Measuring Energy Access in India

Insights from applying a multi-tier framework in cooking energy and household electricity

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This briefing paper reports on the largest energy access survey ever conducted in India, covering a representative sample of the rural poor across six states with interviews in 8,566 households. It adapts the World Bank's multi-tier framework to measure access to household electricity and clean cooking energy, across a spectrum of tiers and a range of attributes. Its findings reveal poor electricity access and difficulties with affording or being able to get a connection. Uptake of off-grid solutions remains limited; however such solutions provide more reliable, but limited electricity access. In cooking energy access, LPG, though limited to a smaller proportion of the population, is the only clean cooking energy solution that has been taken up by significant numbers. However, the majority of the population remains deprived of access to clean cooking energy. We conclude by reflecting on the usefulness of applying a multi-tier framework to measuring energy access.

Executive summary

The premise of this research was that how and what you measure makes a significant difference to your findings. Thus, applying a more nuanced definition of energy access should help reveal new insights about energy poverty in six Indian states.

The research was the largest study of energy access ever conducted in India

The research was the largest study of energy access ever conducted in India (Jain et al., 2015). The survey covered six of the most energy-deprived states and gathered data from a representative sample of 8,566 rural households in 714 villages. The study was also unique as one of the first large-scale applications of a multi-tier framework to measure access to household electricity and clean cooking energy. The framework is an adaptation of the World Bank's framework (only in draft at the time this research was undertaken), adjusted to the realities of the Indian context. It measures energy access according to a range of attributes. For household electricity, for example, these include capacity, availability, quality, reliability, affordability, and legal status. This gives a far more nuanced picture than just collecting information about whether a household has a grid connection or not.

The findings for electricity show that while over 90 per cent of villages are electrified, only 63 per cent of households have a grid electricity connection, and only 37 per cent have any appreciable level of electricity (above Tier 0). There is a reluctance to pay for a grid connection, either because it is unaffordable, or because people feel it is so unreliable as to not be worth it. Limited duration of supply and poor reliability and quality restricts much of the grid households to Tier 0 or 1. It is the poorest who are the least likely to have a grid connection.

Only five per cent of households use off-grid sources of electricity. Even these systems suffered from days of outage, although slightly fewer than for the grid, illustrating a need for better quality products.

The findings for cooking energy access concentrate on the availability and use of LPG compared with biomass. Over three-quarters of households (78 per cent) still rely entirely on biomass for cooking. Only 5 per cent use LPG exclusively. This is due to problems of both cost and availability. At the same time, 31–69 per cent of households (across states) buy traditional cooking fuels. Among these households, those buying only LPG spend less on average than those buying fuelwood. Thus switching to a clean fuel (where available) could save people money.

A multi-tier approach provides useful lessons for policy-makers about where to target efforts

In conclusion, this study reveals the additional insights gained from a multi-tier approach to measuring energy access. This provides useful lessons for policy-makers about how the situation can be addressed and where to target efforts to ensure no one is left behind. Without this more nuanced approach, the energy-poor will continue to be short-changed by services that are not meeting their needs, preventing energy from becoming the powerful enabler of development that it can be.

Introduction: New means of measurement are a better reflection of poor people's energy realities

Why does how you measure something matter? It has long been known that 'Not everything that counts can be counted, and not everything that can be counted counts' (Cameron, 1963). On the other hand, we know that 'what you measure is what you get' (for example Stakeholder Management Pty, 2014). The way energy access is defined is translated into a set of measures against which targets are set and performance is judged. If an energy utility is measured by how many villages have received a new connection, it will focus on this rather than whether people are actually using that electricity (making household connections) or whether electricity is actually flowing through the wires.

To date, access to electricity has been typically measured as 'having an electricity connection', while access to modern cooking solutions has been measured as 'cooking with non-solid fuels'. The most recent global reports of energy access (SE4ALL, 2013, 2015) use these definitions in the absence of data which would allow a more sophisticated analysis.

A binary definition of energy access gives an inaccurate picture of the real situation

However, these measures seem increasingly at odds with a rapidly changing energy access sector with a range of different supply options beyond the grid, and a range of improved cooking options even where solid fuels are still being used. The binary definition gives us an inaccurate picture of the real situation of energy access because, at times:

- It counts people as having electricity even when power rarely flows through their connection.
- It does not capture any other dimensions of supply such as capacity, quality (voltage spikes), or affordability.
- It does not count people who access energy services (lighting, charging devices, or running machines) through energy supplies other than the grid.
- It does not count people who have cooking solutions which are cleaner and more efficient than traditional stoves, but still use solid fuels.
- It only counts the use of energy within households and not for other critical parts of people's lives: how they earn a living or the community services they depend on.

To fill such gaps in current understanding and measurement of energy access, a new system has been developed as part of the Global Tracking Framework by a coalition of partners under SE4ALL and led by the World Bank ESMAP (Bhatia and Angelou, 2015). This multi-tier multi-dimensional framework (MTF) looks at a range of attributes of energy supplies across a range of tiers from 0 to 5. Frameworks have been developed for access to energy in different spheres: households, productive applications, and community facilities.

Practical Action has long advocated for a change in the way energy access is defined and measured: a key theme throughout the *Poor People's Energy Outlook* series. We expect that by using the MTF we will discover more about:

- where the best and worst access is and how this is changing over time;
- how decentralized electricity systems are performing compared with grid electricity.

Measuring in this way would make it possible to set smarter national or sub-national targets. We also recognize that 'The value of the [MTF] for energy-poor people will come not in its application, but in the use of its findings as a tool to highlight gaps and inequalities,

and to guide investment and policy focus to the places and aspects that need them the most' (Practical Action, 2014).

In this study, led by the Council on Energy, Environment and Water (CEEW) and Columbia University, an adapted version of the MTF was developed and applied in the largest primary data collection exercise dedicated to energy access in the history of India (and possibly anywhere in the world). The survey covered six of the most energy-deprived states and gathered data from 8,566 households in 714 villages.

Survey of energy access in six Indian states

The survey covered six of the most energy-deprived states, covering 8,566 households in 714 villages

Historically, access to modern forms of energy in India has been measured as: 1) the number of households using electricity as their primary source of lighting; and 2) the number of households using non-solid fuels as their primary source of cooking. While these measures go somewhat beyond the limited definition of having an electricity or cooking-gas connection, they still cannot describe the ground realities of energy access, especially in terms of quality. Such aggregated measures also cannot reveal the underlying reasons for deprived households not using electricity or cooking gas.

In order to bring out the nuanced view of energy access realities in some of the most energy-deprived states of the country, CEEW in collaboration with Columbia University conducted a large energy access survey (Jain et al., 2015). The survey primarily focused on household-level energy access, touching briefly on community and productive uses of energy. For household electricity access, the survey looked at the aspects of capacity, availability, quality, reliability, affordability, and legal status. For cooking energy, the focus was on health and safety aspects, availability, quality, affordability, and convenience of cooking. The study also focused on people's satisfaction with their current level of energy access, and their preferences and priorities for energy-related decision-making (Aklin et al., 2016).

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The survey covered six states: Uttar Pradesh, Bihar, Jharkhand, Odisha, West Bengal, and Madhya Pradesh. Being some of the most populous states in the country, they collectively account for a population of 400 million. We focused on these states in particular because of their poor situation of energy access in comparison with the rest of India. The survey focused on rural areas because of the significantly poor energy access situation there in comparison with urban areas. The survey was conducted between November 2014 and May 2015. It covered all the 48 administrative divisions in each of the states, reaching out to 714 villages in 51 districts. A comprehensive questionnaire comprising 155 questions was administered by a team of 60 enumerators, to the 8,566 households that constitute this statistically representative sample.

The study developed two multi-dimensional, multi-tier frameworks for access to electricity and clean cooking in households

The study developed two separate multi-dimensional, multi-tier frameworks to evaluate access to electricity and clean cooking energy in households. These tiers are illustrated in Tables 1 and 2. Under the proposed framework, a tier is assigned to each household for each of the dimensions. The tiers, ranging from Tier 0 (lowest) to Tier 3 (highest), represent increasing endowments and a progression in the path to energy access. Finally, each household is assigned an overall tier (one for electricity and one for cooking), corresponding to the minimum tier achieved across all the dimensions within each of the frameworks. While this makes for a conservative estimation of the overall tier, such an approach effectively highlights priority areas of action, making the framework highly valuable for decision-makers and key stakeholders.

The basic structure of the framework we used and many of the dimensions overlap with the MTF. However, adaptations were made to create a better fit with Indian realities. There are differences in the definition of some of the dimensions, setting of thresholds for various tiers, and, in some cases, the nature of responses (use of subjective responses in lieu of objective thresholds). One major modification is a reduced number of overall tiers (four compared with six in the MTF). This was because the survey results from India suggest the data was not widely dispersed or sensitive enough to justify the need for six tiers.

Table 1 Multi-tier framework for household electricity access, adapted for India

Tier / Dimension	Tier 0	Tier 1	Tier 2	Tier 3
Capacity	No electricity	Lighting + Basic entertainment / communication (Radio/ Mobile) (~1–50 W)	Lighting + Air circulation + Entertainment / communication (TV/ Computer) (~50–500 W)	Tier 2 services + Medium to Heavy loads (>500 W)
Duration	<4 hrs	>4 hrs and <8 hrs	>8 hrs and <20 hrs	≥20 hrs
Reliability (black-out days)	5 or more days	2–4 days	1 day	0
Quality*	$N_H > 3$; $N_L > 6$	$N_H = 0–3$; $N_L = 0–6$	$N_H = 0–1$; $N_L = 0–3$	$N_H + N_L = 0$
Affordability	Unaffordable		Affordable	
Legality	Illegal		Legal	

* N_H is number of high voltage days in a month causing appliance damage; N_L is number of low voltage days in a month limiting appliance usage.

Note: For dimensions where the categories span multiple tiers, only the higher tier values apply. For example, affordability can only be categorized as Tier 1 or Tier 3. The same is the case for legality.

Table 2 Multi-tier framework for household cooking energy access, adapted for India

Tier / Dimension	Tier 0	Tier 1	Tier 2	Tier 3
Health and safety	Only traditional fuel used (firewood, dung-cakes, agricultural residue)	A mix of traditional fuel and BLEN (Biogas, LPG, electricity, natural gas) is used		Only source of cooking fuel includes BLEN
Availability	Cooking less because of availability	Unsatisfied with availability	Neutral to availability	Satisfied with availability
Quality	Quality of cooking is not adequate		Quality of cooking is adequate	
Affordability	Not affordable		Affordable	
Convenience	Both difficult to use and time-consuming		Either difficult to use or time-consuming	Neither difficult nor time-consuming

Note: For dimensions where the categories span multiple tiers, only the higher tier values apply. For example quality and affordability dimensions can only be categorized as Tier 1 or Tier 3. Health and safety can only be categorized as Tier 0, Tier 2,or Tier 3.

Tables 3 and 4 highlight some of the key differences in terms of thresholds applied between tiers and the proxies used in this research where it was not feasible to collect accurate information on, for example, indoor air quality.

The minimum level of decent energy access, which is defined at Tier 3 in MTF, is equivalent to Tier 2 in our framing. The framework is developed with a focus on energy services, rather than just the supply or capacity of electricity provision, thus being sensitive to energy efficiency gains. As mentioned earlier, although Total Energy Access, as advocated by Practical Action, is inclusive of households, community, and productive

Table 3 Comparison of frameworks for household electricity: selected attributes

	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Capacity						
Indian framework	None	1–50 W	50–500 W	>500 W		
World Bank	None	3–50 W	50–200 W	200–800 W	800–2,000 W	>2,000 W
Duration						
Indian framework	<4 hours	4–8 hours	8–20 hours	>20 hours		
World Bank	None	4–8 hours	4–8 hours	8–16 hours	16–23 hours	>23 hours
Reliability						
Indian framework Black-out days/month	5 or more days	2–4 days	1 day	0 days		
World Bank Disruptions/ week					Up to max 14	Up to max 3

Table 4 Comparison of frameworks for household cooking: selected attributes

	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Health and Safety / Indoor air quality						
Indian framework	Only traditional fuel used	Mix of traditional fuels and non-solid fuels (gas/elec)		Cook with gas/elec only		
World Bank		Still to be defined			<35 PM2.5 (µg/m3) <7 CO (mg/m3)	<10 PM2.5 (µg/m3) <7 CO (mg/m3)
Convenience						
Indian framework	Both difficult to use and time-consuming		Either difficult to use or time-consuming	Neither difficult nor time-consuming		
World Bank			Tiers based on stove preparation and fuel acquisition and preparation time			
Affordability						
Indian framework	Not affordable		Affordable			
World Bank					Levelised cost of cooking solution (cookstove and fuel) <5% of household income	

Note: PM2.5 (µg/m3) is a measure of the amount of a particular size of particulate matter in the air; co (mg/m3) is a measure of the concentration of carbon monoxide.

Affordability: The Indian framework uses 6% of household income as the affordability limit and only considers running costs

use of energy, this study primarily focused on household energy access. This seems justified as respondents confirmed that energy for household use is their top priority.

Household electricity access results

Over the last decade, there has been extensive focus on rural electrification in India. However, most of it has been limited to extending the grid to villages. Connectivity of all households to the grid, or ensuring flow of power in the wires has not received as much attention. This is partly because of the restricted definition of rural electrification, followed in the policy guidelines.[2] Figure 1 shows that although most of the six states have high levels of village electrification, rates of household electrification vary significantly. The states of West Bengal and Madhya Pradesh are doing better than others in providing an electricity connection to as many households as possible.

In some states, such as Odisha and Madhya Pradesh, although the process of extending the grid started early, most of the households were connected fairly recently. In other states, such as Bihar and Jharkhand, the grid extension itself has started much more recently. Our study finds that the median time gap between a village getting electricity and the majority of its households getting electricity is as high as 25 years in the state of Odisha, compared with two years in the states of Bihar and Jharkhand.

Why does such a high proportion of rural households still lack an electricity connection? For a third of those without electricity, it is simply that it is not available in their village

There has been a significant focus on households electrification in India in the past decade, but rates of connection are highly correlated with household wealth
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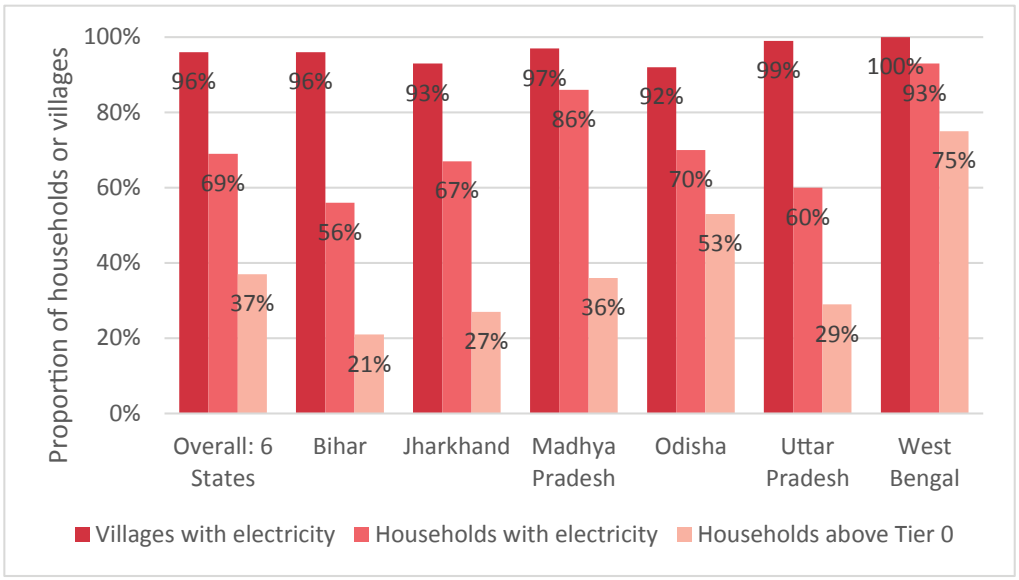


Figure 1 Village vs. household electrification across the surveyed states

Two thirds of households without electricity cannot afford or have chosen not to pay for connection

(still a major bottleneck in Bihar, for example). The remaining two-thirds have *chosen not to pay* for a connection, citing reasons such as inability to afford the connection (56 per cent), high recurring/monthly expenditure (50 per cent), or poor/unreliable supply situation (48 per cent) (Figure 2).

Having an electricity connection is highly correlated with household wealth (monthly expenditure). Unelectrified households have a mean monthly expenditure of 4,370 rupees (US$65.50) per month; electrified households, however, have a mean monthly

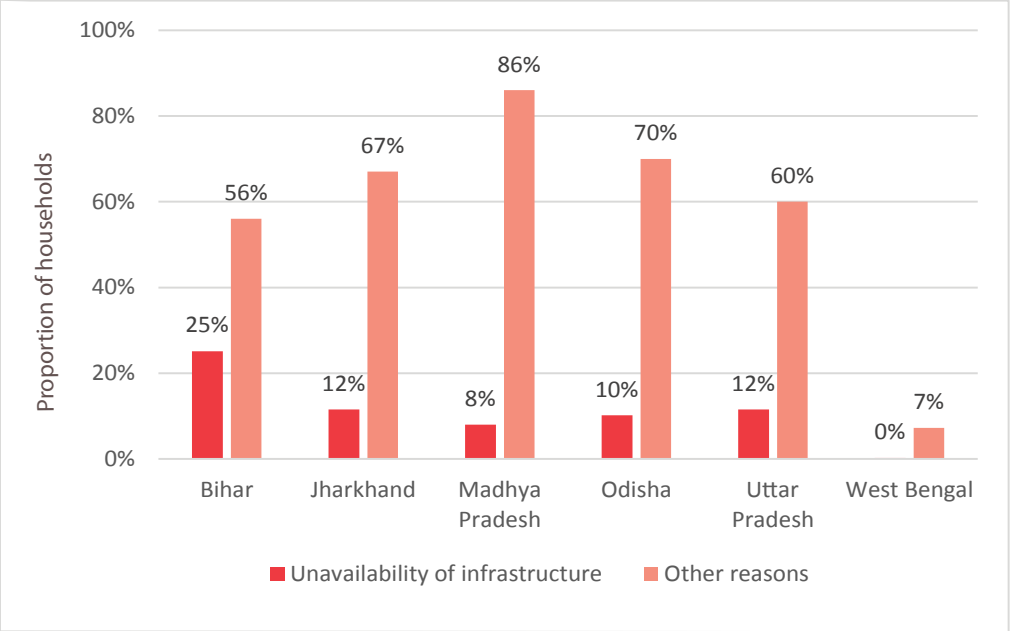


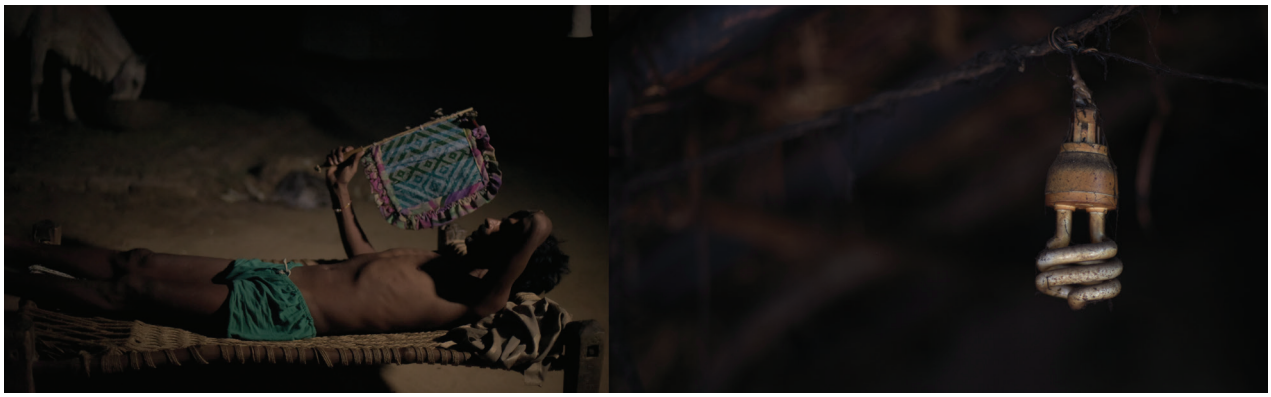
Figure 2 Reasons for not having electricity

expenditure of 5,640 rupees ($84.50) per month – a 30 per cent difference. By contrast, the quality of electricity (in terms of duration or reliability) is not strongly associated with a household's income. All households, rich or poor, are at the mercy of a poor-quality grid.

While 69% of households are electrified, only 37% have any appreciable level of energy access

Going beyond the connections and looking at the multi-dimensionality of energy access, we found that while 69 per cent of rural households are electrified, only about 37 per cent experience any appreciable level of energy access (above Tier 0) (Figure 1). The remaining 63 per cent are in the bottom-most tier (Tier 0) of electricity access.

Among households in Tier 0, half (51 per cent) are electrified. Stated differently, 46 per cent of electrified households have severe issues in terms of supply quality and duration and are in the lowest tier of energy access (Tier 0). The mere provision of a grid electricity connection does not, therefore, guarantee a useful level of electricity access, unless duration and quality of supply meet a certain minimum threshold.



Household electricity: urgently needed for services like lighting and cooling
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The reasons for the majority of households remaining in the lowest tier for electricity access vary across states. For some, this is simply because they do not have an electricity connection (particularly the case in Bihar, Jharkhand, and Uttar Pradesh, Figure 3). However, there are significant proportions that have a connection, but remain in Tier 0 (Figure 4). In Bihar, Jharkhand, and Uttar Pradesh, reliability (five or more complete black-out days in a month) is the biggest problem. In Bihar, grid electricity is so unreliable that 13 per cent said it was available for less than 4 hours a day (duration). In the other three states, quality (voltage irregularity) was the biggest problem. Such an

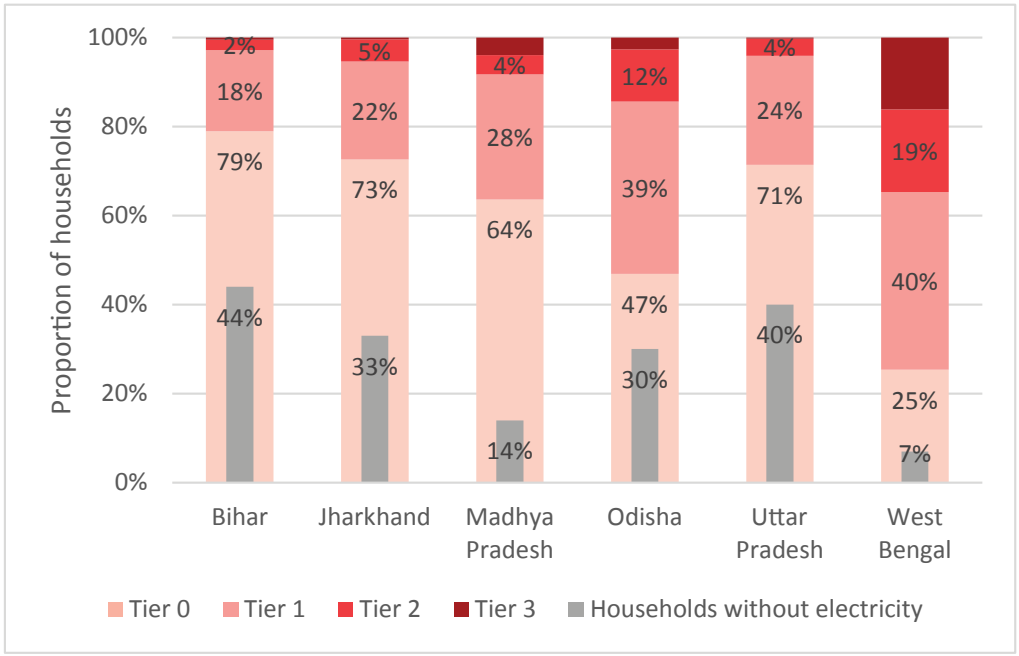

Figure 3 Spread of households across electricity access tiers

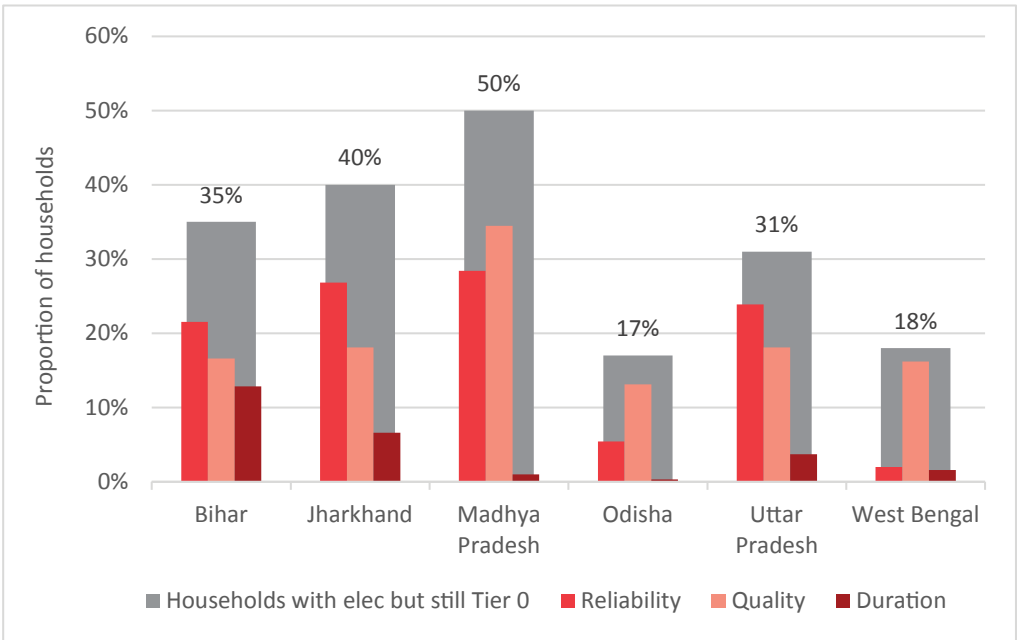

Figure 4 Bottlenecks keeping households at Tier 0

analysis helps administrators and policy-makers to focus on the right problems in order to improve the energy access situation, whether that is the lack of a connection in the first place, or the poor quality of that connection.

Although the majority of rural households across the study states are in Tier 0, a good proportion (27 per cent) have Tier 1 access (Figure 3). These households typically have basic lighting and mobile phone charging technologies, and electricity is available for 4–8 hours, with about 2–4 days of outages in a typical month. Across the study states, the factor inhibiting the leap to Tier 2 tends to be either reliability (Bihar, Jharkhand, Odisha, Uttar Pradesh) or affordability (Madhya Pradesh, Uttar Pradesh, West Bengal).

5 per cent of households have a decentralized electricity connection

We can also compare the performance of grid versus decentralized electricity generation methods (solar home systems, micro-grids, and so on). In our sample, 69 per cent of households have some kind of an electricity connection, while only 64 per cent have a grid electricity connection. Thus, 5 per cent of the households in the sample have a decentralized electricity connection.

In terms of hours of electricity access per day, the grid significantly outperforms decentralized alternatives: grid-connected households have on average 13.1 hours of supply, while non-connected households only have 4.7 hours. The majority of micro-grids and solar lanterns are only designed to supply 3–4 hours of power per day. However, 19 per cent of solar home systems and 9 per cent of lanterns were supplying 12 hours of power (Figure 5).

On the other hand, decentralized electricity performed slightly better than grid electricity in terms of reliability, with 3.3 days of outage per month compared with 3.7 for the grid. What is surprising about this minor difference is the high number of outage days for decentralized electricity technologies.

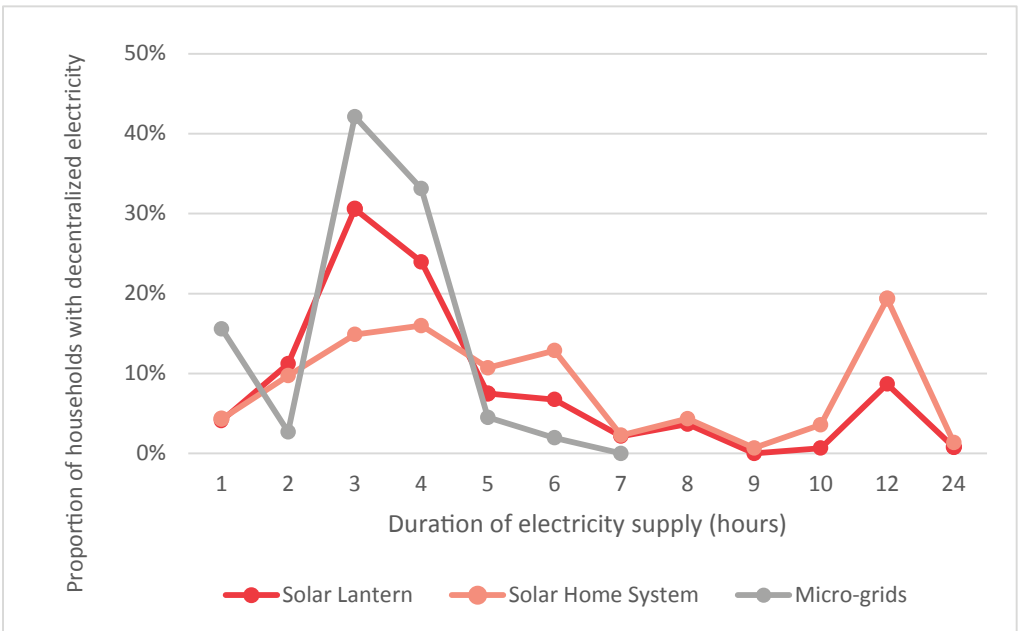

Figure 5 Daily duration of supply for decentralized electricity technologies

Household cooking energy access results

Over the years, the Government of India has rolled out various programmes in order to improve access to cleaner cooking energy. One of the biggest efforts on this front has been the continued subsidy to cooking gas (LPG). However, in most states (except the southern states) the majority of consumption of LPG has remained skewed towards urban areas, with the urban rich being the prime beneficiaries. Since 2009, the government has started making small but focused efforts towards increasing penetration of LPG in rural areas. In May 2016, the government launched a new programme to provide subsidized LPG connections to poor households.

Less than 1% of the rural population is using improved biomass stoves, but 22% has LPG

Apart from LPG, the government started a National Program on Biogas Development (1982) and a National Program on Improved Chulhas (1983). After more than two decades of operations, these programmes were reviewed and launched in a revamped form, with a bid to increase the penetration of clean cooking solutions. However, the current use of these technologies is abysmally low. Our survey in the six states indicates that less than 1 per cent of the rural population is using these technologies. Electricity, given its poor supply and reliability, has not been able to become a significant option for cooking in rural India. Thus, virtually all the clean cooking energy access in rural India is so far limited to LPG access.

Historically, access to clean cooking energy in India has lagged behind electricity access, particularly in the rural areas. Figures from the national census (years 2001 and 2011) as well as National Sample Surveys (2004–05, 2009–10, and 2011–12) testify to this.[3] Our survey found similar results, with little variation across the six states. Although there are perceptible variations in the use and mix of traditional biomass fuels across states, the unifying feature is the limited access to modern cooking fuels. This excessive dependence

Using biomass collected for free for cooking on a traditional stove. Seventy-eight per cent of households have no access to clean fuels and there is virtually no penetration of improved stoves.
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on traditional fuels has significant adverse health impacts as a result of poor indoor air quality. Only 14 per cent of households in rural areas across the six states use BLEN (biogas/LPG/electricity/natural gas) as their primary source of cooking fuel (Figure 6).[4]

In our survey, with the exception of Uttar Pradesh, 8 out of 10 households continued to use traditional fuels exclusively (Figure 7).

Households are classified in Tier 0 for cooking energy access under two conditions:

- complete dependence for cooking energy on traditional fuels;[5] or
- lack of fuel availability to the extent that it adversely impacts the amount of food cooked.

These two situations pertain to the *health and safety* and *availability* dimensions of cooking energy access. Almost 99.5 per cent of the households in Tier 0 fail the health

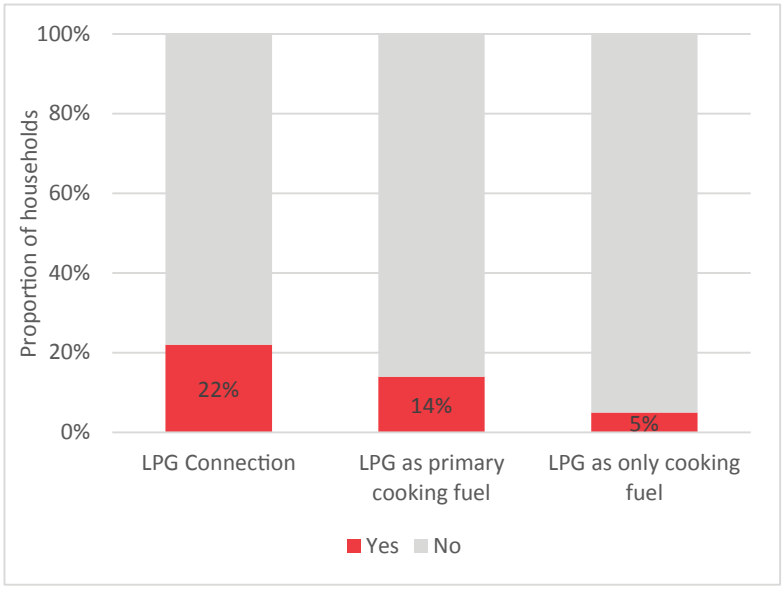

Figure 6 LPG adoption and use across rural areas, six states, 2015

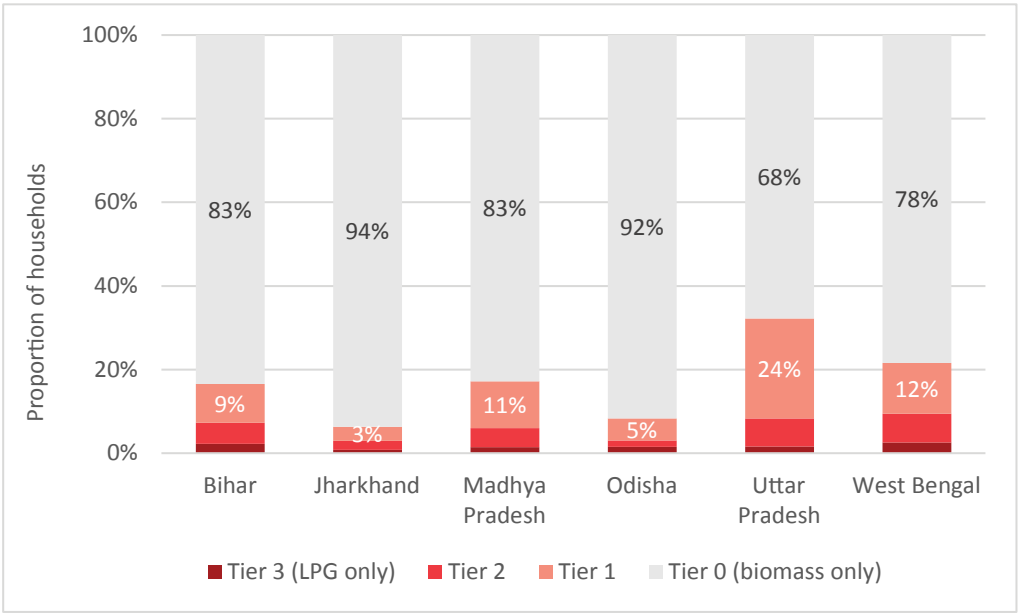

Figure 7 Spread of households across cooking energy access tiers

and safety dimension as they rely entirely on traditional fuels for cooking. In addition, 8.4 per cent of the Tier 0 households also face challenges in fuel availability to the extent that it limits their cooking.

The high upfront cost of LPG is the biggest barrier to adoption

Given that the overriding reason why households remain in Tier 0 is the lack of access to LPG, we explored reasons for this (Figure 8). We found that the high upfront cost of LPG is the biggest barrier to adoption (95 per cent). High recurring expenditure is also cited as a major barrier (88 per cent). These two factors are common across the six states. There is variation in the extent to which LPG is available (a problem for 87 per cent in Odisha but only 51 per cent in West Bengal). A lack of awareness about how to get an LPG connection was an issue for 59 per cent in Bihar, but only 28 per cent in West Bengal.

Only a fifth of households (22 per cent) are in higher tiers, and even then the majority of those (15 per cent of all households) remain in Tier 1. This means having at least some level of access and use of BLEN (primarily LPG), but not using it exclusively. The main reason for not using LPG more is affordability (Figure 9). We found that 60

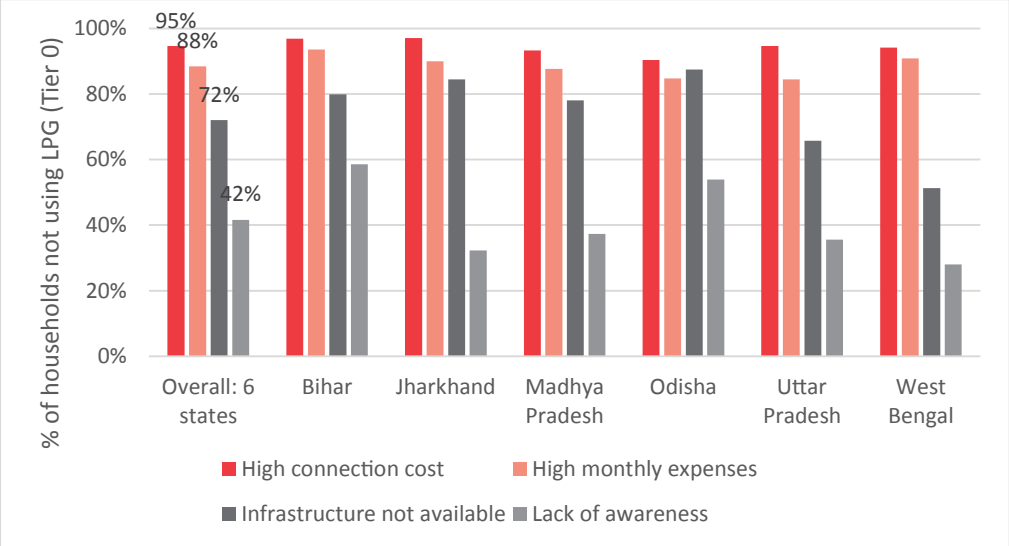

Figure 8 Reasons for not using LPG

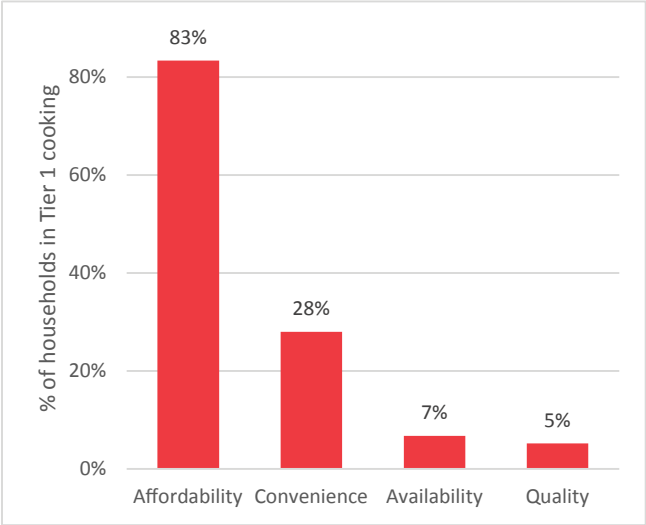

Figure 9 Bottlenecks faced by households in Tier 1 cooking energy access

per cent of the households in Tier 1 spend more than 10 per cent of their monthly expenditure on cooking energy. However, since the majority of these households are stacking fuels, understanding the contribution of LPG and traditional fuels to affordability is important.

Among households who use only LPG to meet their entire cooking energy needs (about 5 per cent of the rural households in these six states), almost half (46 per cent) spend more than 6 per cent of monthly expenses on cooking energy, thereby making it 'unaffordable'. However, only 16 per cent spend more than 10 per cent on cooking energy. Thus, even though affordability is a challenge for households relying entirely on LPG, the extent of the challenge is more severe for households which stack fuels. For households using only LPG, the median monthly expenditure on cooking energy is INR383 ($5.74). However, households that stack fuels spend more on average (INR436; $6.53).

This difference is surprising and could have been exaggerated by:

- *The methodological limitation of approximating expenditure on traditional fuel* based on the product of price and quantity. In reality, this could be different from the actual outlay.
- *Over-reporting of fuel consumption quantities by households who stack fuels.* Recollection of actual quantities could be difficult, especially when consumption of each fuel varies in an irregular way over time, unlike for households who use only one type of fuel.
- *Gap in perception of the relative cost of firewood and LPG.* Even at prices of INR6 ($0.09) or more per kg of wood, which is the average price reported across the six states, this is equivalent to 87.5 kCal of useful energy per INR spent, as opposed to 183 kCal per INR spent on subsidized LPG.

Households buying biomass spend more on fuel than those relying entirely on LPG

Despite these uncertainties about exact expenditures, our findings also show that households purchasing biomass spend more on fuel than those relying entirely on LPG (Figure 10). One reason for higher monthly spending on biomass than LPG is that,

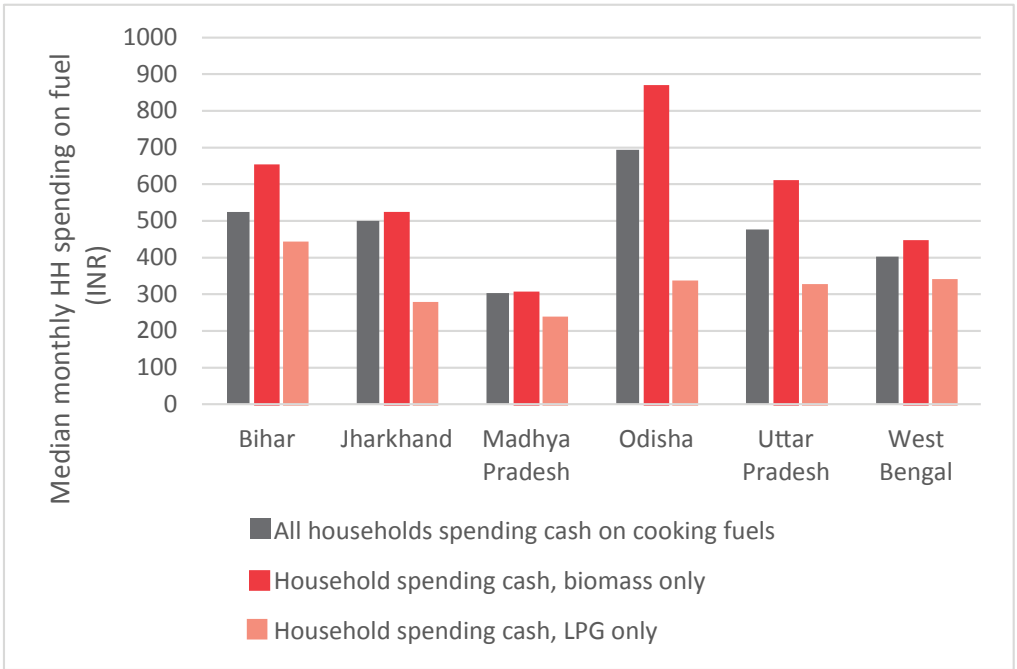

Figure 10 Monthly expenditure on cooking fuel for households reporting real outlay

per kCal of useful energy, biomass is actually more expensive than LPG (at prevailing market prices). Indeed, surprisingly high proportions of households (between one-third and two-thirds) spend at least some money on fuel each month (Figure 11).

Consequently, it appears that switching to subsidized LPG brings both health and economic benefits. However, the limited adoption and use of LPG points to the challenges of high upfront costs, a prevailing information and perceptions gap, and the limited LPG distribution infrastructure in rural areas.

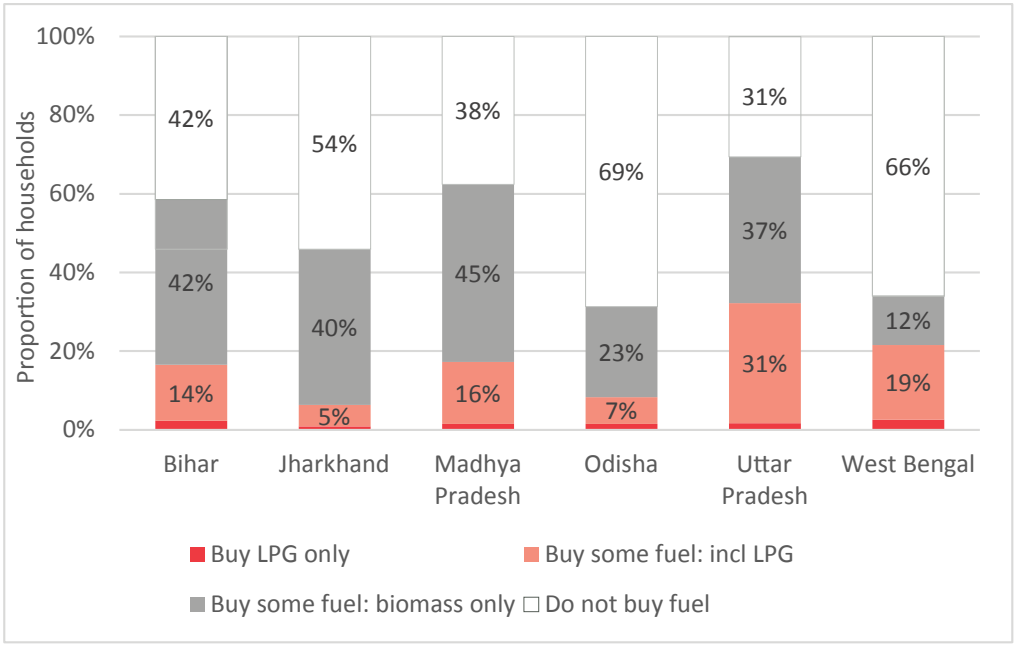

Figure 11 Proportion of households buying cooking fuels each month

Fuel stacking is very common, almost all households that use LPG also continue to use biomass
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Stacking of fuels remains a major issue limiting households to move to Tier 3, to experience complete access to clean cooking energy. The reasons for stacking are many, varying from easy availability of free-of-cost biomass to difficult availability of BLEN (LPG), and from cultural preference to lack of awareness about the adverse impact of exposure to smoke from the use of traditional biomass.

Conclusions: Understanding the realities of energy-poor people

This survey was the first to deploy a multi-tier framework on such a large scale

This survey was the first to deploy any kind of multi-tier framework on such a large scale, with representative samples covering a huge geographical area. It therefore provides a unique opportunity to have a first glimpse at the kinds of insights that could be available globally if the World Bank's MTF is rolled out.

In promoting the adoption of this type of framework, we were hoping that it would provide insights into the correlation (or not) between the electricity grid arriving in a village and people actually having and using meaningful amounts of power. We also anticipated that it would reveal interesting and important differences in the performance of on- and off-grid supplies. In cooking, we hoped it would reveal steps in progress towards improved cooking energy access.

The findings of the survey indeed provide important and new evidence. It demonstrates that there are still considerable barriers to people buying a grid connection even when the grid is available in the area, because of both affordability and unreliable supply situations. Even where people are grid-connected, the performance is poor right across most of the six states. Off-grid solutions have not enjoyed widespread uptake. Where they are used, they only provide limited and basic electricity access, although with somewhat better reliability than the grid.

In terms of clean cooking energy, the findings reveal the low penetration and use of LPG because of both affordability (upfront connection cost as well as fuel cost) and availability (limited distribution networks in rural areas). Some of this would have been revealed by traditional metrics, but what the tier system adds is far greater insight into the degree of fuel stacking. Although the proportion of households spending some money on fuel is far higher than might be expected, those with LPG are still relying at times on the collection and use of free firewood; or they resort to buying firewood in small quantities when they cannot afford the larger outlay for a refilled cylinder, even though it is cheaper in the long run. Thus, despite state subsidies, access to LPG remains the privilege of the better off. The recently launched Pradhan Mantri Ujjwala Yojana scheme by the Government of India aims to bridge this gap by subsidizing the upfront cost of adopting an LPG connection for poor households.

Using a MTF helps to illustrate where policy and action should be directed

At the time of writing, the World Bank is beginning a wider programme to roll out its MTF, but can still only do this in a limited number of countries. The findings from this research support this process, demonstrating the added value and important insights to be gained. Despite the somewhat discouraging picture the research paints about low levels of access to electricity even with widespread grid extension, this work has been welcomed by Indian policy-makers. It helps to illustrate where policy and action can be directed to improve the situation (improved reliability, more affordable connections, etc.). The report was launched by the Minister of Power, Government of India. However, the methodology is far from being adopted as standard practice across the country.

In this work, the research team decided that the MTF required adaptation to make it both workable and applicable to the Indian context. This demonstrates that more work may be needed (and indeed has since happened) to simplify the World Bank's standard questionnaires, to reduce the need for hard-to-obtain data about system performance, for example. However, if a standard model is to be applied and made credible, multiple adaptations in different countries will make global comparisons difficult, which would dilute the overall usefulness of the approach.

If the MTF could be embedded as part of the definition of energy access under Sustainable Development Goal (SDG) 7, this would provide a mandate for global uptake. To do this, however, would depend on agreeing a cut-off point for which tier counts as a minimum level of energy access, which is not yet under discussion. Whether it is embedded in the SDG or not, this research underlines the importance of an approach that goes beyond counting connections to understanding other attributes of energy access. Indeed, if efforts to address energy access are to have real meaning and impact, more nuanced means of measurement are essential. If not, the energy poor will continue to be short-changed by services that are not meeting their needs, preventing energy from becoming the powerful enabler of development that it can be.

Notes

1. A village is deemed as electrified if basic infrastructure such as transformers and distribution lines are provided in the inhabited areas. In addition, public spaces are required to be electrified. The requirement also states that at least 10 per cent of the households in the village must have an electricity connection.
2. See references Census of India (2011) and National Sample Survey Office (2015) for details. These documents also contain the summary statistics for earlier years.
3. BLEN in rural India (especially these six states) is virtually equivalent to LPG only.
4. For all the households who use *only* traditional fuels, we assign them the bottom-most tier, irrespective of the type of cooking device and surrounding environment. We are taking this conservative approach for three main reasons. First, in India the most common device to burn traditional biomass is still the traditional *chulha*. Of the surveyed households, 96 per cent report ownership of at least one traditional *chulha*. Second, the penetration and use of improved cookstoves is limited; only two per cent of households report ownership of an improved cookstove. Further, only 0.74 per cent of households report that they still use their improved cookstove. Third, there is a significant divergence of the on-field performance compared with the theoretical performance of improved cookstoves. All of these together lend support to the conservative estimation of the tier.

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Front page photo: Evening family time under the light of a solar lantern. Only 5% of households own an off-grid solar product, while 64% have grid electricity. But the grid performs so poorly for nearly half of these, that they remain in the dark © CEEW.

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