) Industry (English)	11/94	168/94
	Energy for Rural Development in China: An Assessment Based on a Joint Chinese/ESMAP Study in Six Counties (English)	06/96	183/96
Fiji	Energy Assessment (English)	06/83	4462-FIJ

Region/Country	*Activity/Report Title*	*Date*	*Number*
Indonesia	Energy Assessment (English)	11/81	3543-IND
	Status Report (English)	09/84	022/84
	Power Generation Efficiency Study (English)	02/86	050/86
	Energy Efficiency in the Brick, Tile and Lime Industries (English)	04/87	067/87
	Diesel Generating Plant Efficiency Study (English)	12/88	095/88
	Urban Household Energy Strategy Study (English)	02/90	107/90
	Biomass Gasifier Preinvestment Study Vols. I & II (English)	12/90	124/90
	Prospects for Biomass Power Generation with Emphasis on Palm Oil, Sugar, Rubberwood and Plywood Residues (English)	11/94	167/94
Lao PDR	Urban Electricity Demand Assessment Study (English)	03/93	154/93
Malaysia	Sabah Power System Efficiency Study (English)	03/87	068/87
	Gas Utilization Study (English)	09/91	9645-MA
Myanmar	Energy Assessment (English)	06/85	5416-BA
Papua New Guinea	Energy Assessment (English)	06/82	3882-PNG
	Status Report (English)	07/83	006/83
	Energy Strategy Paper (English)	--	--
	Institutional Review in the Energy Sector (English)	10/84	023/84
	Power Tariff Study (English)	10/84	024/84
Philippines	Commercial Potential for Power Production from Agricultural Residues (English)	12/93	157/93
	Energy Conservation Study (English)	08/94	--
Solomon Islands	Energy Assessment (English)	06/83	4404-SOL
	Energy Assessment (English)	01/92	979-SOL
South Pacific	Petroleum Transport in the South Pacific (English)	05/86	--
Thailand	Energy Assessment (English)	09/85	5793-TH
	Rural Energy Issues and Options (English)	09/85	044/85
	Accelerated Dissemination of Improved Stoves and Charcoal Kilns (English)	09/87	079/87
	Northeast Region Village Forestry and Woodfuels Preinvestment Study (English)	02/88	083/88
	Impact of Lower Oil Prices (English)	08/88	--
	Coal Development and Utilization Study (English)	10/89	--
Tonga	Energy Assessment (English)	06/85	5498-TON
Vanuatu	Energy Assessment (English)	06/85	5577-VA
Vietnam	Rural and Household Energy-Issues and Options (English)	01/94	161/94
	Power Sector Reform and Restructuring in Vietnam: Final Report to the Steering Committee (English and Vietnamese)	09/95	174/95
	Household Energy Technical Assistance: Improved Coal Briquetting and Commercialized Dissemination of Higher Efficiency Biomass and Coal Stoves (English)	01/96	178/96
Western Samoa	Energy Assessment (English)	06/85	5497-WSO
	SOUTH ASIA (SAS)		
Bangladesh	Energy Assessment (English)	10/82	3873-BD
	Priority Investment Program (English)	05/83	002/83
	Status Report (English)	04/84	015/84
	Power System Efficiency Study (English)	02/85	031/85
	Small Scale Uses of Gas Prefeasibility Study (English)	12/88	--

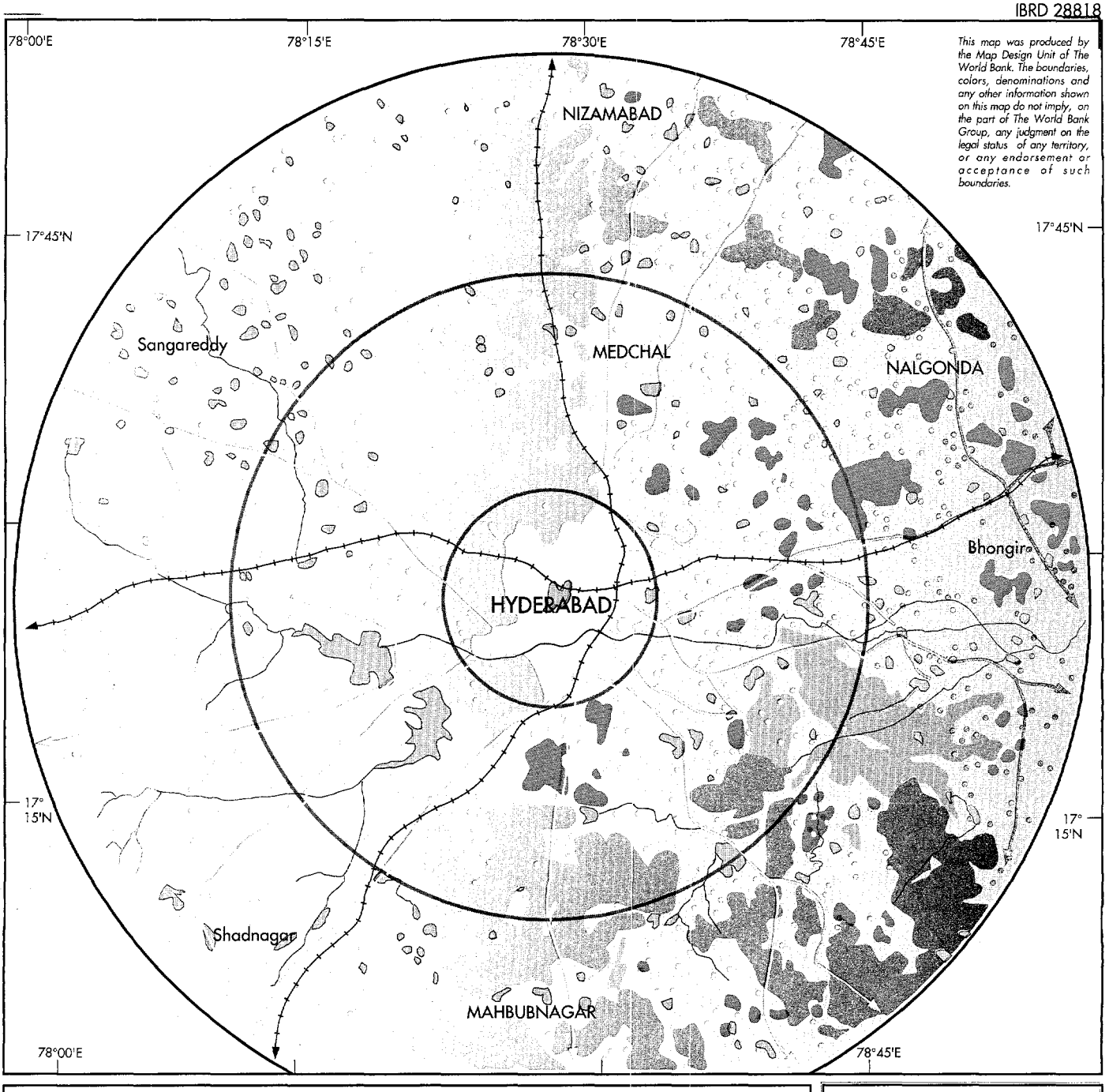
Region/Country	*Activity/Report Title*	*Date*	*Number*
India	Opportunities for Commercialization of Nonconventional Energy Systems (English)	11/88	091/88
	Maharashtra Bagasse Energy Efficiency Project (English)	07/90	120/90
	Mini-Hydro Development on Irrigation Dams and Canal Drops Vols. I, II and III (English)	07/91	139/91
	WindFarm Pre-Investment Study (English)	12/92	150/92
	Power Sector Reform Seminar (English)	04/94	166/94
	Environmental Issues in the Power Sector (English)	06/98	205/98
	Environmental Issues in the Power Sector: Manual for Environmental Decision Making (English)	06/99	213/99
	Household Energy Strategies for Urban India: The Case of Hyderabad	06/99	214/99
Nepal	Energy Assessment (English)	08/83	4474-NEP
	Status Report (English)	01/85	028/84
	Energy Efficiency & Fuel Substitution in Industries (English)	06/93	158/93
Pakistan	Household Energy Assessment (English)	05/88	--
	Assessment of Photovoltaic Programs, Applications, and Markets (English)	10/89	103/89
	National Household Energy Survey and Strategy Formulation Study: Project Terminal Report (English)	03/94	--
	Managing the Energy Transition (English)	10/94	--
	Lighting Efficiency Improvement Program Phase 1: Commercial Buildings Five Year Plan (English)	10/94	--
Sri Lanka	Energy Assessment (English)	05/82	3792-CE
	Power System Loss Reduction Study (English)	07/83	007/83
	Status Report (English)	01/84	010/84
	Industrial Energy Conservation Study (English)	03/86	054/86
	EUROPE AND CENTRAL ASIA (ECA)		
Bulgaria	Natural Gas Policies and Issues (English)	10/96	188/96
Central and Eastern Europe	Power Sector Reform in Selected Countries	07/97	196/97
Eastern Europe	The Future of Natural Gas in Eastern Europe (English)	08/92	149/92
Kazakhstan	Natural Gas Investment Study, Volumes 1, 2 & 3	12/97	199/97
Kazakhstan & Kyrgyzstan	Opportunities for Renewable Energy Development	11/97	16855-KAZ
Poland	Energy Sector Restructuring Program Vols. I-V (English)	01/93	153/93
	Natural Gas Upstream Pricing (English and Polish)	08/98	206/98
	Energy Sector Restructuring Program: Establishing the Energy Regulation Authority	10/98	208/98
Portugal	Energy Assessment (English)	04/84	4824-PO
Romania	Natural Gas Development Strategy (English)	12/96	192/96
Slovenia	Workshop on Private Participation in the Power Sector (English)	02/99	211/99
Turkey	Energy Assessment (English)	03/83	3877-TU

Region/Country	*Activity/Report Title*	*Date*	*Number*
	MIDDLE EAST AND NORTH AFRICA (MNA)		
Arab Republic of Egypt	Energy Assessment (English)	10/96	189/96
Morocco	Energy Assessment (English and French)	03/84	4157-MOR
	Status Report (English and French)	01/86	048/86
	Energy Sector Institutional Development Study (English and French)	07/95	173/95
	Natural Gas Pricing Study (French)	10/98	209/98
	Gas Development Plan Phase II (French)	02/99	210/99
Syria	Energy Assessment (English)	05/86	5822-SYR
	Electric Power Efficiency Study (English)	09/88	089/88
	Energy Efficiency Improvement in the Cement Sector (English)	04/89	099/89
	Energy Efficiency Improvement in the Fertilizer Sector (English)	06/90	115/90
Tunisia	Fuel Substitution (English and French)	03/90	--
	Power Efficiency Study (English and French)	02/92	136/91
	Energy Management Strategy in the Residential and Tertiary Sectors (English)	04/92	146/92
	Renewable Energy Strategy Study, Volume I (French)	11/96	190A/96
	Renewable Energy Strategy Study, Volume II (French)	11/96	190B/96
Yemen	Energy Assessment (English)	12/84	4892-YAR
	Energy Investment Priorities (English)	02/87	6376-YAR
	Household Energy Strategy Study Phase I (English)	03/91	126/91
	LATIN AMERICA AND THE CARIBBEAN (LAC)		
LAC Regional	Regional Seminar on Electric Power System Loss Reduction in the Caribbean (English)	07/89	--
	Elimination of Lead in Gasoline in Latin America and the Caribbean (English and Spanish)	04/97	194/97
	Elimination of Lead in Gasoline in Latin America and the Caribbean - Status Report (English and Spanish)	12/97	200/97
	Harmonization of Fuels Specifications in Latin America and the Caribbean (English and Spanish)	06/98	203/98
Bolivia	Energy Assessment (English)	04/83	4213-BO
	National Energy Plan (English)	12/87	--
	La Paz Private Power Technical Assistance (English)	11/90	111/90
	Prefeasibility Evaluation Rural Electrification and Demand Assessment (English and Spanish)	04/91	129/91
	National Energy Plan (Spanish)	08/91	131/91
	Private Power Generation and Transmission (English)	01/92	137/91
	Natural Gas Distribution: Economics and Regulation (English)	03/92	125/92
	Natural Gas Sector Policies and Issues (English and Spanish)	12/93	164/93
	Household Rural Energy Strategy (English and Spanish)	01/94	162/94
	Preparation of Capitalization of the Hydrocarbon Sector	12/96	191/96
Brazil	Energy Efficiency & Conservation: Strategic Partnership for Energy Efficiency in Brazil (English)	01/95	170/95
	Hydro and Thermal Power Sector Study	09/97	197/97
Chile	Energy Sector Review (English)	08/88	7129-CH
Colombia	Energy Strategy Paper (English)	12/86	--
	Power Sector Restructuring (English)	11/94	169/94

Region/Country	*Activity/Report Title*	*Date*	*Number*
Colombia	Energy Efficiency Report for the Commercial and Public Sector (English)	06/96	184/96
Costa Rica	Energy Assessment (English and Spanish)	01/84	4655-CR
	Recommended Technical Assistance Projects (English)	11/84	027/84
	Forest Residues Utilization Study (English and Spanish)	02/90	108/90
Dominican Republic	Energy Assessment (English)	05/91	8234-DO
Ecuador	Energy Assessment (Spanish)	12/85	5865-EC
	Energy Strategy Phase I (Spanish)	07/88	--
	Energy Strategy (English)	04/91	--
	Private Minihydropower Development Study (English)	11/92	--
	Energy Pricing Subsidies and Interfuel Substitution (English)	08/94	11798-EC
	Energy Pricing, Poverty and Social Mitigation (English)	08/94	12831-EC
Guatemala	Issues and Options in the Energy Sector (English)	09/93	12160-GU
Haiti	Energy Assessment (English and French)	06/82	3672-HA
	Status Report (English and French)	08/85	041/85
	Household Energy Strategy (English and French)	12/91	143/91
Honduras	Energy Assessment (English)	08/87	6476-HO
	Petroleum Supply Management (English)	03/91	128/91
Jamaica	Energy Assessment (English)	04/85	5466-JM
	Petroleum Procurement, Refining, and Distribution Study (English)	11/86	061/86
	Energy Efficiency Building Code Phase I (English)	03/88	--
	Energy Efficiency Standards and Labels Phase I (English)	03/88	--
	Management Information System Phase I (English)	03/88	--
	Charcoal Production Project (English)	09/88	090/88
	FIDCO Sawmill Residues Utilization Study (English)	09/88	088/88
	Energy Sector Strategy and Investment Planning Study (English)	07/92	135/92
Mexico	Improved Charcoal Production Within Forest Management for the State of Veracruz (English and Spanish)	08/91	138/91
	Energy Efficiency Management Technical Assistance to the Comision Nacional para el Ahorro de Energia (CONAE) (English)	04/96	180/96
Panama	Power System Efficiency Study (English)	06/83	004/83
Paraguay	Energy Assessment (English)	10/84	5145-PA
	Recommended Technical Assistance Projects (English)	09/85	--
	Status Report (English and Spanish)	09/85	043/85
Peru	Energy Assessment (English)	01/84	4677-PE
	Status Report (English)	08/85	040/85
	Proposal for a Stove Dissemination Program in the Sierra (English and Spanish)	02/87	064/87
	Energy Strategy (English and Spanish)	12/90	--
	Study of Energy Taxation and Liberalization of the Hydrocarbons Sector (English and Spanish)	120/93	159/93
Saint Lucia	Energy Assessment (English)	09/84	5111-SLU
St. Vincent and the Grenadines	Energy Assessment (English)	09/84	5103-STV
Trinidad and Tobago	Energy Assessment (English)	12/85	5930-TR

Region/Country	*Activity/Report Title*	*Date*	*Number*
	GLOBAL		
	Energy End Use Efficiency: Research and Strategy (English)	11/89	--
	Women and Energy--A Resource Guide The International Network: Policies and Experience (English)	04/90	--
	Guidelines for Utility Customer Management and Metering (English and Spanish)	07/91	--
	Assessment of Personal Computer Models for Energy Planning in Developing Countries (English)	10/91	--
	Long-Term Gas Contracts Principles and Applications (English)	02/93	152/93
	Comparative Behavior of Firms Under Public and Private Ownership (English)	05/93	155/93
	Development of Regional Electric Power Networks (English)	10/94	--
	Roundtable on Energy Efficiency (English)	02/95	171/95
	Assessing Pollution Abatement Policies with a Case Study of Ankara (English)	11/95	177/95
	A Synopsis of the Third Annual Roundtable on Independent Power Projects: Rhetoric and Reality (English)	08/96	187/96
	Rural Energy and Development Roundtable (English)	05/98	202/98
	A Synopsis of the Second Roundtable on Energy Efficiency: Institutional and Financial Delivery Mechanisms (English)	09/98	207/98
	The Effect of a Shadow Price on Carbon Emission in the Energy Portfolio of the World Bank: A Carbon Backcasting Exercise (English)	02/99	212/99

06/29/99



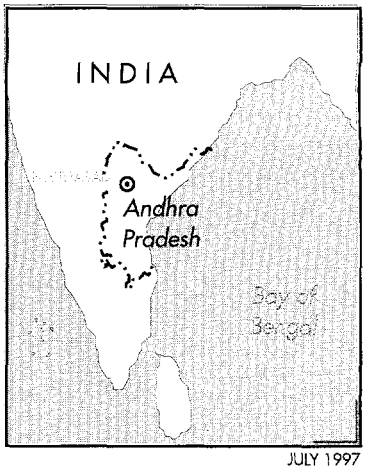
INDIA

HOUSEHOLD ENERGY STRATEGIES FOR URBAN INDIA

LAND USE, METROPOLITAN HYDERABAD AND ITS HINTERLAND (50 KM. RADIUS), 1928

- BUILT-UP AREAS
- SCRUB WOODLAND
- FOREST AREAS
- UPLAND SCANTY THROUGH INTENSIVE AGRICULTURAL AREAS
- ROCKY OUTCROPS
- WATER BODIES
- ROADS
- RAILROADS

NOTE: Radii of Circles - Inner Circle = 10 Kms., Middle Circle = 30 Kms., Outer Circle = 50 Kms.



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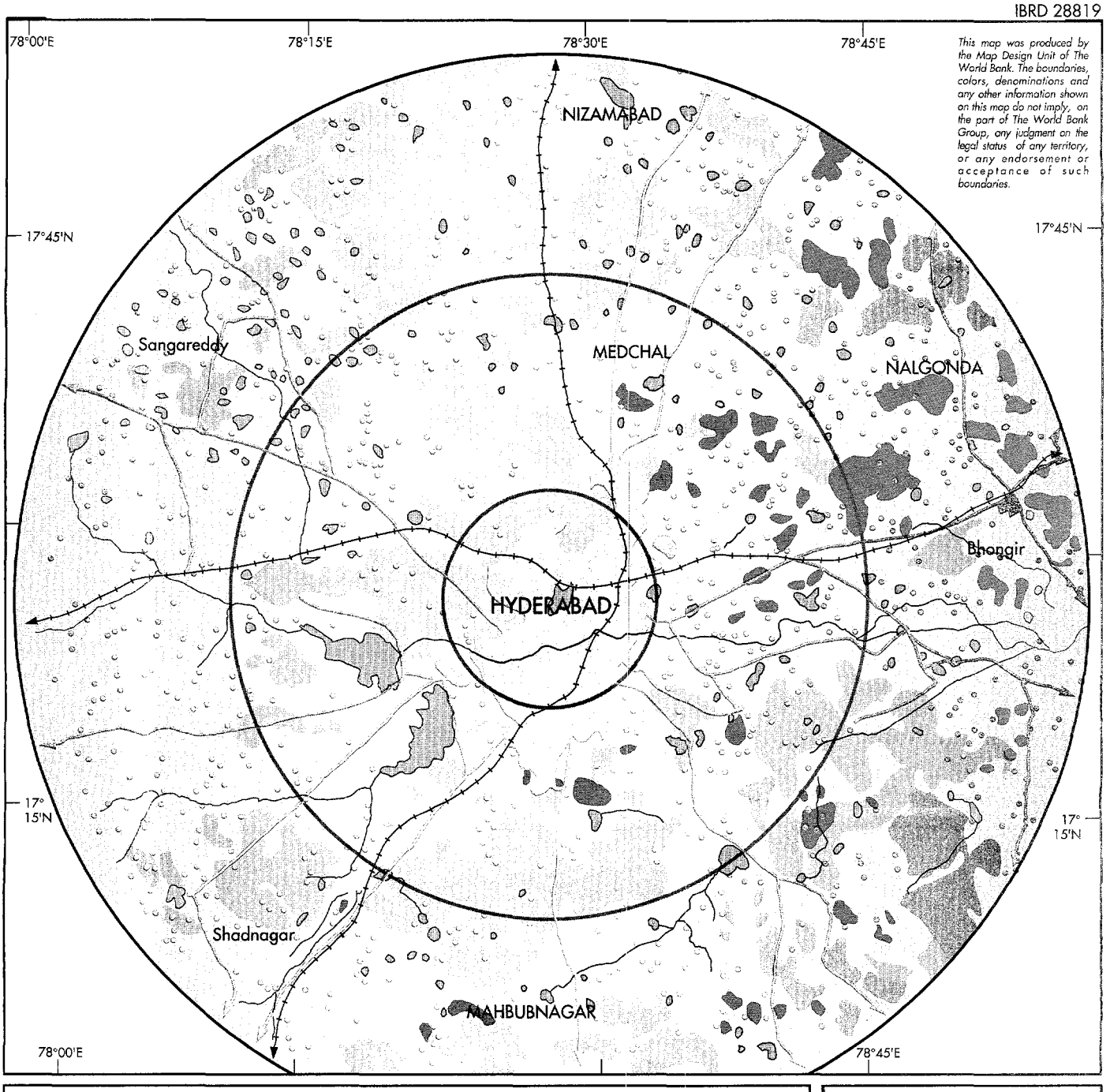

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INDIA

HOUSEHOLD ENERGY STRATEGIES FOR URBAN INDIA

LAND USE, METROPOLITAN HYDERABAD AND ITS HINTERLAND (50 KM. RADIUS), 1963

- BUILT-UP AREAS
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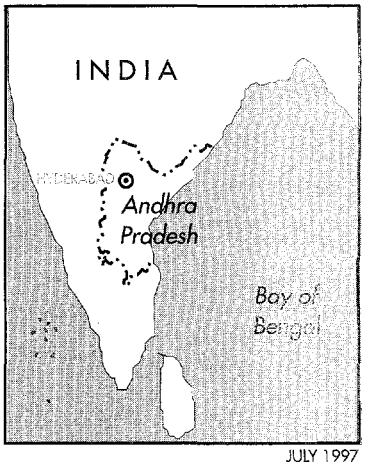

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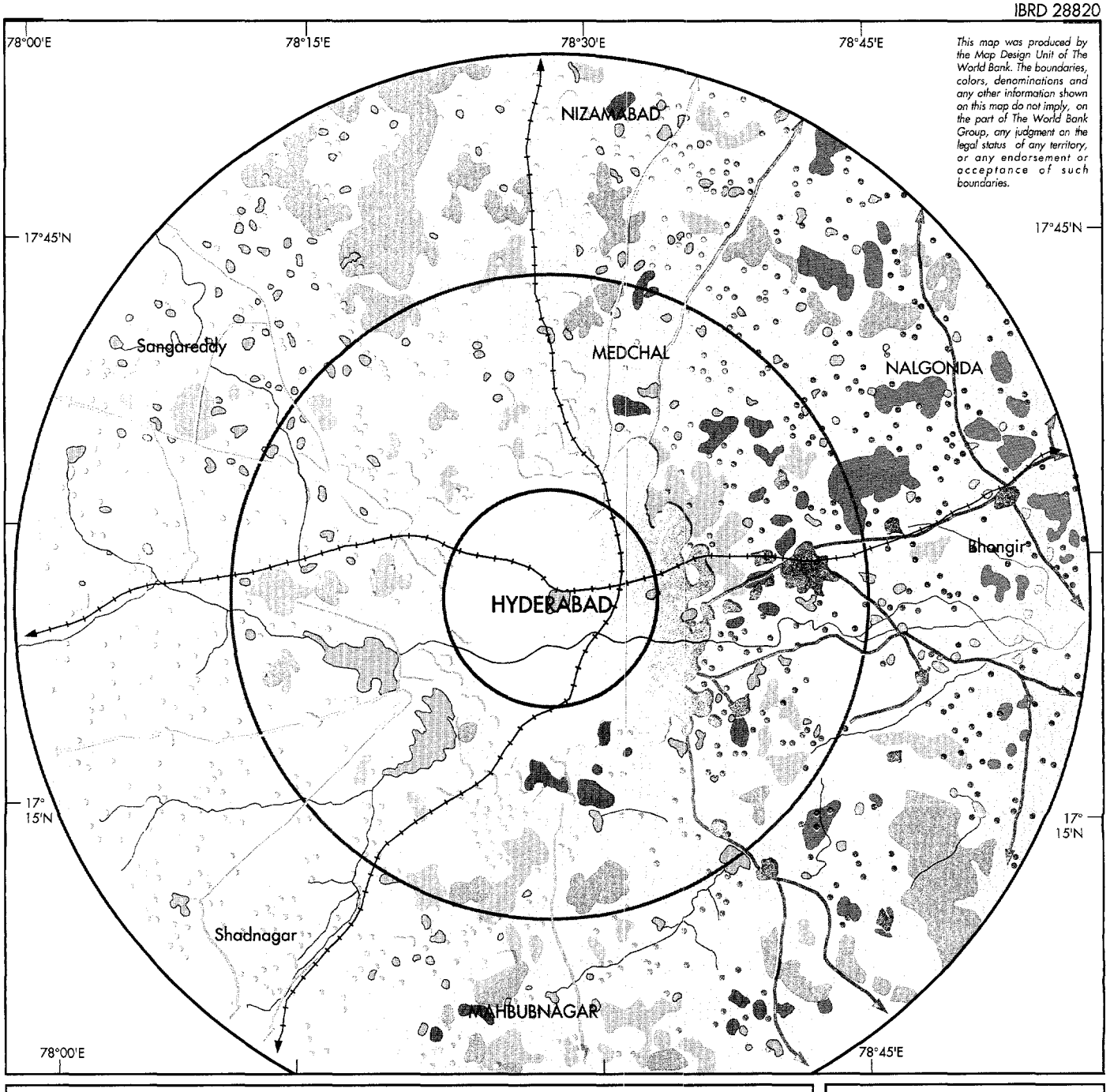

INDIA

HOUSEHOLD ENERGY STRATEGIES FOR URBAN INDIA

LAND USE, METROPOLITAN HYDERABAD AND ITS HINTERLAND (50 KM. RADIUS), 1994

- BUILT-UP AREAS
- SCRUB WOODLAND
- FOREST AREAS
- UPLAND SCANTY THROUGH INTENSIVE AGRICULTURAL AREAS
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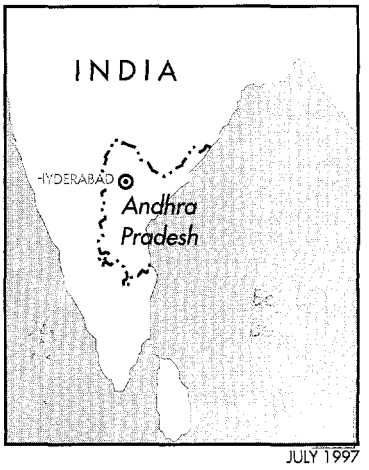

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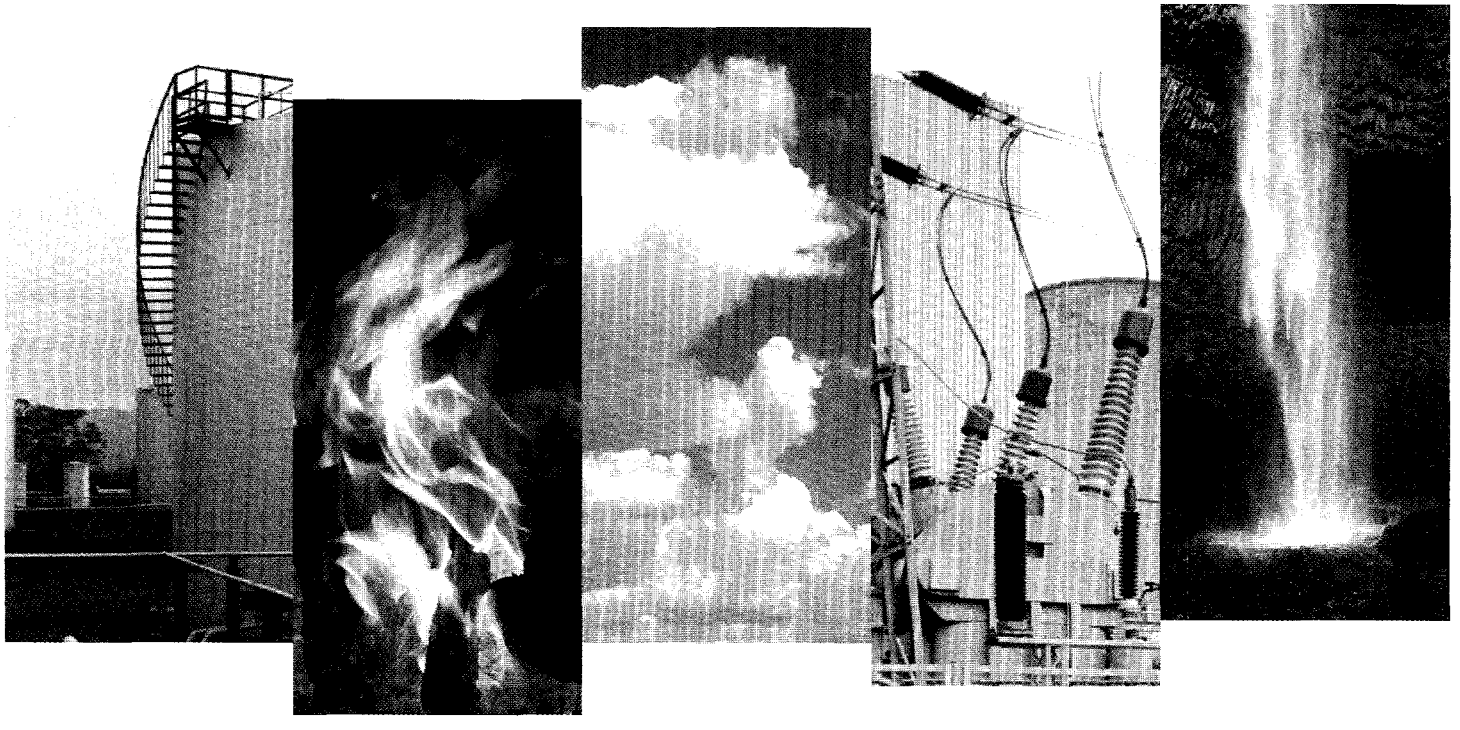

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