CHAPTER 20

FOCUS ON ENERGY POVERTY

HIGHLIGHTS

- Energy poverty affects many Indians and is an important issue for the Indian government. The number of households with access to electricity has risen over the past couple of decades, but access is still far from universal and the availability of modern cooking fuels and technologies is still limited, especially in rural areas. We use an energy development index, based on access to electricity and cleaner cooking fuels and on overall electricity generation per capita, to emphasise the disparity in energy poverty across India and relative to other developing countries.
- There are still some 412 million people without access to electricity in India. In all three *WEO* scenarios, the number of people without access declines, but it falls much faster in the High Growth Scenario. In that scenario, all households in India have access to electricity in 2030. In the Reference Scenario, the electrification rate in 2030 in India is 96% but nearly 60 million people in rural areas will still lack access.
- At an investment cost of $41 per person, it would cost some $17 billion to connect all those without electricity today to the central grid. But grid-based electrification is often not available to remote villages and households, because of the high cost of expanding the network. Diesel generators, mini-hydro, wind turbines, biomass gasifiers and photovoltaics, or a combination of these, could be more economic.
- The number of people relying on fuelwood and dung for cooking and heating declines from 668 million in 2005 to 395 million in 2030 in the High Growth Scenario, 77 million fewer people than in the Reference Scenario. About 22% of the population would still rely on these fuels in India in 2030, even with higher growth.
- According to the World Health Organization, the use of fuelwood and dung for cooking and heating causes over 400 000 premature deaths in India annually, mostly women and children. The concentration of particulate matter in the air in Indian households using biomass is over 2 000 microgrammes per cubic metre, compared to the US standard of 150.
- LPG and kerosene subsidies have been very ineffective in improving the welfare of the poor, particularly in rural areas. The current subsidy scheme benefits most richer households, mainly in urban areas, and has, for the most part, failed to shift fuel consumption patterns away from biomass in poor households. It is estimated that 40% of the subsidies for LPG and kerosene go to the richest 7% of the population.

Outlook for Clean Cooking Fuel and Electricity Access

Poor people in India have minimal access to clean, reliable and efficient energy sources. This is, of course, mostly a result of low incomes – India accounts for about one-third of the world's population living on less than a dollar a day. But there are other barriers to energy access in the poorest households in India, including unreliable energy service delivery, ineffective and regressive subsidies, gender discrimination in policy planning, inadequate information about the health impacts of current fuels and technologies, and administrative hurdles in getting connections.

Electricity access has improved in India – the electrification rate was 62% in 2005,[1] compared to 42% in 1991. From 499 million people with no access in 1991, the number fell to an estimated 412 million in 2005. In contrast, the number of people in India relying on fuelwood, dung and agricultural residues for cooking and heating rose, from 580 million in 1991 to 668 million in 2005.[2] India contains about one-third of all the people in developing countries who rely on inefficient, polluting fuels for cooking and heating. There are great disparities in energy access along the rural/urban divide. In rural areas, some 84% of households rely on fuelwood and dung for cooking, while only 22% do so in urban areas. Some 50% of people living in rural areas have access to electricity, compared to 90% in urban areas.[3]

When a household gains access to electricity, the normal first use is as a substitute for kerosene or biomass for lighting. To meet this basic electricity need is estimated to require 73 kWh per person per year.[4] Actual consumption will rise as per-capita incomes rise. In both the Reference and High Growth Scenarios, access to electricity and to cleaner, more efficient fuels for cooking and heating improves, but the improvements are much greater with higher economic growth (Table 20.1). In the Reference Scenario, the electrification rate in 2030 in India is 96% but nearly 60 million people in rural areas will still lack access. In the High Growth Scenario, all households in India have access to electricity in 2030.

1. This is an IEA estimate based on National Census data for India and information obtained from The Energy and Resources Institute.

2. The number of people relying on biomass has been revised since *WEO-2006*, on the basis of new data (see Box 16.4 in Chapter 16).

3. According to the 2001 Census of India, 44% of rural households and 88% of urban households had access to electricity.

4. The government's rural electrification scheme, Rajiv Gandhi Grameen Vidhyutikaran Yojana, sets minimum electricity consumption at 1 kWh per day per household, or 73 kWh per person per year (assuming five people per household).

Table 20.1: **Number of People in India without Access to Electricity and Relying on Biomass in the Reference and High Growth Scenarios** (million)

	2005*	2015		2030	
		Reference Scenario	High Growth Scenario	Reference Scenario	High Growth Scenario
Without electricity access - rural	380	274	102	59	0
Without electricity access - urban	32	2	0	0	0
Relying on biomass - rural	597	565	529	436	380
Relying on biomass - urban	71	67	51	36	15

* IEA estimate based on 2001 Census of India (www.censusindia.net), TERI for electricity access and NSSO (2007) for reliance on biomass.
Source: IEA analysis.

The number of people relying on biomass is 395 million in 2030 in the High Growth Scenario, 77 million fewer than in the Reference Scenario. But 22% of the population will still be relying on fuelwood and dung for cooking and heating in India in 2030, even with higher growth. This result highlights the urgency of implementing other strategies, such as improving kitchen ventilation and the efficiency of biomass cookstoves in poor households (Box 20.1).

Box 20.1: **Energy Efficiency of Cooking Fuels and Technologies in India**

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The most important energy service in rural areas of India is cooking, but policy efforts have been largely unsuccessful at improving the efficiency and cleanliness of this basic service. Biomass is expected to remain the main cooking fuel in rural areas over the *Outlook* period, as it is the cheapest and most widely available fuel. The energy efficiency of biomass cookstoves is, however, very low compared with other fuel options: 8% with dung and agricultural residues and 9% with fuelwood using traditional stoves, compared to 25% with coal and charcoal, and 50% to 60% with natural gas, superior kerosene stoves and LPG.

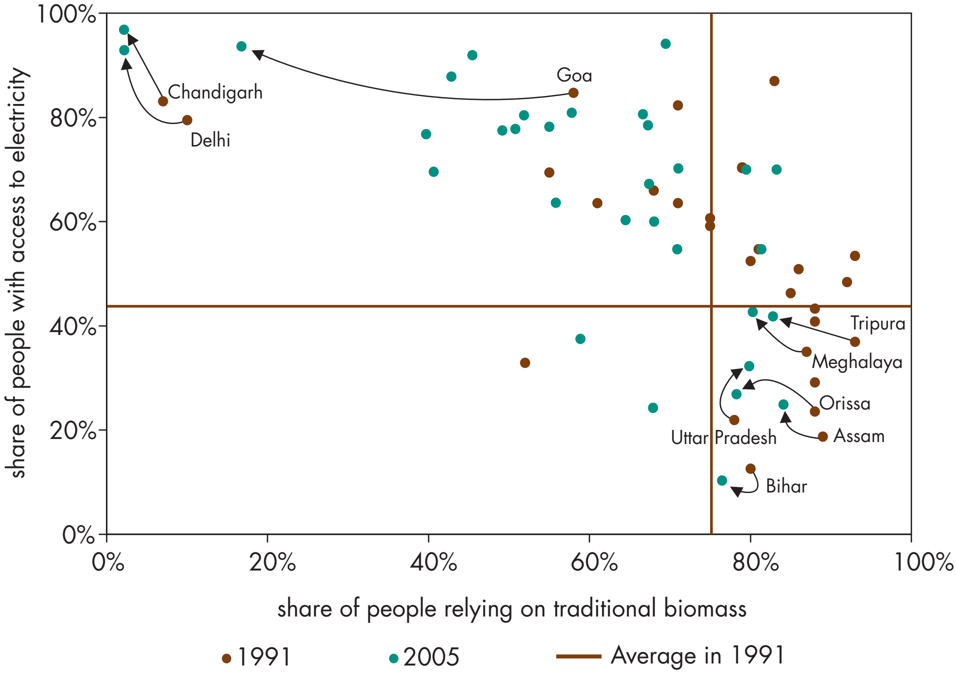
India's Energy Advisory Board report, *Towards a Perspective on Energy Demand and Supply in India in 2004/05*, for the first time postulated a target for a minimum level of energy consumption; but the report projected no major change in the relative shares of cooking fuels in rural areas. The main focus of government policy is to expand the use of improved cookstoves in rural areas. Improved stoves using traditional biomass can achieve efficiencies of 20% to 30%. In the absence of programmes to encourage switching to cleaner fuels, improved cookstoves are the most practical option for cutting smoke exposure, reducing fuel waste and lowering the burden of gathering fuel for large numbers of poor rural women and children. However, there are difficulties in encouraging households to switch to more efficient stoves, including affordability and lack of public awareness of the health impacts of burning biomass. The success of improved cookstove programmes in India has been impeded in the past by an absence of adequate training and support services, as well as a lack of market research to determine concerns of the women who would be using the stoves and their cooking habits. Another concern is the short life of the stoves, about one year for the most basic. There is wide recognition that a business model for scaling up improved cookstove programmes is required in India.

Measuring Energy Poverty

There are different approaches to measuring energy poverty (Pachauri *et al.*, 2004). We have chosen to devise an energy development index (EDI) to measure progress in the transition to cleaner cooking and heating fuels and the degree of maturity of energy end use. The index, which first appeared in *WEO-2004*, has been updated and modified to compare energy development among Indian states and union territories (UTs) and relative to other developing countries. For this *Outlook*'s EDI, we use three indicators: the share of households using cleaner, more efficient cooking and heating fuels (liquefied petroleum gas, kerosene, electricity and biogas); the share of households with access to electricity; and electricity consumption per capita. The third indicator is used to capture the level of overall energy development.

Figure 20.1 shows the change in India in two of the indicators between 1991 and 2005. The point of intersection of the two straight lines in the figure is the average share in 1991 in India of households relying on biomass, 77%, and the share of households with electricity access, 42%. The shares in each state and union territory are shown relative to this average. In Bihar, Assam, Orissa and Uttar Pradesh, access to both electricity and cleaner cooking fuels in 2005 was still below the average for India in 1991. In 2005, Tripura and Meghalaya were close to the 1991 Indian average for electricity access but still showed heavy reliance on biomass.

Figure 20.1: **Electricity Access and Reliance on Biomass in India**



The union territories have a higher energy development index on average than the states (Table 20.2). This is because the territories are much more urban and have higher GDP per capita (see Figure 14.1 in Chapter 14).[5] Goa has the highest electricity generation per capita of the states. Himachal Pradesh has the highest level of electricity access of all the states, but because most households rely heavily on biomass for cooking and heating, its energy development index is 0.44. Access to cleaner cooking fuels is much lower in all states compared with most of the richer developing countries and the union territories. An interesting case is Rajasthan where, although electricity access is relatively high, heavy dependence on biomass for cooking puts its energy development index below those of Nicaragua, Indonesia and Nigeria. Assam and Bihar have the lowest energy development indices. Not only have the poorest states experienced the lowest rates of growth in gaining access to electricity and cleaner cooking fuels, they also continue to have the lowest level of household energy use per capita (Pachauri, 2007).

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5. Although there has been a recent census on slum populations in India, energy access in slums is not included in the Indian census data for access to electricity by state and UT.

The government has focused many programmes and policies on expanding access to electricity. Except for energy subsidies, which have not had the desired effect of benefiting poorer households (see below), much less effort has been made to improve access to clean cooking fuels. The people living in Himachal Pradesh have about the same level of electricity access as Brazil but the clean cooking fuel index is about a third of Brazil's. Similarly, in Gujarat over 80% of households have access to electricity but dependence on biomass is equivalent to that of Senegal where about 30% of people have access to electricity. Bolivia has fewer households with access to electricity than ten Indian states with energy development indices which are lower overall. In most Indian states, household energy consumption patterns differ from other developing countries in that electricity access is relatively high but so is dependence on fuelwood and dung for cooking and heating.[6]

Table 20.2: **Energy Development Index***

Rank	State/UT/country	Clean cooking fuel index	Electricity access index	Electricity generation per capita index	EDI
	Malaysia	1.000	0.979	0.614	0.864
	Chile	0.894	0.978	0.594	0.822
	South Africa	0.778	0.645	1.000	0.808
	Brazil	0.874	0.951	0.383	0.736
1	Delhi (UT)	0.990	0.932	0.279	0.734
2	Goa	0.828	0.940	0.399	0.722
3	Chandigarh (UT)	0.991	0.976	0.153	0.707
	China	0.602	1.000	0.306	0.636
	Thailand	0.577	0.912	0.358	0.616
4	Puducherry (UT)	0.536	0.875	0.372	0.595
5	Punjab	0.507	0.921	0.221	0.550
6	Gujarat	0.436	0.793	0.231	0.487
7	Maharashtra	0.475	0.761	0.152	0.463
8	Sikkim	0.448	0.764	0.172	0.461
9	Andaman and Nicobar (UT)	0.572	0.753	0.051	0.459
	Bolivia	0.658	0.622	0.079	0.453
10	Haryana	0.370	0.821	0.165	0.452
11	Tamil Nadu	0.401	0.768	0.159	0.443
12	Himachal Pradesh	0.239	0.945	0.143	0.442
13	Mizoram	0.561	0.673	0.069	0.434
14	Jammu and Kashmir	0.271	0.795	0.101	0.389

6. Electricity access does not equate with regular supply (see Chapters 16 and 17).

Table 20.2: **Energy Development Index*** *(continued)*

Rank	State/UT/country	Clean cooking fuel index	Electricity access index	Electricity generation per capita index	EDI
15	Karnataka	0.264	0.772	0.110	0.382
16	Andhra Pradesh	0.262	0.646	0.130	0.346
17	Nagaland	0.392	0.606	0.020	0.339
18	Uttarakhand	0.295	0.569	0.109	0.324
19	Kerala	0.221	0.679	0.061	0.321
20	Madhya Pradesh	0.128	0.677	0.083	0.296
	INDIA	**0.265**	**0.519**	**0.102**	**0.295**
21	Chhattisgarh	0.085	0.677	0.115	0.292
22	Manipur	0.255	0.566	0.035	0.285
	Nicaragua	0.320	0.416	0.085	0.274
	Indonesia	0.216	0.482	0.090	0.263
23	Arunachal Pradesh	0.223	0.507	0.058	0.263
24	West Bengal	0.358	0.315	0.064	0.246
	Nigeria	0.297	0.398	0.015	0.237
25	Rajasthan	0.106	0.507	0.096	0.236
	Senegal	0.434	0.247	0.025	0.235
26	Meghalaya	0.118	0.373	0.084	0.192
	Cameroon	0.141	0.351	0.034	0.175
27	Jharkhand	0.257	0.168	0.089	0.171
28	Tripura	0.090	0.363	0.052	0.168
	Ghana	0.013	0.438	0.038	0.163
29	Orissa	0.141	0.197	0.125	0.154
30	Uttar Pradesh	0.129	0.253	0.044	0.142
	Bangladesh	0.099	0.254	0.015	0.123
31	Assam	0.076	0.175	0.017	0.089
32	Bihar	0.161	0.012	0.000	0.058
	Tanzania	0.000	0.000	0.004	0.001

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* To construct the EDI, a separate index was created for each indicator, using the actual maximum and minimum values for the countries covered. Performance is expressed as a value between 0 and 1, calculated using the following formula:

Dimension index = (actual value – minimum value)/(maximum value – minimum value).

The index is then calculated as the arithmetic average of the three values for each country. The *maximum values* are: per-capita electricity generation 5 375 GWh/capita (South Africa); share of biomass in residential energy demand: 91% (Tanzania); and electrification rate: 99% (China). The *minimum values* are per-capita electricity generation: 75 GWh/capita (Bihar); share of biomass in residential energy demand: 1% (Malaysia); and electrification rate: 9% (Tanzania).

Note: Table excludes the UTs of Dadra and Nagar Haveli, Daman and Diu, and Lakshadweep.

Source: IEA analysis.

Expanding Access to Electricity in India

The Electricity Act of 2003 obliges utilities to supply electricity to all areas of India, including villages. The act set out a two-pronged approach, encompassing grid extension and distributed generation. The Integrated Energy Policy 2006 also sets out an objective to provide electricity for all people in India. The greatest challenge is electrification of rural households, especially in remote villages.[7] In 2005, the Ministry of Power introduced the Rajiv Gandhi Grameen Vidhyutikaran Yojana (RGGVY) scheme, which aims to provide electricity to all villages and to all rural households by 2009/10.[8] Before a recent revision, a village was considered electrified in India if electricity was used for any purpose within its boundaries. Under a new definition, a village is considered electrified if 10% of all households have electricity. Other requirements contained in the revision include a provision for distribution transformers and lines to be made available in each village and for power to be available on demand in schools, village council offices, health centres and community centres. The RGGVY scheme is also intended to support electricity for agriculture and for small and medium-sized industries. This would facilitate overall rural development, employment creation and poverty alleviation.

According to the Ministry of Power, using their latest definition (see above), 10% of the households in all of the villages in Andhra Pradesh, Haryana, Maharashtra, Kerala, Punjab, Tamil Nadu, Nagaland and Goa have been electrified. These villages represent 18% of the total population covered under the RGGVY scheme. In contrast, less than 80% of villages in Bihar, Jharkhand, Assam, Orissa, Uttar Pradesh and West Bengal have been electrified. An estimated 380 million people in rural areas did not have access to electricity in 2005. The remoteness of villages and weak infrastructure in poorer states make electrification expensive. As a result, the government offers support for distributed generation systems through a subsidy equivalent to 90% of capital expenditure and soft loans available from the Indian Renewable Energy Development Agency.

Table 20.3 provides an estimate of the cost of providing access to electricity to the 412 million people without access in 2005. The costs are broken down for central grid, mini-grid and off-grid technologies. Off-grid diesel generators have the lowest investment cost per kW, followed by mini-grid hydro-based electrification. However, generators entail an additional annual expense for diesel of about $20 per person. Central-grid electrification involves an additional annual expense of $4 per person.

7. There is no specific plan in place for slum electrification.

8. Information about the scheme is available at http://powermin.nic.in. For a comprehensive review of this and other rural electrification schemes in India, see Modi (2005).

Table 20.3: **Costs of Electrifying Households in India**

	Central grid	Mini-grid hydro	Mini-grid biomass gasifier	Mini-grid wind power	Off-grid diesel	Off-grid photo-voltaic
kWh per household per month	30	30	30	30	30	30
kWh per person per year	73	73	73	73	73	73
Installed kW per person	0.02	0.03	0.05	0.04	0.04	0.04
Investment cost per kW ($)*	2 300	1 150	1 200	3 500	700	10 000
Investment cost per person ($)	41	31	57	133	29	417

*Including investment in transmission and distribution.
Note: Wind power and photovoltaic systems are assumed to include batteries for storage.
Source: IEA analysis.

Providing access to electricity for all 412 million people who do not yet have it would require a mix of central grid, mini-grid and off-grid options. Assuming that the investment cost per person is in the range of $40 to $60, the total investment cost would be between $16 billion and $25 billion. This is very low compared with the total power infrastructure investment needs of almost a trillion dollars in the Reference Scenario over the *Outlook* period.

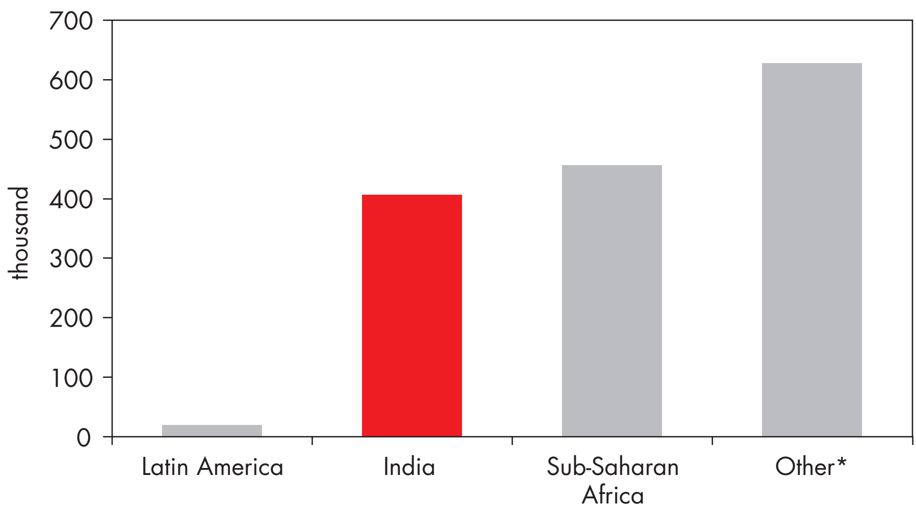
Mini-grids can serve as a node from which schools, health clinics and other public facilities can draw power. One of the main challenges facing these technologies is maintenance. Because mini-grid hydro schemes are often located in remote terrain, providing them with a steady stream of parts and skilled labour is often difficult. Solar PV technology has been successfully employed for lighting at the rural household level in India. The most common type of solar technology promoted at the rural level, however, does not have the capacity to meet the high-load mechanical applications required for agricultural processing, thus its benefits for rural development are limited. Modern biomass systems, in particular small-scale biomass gasifiers, have been successfully used for remote electricity generation in India (Aßmann *et al.*, 2006). The choice of distributed generation technology will depend largely on local conditions.

Health and Energy Poverty

There is a strong correlation between disease, such as chronic bronchitis, tuberculosis, cataracts and acute respiratory infection (ARI), and exposure to indoor air pollution (IAP) from burning biomass fuels on unventilated, inefficient stoves. According to the World Health Organization, the use of biomass for cooking and heating causes over 400 000 premature deaths per year in India (Figure 20.2). The number of such deaths in India each year is equivalent to the population of Luxembourg. Most of the premature deaths are women and children. Women, who are traditionally responsible for cooking, and children suffer most from indoor air pollution because they spend many hours by the cooking fire.

The distribution of particulate matter (PM) in Indian households using biomass is over 2 000 microgrammes per cubic metre ($\mu g/m^3$) (Smith, 2000).[9] This compares with the 150 $\mu g/m^3$ standard set by the US Environmental Protection Agency for good health. During the cooking period, levels in India are much higher and in densely populated communities, high emissions from biomass burning can result in elevated local pollution. Acute respiratory infections make up about one-ninth of the national disease burden in India and are one of the main causes of death in children under five years of age. Such infections in India are the largest single disease category in the world, accounting for 2.5% of the global burden of ill health (WHO, 2007).

Figure 20.2: **Annual Average Premature Deaths from Indoor Air Pollution**



* Includes all other countries except OECD countries, for which WHO does not assess the burden on health from ARI because less than 5% of the population uses solid fuels.
Note: Includes premature deaths among people using coal and biomass for cooking and heating.
Source: World Health Organization (2007).

9. Smith measured particulate matter (PM_{10}) 24-hour concentrations.

Blindness is also more prevalent among people living in households that use biomass than among those living in households using cleaner fuels. The effects are large and statistically significant for both men and women and for urban and rural areas. Some 18% of partial and complete blindness among persons aged 30 and older can be attributed to biomass fuel use in India (Mishra *et al.*, 1999).

Box 20.2: **Energy Poverty and Gender**

Gender issues are attaining increasing prominence in the debate in international forums on sustainable energy development. Women are much more likely to be affected by energy poverty than men. Women suffer most from the negative health impacts of cooking with biomass and from having to walk long distances to collect wood or dung for fuel. In Orissa, for example, women walk up to nine kilometres a day, carrying a load of 35 kilogrammes of fuelwood, to earn Rs 15 ($0.37) from the local sale of fuelwood.

These issues are often discussed as a separate topic rather than integrated with strategies and solutions to energy poverty. In India, the traditional approach to energy in development policy took no account of gender. The situation is changing now. The Planning Commission's Integrated Energy Policy 2006 gives some consideration to gender issues, emphasising that energy subsidies, if properly implemented, could relieve drudgery, reduce health impacts and increase productivity (Planning Commission, 2006). As the major users of biomass resources, women have practical knowledge of how different fuels burn, efficient fire management and fuel-saving techniques. Households in which women are the head are much more likely to use LPG or kerosene for cooking. But it is not just in the use of biomass resources that women have expertise. Women can become managers of fuelwood or oil-seed plantations, retailers of kerosene or LPG, manufacturers of cookstoves or managers of electricity distribution and billing.

The Indian Renewable Energy Development Agency in the Ministry of New and Renewable Energy has been tasked with increasing the participation of poor rural women in integrated approaches to cooking and health. Equal access to credit and training is essential to ensure that clean energy and electricity supplies are available for women's domestic tasks and micro-enterprise activities. Micro-credit for women is still less widely available than in Bangladesh and Nepal, for example. The Indian Working Women's Forum is trying to change this and disbursed Rs 138 million ($3.4 million) to women entrepreneurs in its 14 branches in Tamil Nadu, Karnataka and Andhra Pradesh between April 2005 and March 2006.

Subsidies on Kerosene and LPG, and the Poor

Kerosene and LPG are heavily subsidised in India, with the intended aim of shifting fuel consumption patterns away from biomass to cleaner, more efficient fuels. Since it is mostly poor households that rely on biomass and live in rural areas, the subsidies were designed to support energy access for the poor.[10] However, in practice, this objective has not been met. The current subsidy scheme gives greater benefit to the urban sector and richer households and has for the most part failed to shift fuel consumption patterns away from biomass in rural areas. The Energy and Resources Institute in India estimates that 40% of the subsidies for LPG and kerosene benefits the richest 7% of the population (Misra *et al.*, 2005). In 2006, the Committee on Pricing and Taxation of Petroleum Products reported that restricting the kerosene subsidy to households below the poverty line would reduce the quantity of subsidised kerosene by 40% (Rangarajan, 2006).

In per-capita terms, urban areas consume 20% more subsidised kerosene than rural areas (Gangopadhyay *et al.*, 2005). As the per-unit subsidy is largely the same across sectors, this means that urban areas receive more subsidy than rural areas in per-capita terms. Per-capita purchases of public distribution system (PDS) kerosene rise in line with expenditure in general in rural areas, making the rural subsidy regressive. In the urban sector, per-capita purchases of PDS kerosene peak in the middle-income groups and then slowly decline until they fall off sharply among the wealthiest group. This is largely because the higher expenditure groups in urban areas have shifted out of kerosene to LPG.

LPG and kerosene subsidies have been very ineffective in improving the welfare of the poor, particularly in rural areas.[11] There are, however, new schemes under consideration in India, including a system of energy debit cards which could be issued to the targeted households with a monthly expense limit (Planning Commission, 2006). The debit cards could be used to procure LPG cylinders without paying cash. The system would target subsidies directly to the poor. Stronger and better-targeted policies are needed for cleaner cooking fuels to reach the poorest households. Subsidies on the technology instead of the fuel have been applied in Andhra Pradesh (Box 20.3).

10. See Box 16.5 in Chapter 16 for an explanation of the kerosene subsidy scheme.

11. Kerosene subsidies have benefited the urban poor, although part of the reason for this is that richer households often give their allotment to their poor servants (Barnes *et al.*, 2005).

Box 20.3: **Deepam LPG Scheme in Andhra Pradesh**

The Deepam Scheme, launched in 1998 by the state government in Andhra Pradesh, provides LPG connections free of charge to poor households. About 1.4 million households have benefited. The oil companies who supply the refill canisters had expected demand for an average of eight to nine refills a year, but most households have been able to afford only two or three. The state government provides a subsidy of Rs 1 000 ($25) towards the connection, but does not subsidise the cost of a refill, which is around Rs 250 ($6) per cylinder. There are strong arguments for subsidising the connection to LPG rather than the fuel itself, but many households have reverted to using traditional biomass for cooking. The state government has introduced smaller, 5-kg LPG cylinders, which require a deposit of only Rs 500 ($12) and a refill cost of Rs 100 to Rs 150 ($2.50 to $3.70). It is hoped that the smaller cylinders will lead to more regular consumption of LPG by the poor, especially in rural areas, at a lower cost to the government for subsidies.

Other policy measures can promote switching to LPG, such as campaigns to enhance public awareness about the health benefits of reducing exposure to indoor air pollution from burning fuelwood, dung and agricultural residues in unventilated stoves. Cleaner cooking fuel schemes should focus first on those areas where the availability of free or cheap biomass is diminishing. This will concentrate limited financial resources on those households already motivated to seek alternatives.

The economic, social and environmental benefits of expanding access to clean cooking fuels are so large (UNDP, 2006) as to justify an integrated approach that cuts across all sectors. The challenge of scaling up successful pilot projects in India is huge, first involving systematic evaluation of advantages to identify the most successful and then widespread communication of the results. More efforts are necessary to delegate to local governments, local communities and women the responsibility for delivering energy services.

Energy Demand in Slums

Slum areas in India's major cities are growing. Despite this, there is no specific federal programme in place for extending energy access to the urban poor. The first-ever census of slums in India was undertaken in 2001. Slum data were reported by 26 of the 35 states and UTs. Some 43 million people lived in slums in 2001, about equivalent to the entire population of Spain. Those in slums constituted 15% of the total urban population and 22.6% of the urban population of the reporting states and UTs. Some 11 million of the total slum population lived in Maharashtra, followed by Andhra Pradesh (5.2 million), Uttar Pradesh (4.4 million) and West Bengal (4.1 million). The Greater Mumbai Municipal Corporation, with 6.5 million slum dwellers, had the highest slum population, followed by Delhi, Kolkata and Chennai. In Mumbai, more than 50% of the population lives in slums (Table 20.4). A survey by the National Sample Survey Organisation in 2002 recorded 52 000 slums in Mumbai. These contain only half the poor – the others live on the streets.

Very little information is available about energy use in slums. The 2001 Census indicates that almost all major slum areas have some electricity, but it is mostly used only for street lighting. Households in officially recognised slums are much more likely to have electricity connections, though most do not. A study by the United Kingdom's Department for International Development (DFID) reveals that infrastructure facilities in Delhi slums are sorely lacking; only 15% of slum households have drinking water, electricity and latrines in their premises (USAID, 2006). Less than 25% of them have sanitation systems. Access to modern energy services is undermined by imprecision over property rights or their total absence. Households without an address often cannot qualify for subsidised kerosene or electricity.

Despite low incomes, reliance on fuelwood for cooking is lower in urban slums than in rural areas because fuelwood, as a scarce resource, is often more expensive than subsidised kerosene.[12] Slum dwellers who are able to obtain a ration card for cooking fuels are likely to use kerosene. The priority uses of electricity are for lighting and for fans for cooling in hot seasons and for controlling mosquitoes.

According to the DFID study, about half of slum households in Delhi had illegal electricity connections. An illegal connection is not necessarily a free connection. Slum dwellers who depend on informal methods for acquiring electricity are vulnerable to exploitation by various middlemen, who charge high prices. It is not uncommon for slum dwellers to pay higher rates for electricity and water than most middle-class residents in their city. In Mumbai, pavement dwellers working with the National Slum Dwellers Federation paid Rs 300 ($7.50) a month for an illegal electricity connection.[13] For a cost of about Rs 900 ($22.40) per household, they could obtain a legal connection and a meter, with the result that their monthly costs would fall to about Rs 100 ($2.50). Willingness to pay for a legal connection is high among those with illegal connections.

Sound policy requires more knowledge of slum energy demand in India. The 2001 Census is a step in the right direction, but more information is needed.

12. Barnes *et al.*, (2005) confirmed that fuelwood use in Hyderabad is not an important household fuel, except in the poorest households, and even these use a significant amount of kerosene for cooking.
13. For more information see documentation from the National Slum Dwellers Federation, available at www.sparcindia.org.

Table 20.4: **Cities with More than One Million Inhabitants and Share of Population Living in Slums**

	Population (million)	Share in slums (%)		Population (million)	Share in slums (%)
Greater Mumbai, Maharashtra	12	54	Bhopal, Madhya Pradesh	1.4	9
Delhi	9.9	19	Ludhiana, Punjab	1.4	23
Kolkata, West Bengal	4.6	33	Patna, Bihar	1.4	0.3
Chennai, Tamil Nadu	4.3	19	Vadodara, Gujarat	1.3	14
Bengaluru, Karnataka	4.3	10	Agra, Uttar Pradesh	1.3	10
Hyderabad, Andhra Pradesh	3.6	17	Thane, Maharashtra	1.3	28
Ahmadabad, Gujarat	3.5	14	Kalyan-Dombivli, Maharashtra	1.2	3
Surat, Gujarat	2.4	21	Varanasi, Uttar Pradesh	1.1	13
Kanpur, Uttar Pradesh	2.6	14	Nashik, Maharashtra	1.1	13
Pune, Maharashtra	2.5	20	Meerut, Uttar Pradesh	1.1	44
Jaipur, Rajasthan	2.3	16	Faridabad, Haryana	1.1	47
Lucknow, Uttar Pradesh	2.2	8	Pimpri Chinchwad, Maharashtra	1	12
Nagpur, Maharashtra	2.1	36	Haora, West Bengal	1	12
Indore, Madhya Pradesh	1.5	18			

Source: Census of India (www.censusindia.net).