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## Conclusions and Recommendations

5.1 The foregoing chapters have described the status of the kerosene and LPG markets in India, rural and urban household fuel use patterns as reported in the NSS, and estimates of the impact of phasing down kerosene and LPG subsidies and of a handful of mitigation measures. This chapter compares the findings with those from other countries, and considers the implications given the international price trends of these two fuels in recent years and the market structure in India.

### Evidence from International Experience

5.2 It is useful to look to the experience of other countries that have attempted to promote household use of hydrocarbon-based fuels. The standard approach is to change relative fuel prices by fiscal means. Worldwide, a number of countries, particularly oil producing countries, have had zero or negative taxes on kerosene and other fuels such as diesel and LPG. Countries that subsidize LPG include Côte d'Ivoire, Ecuador, India, Senegal, and Venezuela. LPG subsidies, however, typically benefit middle- and higher-income families in urban areas, and hence are not pro-poor. Some countries have made efforts to make LPG subsidies more pro-poor. For example, Côte d'Ivoire and Senegal have specifically targeted their subsidies at smaller cylinders to make each refill more affordable, promoting the use of 6 kg and smaller cylinders as opposed to the more commonly used 12.5 kg cylinder. However, despite the subsidy (about 25 percent, as of December 1999) making unit costs lower for cylinders smaller than 12.5 kg, consumers in Côte d'Ivoire have not switched to 6 kg cylinders: in 1999, less than 10 percent of LPG was sold in the subsidized 6 kg bottles. In Senegal, 2.75 kg and 6 kg cylinders have historically been heavily cross-subsidized by larger cylinders, and LPG has become the principal cooking fuel for many urban households. However, the urban poor still find (subsidized) LPG expensive, using instead charcoal, which is cheaper and can be purchased daily. The government of Senegal is now in the process of phasing out its LPG subsidy entirely because of its high fiscal cost.

5.3 Worldwide experience shows that it is extremely difficult to use subsidies to induce the poor to switch to kerosene or LPG for cooking. The task is virtually impossible where free biomass is available and time is unconstrained because of the absence of income-generating opportunities. Only when biomass becomes a commodity traded for cash, typically in urban and peri-urban areas, do the poor begin to consider alternative fuel options. Even so, the poor find fuels that can be purchased on a daily basis, such as kerosene or charcoal, more affordable than LPG, which can be purchased only one cylinder at a time. Add to this the higher start-up cost of LPG and its higher price relative to kerosene or charcoal, and LPG is out of reach for the poor.

5.4 Kerosene merits special consideration because it is used for lighting by the poor. Absent a reliable source of electricity, making kerosene available and affordable to poor nonelectrified households has been considered important by many governments. However, no developing country government has been able to develop a successful kerosene subsidy scheme to set an example to follow. Subsidies need to be sizable to induce the poor to take up kerosene, but a large kerosene price subsidy leads to both massive leakage and lack of fiscal sustainability. A coupon scheme, which in principle can allow better targeting and be effective for some goods, does not seem to prevent or significantly reduce kerosene leakage as illustrated by the experience of Nepal. In another example, kerosene was heavily subsidized in Peru from the 1950s until 1991, when the subsidy was withdrawn. During this period, kerosene became the cooking fuel of choice among many households. Subsidized kerosene was not rationed, and a substantial amount was diverted to the automotive diesel sector or was smuggled out of the country. As in India, petroleum product subsidies in Peru amounted to billions of dollars by the late 1980s, eventually leading the government to withdraw the subsidy and liberalize the market. Today, significant private sector participation has made LPG available at competitive prices in large and medium-size cities, with the result that LPG has become the fuel of choice.

5.5 The findings of this study are broadly consistent with those of a series of studies conducted in mainly rural Mexico (Masera and others 2000), (. The researchers found that the exclusive use of fuelwood for cooking tended to be concentrated among low-income households. When households began using LPG, in rural areas they almost never abandoned fuelwood, such that nearly all households that were using LPG were multiple-fuel users. Furthermore, mixed fuel (fuelwood and LPG) users tended to consume more overall energy than fuelwood-only users. As a result, the fuelwood savings from adopting LPG, which ranged from 0 to 35 percent, were much smaller than would have been expected if fuel substitution alone had occurred.

5.6 In the Mexican study (Masera and others 2000), surprising results were found when smoke was measured during cooking. Ambient concentrations of particles smaller than 7 microns were measured around the cook. (In terms of health impact, the smaller the particle the more damaging it is. Particles smaller than 7 microns are therefore suitable for estimating the adverse impact of indoor air pollution on public health.) The average particulate concentration did not decrease consistently as income rose. In fact, the average concentration among the

lowest-income households was 450  $\mu\text{g}/\text{m}^3$ , but this rose to 845  $\mu\text{g}/\text{m}^3$  among the most affluent households where the highest proportion of LPG usage was found. While these findings need to be interpreted with caution because of the small sample size, they nevertheless illustrate the point that air pollution levels do not necessarily decrease monotonically with increasing wealth or by the simple expedient of adopting LPG. The researchers offered several possible explanations for these household pollution measurements results. For example, as income rises the kitchen area is more frequently separated within the house, and some affluent households also will remodel the kitchen, using materials that do not permit as much air flow: for example, replacing wooden walls with cement walls.

5.7 In some countries, governments do not subsidize LPG directly but use moral suasion to prevent retail prices from rising too high. One consequence of setting an arbitrary price ceiling that is unrelated to the international price is that such a move discourages investment in importation infrastructure by constraining the ability to recoup that investment, resulting in LPG supply shortages. This points to the importance of allowing market-determined prices to test consumer willingness to pay and of allowing market forces to equilibrate supply and demand.

5.8 Some governments also require all LPG distributors to supply a certain fraction of their total sale to “remote areas.” This tends to result in an inefficient and costly distribution system, because it is difficult for any one firm to take advantage of economies of scale. If supply to remote areas is a legitimate concern, it may be better to introduce a bidding process whereby a time-bound exclusive right to supply a remote area is given to one (or two) supplier(s) according to performance-based criteria, rather than to require every LPG distributor to supply a mandatory percentage of their product to these areas.

5.9 Reducing the start-up cost is another way of easing the transition to petroleum, and especially gaseous, fuels. The Government of Senegal began its LPG promotion program by removing all import duties on 2.75 kg LPG cylinders and on the cookers designed for these cylinders. In Guatemala, LPG dealers offer installment plans for the cylinder deposit fee and stove purchase. While it actually increases the total payment for start-up, this payment scheme helps households with cash constraints to take up LPG.

5.10 With respect to reducing the start-up cost, the Deepam scheme launched by the State Government of Andhra Pradesh (GoAP) in July 1999 offers some useful insights. Under this scheme, the GoAP agreed to cover the cylinder connection fee of Rs 1,000 for 3 million women from BPL households who are members of self-help groups. The scheme covers only LPG sold by state oil companies. The Deepam scheme differs from the central government’s LPG subsidy in several respects. First, it is a one-off subsidy, covering the connection fee rather than the fuel purchase. Second, it is a targeted subsidy scheme for which only BPL households are eligible. Third, the program especially concentrates on rural areas, with the majority of recipients selected from these areas. Last, it is implemented through women self-help groups which have helped their members to overcome the upfront cost barrier of LPG uptake by providing credit for the purchase of LPG stoves and accessories (amounting to some Rs 1,000).

5.11 A review of the Deepam scheme conducted in 2001–02 (Rajakutty and others 2002) for the previous ESMAP study found that the Deepam Scheme had successfully facilitated the uptake of LPG by the rural poor in Andhra Pradesh, with 1.7 million connections released by February 2002. However, the review also found that biomass remained the main cooking fuel for most Deepam beneficiaries, and especially for the cash-strapped rural households that could not easily afford the relatively high cost of LPG refills. While in principle microcredit schemes may help with LPG purchase, and while self-help groups are ideally suited for microcredits, the groups under the Deepam scheme did not consider this a priority (this is consistent with the general observation that microcredit schemes are most effective when used for production rather than consumption). Among such rural households LPG use was confined to incidental use, such as for making tea or preparing meals for unexpected guests. LPG was most extensively consumed during the monsoon season, which coincides with the beginning of the agricultural season: at this time more cash is available to agricultural laborers, who earn regular wages during this period; less labor is available as a result for firewood collection; and keeping biomass dry is difficult. On average only 2.6 kg of LPG per month per household was consumed by rural Deepam beneficiaries, which is not nearly enough to meet their cooking requirements. The limited use of LPG diminishes the health and other social benefits of LPG uptake as well as the potential for establishing commercially viable LPG markets catering to these poorer households.

5.12 Predictably, LPG consumption was higher among urban households that had higher cash income and limited access to cheap biomass. To facilitate the uptake of LPG, it is important that the targeted beneficiaries can afford regular refills and that they regard this expense as a priority. Those who are too poor to buy LPG regularly may be tempted to take advantage of the cylinder subsidy, but make limited use of it. Overall, the Deepam scheme facilitated the uptake of LPG but failed to encourage substantial and sustainable use by its intended primary beneficiaries, the rural poor, raising questions about its effectiveness.

5.13 In summary, a review of international experience points to two important observations. First, no good example of an effective subsidy scheme for LPG or kerosene has been found. Subsidies to reduce the price of these fuels commonly have resulted in significant leakage and/or mistargeting; the Deepam scheme furthermore has highlighted the limitations of encouraging the poor to use LPG with the help of targeted capital subsidy. Second, the approach that emerges as most sustainable in the long run for the purposes of expanding access and improving the quality of service is to create an open and competitive market with clearly defined and well-enforced rules and regulations for all participants.

5.14 The use of natural gas as a household fuel is limited in India, although its use can potentially expand in the future given recent large gas discoveries. Establishing a distribution system for households is expensive, but it is worth considering the many advantages of natural gas. Aside from electricity, natural gas is the cleanest commercially viable household fuel. Its greatest drawback is the fact that it is primarily viable only for urban and peri-urban areas, because laying down distribution networks to rural areas would in most cases be prohibitively

costly. It nonetheless can serve a useful purpose by supplying a large number of urban households; and with growing urbanization, the percentage of the population that can be served by natural gas will increase. Where indigenous sources of natural gas exist, as in some parts of India, it can be far cheaper than LPG or kerosene. Except where electricity is specifically required, it is perhaps the only fuel that can meet all the energy needs of the urban poor, including heating. Targeted subsidies are also easier to construct, because it is more difficult to “divert” natural gas piped to the household than it is to divert kerosene or LPG. The simplest approach would be to structure the tariff so that there is a small first block, enough to meet the cooking and limited amount of heating needs of poor households, at a (low) “lifeline rate.” This first block could be cross-subsidized by higher blocks so that the scheme entails no government subsidies. Analysis of household use of natural gas in Pakistan indicates that a reasonable first block can cover about 25 to 30 percent of all consumers and those who consume less than the first block limit consume only about 5 percent of the total gas sale to households.

### **Summary of Observed Fuel Use Patterns and Impacts of Policy Alternatives**

5.15 The findings of this study are broadly consistent with observations made in other countries. The majority of households in rural areas and many urban households use multiple energy sources for cooking and lighting. In 1999–2000, the use among the urban poor of LPG and kerosene as primary cooking fuels was found to be limited, and among the rural poor to be essentially nonexistent. Kerosene was used as the primary lighting fuel by the majority of rural households.

5.16 The price subsidy for LPG accrues disproportionately to the urban rich, and is difficult to justify on equity grounds. The kerosene subsidy is subject to massive leakage, with as much as half of the subsidized kerosene being diverted to the black market and to other sectors such as transport. In 1999–2000, this leakage amounted to Rs 40 billion (about US\$ 1 billion) of public funds that did not reach the intended beneficiaries. The kerosene subsidy that actually reaches households benefits the poor more than the nonpoor, but given the level of diversion the cost-effectiveness of the subsidy is low.

5.17 Nationally, three-quarters of all households were using biomass in 1999–2000. In rural areas this level of usage had remained virtually unchanged since 1993–94, with more than 90 percent of rural households using wood, dung, or both. Mirroring the findings in other countries, wood consumption by rural households rose with increasing income, so that boosting income alone would not help to reduce wood use. Close to 60 percent of all rural households were using cash-free wood in 1999–2000. In short, supply conditions in rural areas favor biomass because of the low labor costs in such areas and the ready availability of fuel. This suggests that it would be difficult to design a fiscally sustainable pricing policy that would promote fuel switching from biomass to petroleum fuels in rural areas.

5.18 In contrast, over the same period in urban areas biomass use declined markedly and kerosene consumption also fell, largely in favor of LPG. In 1999–2000, one-third of all urban households were still using biomass, but the proportion of households relying on cash-free

wood was 7 percent, considerably less than the corresponding figure in rural areas. About one-fifth of urban households, including one-third to one-half of the urban poor, were paying on average Rs 100 per month to purchase wood. With continuing urbanization and the increasing scarcity of biomass, wood prices are likely to rise, obliging this group of households to pay more for their fuel and potentially driving them to use modern fuels. This suggests that targeted interventions are likely to meet with greater success in urban and peri-urban areas than in rural areas. Growing urbanization in India also means that those households that are potential candidates for fuel switching will increase as a percentage of the total population.

5.19 In 2002–03, the Ministry of Finance initially provided Rs 45 billion for kerosene and LPG price subsidies. Because of the rising international oil price this proved to be inadequate, and the actual subsidy figure was more than Rs 100 billion, of which the government agreed to pay Rs 63 billion (Business Standard 2003a). Clearly, this situation is not sustainable. Given the enormous sum of public funds involved, coupled with a remarkably high leakage (about half) of the PDS kerosene subsidy and a highly regressive distribution of the LPG subsidy, it is worth seeking alternative uses of this money that from the point of view of increasing public welfare generate higher returns, such as, for example, improving and expanding the provision of basic health care and education, or improving the supply of safe water and sanitation. The subsidy figure of Rs 63 billion for fiscal 2002–03 was the same order of magnitude as the entire central government's spending on education (the Central Plan allocation for education was Rs 62 billion, of which Rs 43 billion was set aside for primary education (The Tribune 2003)), and was markedly higher than the Rs 4 billion allocated for rural employment programs (The Hindu 2002).

5.20 Phasing down subsidies will diminish the ability of the urban poor and low- and middle-income households to use LPG or kerosene as their primary cooking fuels. It is, however, difficult to overlook the problems associated with the current subsidies. There are other means to help these households. Promoting the uptake of LPG and kerosene is a challenge that needs to be addressed, but not necessarily through a government-funded fuel subsidy (see the recommendation section below).

5.21 In the case of lighting, those without connection or a reliable electricity supply have little choice but to continue using kerosene. The amount of kerosene used for lighting is about 4 to 5 liters a month. If the kerosene subsidy were to be eliminated altogether, it could lead to a price increase of Rs 7 per liter (at the international oil price as of February 2003, when oil prices were high). This would translate to an incremental cost of Rs 28 to 35 per month per household, or about an additional 2 percent as a share of the total expenditure of a BPL household. Assuming a world crude oil price that is more representative of historical averages, the impact would be smaller. It is not obvious that this modest amount justifies the current subsidy, half of which is diverted to nonintended users. In the longer term, this issue is expected to be addressed by the improving access to and better quality of electricity services.

5.22 Cash transfer to the poor to compensate for subsidy phase-down or elimination, normally a sensible policy on account of the freedom of choice it gives to recipients, does not

seem suitable for promoting a shift in cooking fuel use toward hydrocarbons. Limited modeling, consistent with international evidence, indicates that the urban poor and all rural households conversely may use more wood if a modest amount of cash is given to them.

5.23 Generally, no effective subsidy mechanism for kerosene or LPG seems to exist. Neither analysis of consumer energy choice in India nor international experience points to any viable subsidy scheme for these petroleum fuels. This is because both kerosene and LPG have attractive alternative uses by the nonpoor (such as vehicle owners), while the poor have other cash expenditure needs that they consider a higher priority than conversion to modern cooking fuels when traditional biomass is widely available. LPG in particular is strongly favored by the rich as a cooking fuel. Any subsidy for these fuels, regardless of its design, therefore is subject to significant leakage, mistargeting, or both. In addition, unlike water, electricity, or natural gas networks, access to which is predicated on the larger community choosing to establish the necessary supply infrastructure, with the decision often taken by the government, the distribution of kerosene and even LPG relies on the individual household's decision and its ability and willingness to pay for the start-up (stove and cylinder) and operating (fuel) costs. The ratio of operating to start-up costs furthermore is much higher for kerosene and LPG than it is for water, electricity, or natural gas, thus limiting the effectiveness of subsidizing the start-up costs for the poor, as illustrated by the Deepam scheme. All these factors compound the difficulties of designing a subsidy to facilitate a shift to kerosene or LPG by low-income households.

5.24 Given the merit qualities of cleaner household energy, the social benefits (health and time savings for women and children) of partial fuel switching, whereby wood continues to be used and only partially substituted by kerosene or LPG, need to be better understood. For example, the health benefits of smoke-free indoor air that could be realized through the full abandonment of traditional biomass fuel use are likely to be compromised by partial fuel switching, but the effects of different combinations of fuels and stove technologies are little understood. Benefits from time savings, however, are more broadly in line with the amount of biomass used, and accrue to women even with partial fuel switching (time savings were the most significant benefit cited by the Deepam beneficiaries). Furthermore, to the extent partial fuel switching is the first step toward full fuel switching and may accelerate the latter, it may warrant efforts to promote it even if the immediate social benefits are limited.

## Recommendations

5.25 **There is a strong case for phasing out the LPG price subsidy.** Aside from equity considerations, subsidy phase-down and eventual elimination would remove an important obstacle to the development of a vigorous LPG market: the unequal treatment given to private versus public sector LPG marketers. Creating a market environment in which fair, healthy, and transparent competition flourishes is the most effective way to enhance efficiency and to pass the efficiency gains to consumers, and thus to expand the supply and availability of LPG. What is important is the introduction of full competition on a level playing field: international experience demonstrates abundantly that nothing forces the oil industry to innovate, increase efficiency,

improve corporate governance, and increase quality of service as much as intense and relentless competitive pressures. At a minimum, such a market environment should help to make more LPG available to those households that are able and willing to pay to switch to LPG. A competitive market also would encourage market innovations and experimentation with different schemes to help low-income households to take up LPG, such as the marketing of smaller cylinders and the introduction of installment plans for the purchase of the LPG cylinder and stove—or even LPG refills if a commercially viable scheme can be designed.

5.26 **Despite some equity concerns, there is a strong case against the policy of universal price subsidy on rationed PDS kerosene.** Kerosene is too close a substitute for automotive diesel to maintain an effective price subsidy. (In some parts of North America, kerosene and diesel are in fact identical in chemical composition and differ only in labeling.) In India, the dual system of kerosene marketing further exacerbates leakage. Subsidy removal would end rationing and supply shortages and would give greater incentives to private marketers of kerosene to establish dealerships in areas where there is demand

5.27 The conclusions of this study therefore lend support to the announcement by the Ministry of Finance in June 2003 that the LPG and kerosene subsidies will be phased down in three years and eliminated by April 2006 (Business Standard 2003d). It should also be noted that there are ways to ease the impact of subsidy phase-down on consumers. Given the subsidy framework in India, subsidy phase-down would be easier for the government when international prices are low, when the subsidy element is small and the impact on households of the phase-down correspondingly small. When international prices are falling, by maintaining end-user prices constant the government may be able to effectively shrink the subsidy component to the point where its removal results in little or no price increase. The three-year period proposed by the Ministry of Finance gives, in principle, sufficient opportunities to implement this approach and eliminate subsidies in a smooth manner, avoiding large price shocks for consumers.

5.28 **There is a clear need to identify options other than LPG and kerosene subsidies to promote cleaner household energy, inside and outside the petroleum sector, that are effective and viable.** The prospects for fuel switching by households and for effective government interventions are distinctly different for urban and rural areas. Access to free or cheap biomass fuel and the availability of income-generating opportunities for those spending time on biomass collection and cooking are critical factors in determining consumer choice. These factors more strongly favor a shift to petroleum fuels in urban than in rural areas. To the extent biomass is traded for cash or has clear opportunity costs in rural areas (such as during harvesting or during the monsoon season), it also influences fuel choice, but on a much smaller scale both in terms of the percentage of households affected and in terms of the relative share of commercial fuels in the total household energy mix. The following are some possible solutions and approaches taking account of these urban/rural differences.

- **For LPG and kerosene, the best way to promote access and uptake in the long run is to liberalize the downstream petroleum market.** To this end, a necessary step is to

phase out subsidies which cause market distortions, impede new entry and competition, and slow down the development of efficient markets.

- **An important role of the government is to establish and enforce adequate technical and safety standards, and ensure consumer protection**, especially against under-filling of LPG cylinders. This merits special attention in the early days of rapid LPG market development, as international experience suggests that in a market with a large number of operators and little enforcement, accidents and commercial malpractice can become common.
- **There are significant opportunities to facilitate a shift away from traditional biomass to clean fuels in urban and peri-urban areas, including among the poor.**
  - Urban and peri-urban households would be among the primary beneficiaries of a fully liberalized, competitive market for LPG and kerosene, which would increase uptake among those who are able to pay.
  - There is scope for expanding the market for these fuels through the use of incentives for low-middle-income households. Neither kerosene nor LPG is likely to become the primary cooking fuel of the poor. There are, however, households that are higher on the income ladder that would consider switching to LPG if they could afford the cylinder connection fee. Market-based schemes to help these households pay for the start-up cost of LPG could be effective. Importantly, these schemes are more likely to be implemented in a competitive market.
  - For those poorer urban and peri-urban households that cannot afford LPG or kerosene but purchase wood for cash, improved (cleaner and more efficient) biomass stoves and fuels (such as biomass waste briquette technologies) may be a cheaper attractive option.
  - In the long term, promoting the use of natural gas in cities with gas pipelines merits consideration, particularly in view of the recent gas discoveries in eastern India. Establishing a distribution network for households is expensive. Nevertheless, natural gas is well suited for a targeted subsidy: diversion is difficult and there is the option of cross-subsidizing a small first block (lifeline tariff) by higher blocks. The gas tariff structure should be carefully designed to allow the urban poor to use natural gas to meet most of their household energy needs without unduly subsidizing middle- and upper-income households.
- **Rural areas are more difficult to deal with and require a concerted multi-sectoral approach over a long period of time.**
  - Establishing an open and competitive market of petroleum fuels would help, even though to a smaller extent than in urban areas.

- Fostering economic growth, employment opportunities (particularly for women), and rural infrastructure development, important in and of themselves, have the collateral benefits of also facilitating fuel switching.
- Accelerating the viable expansion of rural electrification is of special importance, because it would both reduce the need for kerosene for lighting and has been found in a number of countries to be strongly correlated with the uptake of clean fuels for cooking.
- Given that biomass will continue to remain the main practical option for rural India in the foreseeable future, the promotion of cleaner biomass-based household energy products, such as biomass briquettes, biogas, improved stoves, and other appliances, needs to be given greater attention. To be sustainable, however, solutions to the rural household energy problem should be demand-driven and commercially oriented. In particular, it is important to determine what types of biomass-based and other clean energy technologies are likely to work for different economic circumstances and household preferences. Any technological alternatives to free or cheap traditional biomass will be widely adopted only if the incremental costs are affordable and are outweighed by tangible nonmonetary benefits valued by the user.
- In facilitating a long-term shift to clean household fuels and other energy technologies, it is important to identify and target areas where the likelihood of achieving a switch is higher. These include areas that have limited free biomass, so that many households must purchase wood for cash; that have electrified houses; and that have sufficient income-generating opportunities for households to be able to purchase commercial energy products and services on a regular basis.

**5.29 Raising public awareness about the health costs of traditional energy would further facilitate the uptake of clean fuels.** One of the most important and effective roles that the government could perform is to educate the public about the health impacts of traditional household energy, the benefits of using cleaner fuels, and the benefits of other options, such as the use of more efficient stoves. In the early stage of consumer education, the government may even consider providing seed money for the research and development of more efficient, more durable stoves. Public awareness of the adverse impact of indoor air pollution could encourage households to reduce their exposure to smoke emissions and could encourage those who can afford, such as higher-income households in rural areas, to switch out of traditional biomass, to seriously consider switching to kerosene or LPG, or to switch to biomass-based clean technologies for cooking.