Reforming Kerosene Subsidies in India: Towards better alternatives

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Executive Summary

Kerosene in India is primarily available as a subsidized commodity for household use, and was added to the basket of Public Distribution System (PDS) commodities during the 2nd Five Year Plan (FYP). Kerosene has been continued as a subsidised fuel to provide affordable cooking and illumination (lighting) to households for the last 60 years. However, the subsidy program in its current form is marred by high levels of leakage in the distribution of subsidized kerosene. With efficient alternatives emerging to provide the end services being met by kerosene, continuing to subsidize it may not be the most efficient use of fiscal resources. This study aims to address the key question of **how to best rationalize the kerosene subsidy** to improve the government effectiveness as well as provide the maximum benefit to the households spending on the fuel.

To answer this broad question, we first analyzed the current role and use of kerosene in Indian households, using National Sample Survey (NSS) data on consumer expenditure, Council on Energy, Environment and Water's (CEEW's) primary survey on energy access (ACCESS), and findings from field studies conducted in urban-poor sections of two cities, namely Kanpur and Bengaluru. Next, we analyzed the inefficiencies in the current delivery system, using the ACCESS survey data.[1] Subsequently, we conducted a comparative economic analysis of kerosene vis-à-vis alternatives. Finally, based on the economic analysis, we conducted a series of semi-structured interviews with various stakeholders, including representatives from the kerosene wholesale dealers' association, off-grid entrepreneurs, the Department of Food and Civil Supplies at the state level, the Ministry of Petroleum and Natural Gas, and the Ministry of New and Renewable Energy, to chalk out pathways for a transition toward better alternatives.

Kerosene Subsidy in Its Current Form Is Highly Inefficient

1. High levels of leakage in the distribution of PDS kerosene leads to significant inefficiency. Only 49 per cent of the PDS kerosene actually reaches the households at a subsidized price. About 34 per cent of the subsidized kerosene never reaches the household.
2. **Even at subsidized prices, households end up spending an exorbitant amount of money to get very poor end service**, especially in case of lighting, which is by far the predominant use of the fuel in rural India. In the case of cooking, which is the common end use of kerosene among urban-poor households, the amount of subsidized fuel available does not meet their entire needs, and so households spend a significant amount of money to meet their cooking energy needs as well.
3. Rural households spend INR 50–120 per month to meet their lighting needs from kerosene, with a median expenditure of INR 80. In comparison, urban households using kerosene for cooking (along with other fuels), spend anywhere between INR 400–800 per month, with expenditure even above INR 1500 per month in some cases.

Thus, in the contemporary context, **subsidizing kerosene essentially fails to meet the objective of providing affordable cooking and lighting service to households**, given the poor level of service associated with its end use.

The use of kerosene for lighting and cooking is not only inefficient, but in fact is even hazardous to human health, due to the resulting emissions and exposure to it. **Thus subsidizing kerosene, not only fails to meet its primary objective, but also poses a significant public health burden on the overall economy.**

[1] CEEW conducted the largest primary survey on energy access among rural households in India with the aim of understanding energy consumption patterns for cooking and lighting, as well as household perceptions on transitioning to cleaner fuels. The Access to Clean Cooking energy and Electricity: Survey of States (ACCESS) study is available at http://ceew.in/pdf/CEEW-ACCESS-Report-29Sep15.pdf. The study for further reference in this study is referred to as the ACCESS study and referenced as *Jain et al. 2015*.

Continuing to subsidize kerosene reflects the state's failure to provide basic services of electricity and clean cooking. While the government continues to improve the provisioning of these services through the conventional centralized approaches of grid electricity and liquefied petroleum gas (LPG), it is important to recognize the opportunity to transition toward other alternatives, which currently can provide a more cost-effective and improved end service to the households compared to kerosene. A techno-economic analysis of kerosene and alternatives to meet the same end needs suggests that **transitioning away from subsidized kerosene would be economical for both households as well as the government,** while providing better end service to the deprived population.

In the case of lighting, **transition to alternatives could accrue net savings worth INR 8,000–12,000 crore per annum for the lifetime of the alternative**. The lower bound of savings indicates the scenario, where alternatives are provided with a capital subsidy equivalent to a year's worth of kerosene subsidy. The saving also would vary depending upon the international oil prices. In the case of cooking, transitioning households currently using kerosene for cooking to LPG would mean an additional expenditure worth INR 600 crore per annum by the exchequer, in terms of LPG subsidy. However, such a transition would still make economic sense for the government, as it would meet all the cooking energy needs of households—which the kerosene subsidy in its current form does not. It would also eliminate the ill effects of using kerosene for cooking.

While there is a clear case for alternatives to replace kerosene for its end services, such a transition would need to be cognizant of the following realities and plan accordingly.

Alternative Lighting Solutions: Off-grid lighting

Three main challenges need to be addressed in order to achieve an effective and sustained transition toward alternative lighting solutions. First, the high upfront cost of alternatives for the households limit their affordability. Second, limited and poor maintenance/after-sale services lead to unreliable service delivery. Third, pure market-driven penetration excludes poor and very poor households (lack of universal coverage).

These challenges could be addressed through: (i) financing or capital subsidy provision for the alternatives; (ii) an adequate incentive structure for off-grid players to provide lighting as a service, rather than as an appliance/product; (iii) regulating and/or incentivizing off-grid players to provide universal coverage. In addition, the off-grid sector as a whole would need to enhance its capacity exponentially to cater to more than 100 million rural households who currently rely on kerosene for a part or all of their lighting needs. This would require significant capacity building across various levels and multiple dimensions.

Clean Cooking Provision: LPG

Four main challenges currently limit the access and use of LPG in poor households, especially among urban-poor households. First, there are many bureaucratic hurdles to getting a legal connection arising from the issue of unauthorized slum areas and other administrative problems. Second, the high upfront cost of a LPG connection limits many households' ability to get one. Third, the upfront payment for a LPG cylinder—which is high due to the large cylinder capacity—leads to irregular or non-sustained use of LPG for cooking and continued reliance on traditional fuels (which cause indoor air pollution). Fourth, there are significant safety issues pertaining to handling and use of LPG in congested urban-poor spaces.

These could be addressed through: (i) special provisions to release LPG connections in urban-slums through dedicated LPG distributors for such areas with 2–5 kg cylinder connections only; (ii) subsidy of the cost of connection, or reduction of cylinder size; (iii) reduction of the cylinder size to 2–5 kg; (iv) improved composite material cylinders of 2–5kgs; and, (v) generation of much-needed awareness.

Stakeholder Management

Coordination and management of interests of various stakeholders would play a key role in enabling an effective transition. At the ministerial level, transition would need close coordination between the Ministry of Petroleum and Natural Gas (MoPNG), Ministry of New and Renewable Energy, Government of India (MNRE), Ministry of Finance (MoF), and Ministry of Consumer Affairs, Food and Public Distribution (MoCAF&PD). Further, a buy-in from the state governments is required, along with their respective administrative support to enable the transition. State departments of Food and Civil Supplies, State Nodal Agency for MNRE, as well as financial institutions/banks would also need to work in close coordination to make the transition effective.

Kerosene wholesale dealers and PDS retailers selling only kerosene would be two key sets of stakeholders who would be affected by the proposed transition, in terms of loss of income and/or employment. Urban kerosene wholesale dealers could be aided by providing them with licences for distributing only LPG 2 kg and 5 kg cylinders, thereby primarily serving urban-poor households. Rural wholesale dealers could be provided with capacity building, in case they wish to become distributors for off-grid products and services. Kerosene-only PDS retailers could also be provided with capacity-building training to be absorbed in the off-grid sector. Rehabilitation of kerosene dealers and retailers would be important, as the transition to kerosene alternatives would require significant human resources to enable and sustain the shift.

Direct Benefit Transfer (DBT) for Kerosene?

While the government plans to pilot the Direct Benefit Transfer for Kerosene (DBT-K) through the transfer of subsidies to the bank accounts of the beneficiaries, the intended benefits of DBT-K would remain limited and possibly adversely affect low-income households with poor access to banking services. Having a bank account is not a sufficient condition to practically access the subsidy transfer in a regular manner. Moreover, DBT-K would continue subsidizing kerosene for inefficient end uses, when a shift toward better, more cost-effective alternatives is feasible.

Finally, this study is an effort to showcase the existing possibilities, and how these could be realized. We hope that the report will move the debate on kerosene subsidy rationalization to more pragmatic levels, and subsequently lead to practical action.

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ACCESS	Access to Clean Cooking Energy and Electricity-Survey of States
AIKDF	All India Kerosene Dealers Federation
APL	Above Poverty Line
BPL	Below Poverty Line
CAGR	Compounded Annual Growth Rate
CEA	Central Electricity Authority
CEEW	Council on Energy, Environment and Water
CSO	Civil Society Organization
DBT	Direct Benefits Transfer
DBT-K Direct	Benefits Transfer for Kerosene
DBT-L	Direct Benefits Transfer for LPG
FCS	Food and Civil Supplies
FGD	Focused Group Discussion
FPS	Fair Price Shop
FYP	Five Year Plan
INR	Indian Rupees
LaBL	Lighting a Billion Lives
LPG	Liquefied Petroleum Gas
MNRE	Ministry of New and Renewable Energy, Government of India
MoCAF&PD	Ministry of Consumer Affairs, Food and Public Distribution, Government of India
MoF	Ministry of Finance
MoPNG	Ministry of Petroleum and Natural Gas, Government of India
MWEQ	Mega Watt Equivalent
NPV	Net Present Value
NSS	National Sample Survey
OMC	Oil Marketing Company
PAYG	Pay-As-You-Go
PDS	Public Distribution System
PPAC	Petroleum Planning and Analysis Cell
RRB	Regional Rural Bank
SHG	Self Help Group
SHS	Solar Home System
SMG	Solar Microgrids
SNA	State Nodal Agency
TERI	The Energy and Resources Institute
USD	United States Dollar
USOF	Universal Service Obligation Fund
W-LED	White Light Emitting Diode

1.0 Introduction

Kerosene in India is primarily available as a subsidized commodity for household use, distributed through the Public Distribution System (PDS) along with other essential commodities such as food grains. The primary aim of the PDS was to promote food security by providing subsidized food grains and later was expanded to provide essential resources to households at "fair prices" (Balani 2013; Food and Agriculture Organization of the United Nations [FAO], 2006). The PDS has evolved from a rationing system during British rule in India to a social safety mechanism following independence. Over time, the ration shops (or fair price shops [FPS])—which are the end point of delivery of PDS commodities to households—have increased in number from 18,000 in 1957 to 51,000 in 1961 and to about 521,000 FPS outlets today (Department of Food & Public Distribution, 2015).

Kerosene was added to the basket of PDS commodities during the 2nd Five Year Plan (FYP). It has continued in the PDS commodity basket for two main uses at the household level, cooking and illumination (lighting) (MoPNG, 1993). The PDS system was revised to Targeted-PDS in 1996–97, with the aim to target the subsidy by identifying Below Poverty Line (BPL) households who would be the intended beneficiaries of the subsidy program (Department of Food & Public Distribution, 2016). However, kerosene has continued as an entitlement for both BPL as well as APL households across the states.

The issue of subsidies as an instrument for achieving welfare goals has often been debated, gaining greater momentum in the past decade (Anand, Coady, Mohommad, Thakoor, & Walsh, 2013; Rangarajan Committee Report, 2006; Parikh Committee Report, 2010; Nilekani Committee Report 2011; Kelkar Committee Report 2012). Price subsidies provide a certain level of relief to the consumer. However, they may not have a transformative effect on the economic lives of the poor, given that in many instances only a small fraction of the benefits actually accrue to the poor (Economic Survey, 2014–15). The Government of India has undertaken several measures and reforms over the past few years to reduce the subsidy on petroleum products, which have included deregulation of petrol and diesel prices, completely eliminating subsidy support on these fuels. Further, the government had capped the annual number of subsidized LPG cylinders per household for domestic consumption in year 2012 ("UPA hikes," 2014). Recently, the government has introduced direct benefit transfer of subsidy for LPG with the stated objective of reducing diversion of the subsidized commodity to unintended users and uses. Currently, kerosene and domestic LPG are the only subsidized petroleum products in the country.

In the last decade, subsidies (including under-recoveries) on petroleum products[2] saw a compounded annual growth rate (CAGR) of 6.1 per cent (2005–06 to 2014–15) with kerosene under-recoveries seeing a CAGR of 5.6 per cent during the same time period. Subsidy outlay on kerosene was INR 305.74 billion (approximately USD 4.6 billion) in 2013–14 as compared to INR 19,484 crore in 2010–11, while the under-recovery for 2014–15 stood at INR 24,799 crore (Petroleum Planning and Analysis Cell [PPAC], 2016).

[2] Includes Petrol (up to 2010-11, now deregulated), Diesel, Domestic LPG and PDS Kerosene

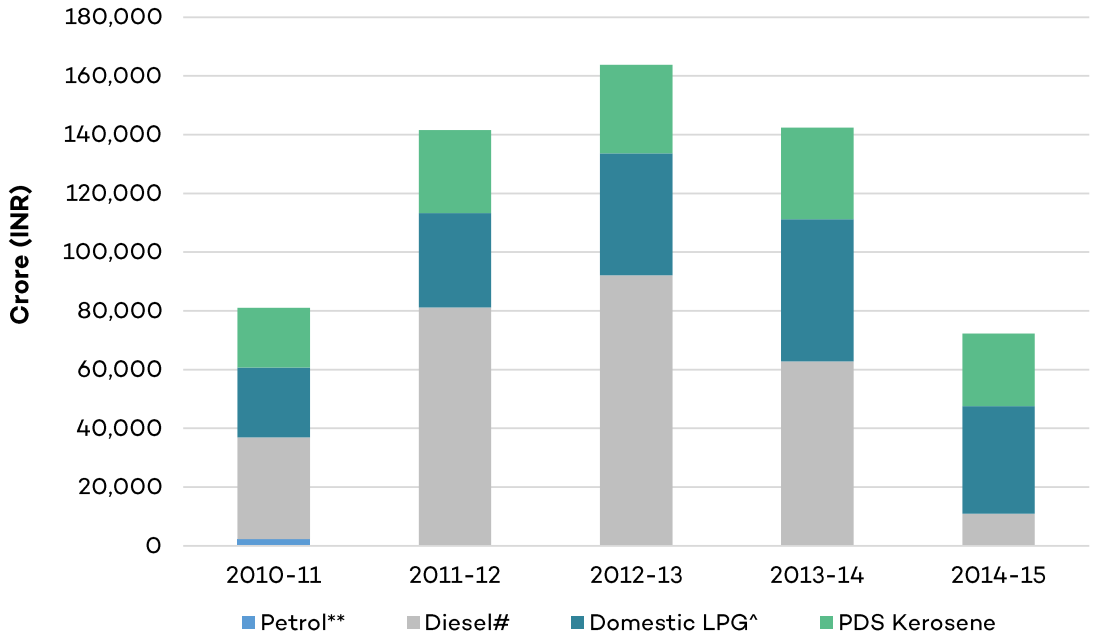

Figure 1: Petroleum products subsidies in India (including under-recoveries by Oil Marketing Companies)

Source: PPAC, 2016.

Various studies have established that kerosene subsidies are inefficient and contain significant leakages in the distribution network, resulting in poor targeting of subsidy, which makes a case for subsidy reform (Integrated Research and Action for Development [IRADe], 2014; National Council for Applied Economic Research [NCAER], 2005; Economic Survey, 2014–15). The Economic Survey of India (2014–15) highlights that leakage in kerosene subsidies cost the exchequer close to INR 100 billion (USD 1.5 billion) and these have a high opportunity cost from the perspective of fiscal management and welfare expenditure. Our analysis of the 68th NSS round data shows that only about 49 per cent of the allocated PDS kerosene is actually procured by the households from PDS, indicating a leakage of up to 51 per cent. If we consider both PDS and non-PDS consumption of kerosene against entire allocation, about 66 per cent is used by households and rest is diverted for other uses.

Given the high level of leakages in the current subsidy regime, appropriate identification of beneficiaries and subsidy targeting are essential. Various studies and commissions set up by the Government of India have suggested moving to a more market-driven pricing mechanism for petroleum-based fuels (Rangarajan Committee, 2006; Parikh Committee, 2010; Kelkar Committee, 2012). It is also suggested that replacing the universal subsidy regime with a re-allocation of public expenditure on efficient alternatives could provide higher welfare impacts and lower the fiscal deficit (Bhanumurthy, Das, & Bose, 2012; Tapsoba, 2013).

Apart from the direct fiscal costs of subsidizing kerosene, the externalities associated with use of kerosene have significant health and environmental costs. The health and safety impacts of kerosene consumption range from burns, indoor air pollution, to accidents such as accidental ingestion of kerosene by children. Studies on the health impact of kerosene for cooking and lighting indicate higher concentrations of PM10 and PM2.5 particulate matter in the household premises can decrease lung capacity up to 3-8 per cent (Azizi & Henry, 1994; Behera, Sood, & Singh, 1998; Awasthi, Glick, & Fletcher, 1996). Such impacts have been recorded across various studies with evidence from sub-Saharan Africa, Bangladesh, India, Sri Lanka and other countries (Mills 2012; Lam, Smith, Gauthier, & Bates, 2012).

With efficient alternatives to kerosene emerging, continuing the subsidy regime may not be the most efficient use of fiscal resources. With this in mind, this study aims to address the key question of "how to best rationalize kerosene subsidy" to improve the effectiveness of government as well as household spending on the fuel. To answer this broad question, we first analyze the current role and use of kerosene in Indian households along with its associated expenditure. Next, we analyze the inefficiencies in the current delivery system. Subsequently, we conduct a comparative economic analysis of kerosene vis-à-vis alternatives. Finally, based on the outcomes of the economic analysis, we discuss how kerosene subsidy could be rationalized, chalking out pathways for a transition toward alternatives.

However, this is just the first step to highlight what rationalizing the kerosene subsidy would mean, and how such a transition could be achieved pragmatically. The impact of this analysis and that of the suggestions provided in this study would be dependent on a confluence of factors. As the Nilekani Committee Report (2011, p.2) states, the "eventual success will hinge upon political will, good governance, incentive-compatible solution design, judicious use of technology, a structured transition plan, meticulous project management, effective supervision, audit and execution." The piloting of the DBT for kerosene (DBT-K) from April 2016, is a significant step in rationalizing kerosene subsidies. This study puts into perspective the benefits of a transition from kerosene to better and more efficient alternatives, similar to the push toward clean cooking with the announcement of a national program to promote LPG access to all households supplemented by budgetary/fiscal support. With the piloting of DBT-K, it would be worthwhile to keep in mind the savings that could accrue—for both the government and the end consumers—in a transition from kerosene-based lighting to better alternatives, thus, improving the efficiency and effectiveness of the cash transfer system.

1.1 RESEARCH METHODOLOGY

The issue of kerosene subsidy rationalization needs thorough understanding of (i) kerosene use and consumption patterns across various socioeconomic groups, (ii) its multiple end uses, (iii) its distribution value chain, (iv) associated levels of leakages and corruption, (v) state–centre relationship on the subject, and (vi) concerns and positions of various stakeholders. The study relies on multiple research tools to assess each of these issues effectively. We started with a review of literature, assessing the nature of energy subsidy reforms in India and, in particular, the historic experience with kerosene subsidies. This followed a detailed analysis of data from the National Sample Survey (NSS), as well as CEEW's primary dataset on energy access among rural households. Further, to get a nuanced understanding of the use of (and dependence on) kerosene in the urban-poor section, we conducted field studies involving semi-structured household interviews and Focus Group Discussions (FGDs) in two cities (Kanpur in Uttar Pradesh and Bengaluru in Karnataka). The field studies involved individual interviews with 35 to 45 households and three FGDs in each city. We enquired about and discussed kerosene use, associated expenditure, availability of alternative energy sources, and—most importantly—the reasons for continued reliance on kerosene.

After understanding these aspects in detail, along with associated expenditures, we conducted a techno-economic analysis comparing kerosene with alternatives providing the same end services (of lighting or cooking). Based on the economic analysis—which provided a clear case of transitioning from subsidized kerosene to efficient alternatives—we conducted a series of unstructured and semi-structured interviews with various stakeholders. These stakeholders included off-grid lighting entrepreneurs, state food and civil supply officers (in Karnataka and New Delhi), representatives of the All India Kerosene Dealers Federation (AIKDF), representatives of the Ministry of Petroleum and Natural Gas (MoPNG) and the Ministry of New and Renewable Energy (MNRE), Oil Marketing Companies (OMCs), other civil society organizations (CSOs) and research institutions. In addition to the interviews, a consultation was held at New Delhi with representation from all stakeholders to discuss and get feedback on key findings and proposed recommendations of the study.

2.0 Kerosene in Indian Households – Uses, consumption, expenditures and entitlements

Kerosene is a versatile fuel that is used for various household purposes ranging from lighting and cooking to uses including as an insecticide and in lieu of diesel in irrigation pump sets. Because we consider rationalizing kerosene subsidy from an end-service perspective, it is important to understand the dominant use of the fuel and the role it plays in the lives of those who use it.

2.1 DOMINANT USE OF FUEL IN HOUSEHOLDS

The household fuel consumption trends captured through NSS consumer expenditure surveys indicate that dependence on kerosene as a primary source of lighting and cooking has declined, particularly because of increasing penetration of electricity and LPG in the country. Simultaneously, the allocation of subsidized kerosene to the states has also gone down from 10.36 million kilolitres (KL) in 2011–12 to 8.97 million KL in 2014–15 (MoPNG, 2016). Despite the decrease in the absolute amount of kerosene consumption, a significant proportion of the population continues to rely on kerosene.

Data from the 2011 suggests that in rural India dependence on kerosene for lighting is far higher than for cooking purposes. About 43.2 per cent of rural households use kerosene as their primary lighting source, compared to only 0.7 per cent of the rural households who primarily use it for cooking. This finding is further corroborated by NSS data over time, where the last round of the consumer expenditure survey (2011–12) indicates the share of rural households primarily dependent on kerosene for lighting to be about 26.6 per cent. Similarly, the NSS data indicates that about 0.8 per cent of rural households use kerosene as a primary source of fuel for cooking. Analysis of the ACCESS survey data[3]—which was recently conducted in 2014–15 across the rural areas of six of the most energy-deprived and populous states of India—further corroborates these findings. Across the states of Uttar Pradesh, Bihar, Jharkhand, Odisha, West Bengal and Madhya Pradesh, about 53.3 per cent of rural households reported using kerosene as their primary lighting source, whereas only 0.07 per cent of households used kerosene as their primary cooking energy source (Jain et al., 2015). The ACCESS survey also observes that, even though kerosene is not used as a primary cooking fuel in rural India, it is often used for initial firing of biomass in the traditional chulha (which continues to be the most prevalent cooking energy arrangement in rural India). Typical consumption of kerosene for initial firing of the cook-stove is about half to one litre of kerosene per household per month (Jain et al., 2015).

In urban India, as per the 2011 census, 7.5 per cent of households use kerosene as the primary cooking fuel, and about 6.5 per cent use it as a primary lighting source. The NSS survey (2011–12) puts these numbers at 5.7 per cent and 3.2 per cent, respectively.

It is important to observe that kerosene remains a major source of illumination in rural India, despite 97.5 per cent of all villages being deemed as electrified (Central Electricity Authority [CEA], 2015). The crux of this paradox lies in the details of rural electrification. Given the skewed definition of village electrification[4] in India, the household-level electrification in rural areas lags significantly behind compared to overall village electrification. The ACCESS survey suggests that despite having a village electrification rate of more than 95 per cent, only about 69 per cent of rural households in these villages have an electricity connection (Jain et al., 2015). Apart from a low household electrification rate, the second challenge is the quality and duration of the electricity supply (especially

[3] CEEW conducted the largest primary survey on energy access among rural households in India with the aim of understanding energy consumption patterns for cooking and lighting and household perceptions on transitioning to cleaner fuels. The Access to Clean Cooking energy and Electricity: Survey of States (ACCESS) study is available at http://ceew.in/pdf/CEEW-ACCESS-Report-29Sep15.pdf. The study for further reference in this study is referred to as the ACCESS study and referenced as ***Jain et al. 2015.***

[4] According to the definition (2004–05), a village is deemed electrified as long as 10 per cent of its households have an electricity connection (See http://powermin.nic.in/upload/pdf/Deendayal_Upadhyaya_Gram_Jyoti_Yojana.pdf).

in the evening hours), which determine the reliance of households on kerosene for their lighting needs. The ACCESS study finds that half of electrified households surveyed across the six states are supplied with electricity for three hours or less in the evening (Jain et al., 2015).

2.2 HOUSEHOLD DEPENDENCE ON PDS KEROSENE

In order to understand the role that kerosene plays across households belonging to various social strata, we analyzed dependence on kerosene across income deciles in rural and urban India using NSS data.[5] **We found that almost 88 per cent of rural households continue to use kerosene**. Of these, only 66 per cent rely exclusively on PDS kerosene. Among the remaining 22 per cent, half of them consume both PDS as well as non-PDS kerosene, whereas the other half depends entirely on non-PDS kerosene (see Figure 2 for decile results). The use of and dependence on black market kerosene varies significantly across states. A very high proportion of rural households consume non-PDS kerosene in the north-east states, i.e., Manipur (61 per cent), Assam (50 per cent), Nagaland (39 per cent), as well as Jharkhand (54 per cent) and Bihar (39 per cent). In terms of absolute number of households using non-PDS kerosene, Bihar (17 per cent) is the leader, followed by Uttar Pradesh (16.6 per cent), West Bengal (10.3 per cent), Assam (6.8 per cent), Jharkhand (6.5 per cent), Madhya Pradesh (5.6 per cent) and Odisha (5.3 per cent). Maharashtra (9.8 per cent) is a unique example where a significant proportion of the rural population use only non-PDS kerosene, with the reported primary end use being neither cooking nor lighting, indicating the use of kerosene for other purposes.

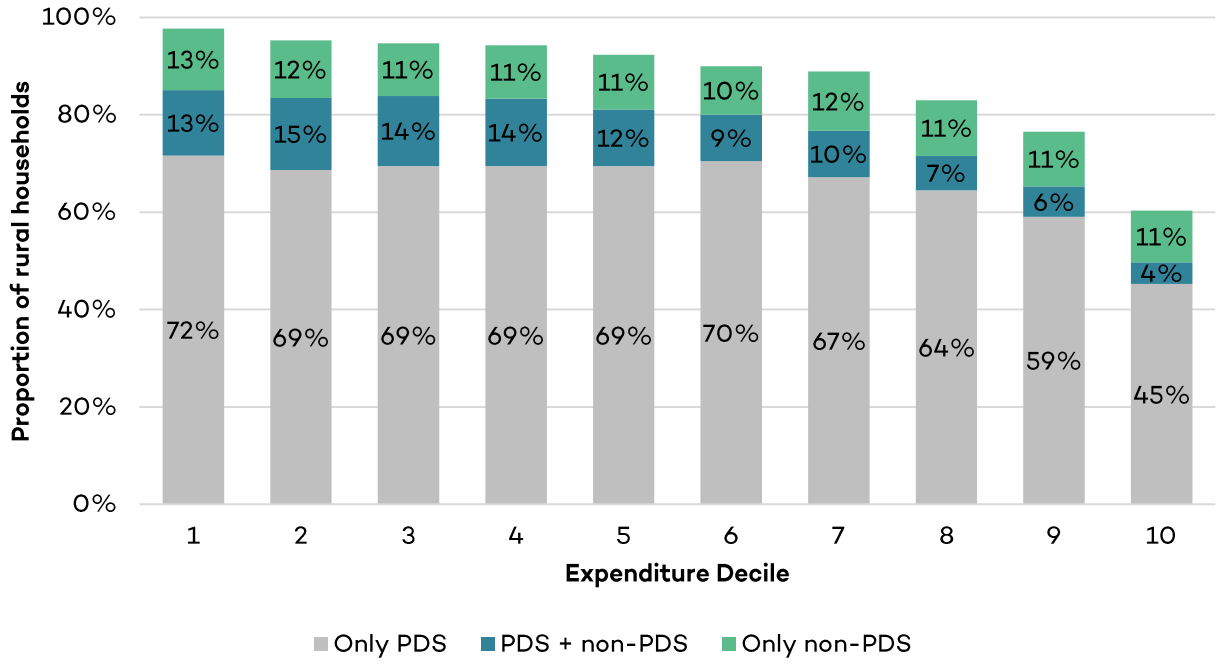

Figure 2: Dependence of rural households on kerosene from different sources

Source: NSS, 2011-12.

In urban India, 42 per cent of the households continue to use kerosene, with about 26 per cent relying exclusively on PDS kerosene. About 12 per cent of households depend entirely on non-PDS kerosene, and 4 per cent use both PDS and non-PDS kerosene. Unlike rural India—where the use of kerosene is not very sensitive to the socioeconomic background of the household—in urban areas demand declines sharply as one climbs up the income deciles (see Figure 3). Even in urban areas, dependency on kerosene varies significantly across states. In terms of number of urban households relying on non-PDS kerosene, Maharashtra (19 per cent) has the highest share, followed by West Bengal (10.5 per cent), Gujarat (10 per cent) and Uttar Pradesh (9.5 per cent).

[5] Henceforth, unless otherwise qualified, NSS data would mean data from 68th (latest) round of consumer expenditure survey of NSS, conducted in 2011–12.

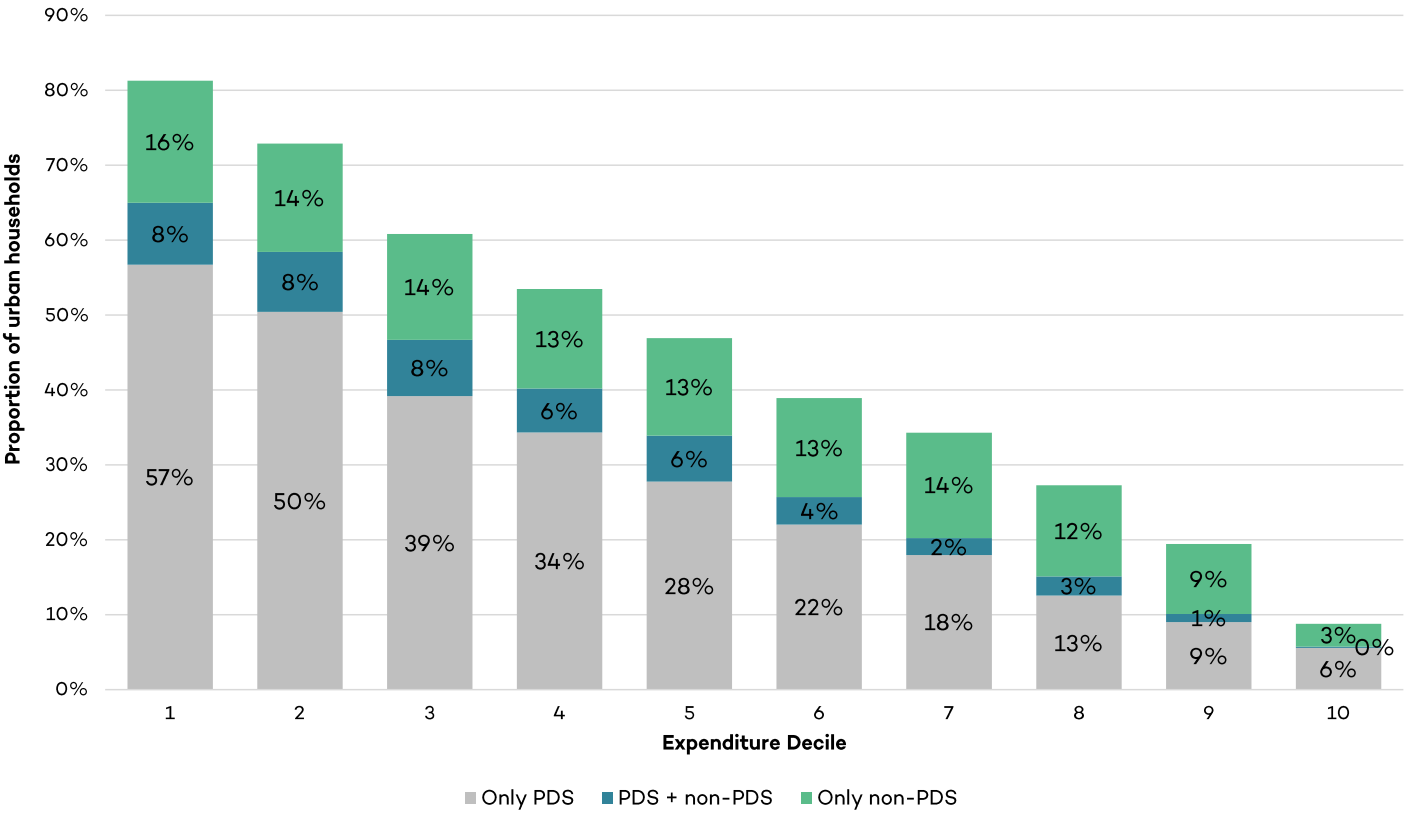

Figure 3: Dependence of urban households on kerosene from different sources

Source: NSS, 2011-12.

It is perplexing to observe that use of kerosene is significant despite the high penetration of LPG and an improving electricity situation in urban India. To further understand the use of kerosene as a fuel and the role that it plays in urban-poor households, the field studies in the two Tier 1 cities, Kanpur and Bangalore, provided significant insights. Further details on the field studies are summarized in Box 1 and Box 2.

2.3 QUANTIFYING KEROSENE CONSUMPTION AND ASSOCIATED EXPENDITURE

2.3.1 Rural Areas

Various supply and demand factors influence the consumption of kerosene across rural households. On the supply front, consumption of PDS kerosene is mainly curtailed by the limited monthly entitlement. On the demand side, a major factor is the availability of alternatives for different end uses (lighting/cooking/other uses). Analysis of both the NSS and ACCESS datasets shows that households without access to grid connection or any other form of electricity access use more monthly kerosene on average compared to those households having access to any alternative source for lighting. Given the dismal electricity situation in rural areas as found in the ACCESS study (particularly in the evening hours) consumption of PDS kerosene does not vary significantly across income deciles (see Figure 4). Households using only non-PDS kerosene show variations in their consumption within the range of 2.4 to 2.8 litres per month, with consumption increasing as incomes rise. Households using both PDS as well as non-PDS kerosene exhibit higher overall consumption. Such households, though small in proportion, consume 4–5.3 litres of total kerosene per month. The consumption variation across income deciles is shown in Figure 4, wherein the size of the bubble indicates the proportion of households.

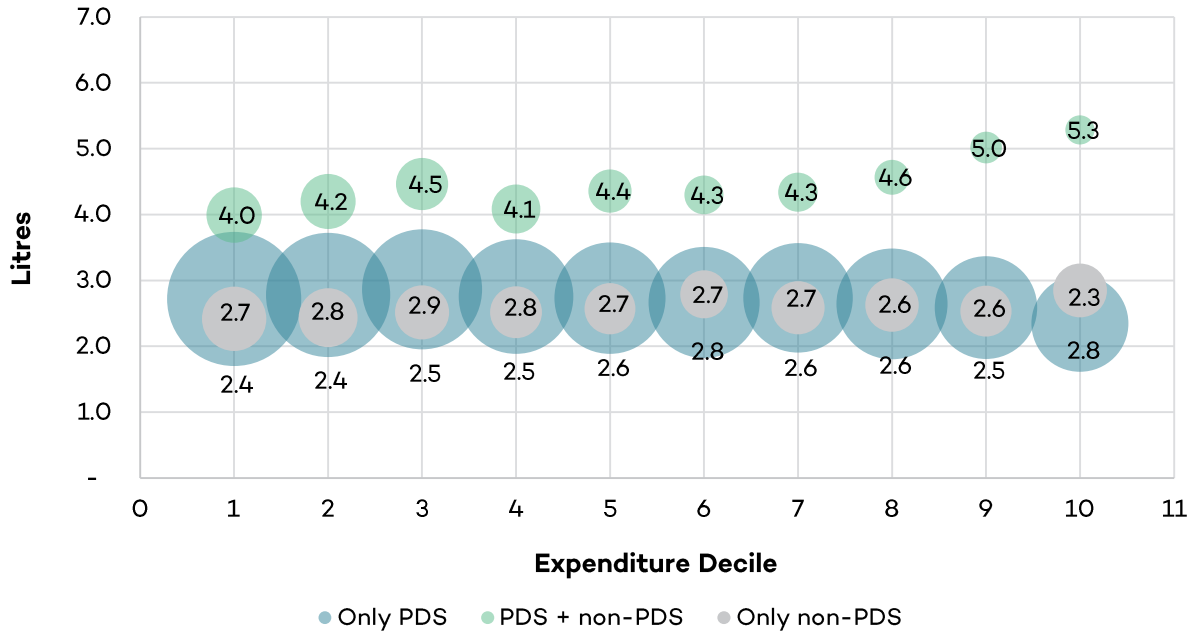

Figure 4: Monthly kerosene consumption of rural households across expenditure deciles

Source: NSS, 2011–12.

Further, we estimate the average monthly expenditure on kerosene, which is a direct reflection of overall consumption, share of PDS and non-PDS kerosene, and their respective prices. Figure 5 clearly shows that, on an average, rural households spend anywhere between INR 36 to INR 130 on procuring their monthly kerosene requirement. With the majority using only PDS kerosene, their expenditure is limited to INR 43 to INR 45. It is important to note that a significant proportion of households in the lower-income groups consume non-PDS kerosene (either along with PDS or otherwise), resulting in higher monthly expenditures (INR 64 to INR 88 per month).

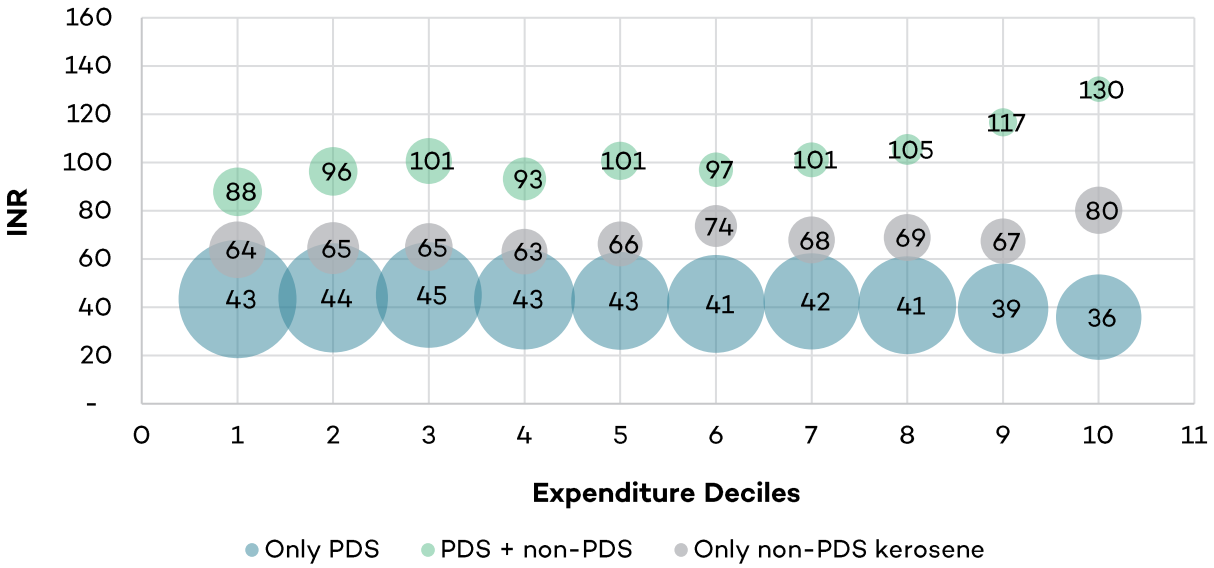

Figure 5: Monthly kerosene expenditure of rural households across deciles

Source: NSS, 2011–12.

One limitation with aggregated analysis at a pan-rural level is that it averages out the numbers across states, providing limited insights. Thus, we further analyze the expenditure on kerosene in rural areas of some of the major kerosene-consuming states, using the more recent ACCESS dataset. It is evident

from Figure 6 that a significant proportion of households spend in the range of INR 100 to INR 180 to procure their monthly kerosene. For the same states, NSS data indicates a monthly household outlay toward kerosene in the range of INR 90 to INR 100.

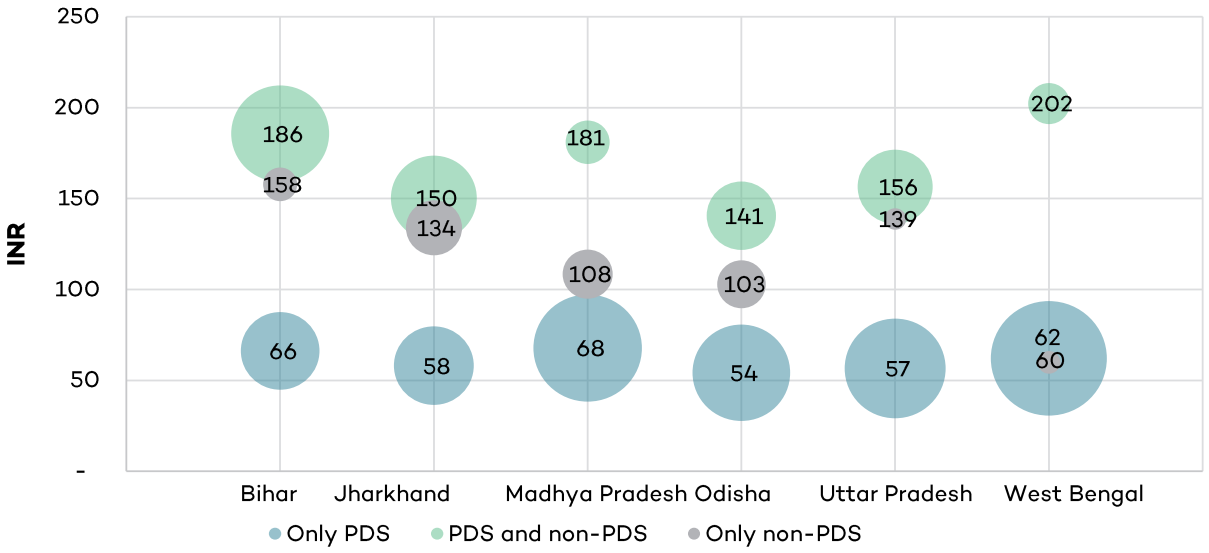

Figure 6: Monthly kerosene expenditure of rural households across states

Source: CEEW, 2015.

2.3.2 Urban Areas

Consumption of kerosene in urban areas is mainly concentrated among the lower-income groups. Similar to rural areas, households using both PDS as well as non-PDS kerosene exhibit higher consumption compared to those who use either. Most of these households are concentrated in the states of Maharashtra, West Bengal, Gujarat and Uttar Pradesh.

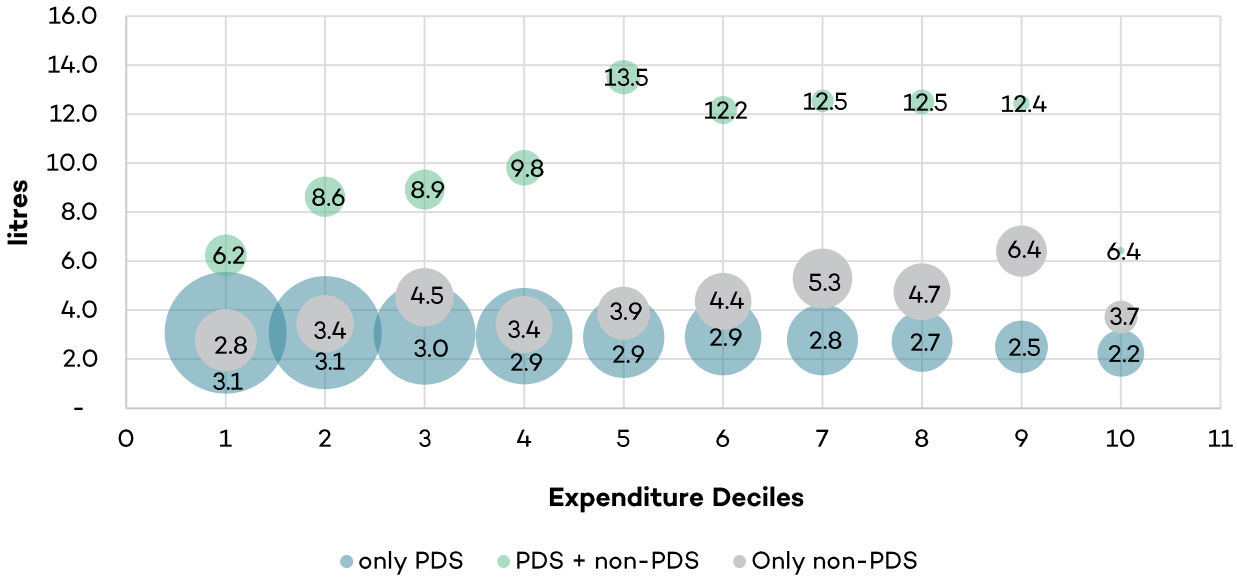

Figure 7: Monthly kerosene consumption of urban households across expenditure deciles

Source: NSS, 2011–12.

We further analyze the average monthly expenditure of urban households on kerosene. The average outlay is significantly higher compared to the rural areas, which may be due to the end use of kerosene. Kerosene is used more often as a cooking fuel among urban-poor households, rather than for lighting, and the quantity of kerosene required for cooking is much higher than for lighting. A more nuanced view of kerosene consumption and associated expenditure in urban areas is captured in the two case studies discussed in Box 1 & Box 2.

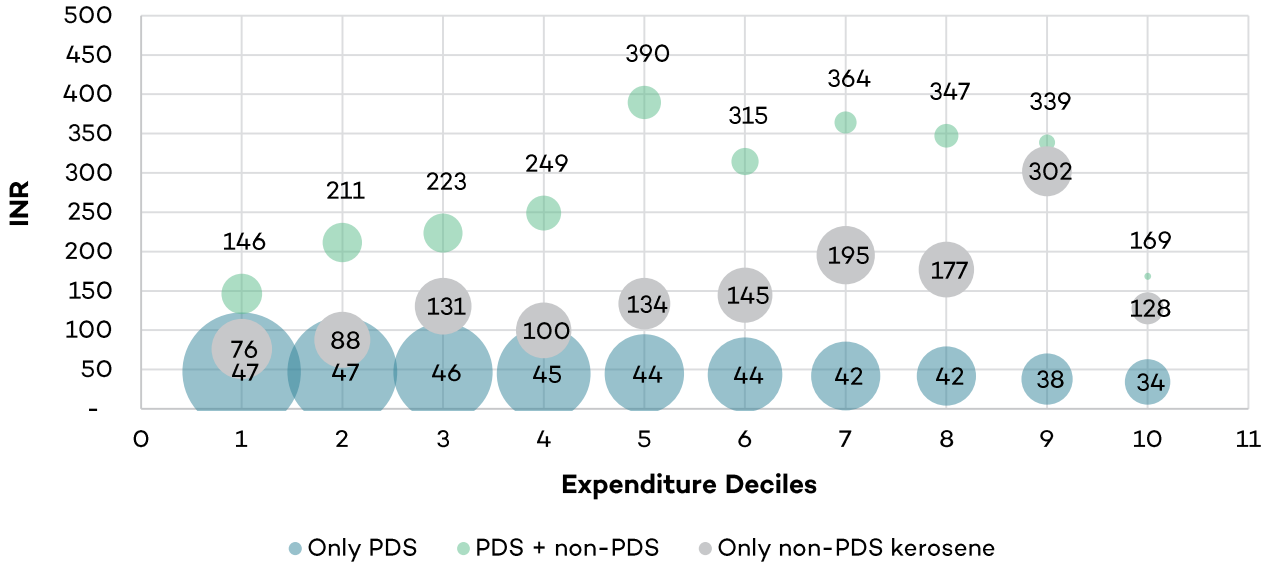

Figure 8: Monthly kerosene expenditure of urban households across deciles

Source: NSS, 2011–12.

Box 1: The Expectation of Equity – Insights from the Field Visit to Kanpur's Slums

As we sat down for a discussion at Rakhi Mandi, an urban slum in the city of Kanpur in Uttar Pradesh, the women expressed almost in unison that whatever is done should be the same for all and not for any particular community or income group. This was the response to the proposal to phase out kerosene from the PDS and making it an open-market commodity.

Most urban-poor households in the city depend on kerosene, and use it mainly for cooking. The lighting utility of kerosene was limited to the use of kerosene lamps during power cuts (as a backup lighting solution).

The average household across the slums use a combination or either of wood, kerosene and LPG to meet their cooking needs. *Chulha* is the most prevalent cooking arrangement, followed by kerosene stoves (often along with *chulha*), and lastly LPG. The average household spends close to INR 750 to INR 900 per month only on procuring cooking fuels.

When asked about the reasons for not having an LPG connection, some claimed that the upfront connection cost of LPG is too high for them to afford, others were wary of safety concerns with LPG. Also, LPG connections were not being given to households citing various reasons (non-serviceability in the area, requirement of a ration card etc.), at times resulting in such households spending about INR 1400 to INR 1500 per month on kerosene (for cooking). The issue of lumped cost associated with large LPG cylinders was also reported as a challenge for sustained use of LPG.

Electricity provision across the urban slums of Kanpur is done through a mix of legal and illegal connections. Some households have metered connections (in some areas these were known as a *Katiya Connection*). Others draw lines from these and paid a monthly sum of around INR 200 to the metered household. This amount varied from slum to slum as well as the appliance use of the borrowing household, ranging from INR 200 to INR 400.

It was observed that the awareness among households is low, particularly about (i) using genuine equipment (gas stove, hose, regulator) of approved quality and safety standards; and, (ii) good and safe practices of using LPG; (iii) government schemes, such as subsidized LPG connection for BPL households; (iv) cost of LPG connection. Very often different distributors provide connections at different costs by adding various non-mandatory items (such as a cylinder trolley) into the upfront connection cost.

Box 2: Struggle with Expensive Kerosene – Field insights from Bengaluru's Urban-Poor Areas

With close to 209 undeclared slums, many migrant workers in the city of Bengaluru find themselves without a local voter ID card, ration card or any other identity to access government support, particularly for their basic energy needs.

A considerable proportion of urban-poor households in Bengaluru are dependent on kerosene. While households in unauthorized slums primarily use kerosene for lighting, households in authorized slums and EWS colonies mostly use it for cooking. Those without ration cards buy black market kerosene for INR 70 to INR 80 per litre, whereas others who were neither receiving their PDS quota nor had access to (black) market kerosene, were purchasing diesel worth INR 600 per month to meet their cooking energy needs. Many households reported purchasing 10–12 litres of black market kerosene for cooking, at INR 70 to INR 80 per litre.

The availability and delivery of LPG was reported as highly efficient and reliable in most areas of Bengaluru. Households' monthly expenditure on cooking energy varied significantly. For households in permanent settlements, depending upon the availability of free-of-cost biomass in the vicinity, the average household expenditure on procuring cooking fuels could range from INR 350 to INR 1,200 per month.

Aggravating the issue of access among **temporary slums**, most such slums do not have any provision for electricity. Households in these areas resort to kerosene or candles for meeting their lighting needs. On average, 2 to 3 litres of kerosene are used for lighting purposes. Because residents of temporary slums lack ration cards, they rely entirely on black market kerosene, leading to a typical monthly expenditure of INR 150 to INR 240 to meet their lighting needs. Few interventions by decentralized energy entrepreneurs or foundations have begun, that might provide solar-powered lighting both as a product and/or service to the households in these areas. Those providing these alternative lighting solutions as a service are charging about INR 100 to INR 200 per month per household.

While most households opted for LPG when asked what would they like to have in lieu of their kerosene subsidy, the safety concerns and the high upfront connection cost were two major deterrents. Interestingly, not many households in Bangalore mentioned that the upfront cost of an LPG cylinder is a barrier in their transition from kerosene.

2.4 INEFFICIENCIES IN THE CURRENT KEROSENE DELIVERY SYSTEM

Finally, in order to complement the top-line understanding of high leakages in the PDS kerosene delivery system, we analyzed the ACCESS dataset to get a bottom-up view of the issue.

Ration Card and PDS Kerosene Entitlement

In the CEEW survey 88 per cent of respondents indicate having a ration card. However, among those who did not have a ration card, almost 56 per cent reported positive consumption of PDS kerosene, indicating lax or ineffective disbursement of the commodity only to ration card holders. The finding does not suggest that households without ration cards could not be genuine beneficiaries, but it points to potentially ineffective identification of deserving households by the state civil supply authorities.

Awareness of PDS Kerosene Entitlement

Only about 72 per cent of ration card holders were found to be aware of their correct monthly entitlement of PDS kerosene. This highlights a significant awareness and information gap among the households about their entitlement to PDS kerosene. Incidentally, Bihar and Jharkhand show a much higher level of awareness compared to the other four states surveyed.

Availability of Entitled Quota

Among those households that indicated knowing their monthly quota (correct or incorrect), only 54 per cent report getting their monthly PDS kerosene quota on an almost-regular basis (see Figure 9). The remaining 46 per cent of the households receive their entire kerosene quota only nine or fewer times per year. We find a relatively higher level of compliance among kerosene retailers in the state of Jharkhand and Bihar, followed by followed by West Bengal and Uttar Pradesh.

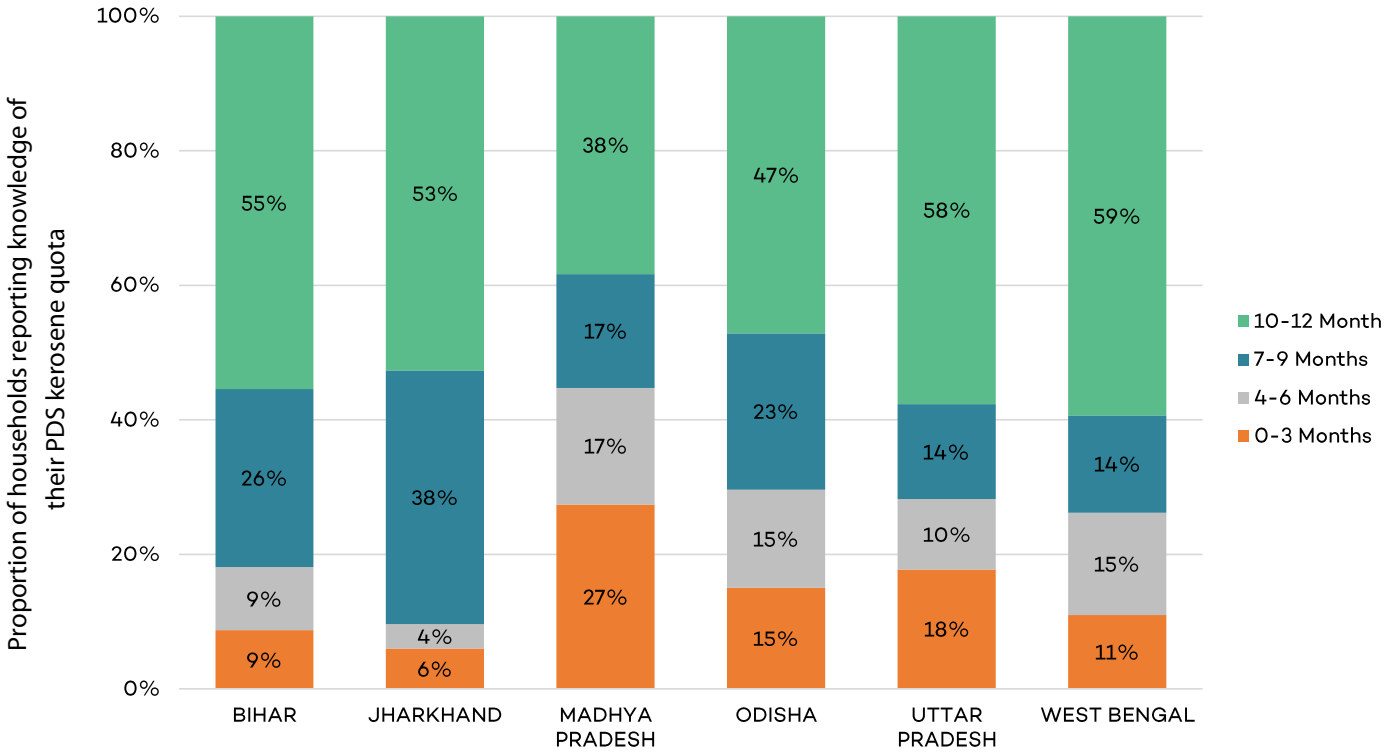

Figure 9: Compliance of kerosene retailers in providing the allocated quota to households

Source: CEEW, 2015.

Public Perception of Corruption and Reselling of PDS Kerosene

Across the six surveyed states, about half the respondents perceive that the prevailing system of kerosene delivery is corrupt. Madhya Pradesh has the highest share (63 per cent) of respondents who perceive that delivery of kerosene through the current arrangement is corrupt, whereas Odisha has the lowest (18 per cent). Further, about 28 per cent of the respondents agree that the practice of reselling PDS kerosene by households exists in their village. The results significantly vary across states, with 68 per cent of households in West Bengal claiming that such a practice exists in their village, compared to only 15 per cent in Jharkhand.

3.0 Assessment of Alternatives to Kerosene – An end-service approach

It is evident that kerosene is being used for lighting and cooking because of poor access to alternatives that could provide the same end service. The continuing kerosene subsidy points to the inefficiency of the public system in enabling access to reliable electricity and cooking energy source alternatives in rural and urban areas. The government is continuing its efforts to improve the electricity situation for all through its 24x7 Power For All mission and increase access to clean cooking with a target of providing LPG for all by 2019 (Ministry of Power, 2015; Press Information Bureau [PIB], 2015; "Govt to make LPG available," 2016). However, given the current situation regarding electricity and LPG access, this section discusses various pragmatic options to provide better alternatives and eliminate the use of an inferior fuel (kerosene) among Indian households that could be considered more immediately.

3.1 ASSESSING ALTERNATIVES FOR LIGHTING

3.1.1 Available Lighting Alternatives

Providing a better supply of electricity, particularly in the evening hours could inarguably be the easiest approach to reducing dependency on kerosene for lighting, at least for grid-connected households. However, this is easier said than done, given the difficulties of state electricity distribution companies regarding energy procurement and management (especially during evening peak hours), and their poor financial health (Upadhyay, 2014; Eapen & Varghese, 2016). Moreover, given that the burden of kerosene subsidy is borne by the central government, there is no direct incentive for state authorities to provide better electricity services to rural households. With such realities, even though grid electricity will remain an alternative for replacing kerosene for lighting, it cannot currently be considered a reliable solution. Reliance on grid supply alone neglects the adverse social welfare impact of eliminating the kerosene subsidy under poor electricity supply situations. A more pragmatic approach would consider alternatives that can reliably eliminate the dependence on kerosene for lighting. Decentralized lighting systems such as solar lanterns, solar home systems, and solar microgrids could serve as primary lighting alternatives to kerosene.

The MNRE suggests that about 302.30 MW_{EQ} has been installed in the off-grid sector cumulatively as of January 2016 (MNRE, 2016). As of 2014, about 3 million solar lanterns and 1 million solar home systems had been sold in India (The Climate Group, 2015). The sector has about 40 established players, with numbers increasing every year. The sector is expected to see a sale of close to 5 million solar home systems between 2014 to 2018 (The Climate Group, 2015). In the following paragraphs, we briefly discuss each of these decentralized technology options.

Solar Lantern

As defined by the MNRE, a solar lantern is a lighting system consisting of a lamp, battery and electronics, all placed in a suitable housing, made of metal, plastic or fibreglass, and a photovoltaic (PV) module. The battery is charged by electricity generated through the solar PV module. It is a portable lighting device suitable for either indoor or outdoor lighting. The MNRE provides certain specific guidelines regarding the design specifications of a solar lantern to ensure quality and reliability of the product.

Of the various designs available in the market, the three lantern products chosen for this study are those made by The Energy and Resources Institute (TERI) as part of its Lighting a Billion Lives (LaBL) program and by Greenlight Planet under the brand name of SunKing All Night and SunKing Pico. These lanterns were chosen based on a review of various systems available in the market, with

the choice limited to those representative of the commonly available system specifications. The examples analyzed in this study are only illustrative. The SunKing Pico was chosen as a system that serves the most basic need for lighting and thus provides a base comparison against kerosene. The specifications of the lanterns are provided in Table 1.

Table 1: Different solar lighting products available in the market

		Specifications	
No	Model	Services	PV Panel Size
1	TERI Solar Lantern	1 LED + 1 charging point	3W
2	SunKing Pro All Night	1 LED + 2 charging points	2.7W
3	SunKing Pico	1 LED (up to 25 lumens)	0.35W

Solar Home Lighting Systems[6]

A solar home lighting system (SHS) provides a comfortable level of illumination in one or more rooms of a house. The SHS consists of a PV module, control electronics, battery, and luminaire(s). There are several SHS models featuring one, two, or four luminaires based on White Light Emitting Diode (W-LED). Depending upon capacity, the system could also be used to run a small DC fan or a 12-V DC television along with the W-LED Lamps. However, this study limits consideration to SHS providing basic service of lighting and mobile charging.

The two solar home lighting systems chosen for this study for economic evaluation are those made by SIMPA and Greenlight Planet under the product name of SunKing. The specifications of the SHS are given in Table 2.

Table 2: Solar Home Systems considered in this study

		Specifications	
S No	Model	Services	PV Panel Size
1	SunKing SHS	3 LED + 2 charging points + 1 portable LED	6W
2	SIMPA PICO	2 LED + 1 charging point	5W
3	SunKing Pico	1 LED (up to 25 lumens)	0.35W

Solar Microgrids

Solar microgrids are decentralized renewable energy systems that generate energy from a small solar plant and distribute it to households and businesses in adjoining areas, along with a provision for energy storage (Tata Power Solar, 2016). The capacity of a microgrid is determined by the number and needs of households and other establishments to be served. Microgrids provide an added advantage of greater system resilience, and greater ability to integrate with the grid.

Based on a series of interviews with different developers operating across India, we find that a typical microgrid in rural India is in the range of 2–4 kW. In the case of rural households, microgrids can provide a clear economically viable case for low-income households, with access to electricity resulting from the provision of a service rather than ownership of a product.

[6] As of 2011, MNRE had deployed about 620,000 SHS and 813,000 lakh solar lanterns.

3.1.2 Determining the Lighting Needs of the Households

In order to determine suitable alternatives, we first need to ascertain the amount of lighting service required (or currently being provided by kerosene) for effective replacement. We determine the lighting needs of the households on the basis of the ACCESS survey data. The estimation provides a lower bound of the lighting need, as it is based on the current use pattern of kerosene-based lighting. It provides the minimum threshold that an alternative lighting solution must provide in order to effectively replace kerosene. Ideally, the lighting needs in engineering terms should be measured in lumen-hours per day. However, given that on-field lumen measurement from kerosene lamps is challenging, we measure the lighting needs in a simplistic functional unit, which is easier for a household to relate to. We call this unit a lamp-hour/day, and is basically determined through cumulative number of hours each kerosene lamp/lantern is used on a daily basis. The analysis suggests that the lighting needs of 90 per cent of households using kerosene is within 18 lamp-hours per day, whereas the needs of 75 per cent of the households are up to 12 lamp-hours per day (see Figure 10). This essentially means that 75 per cent of the households are currently using up to three lamps for four hours each, or two lamps for six hours each and so on.

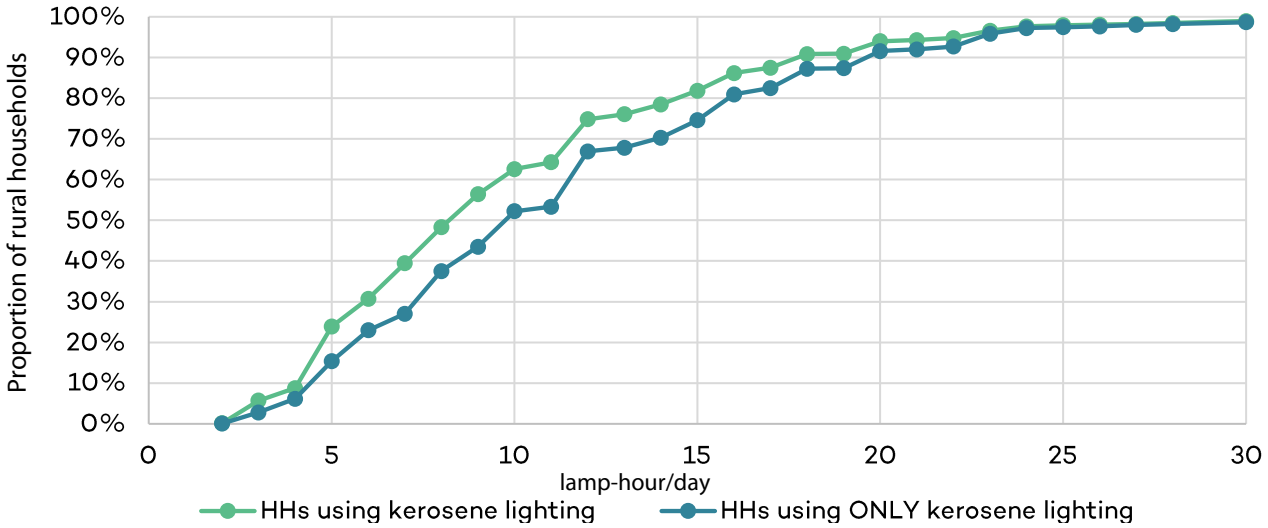

Figure 10: Lighting needs of rural households

Source: CEEW, 2015.

It is evident from Figure 10 that different households have different lighting needs. At the same time, alternative technologies have sufficiently evolved and diversified to match or cater to various service requirements. At one end of the spectrum are solar lanterns, which provide very basic lighting output of as low as 25 lumen,[7] while on the other end, the market also offers high-capacity products such as solar home systems and microgrids. Typically, as lighting service increases (in lumen-hours per day), the associated cost of the alternative also increases. In terms of lighting service level comparisons, Table 3 provides a broader sense of the suite of technologies available for effective replacement of kerosene as a lighting fuel.

[7] For comparison, typical lumen output of a solar lantern vary from 8–50 lumen, mostly around 10–14 lumen per lamp.

Table 3: Matching lighting needs of a household to the technology options available

Lighting needs	Typical existing market options to meet the level of lighting need
9 lamp-hours/day	2 x Pico by Greenlight Planet
12 lamp-hours/day	3 x Pico by Greenlight Planet; 2 x TERI Solar lanterns; 2 x Selco lanterns; All Night + Pico by Greenlight Planet
18 lamp-hours/day	Solar Home System (SHS) by SimpaNetworks; Home60 by Greenlight Planet; Selco SHS

Source: CEEW, 2015.

3.1.3 Economic Analysis - Lighting

We conducted an economic analysis for various lighting needs against products currently being offered in the market. We limit the economic analysis of alternatives to solar lanterns and home systems, given the lack of sufficient data on the monthly tariffs and economics of solar microgrids, though this does not omit microgrids as a possible alternative to kerosene lighting. The analysis compares the cash outflows on kerosene to those for an equivalent alternative for various levels of lighting needs based on the Net Present Value (NPV) principle. For the purposes of this analysis, we compare the alternatives to kerosene on an equivalent or higher lamp-hour basis, i.e., alternatives providing equal or longer duration of lighting (in addition to the higher lumen output). We use publicly available information about the cost and technical specifications of the systems from respective manufacturers/system installers.

It should be noted that there could be various possible products and product combinations that can meet the respective lighting needs of households. The economic analysis is not an exhaustive one for all available products and their possible combinations. Rather, it provides a broader perspective of the economics and cash flows involved in a transition from kerosene to its alternatives—both for the household and the government—for a few representative options. We estimate the cash flows under two scenarios: (i) No government support for alternatives; and, (ii) One year worth of effective kerosene subsidy toward supporting the procurement of an alternative by the household.

The analysis provides a conservative estimate of the savings accruing from to a shift from kerosene to alternatives. Following are the major considerations and assumptions considered for the economic analysis:

(i) Price of PDS kerosene: INR 16 per litre (based on the current price[8] in most states and basis NSS & ACCESS data).

(ii) Price of non-PDS kerosene: INR 35 per litre (mean of the median values of NSS & ACCESS data).

(iii) Monthly allocation of PDS kerosene: 3 litres.

(iv) Government subsidy on kerosene: INR 15 per litre.

(v) Battery replacement: after 2 years for solar lantern; after 4 years for SHS.

(vi) Battery replacement cost: 40 per cent of the capital cost.

(vii) Maintenance cost of alternatives: 5 per cent per year post the warranty period.

(viii) Interest rate (for financing of system): 12 per cent.

(ix) Discount rate (for NPV calculations): 10 per cent.

In addition, to estimate the kerosene consumption for a given lamp-hours need of the household, we use the ACCESS dataset. Analysis suggests a significant variation in the outputs of kerosene lamps across households, as shown in Figure 11. This also corroborates the existing findings in literature

[8] Prices as of November – December 2015.

(Mills, 2003). The median value of the kerosene lamp output is around 88 lamp-hours per litre of kerosene, with the average output being around 95 lamp-hours per litre. We use 90 lamp-hours as the typical output of a kerosene lamp for the purposes of the economic analysis in this study.

It is evident from Table 4 that the existing alternative solutions make a clear economic case for displacement of kerosene for lighting purposes. For low levels of lighting requirement (and concomitant low levels of kerosene expenditure), solar home systems are not economically attractive for households; however, they provide a much higher level of lighting service and an additional service of mobile charging, which offers a value-add to the consumer.

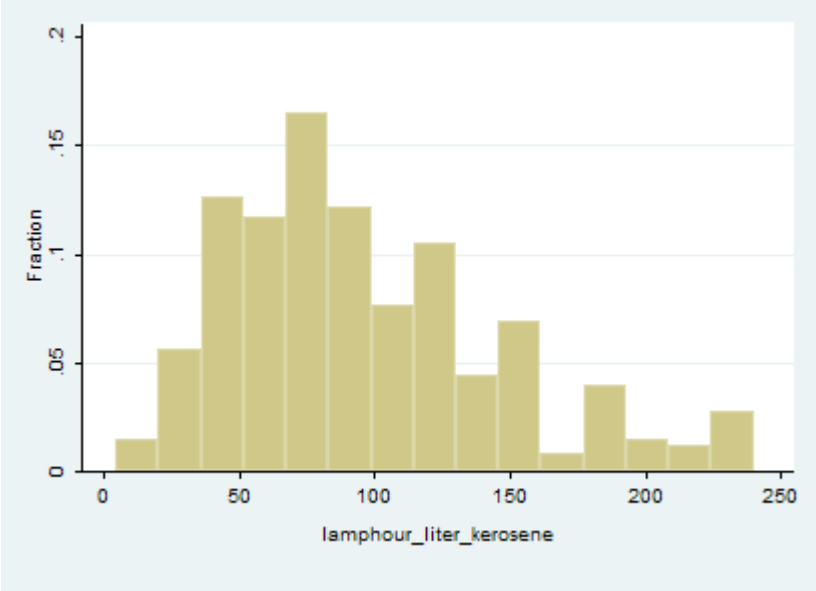

Figure 11: Output of kerosene lamps

Source: CEEW, 2015.

Alternative lighting solution	Lighting Needs	Annual expenditure on kerosene	Annual expenditure on kerosene (NPV)*	Capital Cost of alternative	HH Annual Cash outflow (NPV basis)		Govt saving over lifetime of product	
	lamp-hour/day	INR	INR	INR	No subsidy support; including financing (INR)	Year worth of kerosene subsidy as capital support on alternative (INR)	No subsidy support; including financing (INR)	Year worth of kerosene subsidy as capital support on alternative (INR)
Solar Lanterns (4 years)	9	576	456	1,000	354	104	873.33	622.87
	12	996	789	1,500	531	280		
	15	1416	1,122	2,900	1,027	776		
	18	1836	1,455	2,900	1,027	776		
Solar Home Systems (8 years)	9	576	384	4,000	751	626	734.91	964.29
	12	996	664	4,000	751	626		
	15	1416	944	5,000	939	814		
	18	1836	1,224	5,000	939	814		

Table 4: Economic analysis of technology options for lighting

**assuming no escalation in the cost of PDS or non-PDS kerosene*
Source: CEEW, 2015.

The analysis indicates the savings accruing to the government on account of avoided kerosene subsidy for a rural household. The savings analysis includes the consideration of prevailing leakage rates in the current delivery system, which we estimate to be 51 per cent (based on NSS data and kerosene allocation to the state).

Estimates based on NSS data suggest that that there are about 132 million current beneficiaries of kerosene subsidy in rural India. The potential savings against replacement of subsidized kerosene with

alternative lighting solutions could be in the range of INR 8,223 to 12,725 crore (USD 1.3–2 billion) per year. In a hypothetical scenario of a delivery system with no leakages, the estimated saving would be approximately half, i.e., in the range of INR 4,000 to 6,000 crore (USD 650 million to USD 1 billion) per year.

It is important to note that in the case of 15–18 lamp-hours of daily lighting needs, the monthly outlay by households on kerosene is in the range of INR 118–153. In comparison, when households move to cost-effective solar home systems or even multiple solar lanterns (with mobile charging capability), they are found to have a lower monthly outlay, better quality of light (higher lumen output) and a value-added service of mobile charging. The analysis should be viewed in the broader context in which, compared to kerosene, the solar-based alternatives are not just economically attractive but also provide much better end service to the households, with potential impacts on development.

3.2 ASSESSING ALTERNATIVES FOR COOKING

3.2.1 Available Cooking Alternatives

As shown in the previous chapter, the use of kerosene in urban areas is concentrated among low-income households, with cooking being the major end use. In addition to kerosene, traditional biomass is also used in urban-poor households (as also highlighted by the field cases), but its associated problems—particularly pertaining to indoor air pollution and declining availability that leads to rising costs—make it an unsustainable alternative. With respect to indoor air pollution, even improved cook-stoves do not reduce emissions enough to stay within safety limits, and technological improvements remain a challenge. Even though urban areas generate significant municipal waste, the choice of biogas as an alternative has certain key issues, including: (i) collection and segregation of waste, (ii) availability of land, and, (iii) difficulties in providing a piped network in the congested slums. In the long run, as the safety challenges of laying piped gas networks due to construction and congestion in urban-poor areas are tackled, PNG and/or biogas could become a sustainable cooking energy alternative.

The current scenario leaves LPG and electricity as the only pragmatic choices to meet cooking energy needs, which otherwise are currently being met by kerosene. Both LPG and electricity based cooking provide health benefits by limiting indoor air pollution while enhancing the convenience of cooking for the consumer. The government is also focused on promoting LPG as a clean cooking option in lieu of kerosene, with its policy of removing kerosene from a household's PDS entitlement if uses an LPG connection.

3.2.2 HOUSEHOLD COOKING NEEDS

It should be noted that the use of kerosene mainly for cooking in urban India is interrelated with the simultaneous use of various other fuels for the same task. Poorer urban households meet their cooking energy needs using a variety of fuels, as also highlighted in the evidence from the field studies. Thus, instead of limiting the focus to replacing kerosene as a cooking fuel, we also consider the overall cooking energy needs of the households and analyze the pathways for transitioning toward cleaner cooking energy alternatives.

Household cooking energy needs vary with income and family size. Jain et al. (2014; 2015) established that in terms of useful energy, even though per capita cooking energy increases with rises in income, the attendant reduction in household size (with increasing income) evens out the cooking energy requirement to a significant extent. Based on the NSS analysis, the report further establishes that 9.9 LPG cylinders (of 14.2 kg each) is the average annual consumption of households using only LPG (based on NSS data).

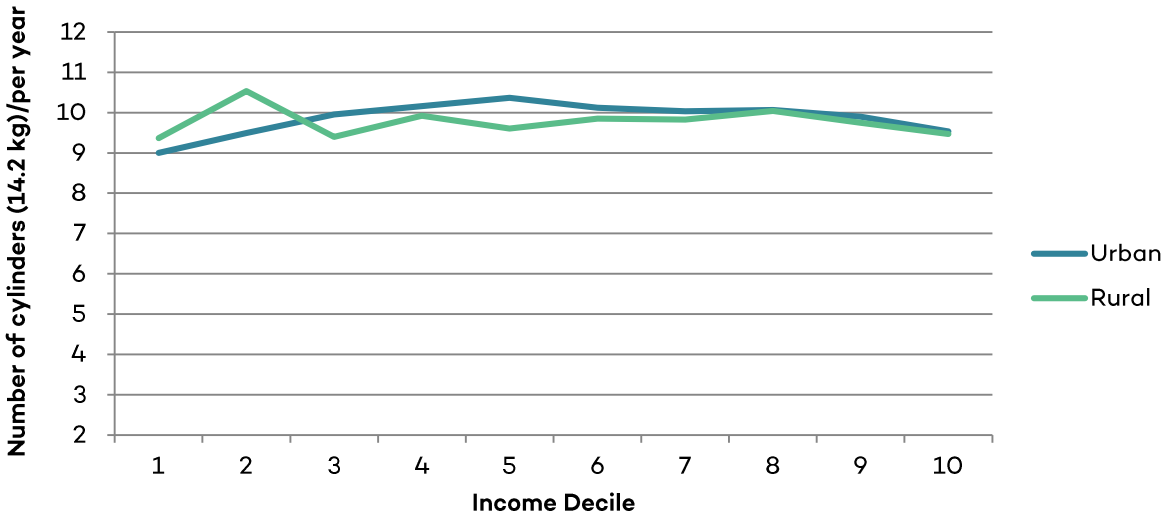

Figure 12: Average LPG consumption across households using only LPG, both rural and urban

Source: NSS, 2011–12.

3.2.3 Economic Analysis – Cooking

Subsidized kerosene is about 25 per cent cheaper than subsidized LPG in terms of useful kCal/INR. However, with 3 to 5 litres of subsidized kerosene being the typical monthly allocation of kerosene for an urban household, it is insufficient for its entire cooking energy needs. The requirement for 9.9 LPG cylinders translates to about 16.4 litres of monthly kerosene, on useful energy terms. Thus for households relying entirely on kerosene for their cooking energy, the gap between their monthly requirement and allocation is covered using non-PDS kerosene (i.e., black market kerosene). Analysis indicates that based on current subsidized prices and non-subsidized prices of kerosene, an urban household would spend as much as INR 588 (on an NPV basis) to meet its monthly cooking energy demand through kerosene. In comparison, a household would spend only INR 256 (NPV basis) for meeting the same demand through subsidized LPG. Even at current unsubsidized prices (INR 657 for 14.2 kg cylinder), the effective monthly expenditure (on NPV basis) would be INR 382 for LPG.

However, it should be noted that given the prohibitive costs associated with procuring non-PDS kerosene, urban-poor households generally tend to meet the gap in their cooking energy needs through alternative fuels such as wood and sawdust. Even under such a scenario, the monthly average outlay of households on cooking energy, as per NSS data, was around INR 340 (for the poorest 30 per cent of urban households not having LPG) in 2011–12. The real expenditure would have increased over the last three or four years due to inflation, and evidence from the field studies corroborates it further. It is imperative to note that if a household is currently spending INR 350 or more on alternative cooking energy sources, it would be economically viable for the household to transition to subsidized LPG, with the current monthly outlay required for using only LPG being about INR 347.

While there is significant potential for direct government savings for a transition away from kerosene for lighting, the shift from subsidized kerosene for cooking to subsidized LPG would result in a net loss to the government. However, it would still increase overall social welfare, with considerable direct and indirect cost savings to the urban-poor households. Based on current prices, the government would incur a loss of INR 615 per household. As per the NSS data, there are about 10.7 million households in urban India that were the beneficiaries of PDS kerosene and did not possess an LPG connection. Transitioning this entire population base would add only an additional INR 658 crore (~USD 100 million) as the LPG subsidy per year, while providing substantial social welfare benefits to the deprived population.

Transitioning to electricity for meeting cooking energy needs is not as economically attractive for households as LPG. At current electricity prices (INR 4.79 per kWh),[9] the expenditure for households to meet their cooking energy requirement would be INR 536 (INR 427 on an NPV basis).

The key considerations and assumptions for the economic analysis in the case of cooking include:

1. Interest rate of 12 per cent (to finance the capital cost).
2. Discount rate of 6 per cent (excluding inflation).
3. Price inflation of fuel is not considered for comparative analysis (which essentially means that a similar rate of price inflation is assumed for kerosene, LPG and electricity).
4. Life of a kerosene stove: seven years.
5. Price of a kerosene stove: INR 1,200.
6. Price of an induction stove: INR 1,200.
7. Life of an induction stove: 10 years.
8. NPV analysis includes cost of finance (for upfront costs beyond INR 1,000); kerosene stove and induction stove are assumed to be self-financed.

[9] CEA – All-India average 2013–14.

4.0 Potential Pathways to Enable Kerosene Subsidy Reform

The preceding sections have established that: (i) the kerosene subsidy in its current form is marred by significant leakages and inefficiencies, and (ii) alternatives to kerosene could be both economically effective and provide better end service. It is imperative to determine by which potential pathways kerosene subsidies could be rationalized to provide end services to the household in an affordable and *efficient* manner. The two possible broad choices for reform are: (i) to continue with subsidized kerosene as a commodity, while improving its efficiency using measures such as DBT, or (ii) to eliminate kerosene as a subsidized commodity altogether and provide households with alternatives to meet the same end need in a better and efficient manner. This section first discusses the option of DBT for kerosene and illustrates the potential benefits and drawbacks of limiting kerosene subsidy reform to only DBT. Subsequently, we discuss the approaches and broad framework within which an effective transition from subsidized kerosene to alternatives could be facilitated.

However, before we discuss each of the two possible approaches in detail, it is relevant to highlight the political economy of kerosene subsidy reform. Any reform on this front would call for a certain degree of alignment between the central and state governments, given the overlapping authority and responsibility of the current delivery system (discussed in detail in the next section).

4.1 DBT FOR KEROSENE

While we discuss DBT for kerosene, it is important to understand the current delivery system for subsidized kerosene. As kerosene is disbursed through the PDS system, the states' departments of food and civil supplies (FCS) submit their respective requirement of kerosene to the Ministry of Petroleum and Natural Gas (MoPNG). MoPNG approves these requests with necessary revisions (e.g., allocations have been reduced to states in India by about 8.5 per cent between 2011–12 to 2012–13 and by about 4.5 per cent between 2012–13 to 2013–14). Once MoPNG finalizes the allocations, it directs the oil marketing companies (OMCs) to provide the respective allocations. The wholesale dealers procure the kerosene from OMC depots at a subsidized price, and subsequently supply it to the fair price shops (FPS), which are the point of sale for the consumer. The subsidized kerosene is sold to the consumer at the FPS as per the entitlement fixed by the state government. The kerosene dealers are given a commission for every kilolitre (KL) of kerosene they sell. The kerosene distribution network involves both the central (MoPNG) and state (Department of FCS) governments, with OMCs and kerosene dealers coming under the purview of MoPNG, while fair price shops and issuing of ration cards for accessing subsidized kerosene comes under the state government's Department for Food and Civil Supplies.

Given the massive enrolment rates, very low levels of failed transactions and largely positive customer experience with DBT of the LPG subsidy, the government has announced it for the kerosene subsidy as well.[10] While the government considers implementation of DBT for kerosene, it is important to analyze the condition of the current delivery system to estimate the potential impact that DBT for kerosene may have.

Broadly, the four main challenges affecting the current kerosene subsidy delivery program, as discussed in the preceding sections, are (i) inadequate identification of beneficiaries; (ii) lack of information and awareness among beneficiaries about their entitlement; (iii) unavailability of the entitled quota to the households; and, (iv) reselling of the subsidized commodity by households. These collectively lead to the overall inefficiency and leakage in the current subsidy system.

[10] pib.nic.in/newsite/mbErel.aspx?relid=134114

Table 5 summarizes how each of these challenges lead to potential leakages and diversion in the current system, and how and to what extent DBT for kerosene could address those.

Table 5: The potential of the DBT mechanism in overcoming challenges in kerosene distribution

Current challenges	Challenges leading to possible diversion and corrupt practices	Potential ways in which DBT could help reduce these diversions
Inadequate identification of beneficiaries	PDS retailers having fake or ghost beneficiaries in their households list and receiving subsidized kerosene against such beneficiaries; Reselling this subsidized kerosene to unintended users or uses at a premium.	DBT would require each beneficiary to have a DBT enabled ration card-linked bank account. If the process is carried out diligently, it would potentially reduce the ghost beneficiaries to a significant extent. This would reduce the monthly quota allocated to a retailer (and in turn wholesale dealer), effectively reducing leakage from ghost beneficiaries.
Out-of-date lists, leading to dormant beneficiaries	PDS retailer getting kerosene against dormant ration cards, where households are not interested in getting all or some of their entitled kerosene. Retailer reselling it to unintended users or uses, at a premium.	DBT would shave off the excess kerosene allocation to the retailer that is against dormant beneficiaries, assuming such customers would not be interested in going through the DBT-K enrolment process. However, there could be certain agreement between retailer and such customers on a mutual benefit-sharing basis. Overall, DBT would help reduce leakage on account of dormant beneficiaries, perhaps not entirely but to a significant extent.
Unavailability of full entitled quota to the households Lack of awareness among beneficiaries about their entitlement	PDS retailer providing less than the entitled amount to the households in one or more ways: (i) Skipping kerosene quota for few months in a year; (ii) Providing less than the entitlement (e.g. 2 litres instead of 3) (iii) Under-measurement	Due to different taxes applicable to diesel and kerosene, the landed market price of diesel and the non-subsidized kerosene would be significantly different. Thus a retailer would still find a market for reselling even non-subsidized kerosene at a premium. (i) DBT may reduce the practice of skipping entire quota to households, as households would come to know if their entitlement was disbursed to someone else (as they will get the subsidy in their bank account) – however, on-the-ground implementation of the scheme as well as information flow and awareness raising would be critical—otherwise the current practice would continue. (ii) DBT would not have much effect, unless consumers are very vigilant about net subsidy payback amount in their account, every month. (iii) DBT would have no impact at all.
Reselling of the subsidized commodity by the households	Households getting the subsidized kerosene and then reselling it to other users.	No impact

Given the lack of detailed studies, data or insights on the contribution of each of the listed possibilities for diversion of subsidies listed in Table 5) it is difficult to quantify to what extent DBT would be able to limit these leakages. However, the discussion in Table 5 provides a qualitative insight on the principal impact that DBT may have on each of these diversion routes. It is important to mention that the success of DBT in limiting leakages would critically depend on the: (i) effective identification of beneficiaries; (ii) awareness raising about entitlements and provision of proactive information to the consumer; (iii) on-the-ground implementation to monitor and ensure that the entitled amount of kerosene is provided to the beneficiary. Each of these has remained a challenge in the current system, and hence the doubts regarding the impact of DBT for kerosene prevail. Apart from these issues, a significant challenge with DBT is the requirement that households possess a bank account. Despite

the continued efforts of the government to improve financial inclusion in the country, access to a bank account in rural areas—especially in those states where the rural population is heavily dependent on kerosene—is low. The ACCESS survey data suggests that as many as 30 per cent of households in Bihar and 24 per cent in Jharkhand did not possess a bank account as of December 2014. Census 2011, although a bit dated, puts the financial inclusion rates at even lower levels, especially for less developed states. While having a bank account is necessary to access the subsidy under DBT, what also matters is adequate access to banking services. With bank density being extremely low and mobile banking still in its infancy, DBT for kerosene could lead to significant barriers for deserving and underprivileged households to access their benefits. All these challenges and issues should be taken into account as government plans to roll out DBT kerosene at scale.

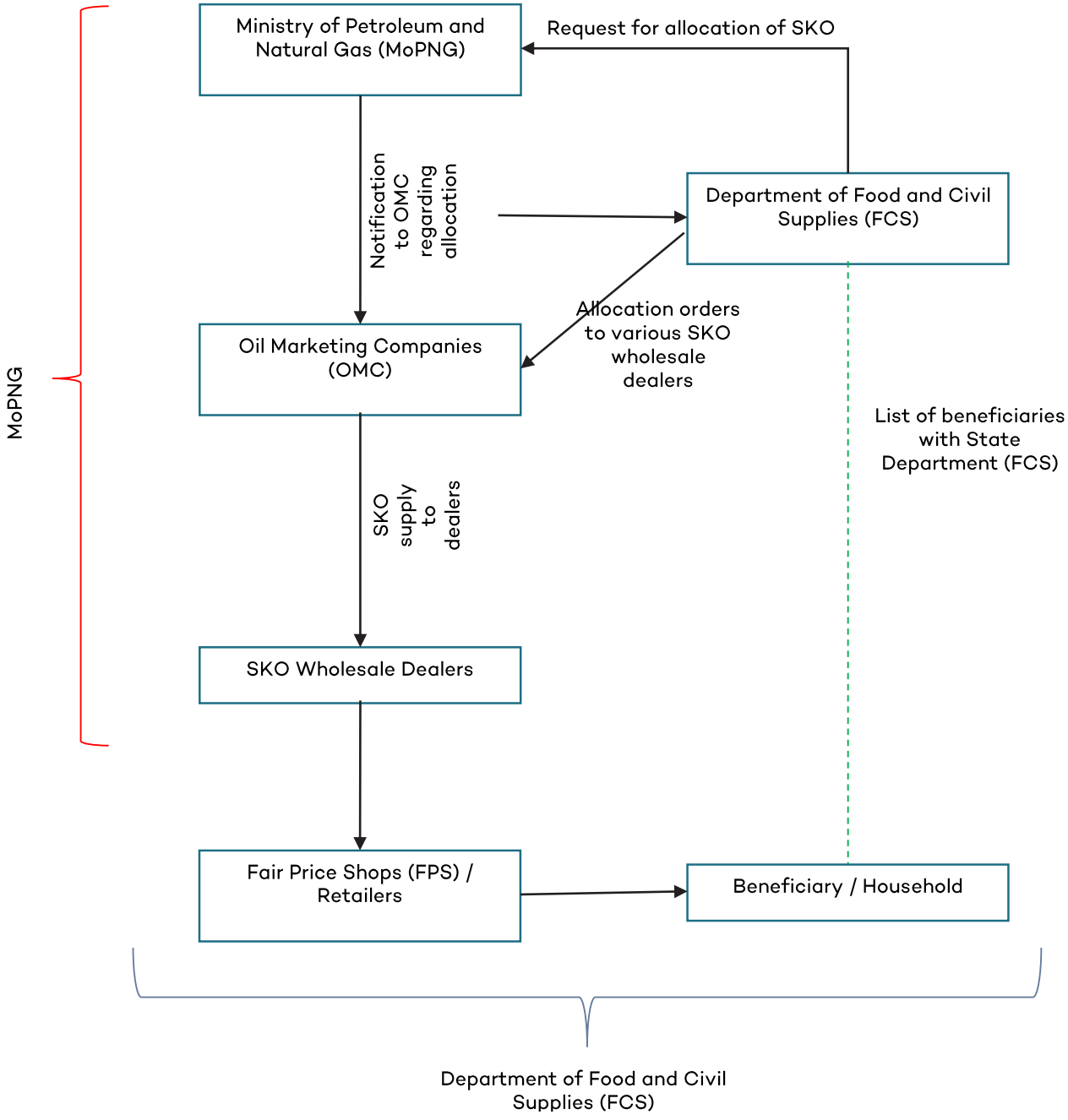

Figure 13: Current distribution mechanism of subsidized PDS kerosene to households in India

4.2 ALTERNATIVES IN LIEU OF KEROSENE SUBSIDY – POTENTIAL APPROACH FRAMEWORK

While the economic case for alternatives to kerosene is established, this section discusses pragmatic approaches and an operational framework within which a transition to alternatives could be facilitated. The proposed framework is based on eliminating subsidized kerosene while allowing its sale as an open-market commodity (after revision of tax structures), given its other miscellaneous uses among households. Simultaneously, the current subsidy allocation *could be* diverted toward uptake of cleaner and more efficient alternatives. The broader idea is to let the households choose between lighting or cooking alternatives as the immediate replacement in lieu of subsidized kerosene. Depending upon their choice, the alternative could be made available to the household. Given the current use pattern of the commodity, it is likely that most of the kerosene users in rural India would opt for an alternative lighting solution, whereas the majority of urban users would opt for an alternative cooking energy solution. Current literature and our research suggest that there are many challenges that need to be addressed to ensure a sustained and effective transition to alternatives. Given that both sets of alternatives have overlapping yet different barriers to resolve, we first look at the common element of the broad framework, and then discuss the detailed challenges and operational approaches for each.

4.2.1 Administrative Framework and Approach

At the central government level, alignment and coordination would be required between the MoPNG and the MNRE, particularly for replacement of kerosene for lighting alternatives. Given that decentralized off-grid solutions are under the purview of the MNRE, it is the central government ministry best placed to play a critical role in the transition. Figure 14 provides an overview of the broader framework, detailing the information and responsibility flow to enable the transition toward alternatives. In terms of administration, the Department of Food and Civil Supplies (FCS) of the respective state government would play a key role. FCS, which maintains the database of all PDS beneficiaries, would share the beneficiaries' details with the central government, specifically MoPNG and MNRE, to ensure accurate identification. In case of lighting alternatives, State Nodal Agencies (SNAs) with support from MNRE would be responsible for implementing the program at the administrative level.

In the case of cooking alternatives, the structure of responsibility for delivery of the service is already in place, with OMCs responsible for fuel availability through their network of LPG distributors. However, in the case of off-grid lighting solutions, there is currently a lack of a well-defined and strong operational structure. These issues will be discussed in further detail in the following sections.

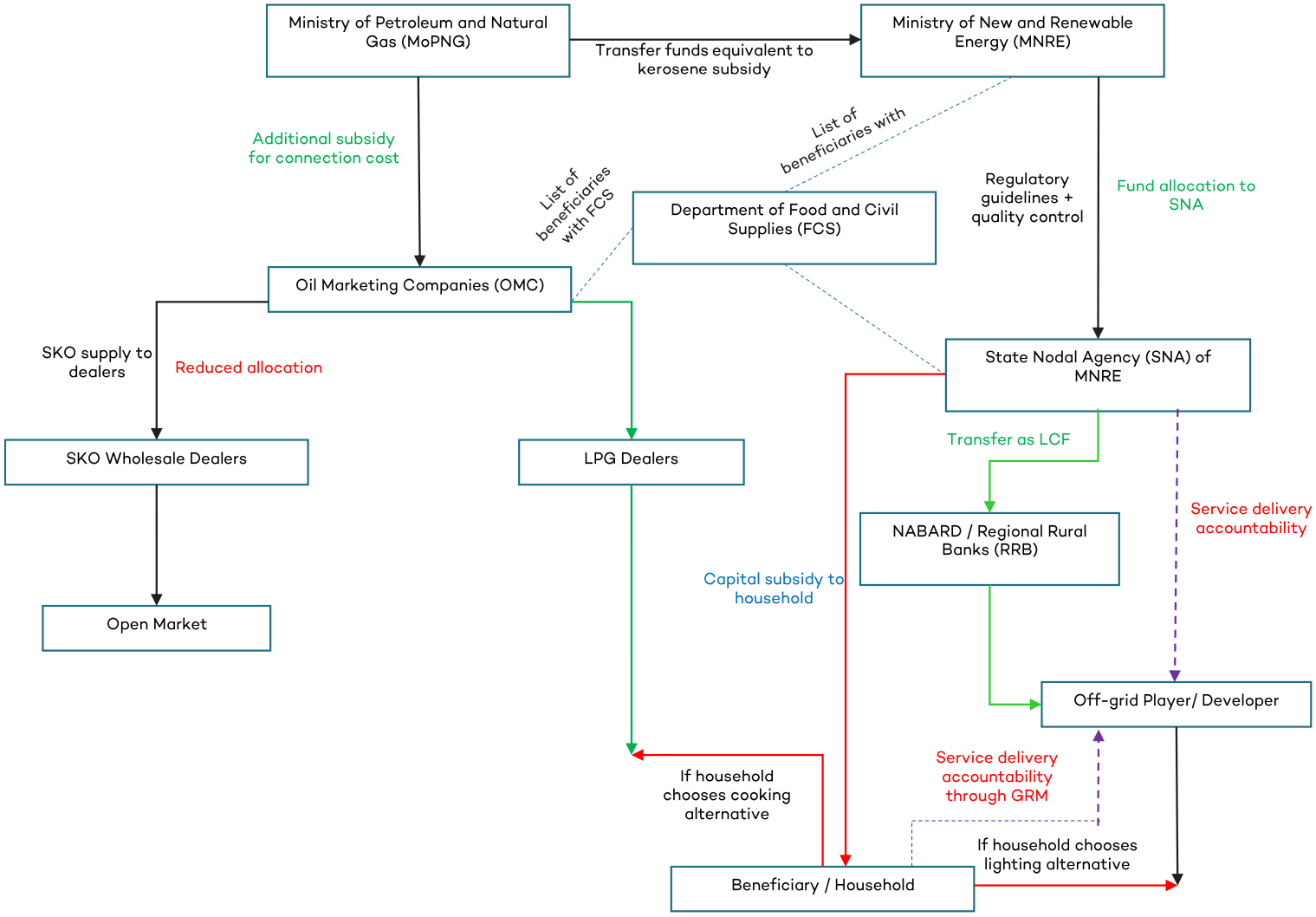

Figure 14: Proposed distribution mechanism of alternatives to kerosene for households in India

4.2.2 Transitioning to Alternative Lighting

Beyond economic viability, the major challenges pertaining to alternatives are associated with their: (i) high upfront cost and hence associated issues of financing, which pose a significant barrier to their adoption (Palit & Chaurey, 2011); (ii) poor quality and after-sale service, which limit their reliability as the sole lighting solution (Martinot, Cabraal, & Mathur, 2001); (iii) coverage of only relatively well-to-do households as a consequence of market-driven approaches to off-grid enterprises, which could leave the bottom-of-the-pyramid households from transitioning toward cleaner alternatives (Jolly, Raven, & Romijn, 2012; Reiche, Covarrubias, & Martinot, 2000).

Each of these challenges represents a significant barrier to the adoption and sustained use of alternative solutions and thus the effective replacement of kerosene for lighting. Together, they translate to three fundamental criteria that need to be addressed to enable a successful transition:

1. Affordability for the households, including affording the upfront cost (through adequate financing).

2. Assurance of quality and service reliability.
3. Universal coverage of the alternative to completely eradicate subsidized kerosene.

Tackling the Challenge of Upfront Cost Using Access to Finance and Business Models

The high upfront cost for off-grid lighting systems, which can vary anywhere between INR 1,000 to INR 5,000 prevents poor rural households from making a direct upfront purchase. The challenge could be tackled through options such as: (i) a capital subsidy; (ii) (low-cost) financing; or, (iii) a mix of subsidy and financing along with innovation in business models.

The government could provide a capital subsidy equivalent to a year's worth of kerosene subsidy (including leakages) to the household (~INR 1,000), so as to reduce the upfront cost for the household. Even after providing such capital subsidy support, there are considerable net savings on account of avoided kerosene subsidy for the next four or eight years (see Section 3). The next question is whether the subsidy should be provided to the off-grid player against each installation, or should it be provided directly to the beneficiaries. During the stakeholder consultation, it was the common view that subsidy support should be given directly to the households, and not be routed through off-grid players. Stakeholders raised concerns regarding pilfering and poor product or service quality when the subsidy would be provided directly to the off-grid enterprise.

In terms of financing, two major factors currently hinder debt financing for off-grid systems. First, the small value of the principal amount and the associated high transaction costs make it an unappealing lending option for the banks. Second, the risk associated with the loan due to low capacity or willingness of the end-consumer to pay back the loan, as well as the Non-Performing Assets (NPA), which arise due to the poor quality of after-sales service by the off-grid players.

There is thus a need to create an enabling environment for banks to be willing to disburse credit for off-grid systems. Service quality issues would be discussed in further detail in the following paragraphs, which would also tackle the issues related to NPAs. However, the small value of loans could be addressed by aggregating local demand and a lump-sum loan could then be disbursed to the off-grid player, who then collects the regular payments from the households. In such a case, the off-grid player becomes an aggregator on behalf of the end consumers, instead of each individual customer approaching the bank for a loan. This would reduce the credit risk for the bank as well as the transaction costs. Moreover, gradually as the adoption of alternatives reaches a certain scale (if subsidized kerosene is discontinued and fiscal support is diverted toward alternatives), banks would disburse loans for such systems more readily.

To address the issue of household capacity to payback the loans, households would need to be supported in the decision-making process to opt for adequate system sizes, i.e., that are within their economic capacity to repay. Very poor households may opt for a set of two lanterns, with a monthly payment of merely INR 30 (NPV basis, see Section 3). On the other hand, to tackle the issue of low willingness to pay—despite having both the capacity to pay and reliable service—businesses are coming up with innovations such as prepaid/pay-as-you-go (PAYG) models, which reduce the issues of irregular payments. Companies such as SimpaNetworks, Boond Engineering and Development, and many others are deploying such PAYG systems (The Climate Group, 2015; Asian Development Bank [ADB], 2013; Overseas Private Investment Corporation [OPIC], 2014). Such multipronged approaches would be required to tackle the issue of high upfront costs and the associated challenges.

Approaches to Ensure Reliable and High-Quality Service

After the discontinuation of subsidized kerosene, households will not have an affordable lighting option on which to fall back. Hence, the issue of service quality is essential to effect and sustain

a smooth transition from kerosene to solar-based lighting systems. Experience over the past few years suggests that the main factors leading to poor service quality and performance of various off-grid installations are: (i) low levels of consumer awareness, coupled with poor quality products penetrating the market (on account of low prices); (ii) cost-prohibitive after-sales services, given low volumes and dispersed markets; and, (iii) low incentives for after-sales service maintenance, leading to disproportionately high focus on product sales only, by off-grid players (Palit, 2013; Chaurey, Ranganathan, & Mohanty, 2004).

Addressing these challenges requires a multifaceted approach. On the consumer-awareness front, information dissemination as well as guidance in decision making—especially at the point of sale (when transition is made from kerosene to alternative)—is required. Information dissemination could occur through various channels such as radio, SMS, posters and pamphlets at the point of sale. The choice between various channels would depend upon their respective cost-effectiveness in a given context. There is also a need for standard guidelines that off-grid players should follow while disseminating their Information-Education-Communication (IEC) content, in order to provide consistent information to the household for easier comparisons. Apart from consumer awareness, in order to control the penetration of poor quality, non-standard (and mostly low-cost) products, stringent import restrictions would also be required. Moreover, the guidelines for product quality need to go beyond merely the product design, but should also include the on-ground performance as well as service quality criteria. Such a pragmatic approach, focusing on in-use performance and end-service quality is required for innovation to thrive, while improving the quality and reliability of the end service.

Regarding costs-of-service, the scale of deployment of off-grid lighting solutions to replace subsidized kerosene provides a unique opportunity to reduce servicing costs, since the high density and volume of deployed systems would lead to significant economies of scale. During the discussion stakeholders suggested that in order to increase the density of deployment for off-grid players in a local area, tenders or contracts could be provided at the block or district level, making one or two players responsible for providing off-grid solutions in the designated areas. However, such contracts would need to include significant penalty clauses in case of poor performance and service reliability of the systems.

Finally, a critical area in improving the quality and reliability of service is formulating adequate incentive structures for the off-grid players to provide sufficient attention and resources to ensure long-term system reliability. To create such an incentive structure, it is important to get the bottom-up information about service quality-related issues. A strong grievance tracking and redressal mechanism is required for this purpose, wherein consumers can log their complaints by calling toll-free numbers. Empowering end consumers to register a complaint about their lighting solution to a centralized grievance redressal system would provide a transparent mechanism to observe the performance of various off-grid system providers. Awareness generation about this system among consumers would be also be imperative to ensuring its effectiveness. This system would help not only in addressing consumer issues, but would also lead to tracking and analysis of the complaints to discover common issues and major challenges that could be addressed effectively. Moreover, based on the performances of off-grid players, various steps could be taken to ensure their accountability toward reliable service of lighting systems. For instance, if household finance is routed through the off-grid players, they could be made liable for the repayment of the entire credit disbursed by the bank in an area, in cases where recurring complaints are received about defunct/poorly performing systems beyond a certain threshold, due to poor service quality, thus ensuring the accountability of the off-grid player.

To sum up: in order to create an ecosystem with off-grid power as a reliable lighting alternative, it is essential for off-grid players to consider themselves as service companies providing the utility of lighting, rather than as a "product-driven" company selling appliances.

Achieving Universal Coverage of Alternative Lighting Systems

In order to entirely eliminate subsidized kerosene, it is necessary to provide an alternative solution to each and every current beneficiary. Thus, universal coverage is fundamentally critical for a successful transition away from kerosene. Historical experiences suggest that a purely market-driven approach would keep the poor—especially very poor households—from opting for these products or services (Kearney & GOGLA, 2013). In order to address this issue, one approach, as also suggested in the "upfront cost issue" is to provide differentiated offerings to households with different capacities to pay. With equal subsidy support from the government, the lowest-income households might opt for the lowest-level offering such as two or three solar lanterns, whereas a relatively better-off household may opt for solar home systems. In cases where the government chooses not to provide a universal capital subsidy, it may consider selectively providing such subsidy support for very low-income households.

Alternatively, universal service obligation approaches, as attempted in the telecom sector in India, could be considered. However, studies suggest that the universal service obligation fund (USOF) has had limited impact on increasing the density of teleservices in rural India, as opposed to various other policy reforms that reduced the cost of service to the consumer (Jain & Raghuram, 2009).

To ensure universality, the identification of beneficiaries is critical. At the same time, the role of the banking sector, particularly the rural regional banks (RRBs), would be critical as lenders and promoters of low-cost finance. During the consultation, it was recognized that banks usually lend only to low risk creditors, suggesting that the off-grid players alone cannot ensure universal coverage. Thus, the implementation program needs to be structured such that the government, financiers and off-grid players work in tandem to provide adequate solutions to even the lowest-income households in line with their economic capacity.

Capacity of the Off-Grid Sector

Apart from these specific issues, at a broader level, the biggest challenge is the capacity of the off-grid sector to enable deployment at a scale of ~100 million installations within a span of a couple of years. The sector so far has deployed about 1 million solar home systems and 3 million solar lanterns. Thus, to achieve the scale at which deployment would be required to enable a shift away from kerosene (for lighting), the sector—including off-grid players, financing institutions, and other stakeholders—needs to significantly enhance capacity.

The need for customized solutions for the user in terms of the product or service being offered (as well as the tweaking of business models to suit the operating context) will assume greater importance. In addition, the off-grid sector would need to operate in synergy with various other electrification initiatives, such as grid extension (which is seen as a priority by the government and the final goal for 24x7 electricity access) and should eventually look at supplementing the grid services.

Last but not the least, the role of the financial sector in increasing its banking networks and innovative end-user financing models would be imperative for enabling the transition at scale.

4.2.3 Transitioning to Alternative Cooking Fuels

While the economic case for households to shift from kerosene-based cooking to LPG is established, there are a number of hurdles that would need to be overcome to enable an effective transition. Given that most of the transition for cooking would take place among the urban-poor strata, the discussion in this section largely focuses on the same, with appropriate mention of challenges pertaining to rural areas, wherever required.

The evidence from our field studies in urban-poor sections suggests four major challenges pertaining to adoption and sustained use of LPG. First, there is the difficulty in accessing LPG due to residence and administrative hurdles. Second, the high upfront cost and the associated issue of financing pose a significant barrier to adoption. Third, the lumped cost of large-sized cylinders can be unaffordable for daily wage labourers. Fourth, there are also significant safety issues regarding LPG. In the following paragraphs, we discuss various possible approaches to deal with each of these challenges.

Enabling Easier Access by Reducing Bureaucratic Hurdles

Households in the urban-poor sections—particularly in unauthorized slum areas—very often do not have recognized addresses. The lack of proof of an address poses a hindrance in obtaining LPG connections. While the government is mandated to provide basic services to each household in the country, including PDS, safe water and sanitation, and electricity, it is important that adequate provisions are made in releasing LPG connections to such households. Given that subsidized LPG is now under DBT, it is also important that such households should not face challenges in terms of having access to a bank account. While the challenge of recognition and legal status of households in such areas is a broader development question, specific provisions could be considered for providing LPG connections to households in such areas. At the very least, reducing hurdles and enabling access to even unsubsidized open-market small (5kg) LPG cylinders could provide an economically viable option for the households, compared to their current expenditure on biomass or black market kerosene.

It was also observed during the field study that regular urban distributors are not keen on providing LPG connections to households in slums or congested areas—primarily because of the difficulty in servicing and few incentives for additional connections, given their already existing consumer base. This could be addressed by providing specific instructions to distributors to not decline any connection requests within their respective service areas. Another approach to address the same is to provide a dealership for 2 kg or 5 kg LPG cylinders to the current kerosene dealers (who would be losing business due to elimination of subsidized kerosene), to serve in these areas.

Reducing Upfront Costs

During our interactions with urban-poor households we observed that even though they are aware of the economic savings in moving from kerosene to LPG, high upfront costs hinder their transition. Currently, the connection cost of for a 14.2 kg connection varies anywhere between INR 3,600 to INR 5,600 (depending upon single or double bottle connections). This is a significant upfront cost for an urban-poor household. To address this issue, the government had extended its scheme to subsidize the connection cost of LPG for BPL households in urban-poor sections as well. However, poor awareness about the scheme, as well as the exclusion of deserving households on grounds of not having a BPL cards, limited the impact of the scheme. Both of these challenges must be addressed.

In additional to subsidizing the cost of connection, another possible approach to overcome the challenge of upfront costs is to provide financing for the connection. Establishing or tapping into microfinancing services run by self-help-groups (SHGs) in the urban-poor areas is one potential way to deal with the financing issue.

Further, the provision of smaller-cylinder connections, can also reduce the cost of connection for the households significantly (by INR 1100 or 2200, depending upon single or double bottle connections). This will also fare well with the urban-poor households given the nature of their cash flows.

Addressing the Lumped Cost Issue

Given that a majority of urban-poor households are day labourers or have irregular cash flows, it is a challenge for most of them to refill a 14.2 kg cylinder at the prevailing non-subsidized price (with the subsidy amount transacting back into their account). Cash flow issues are a main reason why urban-poor households continue using (black market) kerosene for cooking—it is easily available in small quantities (of even less than one litre). This fits well within the cash flow patterns of such households. During the field visits, we also observed that households rely on unauthorized 1 to 2 kg LPG cylinders, refilled through the black market at prices of INR 90 to 100 per kg. Such practices are unsafe as well as corrupt, and could be eradicated by introducing 2–5 kg LPG cylinders in urban areas.

Making LPG Safe in Urban-Poor Sections

Safety concerns related to use, mishandling and storage of large LPG cylinders within congested (and at times temporary) establishments of the urban-poor, pose a major barrier to its adoption. These raise a clear need for: (i) awareness generation among this population regarding the safe use and handling of LPG, while eliminating their misconceptions; (ii) introducing safer, composite (fibreglass)-based LPG cylinders, which provide a fail-safe mechanism in case of fire emergencies; and, (iii) providing smaller LPG cylinders (2–5 kg) in the urban-poor areas. The composite cylinders will also have the added advantage of being lightweight and more portable. However, the limitation of these cylinders is their upfront cost, which potentially may fall with economies of scale as their penetration increases.

4.2.4 Rehabilitation of Kerosene Wholesale Dealers and Retailers

Removal of subsidized kerosene would significantly affect wholesale dealers and retailers of kerosene. Even though unsubsidized open-market kerosene may be allowed to continue to be sold (after tax revisions), if alternatives are well implemented there would be little demand for open-market retail kerosene. This would lead to a significant loss of income for kerosene wholesale dealers and retailers. In order to avoid their lobbying against cleaner and more efficient alternatives, the concerns of wholesale dealers and retailers would need to be taken into consideration, either through consultations or, if required, through rehabilitation approaches.

During the stakeholder consultation, representatives of the kerosene wholesale dealers association expressed their support for eliminating the kerosene subsidy, but continuing kerosene as an open-market commodity. They expressed their interest in providing the kerosene wholesale dealers in urban areas with LPG distributorship of only 2 kg and 5 kg cylinders, as a means of rehabilitating them, after analyzing their loss of income. In the case of rural areas, it was suggested that the wholesale dealers may be provided with capacity building and training opportunities, if they are interested in exploring alternative lighting solution distributorships/service management.

To manage the concerns of the end retailer, it is important to note that two types of kerosene retailers exist today. First are those who sell various PDS commodities including kerosene. Such retailers will have limited concerns, as their sale of other commodities would continue. Second are those who sell only subsidized kerosene. Such dealers would face a significant loss of income. Only a few states have such retailers, and their respective state governments may take the initiative to provide capacity-building options to interested retailers for sale, installation and repair of alternative lighting systems. This would also partially augment the resource requirement gap in the off-grid sector to achieve deployment at scale.

5.0 Policy Recommendations

Based on the findings from this study, we provide the following policy recommendations to improve the effectiveness of current fiscal expenditure on subsidizing kerosene.

1. Given the economic case for alternatives— both for households as well as the government— subsidized kerosene should be replaced with alternatives, over time. While the subsidized commodity is phased out, its sale in open-market retail may be considered (after tax revision)
    a. It is critical that open-market sale of kerosene be allowed only after reforming the existing tax structure, to avoid substitution of kerosene for diesel.

2. In order to facilitate such a transition, the government could consider providing a year's worth of kerosene subsidy to each beneficiary household.
    a. Identification of the beneficiaries would be important to ensure effective targeting and implementation of the program.

3. Coordination and alignment between central and state governments, as well as between various central level ministries (MoPNG, MoF and MNRE) would be required to enable such a transition.

4. To enable such a transition at the national level, it needs to be first piloted in a few districts across multiple states to streamline administrative processes and coordination between various entities and stakeholders. Knowledge gained from these pilots would further inform the strategy to scale up the program nationally.

5. DBT for kerosene could be piloted as planned, but challenges pertaining to its limited impact in controlling leakages, the adverse impact on households excluded due to a lack of a bank account, and additional effort to get the subsidy money from the bank account, needs to be evaluated further. The districts for piloting DBT could be considered as potential districts to pilot the transitioning program.

6. To enable a sustained shift toward alternative lighting solutions (mostly in rural areas), consideration of the affordability of the upfront cost, reliability of service, and universal coverage is important.
    a. MNRE guidelines and product certification would need to go beyond product design and look at in-use performance and service reliability. This would act as a proactive measure to improve the service quality of off-grid systems.
    b. As a reactive—but critical—measure, a centralized grievance redressal mechanism could be developed to track and handle consumer complaints, as well as to have transparency on performance evaluation, and accountability of the various off-grid players.
    c. The implementation program as well as the incentives for off-grid players should be structured in a manner to achieve these goals.

7. Raising consumer awareness on various fronts would also play a significant role in enabling the transition. Specifically, awareness and information gaps need to be addressed on the following fronts:

    a. Awareness of the government's scheme for subsidized LPG connections, for BPL households, and its associated procedures needs to be raised further. Information about the itemized breakup of LPG connection costs (with clear indication of mandatory

components) should be prominently displayed at the LPG distributor's premises. Otherwise, LPG distributors may take undue advantage of the customer's lack of awareness.

   b. Information regarding kerosene entitlements for each category of ration cards should be displayed at PDS outlets, until PDS kerosene is eventually phased out.
   c. An awareness-generation program for information about solar-based lighting solutions and guidelines for off-grid players to provide consistent information to consumers is essential.

8. Capacity building (particularly of the off-grid sector) on skilled human resources would be of critical importance. As the off-grid sector scales up rapidly, it would require a large workforce with the requisite skills and capacity ranging from technology development and deployment to product and service maintenance.

9. Rehabilitation of kerosene wholesale dealers or retailers could be considered, on a loss-of-income basis.
   a. Interested wholesale dealers in urban areas could be provided with the distributorship of 2–5 kg LPG cylinders.
   b. Interested wholesale dealers and exclusive kerosene retailers in rural areas could be provided with skills and capacity-building training, if they chose to transition to the off-grid sector.

10. In order to improve LPG access in urban-poor areas, replacing kerosene, the following could be considered:
   a. Introduction of smaller LPG cylinders (2–5 kg) due to their benefits of low upfront cost, lower lumped cost, and perceived lower safety challenges.
   b. Enabling provision for release of LPG connections to households within slum areas, or at least ensuring availability of open-market LPG in 2–5 kg cylinders.
   c. Government should consider introducing small (2–5 kg) composite cylinders, especially for urban-poor settlements to address the safety issues.

6.0 Conclusion

The Government of India has subsidized kerosene for domestic consumption for more than 60 years. While it provides a safety net for households to meet their lighting and cooking needs, continuing the kerosene subsidy indicates the government's failure to provide reliable electricity and cooking energy to millions of rural and urban-poor households. Simultaneously, the advent of cleaner and more efficient alternatives, meeting the same end needs, challenges the rationale of continuing to subsidize a dirtier fuel that has an adverse impact on health and the environment. This study highlights the inefficiencies of the current subsidy regime, which is plagued by high rates of leakages and corrupt practices. It further identifies that kerosene is used only as a lighting fuel in rural India, except for the initial firing of traditional stoves. In comparison, the use of the fuel in urban India is predominantly for cooking. Alternatives such as solar home systems or a suite of solar lanterns could effectively replace kerosene use for lighting, while providing better end service to the households. Similarly, LPG can provide a more efficient and better cooking experience to the household, replacing kerosene. Comparative economic analysis suggests that alternatives to kerosene, both for lighting and cooking, are more cost-effective for households, and could provide net savings to the government. While alternatives are economically viable, multiple challenges related to financing, service reliability, universal coverage, access, safety, and cash flow need to be resolved to effectively enable such a transition. The transition would require alignment and coordination between various stakeholders including state and central governments, ministries within the central government, states' food and civil supplies department, kerosene wholesale dealers and retailers, oil marketing companies, the off-grid lighting sector and financial institutions.

While the government plans to pilot the direct benefit transfer of kerosene subsidy to the bank accounts of beneficiaries, the intended benefits of DBT-K would remain limited and possibly adversely affect low-income households with limited access to banking services. Moreover, DBT-K would continue to provide and subsidize a dirtier fuel to the households, when a shift toward cost-effective and better alternatives is feasible. A transition toward alternatives, while the government continues to strengthen the existing electricity and cooking energy delivery programs, would be a pragmatic choice. This study puts forth various approaches and recommendations to enable a transition from kerosene to cleaner alternatives.

Finally, this is an effort to showcase the possibilities that exist, and how these could be realized. We hope that this report will take forward the debate on kerosene subsidy rationalization to more pragmatic levels, and subsequently lead to effective on-the-ground action.

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