Chapter 21
Characterizing Energy Poverty: Implications for Energy Access Policies

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21.1 Introduction

The demand for all energy sources is growing dramatically with worldwide energy consumption projected to increase by 36 % by 2035. This is fueled by a population that is predicted to increase 25 % over the next 20 years, with most of that growth emanating from countries with emerging economies, such as China and India. Rising energy demand from economic output and improved standards of living is likely to add pressure on energy supplies.

The most serious issue India must address is the widening gap between energy demand and energy supply. Two reasons for this trend are demographics and economics: not only is India's economy growing, thereby demanding more energy and electricity, but the population is as well. There is also massive urbanization, which is putting more pressure on energy and the environment and leading to energy poverty.

Energy poverty is defined as "the absence of sufficient choice in accessing adequate, affordable, reliable, quality, safe, and environmentally benign energy services to support human development" (UNDP 2005). At a household level, this refers to the lack of modern cooking fuels and minimum electricity for lighting purposes (World Bank and UNDP 2005). A lack of legal access to cleaner, efficient, and sustainable energy is a pressing concern for populations in the developing regions of Africa, Asia, Latin America, and the Caribbean, where large concentrations of urban poor reside and rely on traditional fuels (GNESD 2008; World Bank and UNDP 2005). This has emerged primarily from the Johannesburg Plan of implementation from the World Summit on Sustainable Development (GNESD 2008).

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Energy poverty is one of the challenges faced by India and beyond. It is the result of poverty as well as a contributing factor perpetuating poverty by depriving the poor of modern infrastructure for economic and human development. Approximately 412 million people in India live without access to electricity and 668 million depend on traditional biomass for cooking (IEA 2007). These numbers take about a quarter of people in energy poverty worldwide; 1.5 billion people in developing countries have no access to electricity and 3 billion people rely on the solid fuels for cooking (UNDP 2005).

Recognizing the importance of energy poverty to enhance human welfare and to curb climate change, there is increasing dialogue in both national and international policy arena. In particular, the leaders of "The Group of Twenty" (G20) urged in 2009 at Pittsburgh to increase access to energy by deploying clean, affordable energy resources to the developing world. The Government of India has initiated and implemented various policies and programs, notably "Power for All by 2012" initiative by the Ministry of Power, to provide access to and promote modern and cleaner energy in the rural area under the 11th Five-Year Plan (2007–2012).

The demand for energy, especially electricity, is increasing in the residential sector in India. This is mainly because of increasing urbanization, rising per capita incomes, and changing lifestyles of the consumers. These factors have led to an increase in the usage of electrical appliances for different end-uses in the residential sector. The urban areas, especially the metropolitan cities, in India provide evidence to this trend. Yet, approximately 45 % of rural Indian households do not have access to modern energy services, and more than 85 % use traditional fuel sources, such as dung cake and firewood, for cooking. Providing modern energy services for lighting and cooking is thus widely recognized as an important step to reduce poverty in India. The Indian government has prioritized energy inclusion in its poverty reduction strategy principally through the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) scheme, which aims to electrify all villages by 2012. Although many of the urban poor have energy access, it is often illegal, unsafe, and hazardous to human health, as well as to the environment. The challenge is to facilitate the transition to cleaner and more sustainable fuels for improved quality of life (GNESD 2008; UNDP 2005).

The lack of energy access for the urban poor in developing countries is emerging as one of the most serious yet overlooked developmental concerns of the twenty-first century. Despite the growing recognition that improved energy access is a powerful enabler for achieving the Millennium Development Goals (MDGs), it has no explicit mention in the MDGs, and there has been a lack of adequate strategies focusing on improving energy access for the urban poor. As a result, there are limited success stories on energy access for urban poor. However, the ones that are there can provide crucial learning to address this issue.

21.2 Literature Review

Available literature demonstrates the evidence of energy poverty, lack of energy access, and importance of promoting energy access for sustainable and inclusive development. This, however, has not translated into policies targeted at growing urban poor populations. Despite this, examples of successful initiatives can provide crucial lessons, helping to identify barriers and provide solutions to achieve and sustain energy access to urban poor populations.

Extensive literature on poverty and energy access suggests it to be a two-way causal relationship between the lack of access to adequate, affordable, and appropriate energy forms and poverty. This has often been termed the "energy–poverty nexus" (Masud et al. 2007) or the "vicious cycle of energy poverty" (WHO 2006). The cycle is considered vicious because households that lack access to appropriate energy are often trapped in a vortex of deprivation. The lack of energy, in addition to insufficient access to other key services and assets, affects productivity, time budgets, opportunities for income generation, and more generally, the ability to improve living conditions. The low productivity and livelihood opportunities, in turn, result in low earnings and no or little surplus cash for these people. This contributes to the poor remaining poor and consequently, also energy-poor, since they cannot afford to pay for improved energy services (often neither the fuels nor the equipment).

In a recent World Bank study energy-poverty is measured on the basis of energy demand. As per the study the energy poverty line is defined as the threshold point at which energy consumption begins to rise with increases in household income. The study estimates that in India, in rural areas, some 57% of households are energy-poor, versus 22% that are income-poor. Among urban areas, the energy poverty rate is 28% compared with 20% that are income-poor.

The issue of growing urban poverty in developing countries is the result of increasing population growth rates, migration, and rapid urbanization. Developing countries are experiencing a widening gap between the wealthy and the poor, and their urban poor face barriers that prevent them from accessing basic infrastructure and services—including energy (Baker 2008). Although access is generally higher in urban areas than rural, it remains low for the urban poor, particularly in terms of quality and affordability (Baker 2008; GNESD 2008). Services to these populations are often unreliable, sporadic, and/or accessed informally. Limited affordability for public services combined with the unwillingness of private utility companies to provide services to low-income populations compounds the issue (Baker 2008; GNESD 2008). In addition to unique challenges faced in different regions, lack of formal monitoring mechanisms, disaggregated data for urban populations, and illegal tenure continue to prevent energy access for urban and peri-urban poor (GNESD 2008).

Against this background, the objective of the present study is to understand the way consumers use energy for different end-uses in their homes and to develop richer understanding of access—in terms of access to what—and analyze existing energy policy in the backdrop of energy-poor household.

21.3 Methodology

The methodology includes literature review, primary survey, and stakeholder consultation. An extensive literature review of working papers, academic papers from various national and international sources has been carried out. The sample of households for this study is selected across different income groups in the city of Mumbai. The research site is Mumbai Metropolitan Region (MMR). It includes Greater Mumbai, Thane Municipal Corporation, Kalyan Municipal Corporation, Virar-Bhayandar, Bhiwandi (standard urban area VI), New Mumbai, (administered by the City Industrial Development Corporation, CIDCO) and the rest of the Bombay Metropolitan Region (BMR) (under smaller municipal councils, semiurban areas, and villages). To relieve the burden on the main city and to deflect city growth to the region, the government has accepted the proposal to set up a self-contained twin city across the harbor which is more or less independent of Mumbai.

The population growth has further spilled over in the BMR region and it has been continuously growing over the past 50 years. Migration from within the state and from various parts of the country into the city has played a significant role in its population growth. Greater Mumbai is expected to accommodate 129 million people by 2011 (BMRDA 1994).

In order to validate the research questions household energy access/energy consumption pattern and energy expenditures, we have conducted an in-depth energy survey of 600 households in different parts of Mumbai. The survey was conducted through a stratified random sampling. The survey specifically examines issues related to fuel consumption, household energy expenditure, and factors that serve to reduce the poor households' access to fuels and electricity.

The stratification was done on the basis of specified and a priori defined criteria. Income is one of the major determinants of energy use in households (Reddy 1995). Hence, the households were segmented according to their monthly income. On the basis of this, all the reported households (in census) are classified into four groups: (i) High Income Group (HIG), (ii) Middle Income Group (MIG), (iii) Lower Middle Income Group (LMIG), and (iv) Low Income Group (LIG). In each group, a sample size is determined by using uniform sampling fraction. The simple random sampling method is followed for the consumer household survey. The sample size is 600; 150 from each group. The survey was conducted during Oct. 2010–Jan. 2011 with face-to-face interviews among randomly selected households located in Mumbai municipality.

21.4 Results and Discussion

Using the data collected from 600 households from different parts of Mumbai across different income groups, the present study examined the energy-use pattern and energy expenditure. The findings are presented in this section.

In our sample region, 600 households were interviewed in urban areas of Mumbai. All the households were classified into four categories on the basis of incomes. This classification was made specifically to find out the energy consumption and expenditure pattern. There is a striking disparity in economic status of households in different areas. The income range varies from ₹ 5000 to ₹ 100,000 and in some places the variation is even more. Mumbai is a city of extreme contrasts. Despite having the highest per capita income in the country (₹ 65,361), more than 1.2 million people, or little under 10% of its population, earn less than ₹ 20 a day. This is because of differing educational qualifications and occupational pattern.

There is a stark divide in the occupational structure based on the income groups as expected. People in the lower-income groups are primarily employed as unskilled workers while the middle and higher income classes are employed in nonmanual jobs (Table 21.1).

Much of the energy used by the Indian households is mainly channeled towards two end-uses: cooking and lighting and electronics appliances, to a lesser extent. Kerosene and liquefied petroleum gas (LPG) are the two principal clean household fuels in India used for cooking. Two other alternatives, natural gas and electricity, are not commonly used because of unavailability of natural gas for household use and much higher cost in the case of electricity. With the liberalization of the economy, the availability of LPG has considerably increased which in turn has helped the transition to LPG from kerosene as cooking fuel. Also, electric cooking range is used, but only by a few households. The choice of cooking fuels depends on the availability of fuels, government policies, affordability, and household activity patterns.

In our study, it was found that higher income groups mainly use LPG and electric cooking range and lower income groups use kerosene and LPG. Details pertaining to the end-use technologies used were collected through the questionnaire which is summarized in Table 21.2 and energy consumption pattern and energy expenditure are reported in Table 21.3.

Considerable changes occurred in the Indian household sector over several decades in the use of energy-consuming devices and in the behavior of energy users. The increase in energy use can be the natural increase in population growth and increase in economic activity and development. At the same time, there has been a progressive movement towards modern energy carriers, which are more efficient. Therefore, in spite of increased energy-related activities, per capita energy consumption has declined.

Table 21.1 Occupational profile of the sample (Note: Percentage in parenthesis)

	Self-employed	Government service	Partnership	Working in private sector	Daily wage worker	Any other	Total
HIG	68 (45.3)	12 (8.00)	10 (6.7)	41 (27.3)	0 (00)	19 12.7)	150 (100)
MIG	32 (21.2)	30 (20)	13 (8.6)	54 (35.8)	6 (4.0)	15 (9.9)	150 (100)
LMIG	44 (29.1)	25 (16.6)	3 (2)	58 (38.4)	14 (9.3)	6 (4)	150 (100)
LIG	10 (6.6)	21 (14)	15 (10)	78 (52)	24 (16)	2 (1.3)	150 (100)
Total	148 (24.7)	88 (14.7)	41 (6.8)	230 (38.3)	51 (8.5)	42 (7)	600 (100)

Table 21.2 Technology choices available for different end-uses

End-use	End-use technologies available
Cooking	Kerosene stove, LPG stove, electric cooking range
Water heating	LPG stove, geyser, immersion heater, solar water heater
Room comfort	Fan, air cooler, air conditioner
Water pumping	Manual pump, motor pump
Lighting	Incandescent bulbs, tube lights, compact fluorescent lamps
Appliances	Television, computers, refrigerator, other electrical and electronics appliances

Table 21.3 Energy consumption and expenditure

	LPG (%)	Kerosene (%)	Electricity (in %)	Energy expenditure (in ₹)
LIG	5–10	60–70	15–20	<1000
LMIG	10–20	40–50	30–40	1000–1500
MIG	10–30	Nil	60–70	2000–3000
HIG	10–20	Nil	80–90	>4000

Electricity demand has increased rapidly with higher use of appliances and more intensive lighting, constituting higher component in household energy basket. New variety of gadgets and drop in appliance prices may be the reason behind this. The electricity consumption pattern is different in different income groups varying from basic use in low-income group to higher appliance use in high-income households. Accordingly, the expenditure on electricity and energy expenditure as a whole varies.

The average price of electricity paid by surveyed households from 0 to 100 units ranges between ₹ 0.40 and 1.90, and for 100 to 300 units between ₹ 3.20 and 3.60, and above 300 units from ₹ 4.50 to 5.60. LIG, LMIG, and MIG consume between 0 and 300 units and HIG over 300 units. Maharashtra State Electricity Board (MSEB) has the highest tariff among companies supplying electricity directly; it tries to reduce all customers' electricity bills by implementing a random load shedding schedule. No electricity is supplied to Mumbai suburbs like Bhandup for 3–4 h daily. In the rest of Maharashtra, there is no electricity for 10–12 h/day.

The availability and prices of each fuel vary across the surveyed households. Subsidized kerosene is available through ration shops at a price of ₹ 28/l. The average price paid by a household was surveyed to be more than ₹ 40, thus indicating that households purchase some proportion of kerosene in the open market. The fact is that they buy bulk of their requirement from the open market. The lower income group pays the highest average price as compared to higher group because they buy more from the open market as kerosene is a major component in their consumption basket.

It is a widely accepted fact that the poor, who are the target population of the kerosene subsidy, do not get the fuel at a lower price and sometimes do not get any

fuel at all because it is siphoned off into the flourishing black market. Industries and the service sector, which includes fishing boats, launches, delivery tempos, and even auto-rickshaws, use kerosene, which is largely bought in the black market, where it costs anywhere between ₹ 40 and 50/l against its public distribution system (PDS) price of ₹ 15 (average all India price). In Mumbai, the PDS price of kerosene is ₹ 28.

Further, the government has cut down the quantity of kerosene available to Mumbai and Thane by nearly 30%. Earlier, they used to receive 27,000 t-L of kerosene, but now, receive only 19,000 t-L. As a result, there is a major shortage of kerosene which further increases the price and energy expenditure of LIG.

The price of subsidized LPG is ₹ 402 per cylinder on which the Government of India provides a subsidy of ₹ 502. When it comes to open market it ranges between ₹ 600 and 650 per cylinder. The LIG and LMIG groups basically buy from the open market as they do not have a legal connection. Our survey reports more consumption of LPG among MIG and HIG groups. LPG subsidy is uniform for all income groups, even though some income groups are getting subsidy benefit without really needing it. Ideally, subsidy should only be given to those families which are poor, and they also become energy-poor because they do not get the benefit of subsidy, and hence cannot afford this form of energy.

In Mumbai and Delhi, consumers who are now receiving piped gas have started returning their unwanted cylinders to LPG distributors. But the distributors, in many cases, appear to be continuing to draw their allocated subsidized LPG and reselling to the higher-paying commercial sector. The differential between commercial and household LPG prices is so large that their profits are sizeable. Government should check and divert these connections to LIG and LMIG groups who really need them.

The average household monthly expenditure on all sources of energy except petrol/diesel ranges between ₹ 1,000 and 4,000 and above among different income groups. As a percentage of household income, however, the poorest group has to allocate 20–30% of its income for purchasing energy, while the richest spends less than 5%

HIG and MIG spend more on electricity from their energy expenditure; however, LIG and LMIG spend more on LPG and kerosene. The variation between LIG and HIG is very high as compared to energy use and energy expenditure pattern.

The survey household energy-use pattern shows variations in energy consumption and expenditure among different income groups and certain segments of income groups are energy-poor mainly as they are economic-poor and the benefit of government subsidy does not reach them.

21.5 Conclusion

The objective of the study is to understand the energy consumption pattern of different households under different income groups in the urban residential sector of India. The study shows that lower income groups are energy-poor as they are deprived of their basic energy need because of lack of affordability and proper policy initiatives. This survey result will further help in constructing energy consumption basket and

an index which will reflect the change in the energy price over a period of time and help the government and policy-makers in deciding subsidies and regulation.

The survey reflects several common barriers to legal and cleaner energy access by lower income groups because of which their energy expenditure increases. These include, first, the high cost of service which often they are unable to afford, the infrastructure costs such as meters, wires, appropriate stoves, and safe construction materials. Second, due to their illegal or nonresidential status they are not able to provide documentation to avail subsidized facilities like PDS (public distribution system) kerosene, subsidized LPG, or a legal electricity connection.

The biggest irony is that the government is spending a huge amount of money on subsidized LPG, diesel, and kerosene, which is equivalent to the entire budget of a ministry at the center. Despite these efforts, it is not reaching the beneficiaries fully due to pilferage and leakage. To address the problem of households with energy poverty, policy measures should focus on individual subsidy to weaker section rather than commercial subsidy. The amount of subsidy also should be designed according to the energy basket of target income group. However, Nandan Nilakeni's mechanism of Unique ID project to facilitate direct transfer of subsidies in the bank accounts of beneficiaries hopefully will reduce the energy consumption of lower and middle income groups.

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