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KEROSENE TO SOLAR SWAP
Policy Brief #1

Kerosene Subsidies in India:
The status quo, challenges and the emerging path to reform

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Introduction

This Policy Brief examines the current system of kerosene subsidies in India, looking at key issues and the impact subsidies have on the distribution of clean, off-grid solar lighting solutions.

The paper is one of a series of three policy briefs looking at the links between kerosene use and off-grid solar applications for lighting in rural India. By tackling the current barriers to the market, the brief seeks to reform kerosene subsidy and outlines suggestions for policy solutions that could enhance off-grid solar penetration.

Policy Brief 2 examines the current market situation for off-grid solar technologies in India, and explores current barriers for such technology in more detail. Finally, Policy Brief 3 combines our research and sets out a suite of detailed policy interventions that could be implemented to achieve a systemic transition from kerosene to solar for lighting in rural India.

An Overview of the Kerosene Subsidy System

Census data from 2011 suggests that 43 per cent of rural households in India use kerosene as their primary lighting source, compared with 0.7 per cent who use kerosene as a primary cooking fuel (Ministry of Home Affairs, 2011). Despite kerosene's widespread use, subsidies to the fuel have been at the centre of energy policy debates for years. This is not only due to the intrinsic issues with kerosene use itself (such as health dangers) but also the inefficiencies in kerosene distribution.

Kerosene consumption in India is high—indeed, the country **accounts for 15 per cent of global consumption** (Energy Information Administration [EIA], 2013). Subsidized kerosene sold through the public distribution system (or PDS) remains a primary source of lighting for many rural households and, to a lesser extent, cooking for urban and peri-urban households.

PDS kerosene is sold via a nationwide system of (predominantly) third-party run Fair Price Shops (or FPS). These are administered at the state level, using household ration card[1] allocations for distribution, along with subsidized food and other commodities.

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[1] Ration cards are provided to a range of households classed both BPL (below poverty line) and APL (above poverty line). While the richest socioeconomic sectors do not use ration cards, these are not only for the very poorest segments of Indian society.

PDS eligibility criteria and monthly kerosene allocations are very complex and differ by state. However, across most states, households need, as a minimum, to possess a valid ration card to be eligible. Whether or not households have an LPG connection is also considered, despite kerosene being by far the leading fossil fuel for lighting.

To access kerosene allocations, state governments' 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 and 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 FPS, which sells it to consumers at the FPS as per the entitlement fixed by the state government. The kerosene dealers are given a commission for every kiloliter 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 FCS (Council on Energy, Environment and Water [CEEW], 2016).

Kerosene Subsidy Expenditure

In FY 2015–16, total kerosene subsidies amounted to INR 11,496 crore (USD $1.8 billion), representing 41.7 per cent of all fuel subsidies (INR 27,571 crore, or USD 4.3 billion[2]) (MoPNG, 2015b).

Historically, the retail price of PDS kerosene has been subsidized mainly through so-called "under-recoveries" by OMCs. When the central government regulates the price at which public sector OMCs sell PDS kerosene to FPS retailers, it can lead to under-recoveries. These translate into a loss when retail prices are lower than the cost of supply. Compensation for these under-recoveries form the majority of current PDS kerosene subsidies, representing over 97 per cent of total kerosene subsidy expenditure in FY 2013–14 and 100 per cent in 2014–15. Under-recoveries can be reduced by increasing retail prices or by reductions in international market prices. Following falling oil prices, under-recoveries declined by 19 per cent year-on-year in 2014–15 (MoPNG, 2015a).

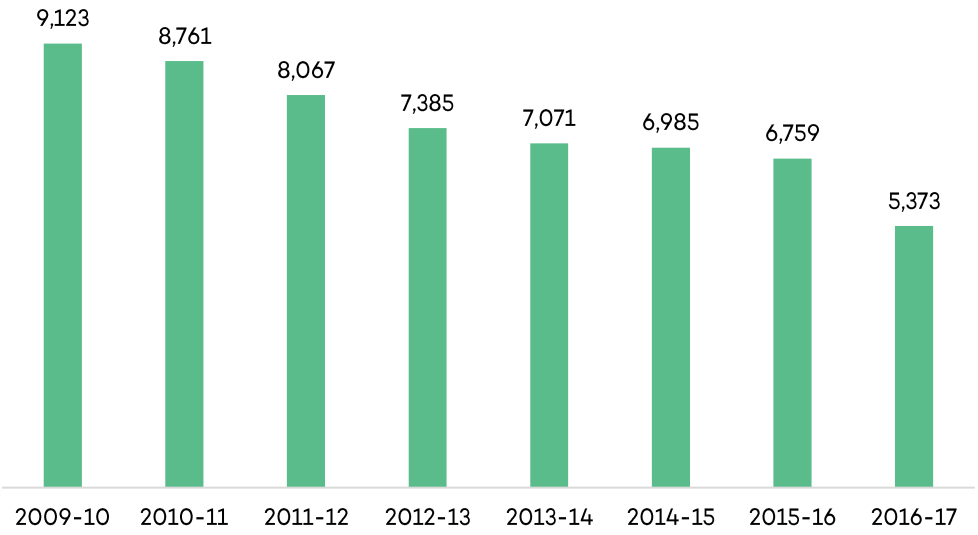

Figure 1. Central government allocations of PDS kerosene ('000 MT)

To control expenditure on kerosene subsidies, the central government has slowly reduced subsidized kerosene allocations to state-based PDS systems. Consequently, from FY 2009/10 onwards, total PDS allocation has fallen significantly (Clarke, 2014; MoPNG, 2015c) (see Figure 1 above). Household consumption of kerosene in India has fallen with the increase of rural electrification efforts, and total kerosene consumption has fallen from 10.2 million metric tonnes in FY 2003–04 to 8.97 million metric tons in FY 2014–15 (MoPNG, 2015c).

[2] Using the Reserve Bank of India's Reference Rate for the US dollar as 62.59 on March 31, 2015.

Until recently, price adjustments have been rare. Between 2002 and 2011,[3] the price for PDS kerosene was increased twice, by around INR 5 (USD 0.07). This excludes minor amendments to dealer commissions and other adjustments. Between June 2016 and February 2017, a number of small monthly and then fortnightly adjustments were made, amounting to a total price increase of INR 3.23. This has also helped to control expenditure, creating savings of around INR 802 crore (USD 120 million) between June 2016 and March 2017 (Docherty, 2017).

Who Benefits From Kerosene Subsidies?

As various studies show (see next section), a significant amount of PDS kerosene is lost to leakage,[4] with **approximately 45 per cent of PDS kerosene diverted to the black market**. Aside from kerosene lost to diversion and theft in the supply chain, of the total PDS kerosene supplied in the formal market by FPSs to households, half goes to the bottom 60 per cent of the rural population, with a large share also attributed to middle-income households (i.e., income deciles 4–6).

The poorest 20 per cent of households in rural India receive approximately 14 per cent of the allocated kerosene share for rural areas. Kerosene subsidy benefits are generally not captured by richer socioeconomic groups, nor are they effective at targeting the poorest groups; and that is without factoring in large-scale leakage across different groups.

In India, the poorest 40 per cent of households consume about 57 per cent of allocated PDS kerosene. Across rural and urban populations, the bottom 20 per cent of all households use similar proportions of total PDS kerosene allocations. Lighting is the predominant use of kerosene in rural India, while cooking is the predominant use in urban areas.

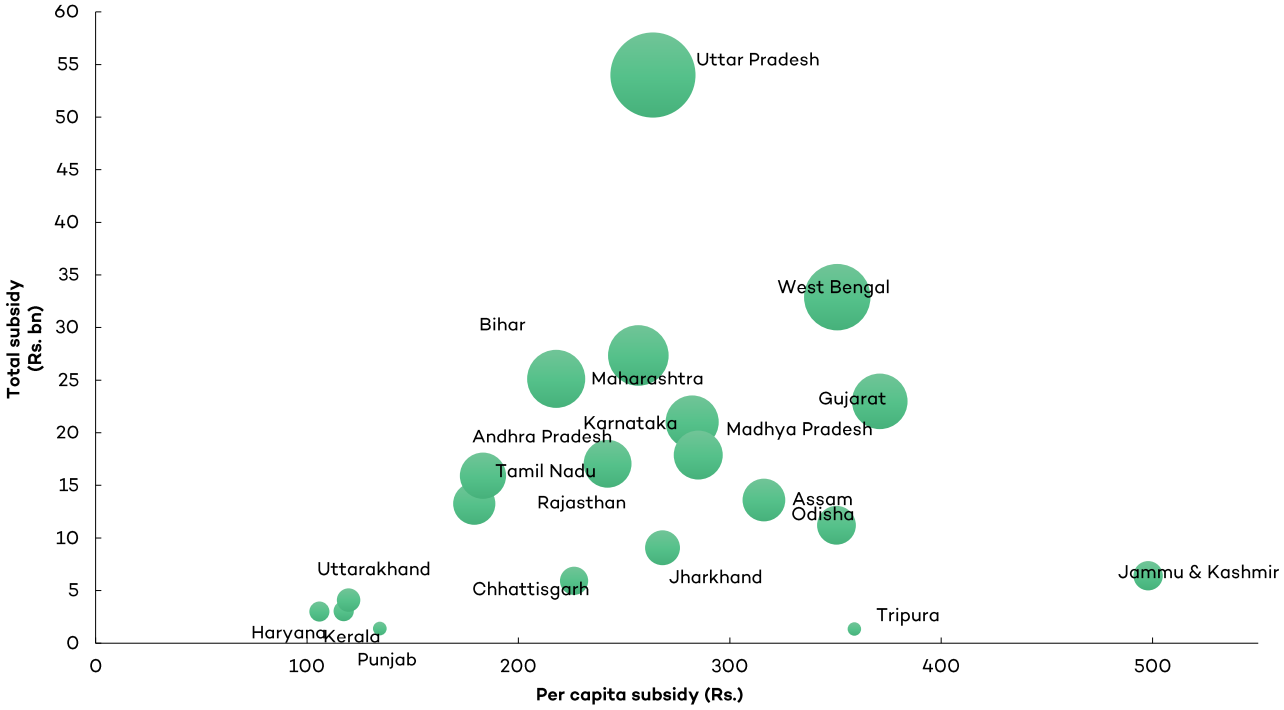

Figure 2. Total and per capita kerosene subsidy by state (2013–14)

Source: Docherty, 2017

As the graph above shows, the distribution of kerosene subsidies varies significantly depending on the region. Remote areas with lower household electrification rates receive large shares of total kerosene subsidies. Figure 2, with 2013–14 figures, shows the subsidy cost per capita and in absolute terms by state.

[3] Increasing by INR 3 per liter in June 2010 and INR 2 per liter in May 2011.

[4] Leakages in the PDS system can be defined as the difference between the supply by the central agencies to the states and union territories (also called off-take) and the demand by households (or consumption by households) (Gulati & Saini, 2015, p. 4).

Efforts to Reduce and Rationalize Kerosene Subsidies

The government has announced several initiatives to reduce spending on kerosene subsidies. This includes the previously mentioned general reduction in state allocation and a series of small, gradual increases in kerosene prices in 2016 and 2017.

Increasing electrification in rural India is, in theory, another way of reducing kerosene subsidy. However, in practice most households in villages deemed "electrified" still do not have access to reliable electricity. As part of its "24x7 Power for All" scheme (CEEW, 2015) the government, together with state governments, has set an ambitious goal of providing more reliable power to largely unelectrified communities by 2020. Rationalizing households' kerosene allocations based on levels of electricity access has been discussed for some time by both central and state governments. The *Hindu* reported in late 2014 that "the Centre plans to write to the States, asking them to provide subsidized kerosene only to unelectrified households. States that have achieved near 100 per cent electrification will be incentivized to become 'kerosene-free'" (Mehra, 2014). While some states, such as Kerala, include electrification of households as an exclusionary determinant of PDS kerosene eligibility, it remains unclear to what extent this principle will be applied more systematically at central or state level.

Another initiative considered by the government is changing the delivery of kerosene subsidy from in-kind support (i.e., sale of low-cost fuel) to cash transfers made directly to consumers after they have purchased fuels at market prices. This planned "direct benefit transfer" (DBT) approach would mimic a similar program for delivery of LPG subsidies (the DBTL or PAHAL program), which has become the world's largest cash transfer scheme. The aim of such schemes is to reduce leakage by removing dual pricing of fuels in retail, thus reducing the incentive for diversion. While some states have piloted a DBT for kerosene, the government is thought to have pulled back from this approach at a national level, as it would prefer to phase out kerosene subsidies completely in the medium term ("Government Unlikely," 2016). The costs and benefits of such cash transfer systems are discussed in detail in Policy Brief 3.

Efforts to reduce kerosene consumption have also been taking place at the city and state levels. Delhi was declared the first kerosene-free city in June 2014 ("Delhi Becomes," 2014). The city of Chandigarh, capital of Punjab and Haryana, declared itself the second kerosene-free city in April 2016, and a number of other cities have since followed suit (Prasad, 2016). On 1 April 2017, the state of Haryana declared itself kerosene-free ("State Becomes," 2017). In part, this has been driven by concern about the costs and health risks of kerosene, and in part by a government commitment to provide cash incentives to states that succeed in reducing their kerosene consumption, though DBT pilots, or any other means (Press Information Bureau, 2016).

Key Issues in the Kerosene Subsidy System

It is well documented that kerosene use has significant negative impacts on health and the environment (these are discussed more fully in Policy Brief 2). It is these externalities that kerosene subsidies encourage by promoting consumption.

The kerosene subsidy system itself in India, however, has two fundamental flaws. Firstly, subsidized kerosene is subject to staggering rates of diversion, theft and leakage. And secondly, the kerosene subsidy system is characterized by considerable inefficiencies related to poor distribution and ineffective targeting.

Leakage and Diversion

PDS kerosene leakage occurs as a result of a number of factors, but mainly as a result of corruption within the supply chain. This is related to the price incentive to use subsidized kerosene to adulterate pricier diesel fuel (for use in transport and generators). Leakage can occur at any stage within the post-refining supply chain, often involving actors upstream and downstream in the supply and distribution process. It can include OMC distributors and sub-contractors who receive subsidized kerosene shipments and FPS operators who channel subsidized kerosene volumes to non-household users through a variety of means.

Evidence clearly shows that consumers themselves can contribute to leakage by purchasing the maximum allocation (and above household needs) then selling it on in a thriving black market at higher prices. **The money-making opportunities that exist within the supply chain mean that kerosene subsidy reform is often fiercely resisted by various vested interests that make up the so-called "leakage lobby"** (CEEW, 2016).

While leakage is difficult to measure, **the national average for leakage is estimated to be a staggering 45 per cent of total PDS kerosene allocations based on data from 2011–12** (Gupta, 2014). According to the Indian Government's own Economic Survey estimates, 41 per cent of the PDS kerosene was lost to leakages in 2011–12 (GoI, 2015, p. 54), representing a tremendous waste on public finances. In that year, kerosene subsidies amounted to INR 20,415 crore (USD 3 billion), implying a leakage cost of INR 8,370 crore (USD 1.2 billion).

Leakage rates are highest in the northeastern states and in states with the largest allocations. The most significant leakages occur in Uttar Pradesh, West Bengal, Gujarat and Maharashtra. Leakage in Nagaland is estimated to be 97 per cent of all subsidized kerosene, 84 per cent in Manipur, 80 per cent in Sikkim, 76 per cent in Arunachal Pradesh, and 70 per cent in Meghalaya.

While the central government's efforts to reduce PDS kerosene allocations are in part motivated by the desire to tighten the availability of subsidized kerosene and reduce leakage, it is not immediately clear that reduced allocations will significantly reduce diversion, given the clear ongoing incentives for, and well-organized nature of the process.

The dependence on black market kerosene varies significantly across states, with those areas with the highest rates of leakage also clearly demonstrating evidence of the largest black markets. According to National Sample Survey (NSS) data, a high proportion of rural households consume non-PDS kerosene in the northeast states such as Manipur (61 per cent of households), Assam (50 per cent) and Nagaland (39 per cent). **It is estimated that about 12 per cent of PDS-eligible households in India depend entirely on non-PDS kerosene** (CEEW, 2016).

Targeting and Access to Subsidized Kerosene

Leakage of the scale currently experienced in India is made possible due to weak enforcement mechanisms within the subsidy supply chain and, as mentioned above, the dysfunctional nature of the PDS system. While this leads to leakage, it also leads to serious failures and waste in product delivery to households. Eligible households are often unable to access their full PDS kerosene allocation for a number of reasons:

- Because of the complex and arcane system of subsidized kerosene eligibility, households often do not have the requisite documentation to prove lack of electrification or LPG access. Indeed, a recent study found only about 72 per cent of ration card holders were aware of their correct monthly entitlement of PDS kerosene (CEEW, 2016).
- Very poor rural households and migrant workers often lack the ration cards necessary to access the PDS system altogether.
- As a result of diversion, subsidized kerosene is very often in short supply. **Recent estimates suggest that only 54 per cent of households receive their full monthly PDS kerosene quota on an almost-regular basis** (CEEW, 2016).

Even when consumers are able to access kerosene it may come at a high cost in both time and effort (Shenoy, 2010). Consumers often have to travel long distances on a monthly basis to FPS shops in rural areas, spend significant periods queuing, and risk failing to secure supplies altogether if kerosene stocks are exhausted (Shenoy, 2010).

The Cost to Households of Kerosene vs Off-Grid Solar Solutions

Given the serious negative externalities and wastefulness involved in kerosene subsidization, there is an urgent need for a policy response to spur a transition from the use of kerosene in both lighting and cooking (Morris et al. 2006; CEEW 2015).

Solar lanterns and solar home systems are a cleaner, increasingly affordable alternative to kerosene. They deliver higher-quality light without the negative effects on health and the environment. Access to solar lighting has also been linked to increased educational and employment opportunities and a reduction in fires and injures related to kerosene (Solar Aid, 2015). The creation of a flourishing off-grid solar sector also supports additional rural jobs and enterprises.

The following part of this brief sets out a series of household cost comparisons between the use of subsidized kerosene and a range of small-scale solar technologies.

Cost Comparison Assumptions

The calculated cost of lighting to households is based on:

- Assumptions for the cost of kerosene
- The type of product purchased
- The lifetime of the products
- And the typical interest rates for loans.

Monthly allocations of PDS kerosene are assumed to be three litres per household, with the rest of monthly household demand, where applicable, obtained from the black market at higher prices. Analysis suggests that 75 per cent of households use four litres or less of all types of kerosene per month, with average usage of around three litres (CEEW, 2016). PDS kerosene currently retails at a fixed price of approximately INR 16 (USD 0.23) per litre.[5] The typical price for black market or unsubsidized kerosene is assumed to be INR 35 (USD 0.51) per litre.[6] The subsidy for PDS kerosene is INR 19 (USD 0.28) per litre (or approximately 54.2 per cent of total cost).

According to the survey analysis, households using entry-level lanterns, with six-hour lighting capacity, replace 2 litres of kerosene consumption per month, whereas households using mid- and high-end lantern technologies with nine-hour lighting capacity are assumed to save 3 litres of kerosene per month (CEEW, 2016).

Three solar lantern types of a leading quality brand are included in the analysis (entry-level, mid-level and high-level). The product life has been estimated as 1.5 times the guaranteed warranty of the product. The product lifetimes assumed here are conservative estimates (often lanterns may last 2–3 times their guaranteed minimum lifetime). An entry-level product emits 25 lumens, has an assumed lifetime of 1.5 years, and provides six hours of lighting per day, at a cost of INR 500 (USD 7.2). A mid-segment product provides 120 lumens, has an assumed lifetime of two years, and provides nine hours of light per day, at a cost of INR 1,800 (USD 26). The high-segment product emits 160 lumens, provides nine hours of lighting per day as well as phone-charging capacities, and a lifetime of two years, at a cost of INR 2,400 (USD 35). The phone-charging capacity of high-level products is a significant source of additional value for households with this technology. This additional value has not been quantified, so the results for this product are not directly comparable. Loans taken to fund the upfront cost of the solar systems are assumed available at an interest rate of 12 per cent per annum (CEEW, 2016).

Cost Comparisons Across Three Technologies

The comparisons presented here compare the cost to households of lighting with kerosene versus solar lanterns. To model the effect of a possible future reduction in kerosene subsidies, three kerosene subsidy scenarios are examined in the cost comparisons below:

[5] Based on the current price in November – December 2015 in most states.
[6] Mean of the median values of NSS and CEEW data.

- Full subsidy: the existing level of subsidized kerosene allocation to household is maintained (3 litre allocation).
- 50 per cent subsidy: subsidized kerosene allocations are reduced by half (1.5 litre allocation), or, equivalently, the assumed per unit price subsidy is reduced by 50 per cent to INR 9.5 per litre.
- No subsidy: households pay market prices for kerosene.

In addition, for mid-level and high-level lanterns, two financing options are examined:

- Households cover upfront costs from savings.
- Upfront costs are financed over two periods from banks/financial institutions at 12 per cent interest per annum.

Based on these inputs, the equivalent household expenditure on kerosene is calculated over the life of these products, and the net savings made by switching to solar—over the life of the product—is then calculated.[7]

Table 1. Household expenditure for lighting, kerosene vs. entry-level lantern (1.5 years) (INR)

	Full Kerosene Subsidy	50% Kerosene Subsidy	Zero Kerosene Subsidy
Kerosene expenditure	576	747	1260
Solar expenditure	500	500	500
Net savings	76	247	760

Table 2. Household expenditure for lighting, Kerosene vs. mid-level lantern (two years) (INR)

	Full Kerosene Subsidy		50% Kerosene Subsidy		Zero Kerosene Subsidy	
	Loan	No Loan	Loan	No Loan	Loan	No Loan
Kerosene expenditure	1,152	1,152	1,836	1,836	2,520	2,520
Solar expenditure	2,130	1,800	2,130	1,800	2,130	1,800
Net savings	**(978)**	**(648)**	**(294)**	**36**	**390**	**720**

Table 3. Household expenditure for lighting, Kerosene vs. high-level lantern (two years) (INR)

	Full Kerosene Subsidy		50% Kerosene Subsidy		Zero Kerosene Subsidy	
	Loan	No Loan	Loan	No Loan	Loan	No Loan
Kerosene expenditure	1,152	1,152	1,836	1,836	2,520	2,520
Solar expenditure	2,840	2,400	2,840	2,400	2,840	2,400
Net savings	**(1,688)**	**(1,248)**	**(1,004)**	**(564)**	**(320)**	**120**

The results for the entry-level solar lighting system (Table 1), show that purchasing a system will reduce the overall cost of lighting. **However, at the current level of kerosene subsidies, household expenditure on entry-level solar lighting system is only marginally lower than that on kerosene**. If kerosene subsidies were to be removed, households would be saving INR 760 (approximately USD 12) or 150 per cent of the capital cost of an entry-level lantern over 1.5 years.

For mid-level systems (Table 2) the analysis suggests that **where kerosene subsidies are maintained it actually costs a household *more* to operate a solar system than to continue to burn kerosene**. For these types of systems, even if kerosene subsidies are halved, households make either very small savings, or incur additional expenditure of INR 294 (USD 25) in the cases where investments in these applications are financed. In the case where kerosene subsidies are removed, households with mid-level systems make significant savings by switching to solar over two years.

[7] Given the short periods involved, discount rates are not applied to future expenditure and savings streams; however, it should be noted that poor households have relatively high discount rates on streams of future savings.

High-level systems are not directly comparable as they also offer the ability to charge phones, a service which may save users money by avoiding charging costs. However, in general, these systems follow the same pattern; their immediate competitiveness for lighting is hampered by the presence of subsidies to kerosene.

Clearly, the economics of solar will improve in situations where households do not receive their full monthly allocations as a result of either leakage of other inefficiencies, and therefore rely on black markets. **Nevertheless, the key findings of this analysis underscore the fact that, when fuel subsidies are removed, a range of solar lantern products tend to be cheaper than kerosene for households over the lifetime of the products**. Where subsidies are left in place, the savings are relatively small for some systems and nonexistent for others. Removing kerosene subsidies, or diverting some of the funds spent on kerosene subsidies to solar lighting technologies, would shift the household economics of solar lighting and enable more households to make the beneficial switch to solar.

Not only are kerosene subsidies a key barrier to the uptake of solar energy, they are also extremely costly, both financially and in terms of externalities. The Indian Government annually spends INR 17,500 crore (USD 2.55 billion) to provide subsidized kerosene lighting in India. **An astounding 45 per cent of this is lost to leakage** (calculated based on Gupta, 2014; GoI, 2015). **If this money was reallocated to support solar lighting, it could fund the full capital cost of 350 million, 97 million or 73 million entry-level, mid-level, and high-level lanterns systems respectively**.

Conclusions and the Path to Reform

The analysis above demonstrates the importance of kerosene subsidy reform in creating cost competitiveness with off-grid solar alternatives.

Kerosene subsidy reform is critical to stimulating a large-scale transition to solar lighting in rural India, replacing kerosene and reducing its negative consequences. There is much that governments at the central and state levels can do to promote this process of reform. Some steps might simply reduce the dysfunctionality of the current subsidy system (e.g., Points 1 and 3 below), while others can be implemented to encourage a larger evolution of cleaner energy use in poor communities.

Key policy initiatives we recommend in order to reform subsidies are:

1. **Streamlining and simplifying eligibility criteria of kerosene subsidies** across states to restrict kerosene subsidy access to only "below poverty line" households, while strictly tying eligibility to lack of electricity access in places where kerosene is mainly used for lighting. Sale of subsidized kerosene in FPSs in *electrified* districts and panchayats (village clusters) should be phased out over an appropriate timeframe.
2. As part of any kerosene geographical phaseout plan, **provide funded retraining programs** to kerosene dealers and allow FPSs to sell accredited lighting alternatives in order to reduce political opposition to the process of reform.
3. Continuing the policy to **gradually decrease the size of subsidized kerosene volumes** through continued year-on-year reductions of PDS kerosene allocations to states; and to **increase the price of subsidized kerosene**, as long as the government is **providing appropriate mitigation policies** to ensure continued access to lighting services for low-income households.
4. **Launch related initiatives to replace kerosene use for cooking with LPG**, through the expansion of Delhi-style Kerosene-Free programs, and continued expansion of LPG access in rural areas. Reducing the reliance of households on kerosene for cooking means the government can undertake kerosene subsidy reform without the risk of depriving these households of cooking fuel.
5. Building on (1) above, experimenting with the gradual implementation of an ambitious **restructuring of the current kerosene subsidy to transform this into a general "lighting subsidy**," under which kerosene subsidy expenditure is redirected toward the purchase of solar lighting solutions. The exact mechanics of this program can be defined over time.

Kerosene subsidy reform is an intrinsically difficult process. In the absence of affordable and widely available lighting alternatives, rapid kerosene subsidy reform risks depriving the poorest households in India of an important social benefit. Furthermore, the political and economic challenges of kerosene subsidy reform are significant. There are considerable vested interests in the maintenance of kerosene subsidies, including among the "leakage lobby" and kerosene dealers, which are often politically powerful. Kerosene subsidy reform is therefore likely to be a difficult and drawn-out process.

Most importantly, because kerosene subsidy reform is impeded by the current lack of widely available, affordable off-grid solar lighting alternatives (while kerosene subsidies themselves constrain solar market development), government policy should increasingly focus on tackling the barriers to greater off-grid solar penetration. In particular, the government should focus on current financial and cost barriers. The other policy briefs in this series will examine this issue in detail, setting out a suite of innovative policy solutions that can be implemented to this end.

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